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Module Catalogue

Austauschstudium FAI

Faculty of Applied Computer Science

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Module GEO-1023: Practical Methods 1 Praktische Arbeitsmethoden 1		5 ECTS/LP
Version 3.0.0 (since WS22/23) Person responsible for module: Dr. Cecile Remy		
Contents: The range of exercises includes, among other things, empirical surveys, qualitative methods of human geography, computer-aided data analysis and modelling, measurement methods, field practicals, laboratory analyses, applications of remote sensing, simulations and geodata analysis and visualization with geographic information systems.		
This module enables students to acquir students are able to describe a specific method independently in the right conte learning and practicing the specific met	re basic geographical working methods. working method in geography (dependi ext and to evaluate the results and class thod(s).	After attending this module, the ing on the course chosen), to use this ify their use. The focus here is on
Workload: Total: 150 h		
Conditions: Depending on the content of the course, special technical requirements may be necessary. In principle, the contents of all basic modules are recommended. None for exchange students. None for exchange students.		Credit Requirements: Pass the module exam
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Praktische Arbeitsmethoden GEO-1023 Mode of Instruction: exercise course Language: German / English Contact Hours: 2		
Assigned Courses:		
Biogeographische Geländeübung (e	xercise course)	
Geographische Datenanalyse und -visualisierung mit R (exercise course)		
Globale Wasserspeicher im Klimawandel (exercise course)		
Immobilienmarkt- und Immobilienwertermittlung (exercise course)		
Klimaresilienz von Kulturökosystemen in der Praxis (exercise course)		
Paläobotanische Geländeübung (exercise course)		
Physisch-geographisches Geländepraktikum (exercise course)		
Stadtklimamodellierung mit ENVImet (exercise course)		

Examination

GEO-1023 Praktische Arbeitsmethoden (5 LP)

practical exam, Protokoll, kurze Hausarbeit, not graded

Description:

protocol, short scientific term

Module GEO-2026: Advance Aufbaumodul 1 - Humangeograph	d Module 1 - Human Geography	6 ECTS/LP
Version 3.0.0 (since WS22/23) Person responsible for module: M	Sc. Niklas Völkening	
Contents: Thematic and regional deepening in the Anthropocene, environment geography of foods, geographic d	of a human-geographical topics, e.g. glob al geography, renewable energies, natura evelopment research.	al change, humans and the environment I resource management, rural areas,
Learning Outcomes / Competer The students can explain in-depth research. The students can analys on the respective topic. In addition The students can organize and m	ices: knowledge on a specific topic of human g se, assess and critically assess the most in h, the students can set up theses on select oderate a scientific discussion and develop	peography and present the current state of mportant principles, theories and methods ted topics and propose possible solutions. p and defend their own arguments.
Workload: Total: 180 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Spezialvorle Language: German / English Contact Hours: 2 ECTS Credits: 3.0	esung Humangeographie GEO-2026	
Assigned Courses:		
Spezialvorlesung Geographie des ländlichen Raumes (lecture)		
Spezialvorlesung Klimaresilienz von Kulturökosystemen (lecture)		

Spezialvorlesung: Environment and Society in the American West (lecture)

Part of the Module: Begleitseminar zur Spezialvorlesung Humangeographie GEO-2026

Language: German / English

Contact Hours: 2

ECTS Credits: 3.0

Assigned Courses:

Begleitseminar 1 Geographie des ländlichen Raums (seminar)

Begleitseminar 1: Environment and Society in the American West (seminar)

Begleitseminar 2 Geographie des ländlichen Raums (seminar)

Begleitseminar 2: Environment and Society in the American West (seminar)

Begleitseminar Klimaresilienz von Kulturökosystemen (seminar)

Examination

Aufbaumodul 1 - Humangeographie

lecture + accompanying seminar, mündl. Prüfung (15 Min.) oder Klausur oder Portfolioprüfung

Description:

Module exam, Oral exam 15 minutes, written exam or portfolio

Module GEO-2027: Advanced M	odule 1 - Physical Geography	6 ECTS/LP	
Aufbaumodul 1 - Physische Geograph	ie		
Version 3.0.0 (since WS22/23) Person responsible for module: Dr. Cecile Remy			
Contents: Thematic and regional deepening of a urban ecology, landscape balance, ve Mediterranean Basin, Alps.	physical-geographical topic, e.g. globa getation history, biochemical cycles, ex	l change, environmental protection, treme events; Africa, India,	
Learning Outcomes / Competences The students can explain in-depth kno state of research. The students can ar and methods on the respective topic. I possible solutions. The students can o arguments.	: wledge on a specific topic of physical g nalyse, assess and critically assess the n addition, the students can set up the rganize and moderate a scientific discu	peography and present the current most important principles, theories ses on selected topics and propose ussion and develop and defend their own	
Workload: Total: 180 h			
Conditions: none		Credit Requirements: Pass the module exam	
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Spezialvorlesung Physische Geographie GEO-2027 Mode of Instruction: lecture Language: German / English Contact Hours: 2			
Assigned Courses:			
Spezialvorlesung Biosphäre im Klin	nasystem / Biosphere in the Climate	system (lecture)	
Spezialvorlesung Klimaresilienz vor	n Kulturökosystemen (lecture)		
Part of the Module: Begleitseminar zur Spezialvorlesung Physische Geographie GEO-2027 Mode of Instruction: seminar Language: German / English Frequency: annually Contact Hours: 2			
Assigned Courses:			
Begleitseminar Biosphäre im Klimasystem / Biosphere in the Climate system (seminar)			
Begleitseminar Klimaresilienz von Kulturökosystemen (seminar)			
Examination Aufbaumodul 1 - Physische Geographie module exam, mündl. Prüfung (15 Min.) oder Klausur oder Portfolioprüfung Description: Oral exam (15 min.) or written exam			

Module GEO-2065: Practical Methods 2 5 Praktische Arbeitsmethoden 2 5		5 ECTS/LP	
Version 3.0.0 (since WS22/23) Person responsible for module: Dr. Cecile Remy			
Contents: The range of exercises includes, among other things, empirical surveys, qualitative methods of human geography, computer-aided data analysis and modelling, measurement methods, field practicals, laboratory analyses, applications of remote sensing, simulations and geodata analysis and visualization with geographic information systems.			
Learning Outcomes / Competences: This module enables students to acquire basic geographical working methods. After attending this module, the students are able to describe a specific working method in geography (depending on the course chosen), to use this method independently in the right context and to evaluate the results and classify their use. The focus here is on learning and practicing the specific method(s)			
Workload: Total: 150 h			
Conditions: Depending on the content of the course, special technical requirements may be necessary. In principle, the contents of all basic modules are recommended.		Credit Requirements: Pass the module exam	
Frequency: each semester	Recommended Semester: 3 6.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Praktische Arbeitsmethoden GEO-2065 Mode of Instruction: exercise course Language: German / English Contact Hours: 2			
Assigned Courses:			
Biogeographische Geländeübung (e	xercise course)		
Geographische Datenanalyse und -v	isualisierung mit R (exercise course)		
Globale Wasserspeicher im Klimawandel (exercise course)			
Immobilienmarkt- und Immobilienwertermittlung (exercise course)			
Innenstadt- und Einzelhandelsentwicklung in Augsburg (exercise course)			
Paläobotanische Geländeübung (exercise course)			
Physisch-geographisches Geländepraktikum (exercise course)			
Stadtklimamodellierung mit ENVImet (exercise course)			
Examination GEO-2065 Praktische Arbeitsmethoden 2 practical exam, Protokoll, kurze Hausarbeit, not graded			

Module GEO-2073: Special Meth Spezielle Methoden der Physischen (nods in Physiscal Geography Geographie	5 ECTS/LP
Version 2.0.0 (since WS22/23) Person responsible for module: Prof Dr. Christoph Beck		
Contents: Basics, application and interpretation various sub-areas of physical geogra	of results of specific qualitative and quant	titative investigation methods from the
Field methods: e.g. soil assessment, methods: e.g. determination of soil typ and modelling: e.g. runoff modelling,	runoff measurement, site climate recordin be, analysis of water components, pollen numerical climate modelling, statistical an	g, vegetation mapping. Laboratory analysis. IT-supported data analysis alysis of geoscientific data sets.
Learning Outcomes / Competences: After attending this module, the students know important methods of investigation in physical geography and can explain the specific procedures. They are able to select and apply appropriate methods in relation to the problem and to interpret the corresponding analysis results.		
Remarks: -		
Total: 150 h 60 h studying of course content using 60 h (self-study) 30 h (attendance)	provided materials (self-study)	
Conditions: none for exchange students		Credit Requirements: Pass the module exam
Frequency: each winter semester	Recommended Semester: 3 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Vorlesung Spez Mode of Instruction: lecture Language: German / English Contact Hours: 2 ECTS Credits: 5.0	zielle Methoden der Physischen Geogra	aphie
Examination Spezielle Methoden der Physischer written exam, kurze Hausarbeit oc	n Geographie Jer praktische Prüfung oder Kurzprotokoll	oder Portfolioprüfung (s.

Veranstaltung) / length of examination: 90 minutes

Test Frequency:

only in the winter semester

Description:

short scientific term paper, practical exercise or short report

Module GEO-3082: Advanced Aufbaumodul 2 - Humangeograph	d Module 2 - Human Geography ^{ie}	6 ECTS/LP
Version 3.0.0 (since WS22/23)		
Person responsible for module: M	Sc. Niklas Völkening	
Contents: Thematic and regional deepening in the Anthropocene, environment geography of foods, geographic d	of a human-geographical topic, e.g. globa al geography, renewable energies, natura evelopment research.	I change, humans and the environment I resource management, rural areas,
Learning Outcomes / Competen The students can explain in-depth research. The students can analys on the respective topic. In addition The students can organize and me	ces: knowledge on a specific topic of human g se, assess and critically assess the most in h, the students can set up theses on select oderate a scientific discussion and develop	peography and present the current state of mportant principles, theories and methods ted topics and propose possible solutions. p and defend their own arguments.
Workload: Total: 180 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each semester	Recommended Semester: 5 8.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Spezialvorle Mode of Instruction: lecture Language: German / English Contact Hours: 2 ECTS Credits: 3.0	esung Humangeographie GEO-3082	
Assigned Courses:		
Spezialvorlesung Geographie d	es ländlichen Raumes (lecture)	
Spezialvorlesung Klimaresilienz	z von Kulturökosystemen (lecture)	
Spezialvorlesung: Environment	and Society in the American West (lect	ure)

Part of the Module: Begleitseminar zur Spezialvorlesung Humangeographie GEO-3082

Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 3.0

Assigned Courses:

Begleitseminar 1 Geographie des ländlichen Raums (seminar)

Begleitseminar 1: Environment and Society in the American West (seminar)

Begleitseminar 2 Geographie des ländlichen Raums (seminar)

Begleitseminar 2: Environment and Society in the American West (seminar)

Begleitseminar Klimaresilienz von Kulturökosystemen (seminar)

Examination

Aufbaumodul 2 - Humangeographie

lecture + accompanying seminar, mündliche Prüfung (15 Min.), Klausur oder Portfolio

Description:

Module exam, Oral exam 15 minutes, written exam or portfolio

Module GEO-3083: Advanced Aufbaumodul 2 - Physische Geogra	Module 2 - Physical Geography phie	6 ECTS/LP
Version 3.0.0 (since WS22/23) Person responsible for module: Dr. Cecile Remy		
Contents: Thematic and regional deepening o urban ecology, landscape balance, Mediterranean Basin, Alps.	f a physical-geographical topic, e.g. globa vegetation history, biochemical cycles, e	al change, environmental protection, xtreme events; Africa, India,
Learning Outcomes / Competenc The students can explain in-depth k state of research. The students can and methods on the respective topi possible solutions. The students ca arguments.	es: nowledge on a specific topic of physical analyse, assess and critically assess the c. In addition, the students can set up the n organize and moderate a scientific disc	geography and present the current e most important principles, theories eses on selected topics and propose ussion and develop and defend their own
Workload: Total: 180 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each semester	Recommended Semester: 5 8.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Spezialvorles Mode of Instruction: lecture Language: German / English Contact Hours: 2 Assigned Courses:	ung Physische Geographie GEO-3083	
Spezialvorlesung Biosphäre im K	limasystem / Biosphere in the Climate	e system (lecture)
Spezialvorlesung Klimaresilienz	von Kulturökosystemen (lecture)	
Part of the Module: Begleitsemin Mode of Instruction: seminar Language: German / English Contact Hours: 2	ar zur Spezialvorlesung Physische Ge	ographie GEO-3083
Assigned Courses:		
Begleitseminar Biosphäre im Klir	nasystem / Biosphere in the Climate s	ystem (seminar)
Begleitseminar Klimaresilienz vo	n Kulturökosystemen (seminar)	
Examination Aufbaumodul 2 - Physische Geog module exam, mündl. Prüfung (Description:	yraphie 15 Min.) oder Klausur oder Portfolioprüfu	ng

Module GEO-3098: Advanced Seminar Hauptseminar		5 ECTS/LP		
Version 2.1.0 (since WS22/23) Person responsible for module: MSC. Robert Gonda				
Contents: In this module, content from the basic courses is deepened and new developments in the subject of geography are dealt with. Advanced seminars are offered on sub-areas of geography, regional focal points and/or special subject areas of geography (such as global change, cultural landscapes, etc.).				
Learning Outcomes / Competences: After completing this module, the students are able to present an in-depth topic of geography in the form of a written work and an oral presentation. For this purpose, the relevant specialist content from the scientific literature is summarized, combined and critically examined. In addition, the moderation and discussion skills of the students are further developed				
Workload: Total: 150 h 100 h preparation of written term papers (self-study) 20 h preparation of presentations (self-study) 30 h (attendance)				
Conditions: Basic knowledge of scientific work is specialist literature is expected.	required. Confident handling of English	Credit Requirements: Pass the module exam		
Frequency: each semester	Recommended Semester: 5 8.	Minimal Duration of the Module: 1 semester[s]		
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program			
Parts of the Module				
Part of the Module: Hauptseminar Mode of Instruction: advanced seminar Language: German / English Contact Hours: 2 ECTS Credits: 5.0				
Assigned Courses:				
Climate Urbanism (advanced seminar)				
Climate-induced Migration, Immobility and Water Controversies (advanced seminar)				
Kryosphäre im Klimasystem (advanced seminar)				

Kulturgeographie (advanced seminar)

Planetare Grenzen (advanced seminar)

Sozialökologische Transformation und multiple Krisen (advanced seminar)

Examination

Hauptseminar

/ work period for assignment: 6 weeks

Test Frequency:

each semester

Description:

Das in der Hausarbeit erarbeitete Thema wird im Hauptseminar präsentiert.

Module INF-0029: Research Distributed Systems Forschungsmodul Softwaremetho	Module Software Methodologies for diken für verteilte Systeme	6 ECTS/LP
Version 1.0.0 (since SoSe13) Person responsible for module: Pr	of. Dr. Bernhard Bauer	·
Learning Outcomes / Competen After participating in the research software methodologies for distrib field and can actively participate in procedures, techniques, and techn students have the teamwork and o techniques to discuss problems in Key qualifications: Ability to think comprehensible, confident, and co communication skills: ability to wo	ces: module, students can understand problems uted systems. They have detailed and up-to n research projects. To this end, they unders hologies and can contribute this knowledge to communication skills, the ability to study liter the field and critically evaluate, combine, ar conceptually, analytically, and conceptually; inconvincing presentation of ideas, concepts, ar rk in teams and understand team processes	of medium complexity in the field of -date knowledge in the mentioned tand advanced concepts, methods, o research projects. In addition, ature, and the learning and working nd present interim results. lependent work with literature; nd results; quality awareness; c principles of good scientific practice:
Workload: Total: 180 h 15 h seminar (attendance) 165 h internship / practical course	(self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Forschungs Mode of Instruction: internship Language: German / English Contact Hours: 1	modul Softwaremethodiken für verteilte	Systeme

Contents:

Current research topics at the DS-Lab.

Literature:

Provided for the respective topics.

Assigned Courses:

Oberseminar zu Softwaremethodik für verteilte Systeme

Examination

Presentation and written paper

internship

Test Frequency:

when a course is offered

Module INF-0048: Research M Science Forschungsmodul Theoretische In	Module Theoretical Computer	6 ECTS/LP	
Version 1.0.0 (since SoSe13) Person responsible for module: Pr	Version 1.0.0 (since SoSe13) Person responsible for module: Prof. Dr. Torben Hagerup		
Learning Outcomes / Competen After successful participation in the intermediate complexity in the field to-date knowledge in the field, ena techniques for their research proje literature research, and evaluate s Key Qualifications: Logical, analytical, and conceptual present thoughts, concepts, and conceptual communication skills; knowledge of	ces: e research module, the students will be in of Theoretical Computer Science. Furthe bling them to actively develop and apply it cts. The students will have team spirit and olutions and results in a critical manner. comprehension; independent work with E onclusions in an understandable, confiden of fundamentals of good scientific practice.	a position to understand problems of rmore, they will have detailed and up- ts concepts, methods, processes, and I the ability to communicate, conduct English technical literature; capability to tt, and convincing way; quality awareness;	
Workload: Total: 180 h 165 h internship / practical course (self-study) 15 h seminar (attendance)			
Conditions: none			
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Research Module Theoretical Computer Science Mode of Instruction: internship Language: German Contact Hours: 1			
Contents: Collaboration on current resea	ch topics of the group.		
Literature: Scientific papers, manuals. 			
Assigned Courses:			
Oberseminar Theoretische Infor	matik		

Examination

Oral presentation and written paper.

	Module Organic Computing	6 ECTS/LP
Forschungsmodul Organic Computing		
Version 1.0.0 (since SoSe14)		
Person responsible for module: P	rof. Dr. Jörg Hähner	
Learning Outcomes / Competen After participating in the research field of "Organic Computing". The participate in research projects. To and technologies and can contribu communication skills, the ability to the field, as well as to critically eval	nces: module, students are able to understand pr y have detailed and up-to-date knowledge i o this end, they understand advanced conc ute this knowledge to research projects. In a p research literature and the learning and we aluate, combine and present interim results	oblems of medium complexity in the in the mentioned field and can actively epts, methods, procedures, techniques addition, students have the teamwork and orking techniques to discuss problems in
Key qualifications: Ability to thin in English; comprehensible, confic communication skills; ability to we	k logically, analytically and conceptually; ind lent and convincing presentation of ideas, o rk in teams and understand team processe	lependent work with specialist literature oncepts and results; quality awareness; s; principles of good scientific practice.
Workload: Total: 180 h 165 h internship / practical course 15 h seminar (attendance)	(self-study)	
Conditions:		
none		
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination	
	regulations of the study program	
Parts of the Module		
Parts of the Module Part of the Module: Research M Mode of Instruction: internship Language: German / English Contact Hours: 1	odule Organic Computing	
Parts of the Module Part of the Module: Research M Mode of Instruction: internship Language: German / English Contact Hours: 1 Contents: Collaboration on current resea	odule Organic Computing	
Parts of the Module Part of the Module: Research M Mode of Instruction: internship Language: German / English Contact Hours: 1 Contents: Collaboration on current resea Literature: Depending on the topic to be w • Paper • Book • Handbook	odule Organic Computing rch topics. vorked on:	
Parts of the Module Part of the Module: Research M Mode of Instruction: internship Language: German / English Contact Hours: 1 Contents: Collaboration on current resea Literature: Depending on the topic to be w • Paper • Book • Handbook Assigned Courses:	odule Organic Computing rch topics. vorked on:	

Presentation and final report.

Module INF-0075: Research Mo Systems	Description Databases and Information	6 ECTS/LP		
Version 1.2.0 (since SoSe14) Person responsible for module: Prof. Dr. Peter Michael Eischer				
Person responsible for module: Prof. Dr. Peter Michael Fischer Learning Outcomes / Competences: After participating in the research module, students can understand medium-complexity problems in the field of databases and information systems. They have detailed and up-to-date knowledge in the aforementioned field and can actively participate in research projects. To this end, they understand advanced concepts, methods, procedures, techniques, and technologies out of this field and can apply this knowledge to research projects. In addition, students have skills in teamworking and communication, the ability to study research literature and the methods to discuss problems in the field, as well as to critically evaluate, combine and present intermediate results. Key Skills: Logical, analytical, and conceptual thinking; Independent work with English-language literature; Intelligible, confident, and persuasive presentation of ideas, concepts, and results; Quality awareness; Communication skills; Working in teams and understanding team processes: Principles of good scientific practice.				
Workload: Total: 180 h 15 h seminar (attendance) 165 h internship / practical course (self-study)				
Conditions: Module Database Systems (INF-007	3) - recommended			
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]		
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program			
Parts of the Module				
Part of the Module: Forschungsm Mode of Instruction: internship Language: German / English Contact Hours: 1	odul Datenbanken und Informationssys	teme		

Current research topics in the field of database systems and Big Data

Literature:

- Current research articles with relation to "Big Data"
- · Manuals of the relevant products and frameworks

Assigned Courses:

Forschungsmodul Datenbanken und Informationssysteme (internship)

Oberseminar Datenbanken und Informationssysteme

Examination

Software acceptance, presentation, final report

Madula INE 0080, Saminar Multir	nodia Computing & Computer	
Vision (BA)	neula computing & computer	4 ECT3/LF
Seminar Multimediale Datenverarbeitu		
Version 1.0.0 (since SoSe14)		
Person responsible for module: Prof. D	r. Rainer Lienhart	
Learning Outcomes / Competences:		
After attending the seminar, the studen	ts can independently work out and analy	vse advanced problems, concepts,
methods, procedures, techniques, and	technologies from the field of multimedia	a computing and computer vision (e.g.
image and video processing, machine	learning, and image and video search) a	nd evaluate them in relation to the
individual seminar topic.		
Participants possess scientific methodo	ology, communication skills, and the abili	ty to present a special topic clearly and
comprehensibly in speech and writing a	and to discuss and evaluate scientifically	challenging topics from the named
field critically and argumentatively.		
Furthermore, they learn to recognise lo	gical structures of thinking and argumen	tation and use them in a goal-
oriented manner. The participants can	formulate clearly and comprehensibly an	d present subject content freely.
They understand how to structure a tall	k that is clear and easy to follow. Addition	nally, the students know how to
focus on essential messages and conv	ey them in a comprehensible way, even	with complex content. They skilfully
apply chains of argumentation and solu	ition strategies in the event of disruption	s. The students understand how to
confidently deal with common presenta	ition media and use them interactively. I	hey manage to gear a talk to a specific
target group, apply various moderation	techniques, and keep their audience en	gaged even over a longer period.
Key qualifications: Presentation techr	niques; literature research; principles of g	good scientific practice; evaluating
solution approaches, procedures, techr	niques, and technologies from different p	oints of view.
Workload:		
Total: 120 h		
30 h seminar (attendance)		
90 h preparation of written term papers (self-study)		
Conditions:		
none		
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module:
	from 3.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	
Porto of the Medule		

Parts of the Module

Part of the Module: Seminar Multimediale Datenverarbeitung

Mode of Instruction: seminar

Language: German

Frequency: each winter semester

Contact Hours: 2

Contents:

The topics of the seminar from the wide-ranging field of multimedia and machine vision are determined each year and adapted to current trends.

Literature:

Current research literature

Assigned Courses:

Seminar über Multimediale Datenverarbeitung (Bachelor) (seminar)

Examination Presentation and written paper seminar Test Frequency: when a course is offered

Module INF-0090: Research Mo	dule Multimedia Computing &	6 ECTS/LP	
Computer Vision (BA)			
Forschungsmodul Multimedia Computing & Computer Vision			
Version 1.0.0 (since SoSe14)			
Person responsible for module: Prof.	Dr. Rainer Lienhart		
Learning Outcomes / Competence	s:		
After participating in the research mo	dule, students can understand problems	of medium complexity in the field of	
multimedia (image, video, and audio	processing with machine learning). They	have detailed and up-to-date knowledge	
In the alorementioned field and can a	includes and technologies and can apply th	ins end, they understand advanced	
In addition, students have teamwork	and communication skills, the ability to res	search literature, and techniques to	
discuss problems in the field, as well	as to critically evaluate, combine, and pre	sent interim results.	
Key qualifications: Ability to think lo	gically, analytically and conceptually; inde	pendent work with specialist	
literature; comprehensible, confident	and convincing presentation of ideas, cor	cepts and results; quality awareness;	
communication skills; ability to work i	n teams and understand team processes;	principles of good scientific practice.	
Workload:			
Total: 180 h			
15 h seminar (attendance)			
165 h internship / practical course (se	elf-study)		
Conditions:			
none			
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours:	Repeat Exams Permitted:		
1	according to the examination		
	regulations of the study program		
		·	
Parts of the Module			
Part of the Module: Research Mod	ule Multimedia Computing & Computer	Vision	
Mode of Instruction: internship			
Eraguage: German			
Contact Hours: 1			
The specific task from the wide-ra	anging field of multimedia and machine vis	ion (image video and audio	
processing, object recognition, se	earch of image, video and audio material)	is designed individually for each student	
every year.			
scientific papers, manuals			
Assigned Courses:			
Oberseminar Multimedia Computing			
Presentation and written paper			

Module INF-0105: Research Module Teaching Professorship Informatics Forschungsmodul Lehrprofessur für Informatik		6 ECTS/LP
Version 1.0.0 (since SoSe14) Person responsible for module: Pro	f. Dr. Robert Lorenz	I
Learning Outcomes / Competence After participating in the research m fields of <i>concurrent systems</i> , <i>petri m</i> aforementioned field and can active concepts, methods, procedures, teo In addition, students have teamwork discuss problems in the field, as we	es: odule, students can understand problems of ets or process mining. They have detailed a ly participate in research projects. To this e chniques and technologies and can apply th and communication skills, the ability to res II as to critically evaluate, combine, and pre	of medium complexity in the and up-to-date knowledge in the nd, they understand advanced is knowledge in research projects. search literature, and techniques to sent interim results.
Key qualifications: Ability to think literature; comprehensible, confider communication skills; ability to work	logically, analytically and conceptually; inde it and convincing presentation of ideas, con in teams and understand team processes;	pendent work with specialist cepts and results; quality awareness; principles of good scientific practice.
Workload: Total: 180 h 165 h internship / practical course (15 h seminar (attendance)	self-study)	
Conditions: Basic knowledge in research topics <i>mining</i>	concurrent systems, petri nets or process	
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Research Module Teaching Professorship Informatics

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Collaboration on current research topics in the field of concurrent systems, petri nets or process mining.

Literature:

- J. Desel, W. Reisig, G. Rozenberg: Lectures on Concurrency and Petri Nets, Springer, Lecture Notes in Computer Science 3098, 2004
- Wil M. P. van der Aalst: Process Mining. Data Sciemce in Action. Springer, 2016.

Assigned Courses:

Oberseminar zu Lehrprofessur für Informatik

Examination

Research Module Teaching Professorship Informatics

practical exam

Module INF-0124: Seminar Robotics Seminar Robotik	4 ECTS/LP	
Version 1.1.0 (since SoSe14) Person responsible for module: Prof. Dr. Wolfgang Reif		
Learning Outcomes / Competences: After successful completion of the seminar, the students are able to understan methods, procedures, techniques and technologies in the field of robotics.	d and solve basic problems, concepts,	
They will have the working techniques, communication skills and ability to use appropriate media in order to present a special topic clearly and comprehensibly and to critically and argumentatively discuss topics from the aforementioned field. Furthermore they are able to recognise the logical structures of thinking and arguing and use them in a goal-oriented manner.		
Participants can formulate clearly and comprehensibly and present subject constructure a lecture in a clear and comprehensible way and to focus on the con-	ntent freely. They understand how to vey these in an understandable way.	
The students understand how to present themselves and how to deal confident They manage to gear a lecture to a specific target group and to motivate the list	tly with current presentation media. stener.	
Soft-skills:		
 Independently work with technical literature, including English-language Analytical competence Working methodical Principles of good scientific practice Ability to present (in writing and orally) ideas,concepts and results (pract them Ability to think logically, abstractly, analytically and conceptually, and to a Awareness for quality aspects Communication skills Time management 	literature. ical or theoretical) and to document argue precisely	
Workload:		
30 h seminar (attendance)		
90 h preparation of written term papers (self-study)		
Conditions:		
Frequency: each summer semester Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: Repeat Exams Permitted: 2 according to the examination regulations of the study program		

Part of the Module: Seminar Robotik

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

The concrete topics of the seminar deal with the use and programming of robots of all kinds and are determined annually and adapted to current developments.

Literature:

Depends on the concrete topics of the seminar.

Assigned Courses:

Seminar zu Robotik (seminar)

Examination

Seminar Robotik

written/oral exam / length of examination: 45 minutes

work period for assignment: 3 months

Test Frequency:

when a course is offered

Module INF-0125: Seminar Intern Seminar Internetsicherheit	et Security	4 ECTS/LP	
Version 2.0.0 (since SoSe17)			
Person responsible for module: Prof. D	Person responsible for module: Prof. Dr. Wolfgang Reif		
Learning Outcomes / Competences: After completion of the seminar, students are able to understand basic problems, concepts, methods, procedures, techniques and technologies in the field of Internet security and independently learn new such concepts.			
They have the working techniques, communication skills and ability to use appropriate media to present this field clearly and comprehensibly in speech and writing and to discuss topics from the mentioned field critically. They will also be able to recognize the logical structures of reasoning and argumentation and use them.			
The participants are able to formulate clearly and understandably and to present specialist knowledge freely. They understand how to structure a presentation in a clear and comprehensible way and how to focus the presentation on the core messages and convey them in a comprehensible way.			
The students understand how to prese manage to focus a presentation to a sp	nt themselves and how to work with com pecific target group and to motivate the a	imon presentation media. They udience.	
Soft Skills:			
 Literature research Independently work with English technical literature Analytical competence Working methodical Principles of good scientific practice Ability to present (written and oral) ideas, concepts and results in a comprehensible and convincing manner and to document them Ability to think logically, abstractly, analytically and conceptually and to argue precisely Awareness for quality aspects Communication skills Time management 			
Workload:			
Total: 120 h 30 h seminar (attendance)			
90 h preparation of written term papers (self-study)			
Conditions: none			
Frequency: irregular (usu. summer semester)	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			

Part of the Module: Seminar Internet Security

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

The specific topics of the seminar deal with the security of computer systems on the Internet and they change from year to year to adapt to current developments.

Literature:

Depends on the concrete topic.

Assigned Courses:

Seminar zu Internetsicherheit (seminar)

Examination

Seminar Internet Security

written/oral exam / length of examination: 45 minutes

work period for assignment: 3 months

Test Frequency:

when a course is offered

Module INF-0126: Seminar Softwa (Bachelor)	are- and Systems Engineering	4 ECTS/LP		
Version 1.1.0 (since SoSe14) Person responsible for module: Prof. Dr. Wolfgang Reif				
Learning Outcomes / Competences: After successful completion of the seminar, students are able to understand basic problems, concepts, methods, procedures, techniques and technologies in the field of software and systems engineering and independently learn new such concepts.				
They have the working techniques, communication skills and the ability to use appropriate media to present a specific topic clearly and comprehensibly in speech and writing and to discuss topics from the aforementioned field critically. They will also be able to recognize the logical structures of reasoning and argumentation and use them.				
The participants are able to formulate clearly and understandably and to present specialist knowledge freely. They understand how to structure a presentation in a clear and comprehensible way and how to focus the presentation on the core messages and convey them in a comprehensible way.				
The students understand how to present themselves and how to deal confidently with common presentation media. They manage to focus a presentation to a specific target group and to motivate the audience.				
 Soft Skills: Literature research Independently work with English technical literature Analytical competence Working methodical Principles of good scientific practice Ability to present (written and oral) ideas, concepts and results in a comprehensible and convincing manner and to document them Ability to think logically, abstractly, analytically and conceptually and to argue precisely Awareness for quality aspects Communication skills Time management Workload: Total: 120 h 90 h preparation of written term papers (self-study) 30 h seminar (attendance)				
Conditions: none				
Frequency: each winter semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]		
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program			
Parts of the Module				
Part of the Module: Seminar Software- und Systems Engineering (Bachelor) Mode of Instruction: seminar Language: German / English				

Contact Hours: 2

Contents:

The topics of the seminar deal with current trends in Software and Systems Engineering on the level of undergraduate students. The topics change from year to year and are regulary adapted to reflect new developments.

Literature:

Depends on the concrete topic.

Examination

Seminar Software- und Systems Engineering (Bachelor)

written/oral exam / length of examination: 45 minutes work period for assignment: 3 months

Test Frequency:

when a course is offered

Module INF-0127: Research Module Software- and Systems Engineering Forschungsmodul Software- und Systems Engineering		6 ECTS/LP		
Version 1.1.0 (since SoSe14) Person responsible for module: Prof. Dr. Wolfgang Reif				
Learning Outcomes / Competences: After participating in the research module, students are able to understand problems of medium complexity from the field of software and systems engineering. They have detailed and up-to-date knowledge in the aforementioned field and can actively participate in research projects. They understand advanced concepts, methods, procedures, techniques and technologies and can apply this knowledge in research projects. In addition, students have teamwork and communication skills, the ability to do literature research and the learning and working techniques to discuss problems in the field, as well as to critically evaluate, combine and present intermediate results.				
Soft Skills:				
 Skill in logical, analytical and conceptual thinking. Ability to work independently with technical literature, including English literature Clear, confident and convincing presentation of ideas, concepts and results Awareness for quality aspects Communication skills Ability to work in teams and understand team processes Principles of good scientific practice 				
Workload: Total: 180 h 165 h internship / practical course (s 15 h seminar (attendance)	self-study)			
Conditions:				
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]		
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program			
Parts of the Module				
Part of the Module: Research Module Software- and Systems Engineering Mode of Instruction: internship				

Language: German / English

Contact Hours: 1

Contents:

Contribution to current research projects of the chair for Software Engineering

Literature:

Depends on the project: Scientific papers, system documentation, books, ...

Assigned Courses:

Oberseminar Software- und Systems Engineering

Examination

Research Module Software- and Systems Engineering Project Presentation

practical exam / work period for assignment: 6 weeks

Test Frequency:

when a course is offered

Module INF-0173: Research Module Human-Centered Multimedia Forschungsmodul Human-Centered Multimedia		6 ECTS/LP		
Version 1.0.0 (since SoSe13) Person responsible for module: Prof. Dr. Elisabeth André				
Learning Outcomes / Competences: After participating in the research module, students are able to understand problems of medium complexity in the field of "Human-Centered Multimedia". They have detailed and up-to-date knowledge in the aforementioned field and can actively participate in research projects. To this end, they understand advanced concepts, methods, procedures, techniques and technologies and can apply this knowledge in research projects. In addition, students have the teamwork and communication skills, the ability to research literature and the learning and working techniques to discuss problems in the field, as well as to critically evaluate, combine and present intermediate results. Key qualifications: Skill in logical, analytical, and conceptual thinking; Independent work with English-language literature; Understandable, confident, and persuasive presentation of ideas, concepts, and results; Quality awareness; Communication skills; Skill in working in teams and understanding team processes; Principles of good scientific practice:				
Workload: Total: 180 h 165 h internship / practical course (self-study) 15 h seminar (attendance)				
Conditions: none				
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]		
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program			

Parts of the Module

Part of the Module: Research Module Human-Centered Multimedia

Mode of Instruction: internship

Language: German

Contact Hours: 1

Contents:

Collaborate on current research topics in the area of Human-Centered Multimedia.

Literature:

Literature references will be given at the beginning of the module depending on the topic.

Assigned Courses:

Oberseminar Human-Centered Multimedia

Examination

Research Module Human-Centered Multimedia

practical exam
Module INF-0188: Seminar Bachelors Seminar Algorithmen und Date	Algorithms and Data Structures for	4 ECTS/LP
Version 1.0.0 (since WS15/16) Person responsible for module	Prof. Dr. Torben Hagerup	
Learning Outcomes / Competent Upon completion of the seminal less demanding original scienting They will understand how to con Key Qualifications: Capability of logical, analytical, topics; literature research; self- communication skills; time mar	tences: r, the students will be able to independently acc fic texts and to present them clearly and unders ndense a text to its essentials and to structure a and conceptual comprehension and of participa contained work with English technical literature agement.	quire algorithm-related contents from tandably, in spoken and written form. a presentation within a given time frame. ating in concise debates on technical g quality awareness; meticulousness;
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term	papers (self-study)	
Conditions: Familiarity with basic algorithm course "Informatik III") will be h	s and data structures (as imparted, e.g., by the ighly useful.	
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Mode of Instruction: seminar Language: German Contact Hours: 2	Algorithms and Data Structures	

Contents:

Current and classical topics from the field of Algorithms and Data Structures are studied, using original literature.

Literature:

Selected scientific articles.

Examination

Written paper and oral presentation.

seminar

Seminar Datenbanksysteme für Bachelor	4 2013/26	
Version 1.0.0 (since SoSe16) Person responsible for module: Prof. Dr. Peter Michael Fischer		
Learning Outcomes / Competences: After attending the seminar, students are able to independently work of methods, procedures, techniques and technologies in the field of data They have the working techniques, communication skills and ability to clearly and comprehensibly, both verbally and in writing, and to discuss and argumentatively. They will also be able to recognize and use logic a goal-oriented manner. The participants are able to formulate clearly and understandably and understand how to structure a lecture in a clear and comprehensible w messages and convey them in a comprehensible way. The students understand how to present themselves and how to deal They manage to gear a lecture to a specific target group and to motivate techniques. Key qualifications: Literature research; Independent work with English methodical competence; Scientific methodology; Principles of good so confident and convincing (written and oral) presentation of (practical of for their documentation; Skill in logical, abstract, analytical and concept awareness, meticulousness; Communication skills; Time management and and and and and and and and and and	but and understand basic problems, concepts, abase systems. In use appropriate media to present a special topic as topics from the aforementioned field critically cal structures of reasoning and argumentation in to present specialist content freely. They way and how to focus the lecture on essential confidently with common presentation media. ate the listener and to apply various moderation a-language specialist literature; Analytical- cientific practice; Skill in the comprehensible, or theoretical) ideas, concepts and results and obtual thinking and formal argumentation; Quality at.	
Workload: Total: 120 h 90 h preparation of written term papers (self-study) 30 h seminar (attendance)		
Conditions: Module Database Systems (INF-0073) - recommended		
Frequency: each semester Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: Repeat Exams Permitted: 2 according to the examination regulations of the study program	am	

Parts of the Module

Part of the Module: Seminar Datenbanksysteme für Bachelor

Mode of Instruction: seminar

Language: German / English

Frequency: irregular (usu. summer semester)

Contact Hours: 2

Contents:

Current research contributions from the field of "Databases and Information Systems".

Literature:

Current research contributions

Assigned Courses:

Seminar Datenbanksysteme für Bachelor (seminar)

Examination Presentation and written elaboration seminar

Module INF-0261: Practical Modu	Jle on Manufacturing Technology	5 ECTS/LP
Praktikum Produktionstechnik		
Version 1.1.0 (since WS17/18)		
Person responsible for module: Prot. D	rIng. Johannes Schilp	
Learning Outcomes / Competences: Students will be able to apply basic known They transfer theoretical methods and They are able to successfully solve and Key qualifications: Teamwork and com problem solving, evaluation of results a conceptually.	owledge of production engineering and te models from the lecture Production Engi d present project tasks in small groups. munication skills, structured and conscie and weighing of solution approaches, abil	echnical order processing in practice. neering to practice-oriented tasks. entious work, application-oriented lity to think logically, analytically and
Remarks: It is not possible to take INF-0261 if the	e module INF-0242 has already been tak	en!
Workload: Total: 150 h 90 h studying of course content throug 60 h internship / practical course (atten	h exercises / case studies (self-study) idance)	
Conditions: Recommendation: First experience with It is recommended that you have previous modules: INF-0196: Production Informatics INF-0197: Process modeling and pro- INF-0260: Production Engineering	h Catia V5 (preliminary course). ously taken one of the following oduction control	
Frequency: each summer semester	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Practical Module Mode of Instruction: internship Language: German Contact Hours: 4	on Manufacturing Technology	
Contents: In the internship, project tasks/expe Production organization	eriments/learning games are offered on e	each of the following main topics:

- Automation technology
- Production planning and control
- Quality management
- Logistics

Assigned Courses:

Praktikum für Produktionstechnik (internship)

Examination

Praktikum Produktionstechnik

practical exam / length of examination: 45 minutes

Module INF-0267: Practical Modu Praktikum Deep Learning	Ile Deep Learning	5 ECTS/LP	
Version 1.1.0 (since WS17/18)			
Person responsible for module: Prof. D)r. Björn Schuller		
Learning Outcomes / Competences:	1		
The students get to know systems for p neural machine learning methods. Afte and concepts of neural networks, in pa their implementation, such as Tensorfly	Dattern recognition by means of deep lea r participating in the practical course, the irticular their mathematical foundations, a ow.	rning and acquire basic knowledge of students understand the functionality and the concepts of software tools for	
The participants can evaluate intelliger knowledge and solution approaches to evaluating the performance of a corres deep learning can be analyzed and be	It neural systems in relation to the algorit other problems. They are also familiar w ponding system. In addition, fundamenta haviors of deep neural networks can be i	hmic solution and transfer their vith methods for quantitatively al problems of pattern recognition and interpreted.	
The students can specify different type within the framework of practical prograsolutions to reduce it.	s of information processing and analysis amming tasks. You can also critically ide	and implement them algorithmically ntify and evaluate misconduct and find	
Key qualifications: Implementation of structure IT problems and to develop a of design alternatives, evaluation in the document and present results; quality	Key qualifications: Implementation of solution concepts using machine learning in software; Ability to analyze and structure IT problems and to develop and implement solution strategies; Knowledge of the advantages/disadvantages of design alternatives, evaluation in the respective application context; skill of teamwork; Ability to understand, document and present results; quality awareness.		
Workload: Total: 150 h 90 h studying of course content throug 60 h internship / practical course (atter	h exercises / case studies (self-study) idance)		
Conditions:		Credit Requirements: Bestehen der Modulprüfung	
Frequency: usu. at least once per acad. year	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours:	Repeat Exams Permitted:		
4	according to the examination		
	regulations of the study program		
Parts of the Module			
Part of the Module: Praktikum Deep Mode of Instruction: internship Language: English	Learning		

Frequency: each semester

Contact Hours: 4

Contents:

On the basis of practical tasks, primarily neural models for information processing are considered. Examples include intelligent processing of audio and video signals. Common current network topologies such as convolutional networks, recurrent networks with memory or generative adversial networks are presented. In the field of deep learning, complex neural networks are treated, whose behavior cannot be easily predicted and which are subject to constant change.

Literature:

Will be announced by the lecturer.

Assigned Courses:

Praktikum Deep Learning (internship)

Praktikum Digital Health (internship)

Examination

Praktikum Deep Learning

practical exam

Module INF-0268: Practical Mo Praktikum Computational Intelligence	odule Computational Intelligence	5 ECTS/LP
Version 1.5.0 (since WS17/18)		
Person responsible for module: Pro	f. Dr. Björn Schuller	
Learning Outcomes / Competence The students get to know and be ab to practical problems after participat data-based modelling, including its software tools and libraries. The par and transfer their knowledge and so quantitatively evaluating the perform recognition can be analyzed and the machines, or neural networks, can b and analysis and implement them a also critically identify and evaluate r solution concepts using machine lea and implement solution strategies; k in the respective application context awareness.	es: le to use the basic concepts and algorithm ing in the internship. The students underst mathematical foundations, and can apply t ticipants can evaluate intelligent systems of lution approaches to other problems. They hance of a corresponding system. In additive behavior of machine learning methods, s be interpreted. The students can specify di lgorithmically within the framework of pract nisconduct and find solutions to reduce it. I arning in software; Ability to analyze and st Knowledge of the advantages/disadvantage; skill of teamwork; Ability to understand, d	as of machine learning transfer these and the functionality and concepts of he knowledge gained using various with regard to their algorithmic solution v are also familiar with methods for on, fundamental problems of pattern uch as decision trees, support vector fferent types of information processing tical programming tasks. You can Key qualifications: Implementation of tructure IT problems and to develop es of design alternatives, evaluation locument and present results; quality
Workload: Total: 150 h 60 h internship / practical course (at 90 h studying of course content thro	tendance) ugh exercises / case studies (self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: irregular (usu. winter semester)	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Praktikum Computational Intelligence

Mode of Instruction: internship

Language: English

Frequency: irregular

Contact Hours: 4

Contents:

Introduction to intelligent systems. Symbolic and signal-based features. basis of machine intelligence: linear decision functions, distance classifiers, nearest neighbor rule, Kernel machines, Bayesian classifier, rule-based methods, decision trees, ensemble learning, neural networks, dynamic classification. Classification and Regression. learning method. feature reduction and feature selection. Methods of cluster analysis, semi-supervised learning. evaluation.

Literature:

- I.H. Witten, F. Eibe, M.A. Hall: Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2011.
- B. Schuller: Intelligent Audio Analysis, Springer, 2013.
- K. Kroschel, G. Rigoll, B. Schuller: Statistische Informationstechnik, 5. Neuauflage, Springer, 2011.

Examination

Praktikum Computational Intelligence

written exam / length of examination: 90 minutes

Module INF-0269: Seminar Embe and Wellbeing (Bachelor) Seminar Embedded Intelligence for He	added Intelligence for Health Care	4 ECTS/LP	
Version 1.0.0 (since WS17/18) Person responsible for module: Prof. D	r. Björn Schuller		
Learning Outcomes / Competences: After attending the seminar, the studen concepts, methods, procedures, techni working techniques, communication sk and written form in a clear and underst argumentatively. You can also recognize	ts are able to independently develop and ques and technologies in the field of e-h ills and ability to use the appropriate me andable way and to discuss topics from ze the logical structures of thinking and a	d understand basic problems, ealth and m-health. You have the dia to present a specific topic in spoken the area mentioned critically and arguing and use them effectively.	
The participants can formulate clearly a to structure a presentation clearly and t understandable way.	The participants can formulate clearly and understandably and present specialist content freely. You know how to structure a presentation clearly and to focus the presentation on essential messages and to convey them in an understandable way.		
The students know how to be present and how to handle common presentation media confidently. You manage to a specific target group and to motivate the listener and to use various moderation techniques.			
Key qualifications: Principles of good scientific practice; Analytical-methodical competence; time management; literature research; Independent work with English-language specialist literature; communication skills; Ability to present practical and theoretical ideas in an understandable, secure and convincing (oral and written) way, writing papers in the LaTeX typesetting language; guality awareness.			
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)		
Conditions: Credit Requirements: none Bestehen der Modulprüfung			
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		

Parts of the Module

Part of the Module: Seminar Embedded Intelligence for Health Care and Wellbeing (Bachelor)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

The seminar deals with current relevant topics in the context of embedded intelligence in the health sector. These include u.a. Sensor technologies for knowledge-based monitoring of health-related activities, vital signs and context factors, multi-sensory acquisition, analysis and interpretation of biological parameters (e.g. metabolic, cardiological and neurological signals), but also user modeling and user interfaces for health and fitness applications.

The students work on the given topic based on scientific literature and give a presentation and prepare a written summary.

Literature:

Will be announced by the lecturer

Examination Seminar Embedded Intelligence for Health Care and Wellbeing (Bachelor) written/oral exam

	1
Module INF-0271: Research Module Embedded Intelligence for	6 ECTS/LP
Health Care and Wellbeing	
Forschungsmodul Embedded Intelligence for Health Care and Wellbeing	
Version 1.1.0 (since WS17/18)	1

Person responsible for module: Prof. Dr. Björn Schuller

Learning Outcomes / Competences:

After participating in the research module, students are able to understand problems of medium complexity in the field of intelligent embedded systems, in particular signal analysis for e-health and m-health applications. They have detailed and up-to-date knowledge in the area mentioned and can actively participate in research projects. In addition, they understand advanced concepts, methods, procedures, techniques and technologies and can contribute this knowledge to research projects. In addition, the students have the team and communication skills, the ability to research scientific literature and the learning and working techniques to discuss problems in the field, as well as to critically evaluate, combine and present interim results.

Key Qualifications: Ability to think logically, analytically and conceptually; Independent work with English-language specialist literature; Understandable, safe and convincing presentation of ideas, concepts and results; quality awareness; communication skills; Team collaboration skills and understanding of team processes; principles of good scientific practice; project management skills; Scientific Method.

Workload:

Total: 180 h

165 h internship / practical course (self-study)

15 h seminar (attendance)

Conditions:		Credit Requirements:
none		Bestehen der Modulprüfung
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module:
Contact Hours:	Repeat Exams Permitted:	
1	according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Research Module Embedded Intelligence for Health Care and Wellbeing

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Participation in current research topics.

Literature:

Scientific publications; manuals; is provided by the chair.

Assigned Courses:

Oberseminar Embedded Intelligence for Health Care and Wellbeing

Examination

Presentation and written paper

practical exam

Version 1.0.0 (since SoSe18) Person responsible for module: Prof. Dr. Bernhard Bauer Learning Outcomes / Competences: After participating in the practical course Automotive Software Engineering, the students understand practical problems of higher complexity in the field of development and validation of driving assistance systems with current methods and tools of model-based development of embedded systems. The students acquire in-depth subject-specific and interdisciplinary knowledge and skills, such as control engineering, driving physics, and mathematics. They are able to develop concepts, methods, procedures, techniques, and technologies of the named area in research projects and are able to apply strategies in solving problems. In addition, students have teamwork and communication skills the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skille	Module INF-0276: Practical Module Automotive Software Engineering (BA)	6 ECTS/LP	
Version 1.0.0 (since SoSe18) Person responsible for module: Prof. Dr. Bernhard Bauer Learning Outcomes / Competences: After participating in the practical course Automotive Software Engineering, the students understand practical problems of higher complexity in the field of development and validation of driving assistance systems with current methods and tools of model-based development of embedded systems. The students acquire in-depth subject-specific and interdisciplinary knowledge and skills, such as control engineering, driving physics, and mathematics. They are able to develop concepts, methods, procedures, techniques, and technologies of the named area in research projects and are able to apply strategies in solving problems. In addition, students have teamwork and communication skills the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skille	Praktikum Automotive Software Engineering (BA)		
Person responsible for module: Prof. Dr. Bernhard Bauer Learning Outcomes / Competences: After participating in the practical course Automotive Software Engineering, the students understand practical problems of higher complexity in the field of development and validation of driving assistance systems with current methods and tools of model-based development of embedded systems. The students acquire in-depth subject-specific and interdisciplinary knowledge and skills, such as control engineering, driving physics, and mathematics. They are able to develop concepts, methods, procedures, techniques, and technologies of the named area in research projects and are able to apply strategies in solving problems. In addition, students have teamwork and communication skills the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skille	Version 1.0.0 (since SoSe18)		
Learning Outcomes / Competences: After participating in the practical course Automotive Software Engineering, the students understand practical problems of higher complexity in the field of development and validation of driving assistance systems with current methods and tools of model-based development of embedded systems. The students acquire in-depth subject-specific and interdisciplinary knowledge and skills, such as control engineering, driving physics, and mathematics. They are able to develop concepts, methods, procedures, techniques, and technologies of the named area in research projects and are able to apply strategies in solving problems. In addition, students have teamwork and communication skills the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skills	Person responsible for module: Prof. Dr. Bernhard Bauer		
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and are able to apply strategies in solving problems. In addition, students have teamwork and communication skills the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skills	able to develop concepts, methods, procedures, techniques, and technologies of the named area in research projects		
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classify, combine, present, and document intermediate results and innovative ideas in an understandable way. Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skills	the ability to research literature to discuss problems in the field, define intermediate goals, and critically evaluate,		
Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skills	classify, combine, present, and document intermediate results and innovative ideas in an understandable way.		
technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management	Key gualifications: Ability to think logically, analytically, and conceptually: Independent work with English-language		
awareness; Communication skills; Ability to work in teams and understand team processes; Project management	technical literature: Understandable, confident, and convincing presentation of ideas, concepts, and results: Quality		
ekille	awareness: Communication skills: Ability to work in teams and understand tear	n processes: Project management	
-30/01-3	skills	r processo, r rojsor managoment	

Total: 180 h

90 h studying of course content through exercises / case studies (self-study)

90 h internship / practical course (attendance)

Conditions: Empfohlen wird die Teilnahme am links aufgeführten Seminar.		
Module Seminar Basics of Software Engineering for Automotive Systems (BA) (INF-0027) - recommended		
Frequency: irregular (usu. winter semester)	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Automotive Software Engineering (BA)

Mode of Instruction: internship

Language: German

Frequency: each winter semester

Contact Hours: 6

Contents:

In the automotive practical course, participants learn how various selected functions within vehicles can be simulated and analyzed. The necessary theoretical foundations are laid for working on the experimental task in a two-day introductory course. The anti-lock braking system (ABS) model is treated on control units during the initial period. Among other things, the participants will get to know the modeling tool combination "Matlab/Simulink", which is frequently used in the automotive environment, and the graphical simulation and analysis tool "CarMaker" and gain a practical insight into the functioning of FlexRay bus systems.

After the introductory course, the model of an ACC (Adaptive Cruise Control) system will be created, simulated, and verified in groups of two to three participants.

Literature:

depending on the subject

Examination

Practical Module Automotive Software Engineering (BA)

oral exam / length of examination: 30 minutes

Test Frequency:

when a course is offered

Module INF-0313: Seminar IT Infrastructure in Medical Information Systems for Bachelor Students Seminar IT-Infrastrukturen in der Medizin für Bachelor	4 ECTS/LP	
Version 1.0.0 (since SoSe19)		
Person responsible for module: Prof. Dr. Frank Kramer		
Learning Outcomes / Competences:		
After attending the seminar, students are able to independently work out a	and understand basic problems, concepts,	
methods, procedures, techniques and technologies in the field of IT infras	structures for translational medical research.	
They have the working techniques, communication skills and ability to use	They have the working techniques, communication skills and ability to use appropriate media to present a specific	
topic clearly and comprehensibly, both verbally and in writing, and to discuss topics from the aforementioned field		
critically and argumentatively. They will also be able to recognize and use logical structures of reasoning and		
argumentation in a goal-oriented manner. The participants are able to for	mulate clearly and understandably and to	
present specialist content freely. They understand how to structure a lecture in a clear and comprehensible way and		
how to focus the lecture on essential messages and convey them in a comprehensible way. The students understand		
now to present themselves and how to deal confidently with common presentation media. They manage to gear a		
ecture to a specific target group and to motivate the listener and to apply various moderation techniques.		
Key qualifications: Literature research; Independent work with English-language specialist literature; Analytical-		
methodical competence; Scientific methodology; Principles of good scientific practice; Skill in the comprehensible,		
confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and		
in documenting them; Skill in logical, abstract, analytical and conceptual thinking and formal argumentation; Quality		
awareness, meticulousness; Communication skills; Time management.		

Workload:

Total: 120 h

30 h seminar (attendance)

90 h preparation of written term papers (self-study)

Conditions: none		Credit Requirements: Passing the module examination
Frequency: each semester	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar IT Infrastructure in Medical Information Systems for Bachelor Students

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

Current topics of IT infrastructures in medicine

Literature:

will be presented in the respective kickoff event.

Examination

Seminar IT Infrastructure in Medical Information Systems for Bachelor Students written/oral exam

Valid Sommersemester 2023 - Printed 11.04.2023

Module INF-0321: Practical Praktikum Speech Pathology	Module Speech Pathology	5 ECTS/LP
Version 1.0.0 (since WS19/20) Person responsible for module:	Prof. Dr. Björn Schuller	
Learning Outcomes / Competer Knowledge: The students learn and language pathology, feature exemplified through the analysis learning principles, with a partice voice pathologies. They will lear relevant in the context of health Skills: Participants are trained in skills to transfer their knowledge signal processing and machine of voice pathology detection. All Students will be able to assess technical evolution and novelties Competences: The students are solutions for intelligent signal and document results in a reasonabl distribution in an autonomous w Key skills: Formal methods; Kno Systematical advancement of de of workflows and processes; Ab awareness; Scientific working. Workload: Total: 150 h 60 h internship / practical course 90 h studying of course content	ences: concepts relating to signal processing, spee e extraction, denoising, information reductio s of automated voice pathology detection. T ular focus on deep learning solutions, as is n about different problems and solutions in care and wellbeing. • their logical, analytical and conceptional sl • to a practical task. The students will be ab intelligence, further develop these, design r knowledged obtained during the Praktikum developed systems in a scientific way. They is in the fields of speech analysis and medic e able to characterise, judge on the quality a alysis with a focus on voice pathology dete le and meaningful way. Students will work in ay. owledge of advantages and disadvantages of esign tools; Ability to work in teams; Unders ility to find solutions for practical problems;	ech production, phonetics, speech n and natural language processing as hey further gain insight into machine needed to diagnose a range of different the analysis of a variety of speech, kills as well as in practical programming le to choose appropriate algorithms of new solutions, and apply these to the task is applied in practice-oriented tasks. / will be able to recognise important al machine learning. and suitability, and design suited algorithmic ction. They are further able to present and in teams and organise their work and task of different design alternatives; standing of team management; Knowledge Ability to work autonomously; Quality
Conditions:		Credit Requirements:
Frequency: irregular	Recommended Semester: from 3.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum Mode of Instruction: internship Language: English	Speech Pathology	

Contact Hours: 4

Contents:

The course "Speech Pathology Praktikum" will give an introduction to models of speech production (e.g., sourcefilter models) with a focus on aspects that are relevant to pathologies and their recognition using automated methods of signal processing and machine learning. Moreover, students learn about robust feature extraction, modern methods of machine learning and machine intelligence, and implementation of such systems on devices

Topics: Speech production; Phonetics; Speech and language pathology; Signal processing; Natural language processing; Speech analysis; Feature extraction; Machine learning; Deep learning; Denoising; Information reduction; Healthcare.

Literature:

- Björn Schuller, Anton Batliner: "Computational Paralinguistics: Emotion, Affect and Personality in Speech and Language Processing", Wiley, ISBN: 978-1119971368, 2013.
- Further literature is going to be announced during the lecture.

Examination

Praktikum Speech Pathology

practical exam

Module INF-0327: Research Module IT Infrastructure in Medical	6 ECTS/LP
Information Systems	
Forschungsmodul IT-Infrastrukturen in der Medizin	
Version 1.0.0 (since WS19/20)	

Person responsible for module: Prof. Dr. Frank Kramer

Learning Outcomes / Competences:

After participating in the research module, students are able to understand problems of medium complexity in the field of IT infrastructures in translational medical research. They have detailed and up-to-date knowledge in the aforementioned field and can actively participate in research projects. To this end, they understand advanced concepts, methods, procedures, techniques and technologies and can apply this knowledge in research projects. In addition, students have the teamwork and communication skills, the ability to research literature and the learning and working techniques to discuss problems in the field, as well as to critically evaluate, combine and present intermediate results.

Key Skills: Skill in logical, analytical, and conceptual thinking; Independent work with English-language literature; Understandable, confident, and persuasive presentation of ideas, concepts, and results; Quality awareness; Communication skills; Skill in working in teams and understanding team processes; Principles of good scientific practice.

Workload:

Total: 180 h

Conditions: none		Credit Requirements: Passing the module examination
Frequency: each semester	Recommended Semester: from 3.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Research Module IT Infrastructure in Medical Information Systems

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Current research topics in the field of IT infrastructures in translational medical research.

Literature:

scientific essays, manuals

Assigned Courses:

Oberseminar IT-Infrastrukturen für die Translationale Medizinische Forschung

Examination

Research Module IT Infrastructure in Medical Information Systems

practical exam

Module INF-0330: Seminar Com Seminar Computational Intelligence (putational Intelligence (Bachelor) Bachelor)	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof.	Dr. Björn Schuller	,
Learning Outcomes / Competences	3:	
After attending the seminar, students statements, concepts, methods, appr They possess the scientific technique understandingly a special topic in spo from the field in a critical way. Further them constructively. Participants can express themselves how to structure a talk, to focus it - als them in a suitable way. The lines of a Students know how to perform energy manage to orient a talk toward a certa	will be able to autonomously acquire and oaches, techniques, and technologies in t is, communication skills, and the ability to oken and written, and to discuss and evalu- more, they can recognise logical structur in a clear and understandable way and p so given a complex content - on the esset rguments and strategies in case of distur- etically, to cope with the presentation med ain audience, to motivate the listeners als	I understand advanced problem the field of Computational Intelligence. employ suitable media, to present uate scientifically challenging themes es of thinking and debating and employ resent scientific topics. They understand ntial messages, and to communicate bances are applied by the students. dia and to use them interactively. They o over a longer duration, and to employ
Key qualifications: Fundamentals of management; Literature research; Se to present (in written and spoken) pra Writing a report in the markup langua aspects; Quality awareness.	of good scientific practice; Analytical-meth If-contained work with English technical li Inctical and theoretical ideas in an understa ge LaTeX; Evaluation of methods, techno	odological competency; Time iterature; Communication skills; Ability andable, confident, and convincing way; ologies, and solutions w.r.t. different
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term pape	rs (self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Comp Mode of Instruction: seminar	utational Intelligence (Bachelor)	

Language: German / English

Contact Hours: 2

Contents:

Fuzzy Logic, Neural Networks, Evolutionary Computation, Learning Theory, Probabilistic Methods

Literature:

To be announced by the lecturers.

Assigned Courses:

Seminar Computational Intelligence (Bachelor & Master) (seminar)

Examination Seminar Computational Intelligence (Bachelor) written/oral exam

		T
Module INF-0332: Artificial Intelli Artificial Intelligence	igence	5 ECTS/LP
Version 1.1.0 (since SoSe20)		
Person responsible for module: Prof. L)r. Björn Schuller	я
Learning Outcomes / Competences: The course Artificial Intelligence covers Learning, Knowledge representation, F Creativity, Reasoning, Problem Solving Upon completing the course, students and for specific tasks in artificial intellig respective application context. They w and systems. During the course, the participants will gain the ability to make scientifically m methods. They will get used to the way Moreover, students will gain the ability to apply their new knowledge to practic of machine learning. They will also dev Key qualifications: analytical skills, d practical systems, ability to present an practical conditions, self-reflection, qua	s the broad research area of artificial inter Perception, Natural Language Processing g, Planning, and General intelligence. will have the skills and knowledge to be a gence and know the pros and cons of des ill be able to apply and implement the dis improve their skills in logical, analytical, a eaningful assessments in the field of artif / of thinking and the language of relevant to, convincingly, present their developed cal tasks and solve many real-life problem /elop the competence to identify significa ata science cross-disciplinary knowledge d document results in a comprehensible ality awareness, meticulousness, teamwore	Iligence including the core topics a, Socio-Emotional Intelligence, Artificial able to choose suitable approaches sign alternatives, as assessed in the cussed technical concepts in programs and conceptual thinking. Students will ficial intelligence using appropriate t disciplines. I ideas and concepts. They will be able ns through the appropriate application nt technical developments in the field. e, procedures and processes in creating way, skill to solve problems under ork
Workload: Total: 150 h 15 h studying of course content using h 15 h studying of course content using h 30 h lecture (attendance) 60 h studying of course content throug 30 h exercise course (attendance)	literarture (self-study) provided materials (self-study) h exercises / case studies (self-study)	
Conditions:	es should he present	Credit Requirements: Bestehen der Modulprüfung
semester)	from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Artificial Intellige Mode of Instruction: lecture Language: German Contact Hours: 2	ence (Vorlesung)	
Contents: Learning, Knowledge representation Artificial Creativity, Reasoning, Pro	on, Perception, Natural Language Proces blem Solving, Planning, and General inte	sing, Socio-Emotional Intelligence, elligence.

Literature:

Literature will be anounced during the lecture.

Part of the Module: Artificial Intelligence (Übung)

Mode of Instruction: exercise course Language: English Contact Hours: 2

Examination

Artificial Intelligence

written exam / length of examination: 90 minutes

Module INF-0334: Practical Modu Intelligence for Health Care Appl Praktikum Human-Centered Artificial Ir	Ile Human-Centered Artificial ications ntelligence for Health Care Applications	8 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. D	r. Elisabeth André	
Learning Outcomes / Competences: After successful participation in this mo development of health-related applicati master the selection and safe application in the research field. Furthermore, com organization are taught through the pro- of these project tasks, knowledge of the and presentation of project results.	odule, students are familiar with basic co ons. They are able to translate technical on of suitable methods. In addition, they petencies in the areas of teamwork and pcessing of project tasks and their indepe e mindset and language of the research	ncepts of artificial intelligence for the I solution concepts into models and will gain an insight into current work communication skills as well as self- endent project planning. In the context field is fostered through the discussion
Key qualifications: Conversion of tech consolidation; interdisciplinary knowled knowledge of the mindset and languag of practice-relevant tasks; familiarity wi science; ability to present and document independently; competence in recognize	nnical solution concepts into programs a lge; ability to make scientifically meaning e of application-relevant disciplines; abil th procedures and processes in the appl nt results in a comprehensible manner; a zing significant technical developments.	nd models; subject-specific gful evaluations using suitable methods; ity to work in teams; knowledge lication environment of computer ability to expand existing knowledge
Workload: Total: 240 h 150 h studying of course content throug 90 h internship / practical course (atten	gh exercises / case studies (self-study) dance)	
Conditions: Programming experience		
Frequency: each summer semester	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted:	

Parts of the Module

6

Part of the Module: Practical Module Human-Centered Artificial Intelligence for Health Care Applications Mode of Instruction: internship

according to the examination regulations of the study program

Language: German

Contact Hours: 6

Assigned Courses:

Praktikum Human-Centered Artificial Intelligence for Health Care Applications (internship)

Examination

Practical Module Human-Centered Artificial Intelligence for Health Care Applications practical exam

Module INF-0336: Seminar Emb	edded Systems (Bachelor)	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof.	Dr. Sebastian Altmeyer	
Learning Outcomes / Competences After attending the seminar, students methods, procedures, techniques and	are able to independently work out and un technologies in the field of embedded sy	nderstand basic problems, concepts, stems.
They have the working techniques, co clearly and comprehensibly, both vert and argumentatively. They will also be in a goal-oriented manner. The partici freely. They understand how to structu the presentation on essential messag	mmunication skills and ability to use approach of the second structure and in writing, and to discuss topics for able to recognize and use logical structure pants can formulate clearly and compreheure a scientific presentation in a clear and se and convey them in a comprehensible	ropriate media to present a special topic from the aforementioned field critically ures of reasoning and argumentation ensibly and present specialist content comprehensible way and how to focus way.
The students understand how to prese They manage to gear a presentation t moderation techniques.	ent themselves and how to deal confident o a specific target group and to motivate	ly with common presentation media. the listener and to apply various
Key qualifications: Literature researce methodical competence; Scientific methodical convincing (written and confident and convincing (written and for their documentation; Skill in logical awareness, meticulousness; Commun	ch; Independent work with English-langua thodology; Principles of good scientific pr oral) presentation of (practical or theoreti l, abstract, analytical and conceptual think nication skills; Time management.	age specialist literature; Analytical- actice; Skill in the comprehensible, cal) ideas, concepts and results and king and formal argumentation; Quality
Workload: Total: 120 h 90 h preparation of written term paper 30 h seminar (attendance)	s (self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module	·	·

Part of the Module: Seminar Embedded Systems (Bachelor)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

In the seminar, topics from the field of embedded systems will be covered. Each seminar participant receives individual literature references, which are then to be supplemented in the course of the seminar by further independently compiled references. The seminar will end with a written paper and a presentation on the topic covered.

Literature:

given individually and self research

Assigned Courses:

Seminar Embedded Systems (Bachelor) (seminar)

Examination

L

Seminar Embedded Systems (Bachelor)

written/oral exam

Module INF-0338: Research M Forschungsmodul Embedded Syste	odule Embedded Systems	6 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prot	f. Dr. Sebastian Altmeyer	
Learning Outcomes / Competence After participating in the research m of embedded systems. They have d participate in research projects. To t and technologies and can apply this communication skills, the ability to re the field, as well as to critically evalu	es: odule, students are able to understand pro etailed and up-to-date knowledge in the af this end, they understand advanced conce knowledge in research projects. In addition esearch literature and the learning and wo uate, combine and present intermediate res	blems of medium complexity in the field orementioned field and can actively pts, methods, procedures, techniques n, students have the teamwork and rking techniques to discuss problems in sults.
Key qualifications: Skill in logical, i literature; Intelligible, confident, and Communication skills; Skill in workir practice.	analytical, and conceptual thinking; Indepe persuasive presentation of ideas, concept ng in teams and understanding team proce	ndent work with English-language s, and results; Quality awareness; sses; Principles of good scientific
Workload: Total: 180 h 15 h seminar (attendance) 165 h internship / practical course (s	self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Part of the Module: Forschungsmodul Embedded Systems

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Participation in current research topics.

Literature:

scientific papers, handbooks

Assigned Courses:

Oberseminar Embedded Systems

Examination

Forschungsmodul Embedded Systems

practical exam

Module INF-0341: Seminar Digita Seminar Digital Health (Bachelor)	I Health (Bachelor)	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. D	r. Björn Schuller	
Learning Outcomes / Competences: After attending the seminar, students w statements, concepts, methods, approx M-Health. They possess the scientific t present understandingly a special topic themes from the field in a critical way. I employ them constructively.	vill be able to autonomously acquire and aches, techniques, and technologies in the echniques, communication skills, and the in spoken and written, and to discuss an Furthermore, they can recognise logical	understand advanced problem he field of Digital Health, E-Health and e ability to employ suitable media, to nd evaluate scientifically challenging structures of thinking and debating and
Participants can express themselves in how to structure a talk, to focus it - also them in a suitable way. The lines of arg Students know how to perform energet manage to orient a talk toward a certain different methods of moderation.	a clear and understandable way and pro- given a complex content - on the essen juments and strategies in case of disturb ically, to cope with the presentation med in audience, to motivate the listeners also	esent scientific topics. They understand tial messages, and to communicate bances are applied by the students. lia and to use them interactively. They o over a longer duration, and to employ
Key qualifications: Fundamentals of g management; Literature research; Self- to present (in written and spoken) pract Writing a report in the markup language aspects; Quality awareness.	good scientific practice; Analytical-metho contained work with English technical lit tical and theoretical ideas in an understa a LaTeX; Evaluation of methods, technol	dological competency; Time erature; Communication skills; Ability ndable, confident, and convincing way; logies, and solutions w.r.t. different
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	(self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Digital Health (Bachelor)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

In the seminar Digital Health, recent research works in this field are going to be discussed. This comprises both the acquisition of data through sensors and (e.g., microphones or electrodes) and the analysis and the modelling of the data. One important aspect is also the practicability of modern deep learning methods. Digital Health applications reach from tracking of health states (e.g., epilepsy or depression) to personal assistance services. The participating students will work on a certain aspect, supervised by a research associate of the chair. They will summarise their results in a written report and an oral presentation.

Topics: E-Health, M-Health, Sensor Signal Analysis, Vital Signs, Big Data.

Literature:

Depends on the chosen topic

Assigned Courses:

Seminar Digital Health (Bachelor & Master) (seminar)

Examination

Seminar Digital Health (Bachelor) written/oral exam

Module INF-0343: Seminar Softw Systems (BA) Seminar Software Engineering verteil	ware Engineering of Distributed	4 ECTS/LP
Person responsible for module: Prof.	Dr. Bernhard Bauer	
Learning Outcomes / Competences After attending the seminar, students methods, procedures, techniques, and seminar topic from the named field. The appropriate media to present a specific evaluate scientifically challenging topic recognize the logical structures of thirr formulate clearly and comprehensibly clearly and understandably, focus the complex content. They skillfully apply students understand how to present the interactively. They manage to gear and durations, and apply various moderation Key qualifications: Literature research methodical competence; scientific me confident, and convincing (written and in documenting them; skills in logical, awareness, meticulousness; communications	can independently analyze and evaluate a d technologies in distributed systems softeney have the scientific methodology, come c case clearly and comprehensibly in spe cs from the named field critically and argu- king and argumentation and use them go and present subject content freely. They study on essential messages, and unders chains of argumentation and solution stra- nemselves and confidently deal with joint ecture to a specific target group, motivate on techniques. ; independent work with English-language thodology; principles of good scientific pra- l oral) presentation of (practical or theoret abstract, analytical and conceptual thinkin ication skills; time management. Translate	advanced problems, concepts, ware engineering about the particular munication skills, and ability to use eech and writing and to discuss and umentatively. Furthermore, they can al-oriented. The participants can understand how to structure a lecture standably convey them, even with tegies in the event of disruptions. The presentation media and use them a the listener even during longer lecture e specialist literature; analytical- actice; skills in the understandable, ical) ideas, concepts, and results and ng and formal argumentation; quality ed with www.DeepL.com/Translator
Total: 120 h 90 h preparation of written term paper 30 h seminar (attendance)	s (self-study)	
Conditions: The previous course "Seminar on Sof Systems (BA)" (INF-0026) must not h	tware Engineering of Distributed ave been taken due to overlaps.	
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Softwa Mode of Instruction: seminar Language: German Contact Hours: 2 Contents:	re Engineering verteilter Systeme (BA)
Current software engineering topic	es from industry and research.	

Will be presented at the respective kick-off event.

Assigned Courses:

Seminar Software Engineering verteilter Systeme (Bachelor) (seminar)

Examination

Seminar Software Engineering verteilter Systeme (BA)

written/oral exam **Test Frequency:**

when a course is offered

$\Gamma_{\text{region optimes}}(D\Lambda)$	Automotive Software and Systems	4 ECTS/LP
Seminar Automotive Software a	nd Systems Engineering (BA)	
Version 1.0.0 (since SoSe20) Person responsible for module:	Prof. Dr. Bernhard Bauer	
Learning Outcomes / Competer After attending the seminar, stuck methods, procedures, technique working techniques, communica and comprehensibly in speech a Furthermore, they can recognize The participants can formulate c to structure a lecture clearly and comprehensible way. The studen media. They manage to gear a le	ences: dents can independently work out and unders s, and technologies in automotive software & tion skills, and ability to use appropriate med and writing and discuss issues from the name the logical structures of thinking and argum learly and comprehensibly and present subje understandably, focus the study on importar ints understand how to present themselves an ecture to a specific target group, motivate the	tand fundamental problems, concepts, systems engineering. They have the ia to present a particular topic clearly d field critically and argumentatively. entation and use them goal-oriented. ect content freely. They understand how it messages, and convey them in a ind deal confidently with joint presentation e listener, and apply various moderation
Key qualifications: Literature res methodical competence; Scientil confident, and convincing (writte in documenting them; Skill in log awareness, meticulousness; Col	earch; Independent work with English-langua fic methodology; Principles of good scientific n and oral) presentation of (practical or theor ical, abstract, analytical and conceptual think mmunication skills; Time management.	age specialist literature; Analytical- practice; Skill in the understandable, retical) ideas, concepts, and results and king and formal argumentation; Quality
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term	papers (self-study)	
Conditions: The previous course "Seminar F Automotive Systems (BA)" (INF- overlaps.	undamentals of Software Engineering for 0027) must not have been taken due to	
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted: according to the examination	
2	regulations of the study program	

Language: German

Contact Hours: 2

Contents:

Current software engineering topics from industry and research.

Literature:

Will be presented in the respective kick-off event.

Examination

Seminar Automotive Software and Systems Engineering (BA)

written/oral exam

Test Frequency:

when a course is offered

	nic Software and Systems	4 ECTS/LP
Engineering (BA)	-	
Seminar Avionic Software and System	s Engineering (BA)	
Version 1.0.0 (since SoSe20)		
Person responsible for module: Prof. D	Dr. Bernhard Bauer	
Learning Outcomes / Competences: After attending the seminar, students or methods, procedures, techniques, and seminar topic from the named field. The appropriate media to present a specific evaluate scientifically challenging topic recognize the logical structures of think formulate clearly and comprehensibly a clearly and understandably focus the s in the case of complex content. They s disruptions. The students understand h and use them interactively. They mana longer lecture durations, and apply vari Key qualifications: Literature research; methodical competence; scientific meth confident, and convincing (written and in documenting them; skills in logical, a awareness, meticulousness; communic (free version)	an independently analyze and evaluate a technologies in Avionic Software & Syst ey have the scientific methodology, come case clearly and comprehensibly in spe s from the named field critically and argu- king and argumentation and use them go and present subject content freely. They tudy on essential messages and convey killfully apply chains of argumentation an now to present themselves and confident age to gear a lecture to a specific target g ious moderation techniques. independent work with English-language hodology; principles of good scientific pra oral) presentation of (practical or theoret abstract, analytical and conceptual thinkin cation skills; time management. Translate	advanced problems, concepts, ems Engineering about the particular munication skills, and ability to use ech and writing and to discuss and unentatively. Furthermore, they can al-oriented. The participants can understand how to structure a lecture them in a comprehensible way, even ad solution strategies in the event of ly deal with joint presentation media group, motivate the listener even during e specialist literature; analytical- actice; skills in the understandable, ical) ideas, concepts, and results and ng and formal argumentation; quality ed with www.DeepL.com/Translator
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)	
Conditions: The previous course "Seminar Grundla Avionic Systems (BA)" (INF-0028) mus	agen des Software Engineering für st not have been taken due to overlaps.	
Conditions: The previous course "Seminar Grundla Avionic Systems (BA)" (INF-0028) mus Frequency: irregular	agen des Software Engineering für st not have been taken due to overlaps. Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Conditions: The previous course "Seminar Grundla Avionic Systems (BA)" (INF-0028) mus Frequency: irregular Contact Hours: 2	Agen des Software Engineering für st not have been taken due to overlaps. Recommended Semester: from 5. Repeat Exams Permitted: according to the examination regulations of the study program	Minimal Duration of the Module: 1 semester[s]
Conditions: The previous course "Seminar Grundla Avionic Systems (BA)" (INF-0028) mus Frequency: irregular Contact Hours: 2 Parts of the Module	agen des Software Engineering für st not have been taken due to overlaps. Recommended Semester: from 5. Repeat Exams Permitted: according to the examination regulations of the study program	Minimal Duration of the Module: 1 semester[s]

Literature:

Will be presented in the respective kick-off event.

Examination

Seminar Avionic Software and Systems Engineering (BA)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0350: Practical Modu	lle Engineering 4.0	6 ECTS/LP
Praktikum Engineering 4.0		
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. DrIng. Johannes Schilp		
Learning Outcomes / Competences:		
After students have attended the module, they will be able to,		
understand mechatronic development processes and the associated methods and process models		
apply various tools for digital development processes themselves		
design and use digital development processes with a focus on virtual commissioning		
exercise agile development in practical projects		
Key qualifications: Teamwork and communication skills, structured and conscientious work, application-oriented		
problem solving, evaluation of results and weighing of solution approaches, ability to think logically, analytically and		
conceptually		
Workload:		
Total: 180 h		
120 h studying of course content through exercises / case studies (self-study)		
60 h internship / practical course (attendance)		
Conditions:		
Frequency: each summer semester	Recommended Semester:	Minimal Duration of the Module:
	from 4.	1 semester[s]
Contact Hours:	Repeat Exams Permitted	
4	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Practical Module Engineering 4.0		
Mode of Instruction: internship		
Language: German		
Contact Hours: 4		
ECTS Credits: 6.0		
Contents:		
Theory:		
Basics of mechatronic and agile development		
digital engineering		
Output and discussion of the development task		
Application:		
Requirements analysis, concept phase, design, virtual commissioning, prototypical construction and		
implementation of a miniature packaging system.		
agile development methodology Scrum (Sprint Planning, Sprint Review, Sprint Retrospective, Sprint Planning)		
The internship takes place in the premises of our partner institute, the Fraunhofer IGCV in Augsburg. The		
participants are responsible for their own travel to and from the practical module.		
Literature:		
Gloger, B.: Scrum. Produkte zuverlässig und schnell entwickeln. 4. Aufl. München: Hanser 2013. ISBN:		
978-3-446-43338-0.		
Bracht, Uwe, Dieter Geckler,	and Sigrid Wenzel. "Digitale Fabrik." Me	thoden und Praxisbeispiele, Berlin,
Heidelberg (2011).		

Assigned Courses:

Praktikum Engineering 4.0 (internship)

Examination

Practical Module Engineering 4.0

practical exam / length of examination: 60 minutes
Module INF-0352: Practical Mod (Bachelor)	dule Biomedical Programming	6 ECTS/LP
Praktikum Programmieren in der biol	medizinischen Informatik (Bachelor)	
Version 1.0.0 (since SoSe20) Person responsible for module: Prof.	Dr. Frank Kramer	
Learning Outcomes / Competence	s:	
After participation in the practical couproblems of higher complexity in the biomedical informatics. Students will skills, for example bioinformatics, me techniques and technologies of the n solving problems. This enables them and to make their own scientific contraskills, the ability to research the literal intermediate goals, and critically eval innovative ideas in an understandabl Key Skills: Ability to think logically, an Present ideas, concepts, and results Communication skills: Teamwork skil	field of software development and evalu gain in-depth subject-specific as well as dical informatics and statistics. They ar- nentioned field in research projects and to link up with international research ribution in this field. In addition, students ture and the scientific methodology to c luate, classify, combine, present and do e way. nalytically, and conceptually; Work indep in an understandable, confident, and po-	s, students will understand practical lations in the application areas of s cross-disciplinary knowledge and e able to develop concepts, methods, are able to apply innovative methods in s have the teamwork and communication liscuss problems in the field, define cument intermediate results and bendently with technical literature; ersuasive manner; Quality awareness;
Remarks: Wenn Sie bereits das Modul "INF-03 Informatik" gehört haben, ist eine ern	25: Praktikum Grundlagen des Program eute Einbringung nicht möglich!	mierens in der biomedizinischen
Workload: Total: 180 h 30 h studying of course content throu 30 h studying of course content using 90 h internship / practical course (atte 30 h studying of course content using	igh exercises / case studies (self-study) g literarture (self-study) endance) g provided materials (self-study)	
Conditions: none		Credit Requirements: Passing the module examination
Frequency: irregular (usu. winter semester)	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Practical Modu Mode of Instruction: internship Language: German / English	lle Biomedical Programming (Bachel	or)

Frequency: irregular (usu. summer semester)

Contact Hours: 6

Contents:

Participants of the Bio-/Medical Informatics Programming Internship will learn how to implement small application and infrastructure programs in a biological and medical context.

The goal of the internship is for students to develop various small programs in Python related to medical issues. Through daily work assignments, students will acquire basic knowledge of:

Python programming

Use of biological/medical databases

Data transformation in a biological and medical context

Disease research in bio/medical informatics

High throughput data analysis

The internship is offered as a 2-week block course during the semester break, consists of a short daily introduction to the current work tasks and subsequent independent implementation by the students.

During independent work, a supervisor will be present at designated times for assistance and questions.

There will be a one-time meeting during the semester for organizational reasons.

Examination

Practical Module Biomedical Programming (Bachelor)

practical exam / length of examination: 30 minutes

Module INF-0363: Seminar Software Engineering in Safety- and Security-Critical Systems (BA) Seminar Software Engineering in sicherheitskritischen Systemen (BA)	4 ECTS/LP
Version 1.0.0 (since WS20/21) Person responsible for module: Prof. Dr. Bernhard Bauer	
Learning Outcomes / Competences: After attending the seminar, students can independently develop, analyze and concepts, methods, procedures, techniques, and technologies in software eng their related disciplines about the particular seminar topic from the named field communication skills, and ability to use appropriate media to present a specific in speech and writing and to discuss and evaluate scientifically challenging top and argumentatively. Furthermore, they can recognize the logical structures of them goal-oriented. The participants can formulate clearly and comprehensibly They understand how to structure a lecture clearly and understandably focus t understandably convey them, even in the case of complex content. They skillfu solution strategies in the event of disruptions. The students understand how to deal with joint presentation media and use them interactively. They manage to group, motivate the listener even during longer lecture durations, and apply va	evaluate advanced problems, ineering in safety-critical systems and . They have the scientific methodology, case clearly and comprehensibly ics from the named field critically thinking and argumentation and use and present subject content freely. the study on important messages and ally apply chains of argumentation and present themselves and confidently gear a lecture to a specific target rious moderation techniques.
Key qualifications: Literature research; independent work with English-languag methodical competence; scientific methodology; principles of good scientific pr confident, and convincing (written and oral) presentation of (practical or theore in documenting them; skills in logical, abstract, analytical and conceptual think awareness, meticulousness; communication skills; time management. Transla (free version)	e specialist literature; analytical- actice; skills in the understandable, tical) ideas, concepts, and results and ing and formal argumentation; quality ted with www.DeepL.com/Translator

Workload:

Total: 120 h 30 h seminar (attendance)

90 h preparation of written term papers (self-study)

Conditions:		
none		
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Software Engineering in Safety- and Security-Critical Systems (BA)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

Current software engineering topics from industry and research.

Literature:

Will be presented in the respective kick-off event.

Assigned Courses:

Seminar Software Engineering in sicherheitskritischen Systemen (Bachelor) (seminar)

Examination

Seminar Software Engineering in Safety- and Security-Critical Systems (BA)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0365: Practical Modu Engineering for Health Care Appl	le Interaction Design and lications	8 ECTS/LP	
Praktikum Interaction Design and Engir	Praktikum Interaction Design and Engineering for Health Care Applications		
Version 1.0.0 (since WS20/21)			
Person responsible for module: Prof. D	r. Elisabeth André		
Learning Outcomes / Competences:			
Students are familiar with methods and techniques of interaction design and engineering for health care applications. After successful participation, they will have the necessary knowledge to analyze application scenarios according to the guidelines of the user-centered design process and to design software solutions tailored to the target group. They are able to translate current interaction paradigms and design guidelines into models and programs for novel interaction devices, as well as to independently familiarize themselves with the necessary technologies. Furthermore, they are able to apply practice-relevant evaluation methods to assess the quality of the created software prototype. They are able to plan larger project tasks in small teams, solve them according to a self-developed project plan and discuss the results appropriately in plenary sessions and present them as a team. Key qualifications: Skill in confident and persuasive presentation of ideas and concepts; knowledge of the mindset and language of application-relevant disciplines; understanding of team processes; skill in collaborating in teams; skill in leading teams; skill in presenting and documenting results in a comprehensible manner; ability to expand existing knowledge independently; ability to contribute to science; competence in recognizing significant technical developments; quality awareness, meticulousness.			
Workload:			
1 otal: 240 h			
90 h internship / practical course (attendance)			
Conditions: none			
Frequency: each winter semester	Recommended Semester:	Minimal Duration of the Module:	

requency. each winter semester	from 3.	1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Interaction Design and Engineering for Health Care Applications Mode of Instruction: internship

Language: German

Contact Hours: 6

Contents:

The specific assignment for student projects is designed each year.

Literature:

Literature references will be announced at the beginning of the semester depending on the topic.

Examination

Practical Module Interaction Design and Engineering for Health Care Applications practical exam

Module INF-0372: Research Module Resource Aware	6 ECTS/LP
Algorithmics Forschungsmodul Resource Aware Algorithmics	
Version 1.0.0 (since WS20/21)	

Person responsible for module: Prof. Dr. Tobias Mömke

Learning Outcomes / Competences:

After attending this research module, the students are able to understand algorithmic problems and solutions of medium difficulty in the area of resource aware algorithmics. They have acquired a detailed understanding of up-todate topics within the area and can actively participate in research projects. Furthermore, they understand some deep concepts, methods, tools and technologies and can apply the acquired knowledge in research projects. Besides the technical abilities, they train their team and communication skills, the ability to perform literature research and to discurss and present technical topics.

Key Qualifications: Ability to perform analytical and logic thinking; self-sufficient work with scientific literature in English language; ability to present results and ideas in form of understandable and inspiring presentations; aim for high-quality results; communication skills; ability to work with a team and to understand team processes; respect for clean scientific practices.

Workload:

Total: 180 h

165 h internship / practical course (self-study)

15 h seminar (attendance)

Conditions:		
none		
Frequency: each semester	Recommended Semester: 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Forschungsmodul Resource Aware Algorithmics

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Contribution to research on state of the art research topics.

Literature:

scientific papers, books

Assigned Courses:

Oberseminar Resource Aware Algorithmics

Examination

Reseach Module Resource Aware Algorithmics

portfolio exam

Module INF-0384: Seminar Resou	urce Aware Algorithmics	4 ECTS/LP
Seminar Resource Aware Algorithmics	Seminar Resource Aware Algorithmics (Bachelor)	
Version 1.0.0 (since SoSe21)		
Person responsible for module: Prof. D	r. Tobias Mömke	
Learning Outcomes / Competences:		
After attending the seminar, the studen	its are able to understand basic algorithm	nic concepts, methods, tools and
techniques in a self-sufficient manner.		
They have acquired communication ski scientific topic both as a talk and in writ	ills, knowledge about work processes an tte form.	d the use of media to present a specific
The participants have learned to exprese have learned to confidently stand in fro are able to tailor the talk to the respection	ss techical contents in a sturctured, unde nt of the audience, using state of the art ive audience.	erstandable and inspiring manner. They presentation tools and media. They
Key Qualifications: Literature research; work with scientific literature in English language; analytic copetences; clean scientific practice; ability to present techincal content in confident, understandable and structured manner (both in written and spoken form); abstract, logical and analytical thinking; ability to argue formally; aim for high quality; communication skills; time management.		
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term papers	s (self-study)	
Conditions: Good knowledge of content taught in m as "Mathematik für Informatiker 1" and Knowledge about algorithms and data	nathematical Bachelor classes such I "Diskrete Strukturen und Logik." structures (Informatik 3) is useful.	Credit Requirements: Passing of Module exam
Frequency: irregular	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	
Parts of the Module		
Parts of the Module		
Parts of the Module Part of the Module: Seminar Resource Mode of Instruction: seminar Language: German / English Contact Hours: 2	ce Aware Algorithmics (Bachelor)	
Parts of the Module Part of the Module: Seminar Resource Mode of Instruction: seminar Language: German / English Contact Hours: 2 Contents: The topics of the seminar are related time, in order to reflect up-to-date d	ce Aware Algorithmics (Bachelor) ed to research in resource aware algorith levelopments.	mics. The precise topics change over
Parts of the Module Part of the Module: Seminar Resource Mode of Instruction: seminar Language: German / English Contact Hours: 2 Contents: The topics of the seminar are related time, in order to reflect up-to-date d Literature:	ce Aware Algorithmics (Bachelor) ed to research in resource aware algorith levelopments.	mics. The precise topics change over
Parts of the Module Part of the Module: Seminar Resource Mode of Instruction: seminar Language: German / English Contact Hours: 2 Contents: The topics of the seminar are related time, in order to reflect up-to-date de Literature: Depending on the topic of the seminar	ce Aware Algorithmics (Bachelor) ed to research in resource aware algorith levelopments.	mics. The precise topics change over

Seminar Resource Aware Algorithmics (Bachelor) (seminar)

Examination

Seminar Resource Aware Algorithmics (Bachelor)

written/oral exam

Module INF-0386: Practical Module Biomedical Analysis of Single	8 ECTS/LP
Cell Data Praktikum Biomedical Analysis of Single Cell Data	
Version 1.0.0 (since SoSe21)	

Person responsible for module: Prof. Dr. Matthias Schlesner

Learning Outcomes / Competences:

In the practical course, students learn how to analyze and integrate single cell data across multiple omics levels. To answer current biological questions, students perform complex analysis workflows. During the course, creative problem solving approaches are developed in teams and professionally presented and documented. After participating in the course, students will be familiar with commonly used bioinformatical software packages and will be able to critically compare, extend, and combine available solutions in innovative ways. The students will be well versed in the application of common methods of dimensionality reduction and visualization, up to interactive visualization of high dimensional data. They will be familiar with current methods for pre-processing and quality assurance of data and will be able to combine data sets from different sources using appropriate batch corrections. They will know the basic methods for clustering single cell data and will be able to efficiently apply them to larger data sets using appropriate program libraries. They will be able to identify characteristic features of cell clusters, such as marker genes, using appropriate statistical methods. The students will be able to critically assess and appropriately apply advanced analyses from the field of pseudo-time analysis. They will be able to analyze multidimensional datasets across different omics levels in an integrated manner. This methodological knowledge builds on a biological understanding of the different underlying omics levels, including their interplay in the cell. As part of the course, students will examine the function of biological tissues and differentiation systems. They will be familiar with the current literature on this topic and will be able to develop their own analysis strategies using the current literature and evaluate them in their context. The students perform all these analysis tasks independently using Python and R and document their approach as well as their biological results in interactive notebooks.

Key Skills: Skills in logical, analytical, and conceptual thinking; Skills in solving programming tasks independently and learning new software packages using existing documentation; Skills in presenting ideas and concepts confidently and persuasively; Ability to work independently with technical literature; Ability to collaborate in teams; Ability to work independently to present results clearly;

Workload:

Total: 240 h

90 h internship / practical course (attendance)

30 h studying of course content using literarture (self-study)

30 h studying of course content using provided materials (self-study)

90 h studying of course content through exercises / case studies (self-study)

Conditions:		Credit Requirements:
Module Computer Science 1 (INF-0097	Module Computer Science 1 (INF-0097) - recommended	
Module Bioinformatics 1 (INF-0402) - recommended		
Module Bioinformatics 2 (INF-0403) - recommended		
Frequency: irregular (usu. summer	Recommended Semester:	Minimal Duration of the Module:
semester)	from 3.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
6	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Praktikum Biomedical Analysis of Single Cell Data

Mode of Instruction: internship

Language: German / English

Contact Hours: 6

Contents:

- · Biological principles for understanding current issues in the field of single cell data.
- Application of current bioinformatic program libraries and biostatistical methods for the analysis of single cell data sets
- Performance of complex analysis workflows, starting with the initial pre-processing of data, up to the integration of data from different omics levels
- · Analysis and documentation with interactive notebooks (Jupyter or R Markdown)
- · Data visualization

Assigned Courses:

Praktikum zu Biomedical analysis of single cell data (internship)

Examination

Praktikum Biomedical Analysis of Single Cell Data

portfolio exam

Module INF-0406: Seminar Digita	I Ethics (Bachelor)	4 ECTS/LP
Seminar Digitale Ethik (Bachelor)		
Version 1.0.0 (since WS21/22) Person responsible for module: Prof. Dr. Robert Lorenz		
Learning Outcomes / Competences:		
After attending the seminar, the studen methods, procedures, techniques, and individual seminar topic.	ts can independently work out and analy technologies from the field of digital ethic	rse advanced problems, concepts, cs and evaluate them in relation to the
Participants possess scientific methodology, communication skills, and the ability to present a special topic clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively.		
Furthermore, they learn to recognise logical structures of thinking and argumentation and use them in a goal- oriented manner. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a talk that is clear and easy to follow. Additionally, the students know how to focus on essential messages and convey them in a comprehensible way, even with complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to confidently deal with common presentation media and use them interactively. They manage to gear a talk to a specific target argumentation apply various mediaretion techniques, and keep their audience engaged even over a lenger period.		
Key qualifications: Presentation techr solution approaches, procedures, techr	niques; literature research; principles of g niques, and technologies from different p	good scientific practice; evaluating oints of view.
Workload: Total: 120 h 90 h preparation of presentations (self-study) 30 h seminar (attendance)		
Conditions: Credit Requirements: Module Database Systems (INF-0073) - recommended Passing the module examination Module Computer Science 1 (INF-0097) - recommended Passing the module examination Module Computer Science 2 (INF-0098) - recommended Passing the module examination Module Computer Science 3 (INF-0111) - recommended Passing the module examination		Credit Requirements: Passing the module examination
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Digital Ethics (Bachelor) Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 4.0		
Contents: The topics change over time, in order to reflect up-to-date developments		
Literature: Literature depends on the chosen topic		

Examination

Seminar Digital Ethics (Bachelor)

presentation / length of examination: 45 minutes

Medule INE 0424, Seminer Or	reanic Computing (Bachalar)	
Seminar Organic Computing (Bach	nelor)	4 ECT5/LP
Version 1.0.0 (since WS22/23) Person responsible for module: Pro	of. Dr. Jörg Hähner	
Learning Outcomes / Competend After attending the seminar, studer methods, procedures, techniques a	ces: Ints are able to independently work out and and technologies in the field of ad-hoc and	l understand basic problems, concepts, I sensor networks.
They possess the working technique topic clearly and comprehensibly in argumentatively. Furthermore, they a goal-oriented manner.	ues, communication skills and ability to us a speech and writing and to discuss topics a can recognise the logical structures of th	e appropriate media to present a special from the named field critically and inking and argumentation and use them in
Participants can formulate clearly a structure a presentation in a clear a convey them comprehensibly.	and comprehensibly and present specialis and reasonable way and how to focus the	t content freely. They understand how to presentation on essential messages and
The students understand how to pr They manage to gear a talk to a sp techniques.	resent themselves and how to deal confid ecific target group and to motivate the list	ently with common presentation media. ener and apply various moderation
Key qualifications: Literature rese	earch; independent work with English-lang	juage specialist literature;
Analytical-methodical competence;	scientific methodology; principles of good	scientific practice;
Ability to describe and document (practical and theoretical) ideas, concepts and results in a comprehensible, confident and convincing manner (written and oral); ability to think logically, abstractly, analytically and conceptually and to argue formally; quality awareness, meticulousness; communication skills; time management.		
Workload: Total: 120 h 90 h preparation of written term pa 30 h seminar (attendance)	pers (self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Org Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 4.0	anic Computing (Bachelor)	
Contents: The topics of the seminar are d	etermined each year and adapted to curre	ent trends.
Literature: Literature depending on the cur	rent topics: scientific papers or books.	
Assigned Courses:		
Seminar Organic Computing (Ba	chelor) (seminar)	

Examination

L

Presentation and written paper.

written/oral exam

Module INF-0423: Seminar Machine Learning (BA) Seminar Machine Learning (BA)	4 ECTS/LP
Version 1.0.0 (since WS22/23)	

Person responsible for module: Prof. Dr. Bernhard Bauer

Learning Outcomes / Competences:

After attending the seminar, students are able to work out and understand fundamental problems, concepts, methods, procedures, techniques, and technologies in the field of Medical Information Sciences independently. They have the working techniques, communication skills, and the ability to use appropriate media to present a particular topic clearly and comprehensibly in speech and writing and discuss issues from the mentioned field critically and argumentatively. Furthermore, they can recognize the logical structures of thinking and argumentation and use them goal-oriented. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a lecture clearly and understandably, focus the study on important messages, and convey them in a comprehensible way. The students understand how to present themselves and deal confidently with joint presentation media. They manage to gear a lecture to a specific target group, motivate the listener, and apply various moderation techniques.

Key qualifications: Literature research; independent work with English-language specialist literature; analyticalmethodical competence; scientific methodology; principles of good scientific practice; skills in the understandable, confident, and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts, and results and in documenting them; skills in logical, abstract, analytical and conceptual thinking and formal argumentation; quality awareness, meticulousness; communication skills; time management.

Workload:

Total: 120 h

90 h preparation of written term papers (self-study)30 h seminar (attendance)

Conditions: none		
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Machine Learning (Seminar)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

This seminar will cover the basics of Medical Information Sciences. Various topics are to be worked on which are to serve as a basis for a subsequent practical course.

Literature:

Will be presented in the respective kick-off event.

Assigned Courses:

Seminar Machine Learning (Bachelor) (seminar)

Examination

Presentation and written paper

written/oral exam

Test Frequency:

when a course is offered

Module INF-0426: Wearable Teo Healthcare	chnology Applications in	8 ECTS/LP
Wearable Technology Applications in	Healthcare	
Version 1.0.0 (since WS22/23)		
Person responsible for module: Prof.	Dr. Elisabeth André	
Students are familiar with methods an After successful participation, they wi to the guidelines of the user-centered They are able to translate current inter interaction devices, as well as to inder they are able to apply practice-releva They are able to plan larger project ta discuss the results appropriately in plan	nd techniques of interaction design and e Il have the necessary knowledge to anal I design process and to design software eraction paradigms and design guidelines ependently familiarize themselves with th nt evaluation methods to assess the qua asks in small teams, solve them accordin	engineering for health care applications. yze application scenarios according solutions tailored to the target group. s into models and programs for novel e necessary technologies. Furthermore, lity of the created software prototype. g to a self-developed project plan and
and language of application-relevant skill in leading teams; skill in presenti existing knowledge independently; ab developments; guality awareness. mo	disciplines; understanding of team proce ng and documenting results in a compre pility to contribute to science; competence eticulousness.	sses; skill in collaborating in teams; hensible manner; ability to expand e in recognizing significant technical
Workload: Total: 240 h 15 h studying of course content using 15 h studying of course content using 120 h studying of course content thro 30 h lecture (attendance) 60 h exercise course (attendance)	g provided materials (self-study) g literarture (self-study) pugh exercises / case studies (self-study)	
Conditions: Programming experience		
Frequency: each winter semester	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Interaction Design and Engineering for Health Care Applications

Mode of Instruction: lecture

Language: English

Frequency: each summer semester

Contact Hours: 2

Contents:

The specific assignment for student projects is designed each year.

Literature:

Literature references will be announced at the beginning of the semester depending on the topic.

Part of the Module: Wearable Technology Applications in Healthcare (Exercise Course) Mode of Instruction: exercise course Language: English

Contact Hours: 4

Examination

Practical Module Interaction Design and Engineering for Health Care Applications

portfolio exam

Module INF-0435: Research Forschungsmodul Quantenalgo	h Module Quantum Algorithms rithmen	6 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module:	Prof. Dr. Jakob Siegfried Kottmann	
Learning Outcomes / Compet Nach der Teilnahme am Forsch auf dem Gebiet der Quantenalg dem genannten Gebiet und kön Konzepte, Methoden, Verfahrer einbringen. Außerdem verfügen Literaturrecherche und die Lern Zwischenergebnisse kritisch zu Schlüsselqualifikationen: Ferf mit englischsprachiger Fachliter und Ergebnissen; Qualitätsbewiv Verstehen von Teamprozessen	ences: ungsmodul sind die Studierenden in der Lage orithmen verstehen. Sie verfügen über detailli nen in Forschungsprojekten aktiv mitarbeiten. n, Techniken und Technologien und können di die Studierenden über die Team- und Komm - und Arbeitstechniken, um Problemstellunger bewerten, zu kombinieren und zu präsentiere tigkeit zum logischen, analytischen und konze ratur; Verständliche, sichere und überzeugend ußtsein; Kommunikationsfähigkeit; Fertigkeit o ; Grundsätze guter wissenschaftlicher Praxis	, Problemstellungen mittlerer Komplexität ertes und aktuelles Wissen auf Dazu verstehen sie weiterführende eses Wissen in Forschungsprojekten unikationsfähigkeit, die Fähigkeit zur n auf dem Gebiet zu diskutieren, sowie n. ptionellen Denken; Eigenständige Arbeit le Präsentation von Ideen, Konzepten der Zusammenarbeit in Teams und
Workload: Total: 180 h 165 h internship / practical cour 1 h seminar (attendance)	se (self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: as needed	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Forschun Mode of Instruction: internship	gsmodul Quantenalgorithmen	

Language: English / German Contact Hours: 1

Contents:

Mitarbeit an aktuellen Forschungsthemen

Literature:

Abhängig vom jeweiligen Thema

Assigned Courses:

Oberseminar Quantenalgorithmik

Examination

Forschungsmodul Quantenalgorithmen

practical exam

Test Frequency:

when a course is offered

Medule INE 0429, Seminer Quest	um Algerithme (Beeheler)	
Seminar Quantenalgorithmen (Bachelo	r)	4 ECT5/LP
Version 1.0.0 (since SoSe23)		
Person responsible for module: Prof. D	r. Jakob Siegfried Kottmann	
Contents: Im Seminar werden die Inhalte aus der parallele Besuch der Vorlesung wird en werden in der Vorlesung aufgegriffene erschlossen. Das Seminar eignet sich a	Vorlesung "Grundlagen der Quanteninfo npfohlen. Spezifische Themen orientiere Anwendungsbeispiele und Themenfelde als Vorbereitung einer Abschlussarbeit ir	ormationsverarbeitung" vertieft. Der en sich an aktueller Forschung. Hierbei er vertieft oder neue Themenfelder en Bereicht der Quantenalgorithmik.
Learning Outcomes / Competences: Nach dem Besuch des Seminars sind of Methoden, Verfahren, Techniken und T erarbeiten und zu verstehen. Sie verfügen über die Arbeitstechniken, um ein spezielles Thema in Wort und S genannten Gebiet kritisch und argumer Denkens und Argumentierens erkennen Die Teilnehmenden können klar und ver Vortrag klar und nachvollziehbar zu stru verständlich zu vermitteln. Die Studierenden verstehen es, präsen Sie schaffen es, einen Vortrag auf eine verschiedene Moderationstechniken an	lie Studierenden in der Lage, grundleger echnologien auf dem Gebiet der Quante k Kommunikationsfähigkeit und Fähigkei ichrift klar und verständlich zu präsentier ntativ zu diskutieren. Außerdem können n und zielführend einsetzen. erständlich formulieren und Fachinhalte f ukturieren und den Vortrag auf wesentlic t aufzutreten und souverän mit gängiger bestimmte Zielgruppe auszurichten und zuwenden.	nde Problemstellungen, Konzepte, enalgorithmen selbstständig zu t zum Einsatz entsprechender Medien, ren und Themenstellungen aus dem sie die logischen Strukturen des rei vortragen. Sie verstehen es, einen ehe Botschaften auszurichten und diese n Präsentationsmedien umzugehen.
Schlüsselqualifikationen: Literaturred Analytisch-methodische Kompetenz; W Fertigkeit der verständlichen, sicheren (praktischen oder theoretischen) Ideen, logischen, abstrakten, analytischen und Akribie; Kommunikationsfähigkeit; Zeitr	cherche; Eigenständiges Arbeiten mit en lissenschaftliche Methodik; Grundsätze g und überzeugenden (schriftlichen und m Konzepten und Ergebnissen und zu de konzeptionellen Denken und formaler A nanagement	glischsprachiger Fachliteratur; guter wissenschaftlicher Praxis; ündlichen) Darstellung von ren Dokumentation; Fertigkeit zum Argumentation; Qualitätsbewußtsein,
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term papers	(self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: each summer semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Part of the Module: Seminar Quantenalgorithmen (Bachelor)

Mode of Instruction: seminar

Language: English / German

Contact Hours: 2

Contents:

Die Themen des Seminars werden jedes Mal neu festgelegt und aktuellen Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Assigned Courses:

Seminar Quantenalgorithmen (Bachelor) (seminar)

Examination

Seminar Quantenalgorithmen (Bachelor) written/oral exam Test Frequency: when a course is offered

Module INF-0442: Seminar on Th Systems (Bachelor) Seminar Theorie verteilter und parallel	eory of distributed and parallel	4 ECTS/LP
Version 1.0.0 (since SoSe23)		
Person responsible for module: Prof. D	r. Kirstin Peters	
Learning Outcomes / Competences: Nach dem Besuch des Seminars sind of Methoden, Verfahren, Techniken und T selbstständig zu erarbeiten und zu vers Sie verfügen über die Arbeitstechniken um ein spezielles Thema in Wort und S genannten Gebiet kritisch und argumen Denkens und Argumentierens erkenne Die Teilnehmenden können klar und ver Vortrag klar und nachvollziehbar zu str verständlich zu vermitteln. Die Studierenden verstehen es, präser Sie schaffen es, einen Vortrag auf eine	die Studierenden in der Lage, grundlege Fechnologien auf dem Gebiet der Theorie stehen. , Kommunikationsfähigkeit und Fähigkei Schrift klar und verständlich zu präsentier ntativ zu diskutieren. Außerdem können n und zielführend einsetzen. erständlich formulieren und Fachinhalte f ukturieren und den Vortrag auf wesentlic nt aufzutreten und souverän mit gängiger bestimmte Zielgruppe auszurichten und	nde Problemstellungen, Konzepte, e verteilter und paralller Systeme t zum Einsatz entsprechender Medien, ren und Themenstellungen aus dem sie die logischen Strukturen des rei vortragen. Sie verstehen es, einen che Botschaften auszurichten und diese n Präsentationsmedien umzugehen.
Schlüsselqualifikationen: Literaturred Analytisch-methodische Kompetenz; W Fertigkeit der verständlichen, sicheren (praktischen oder theoretischen) Ideen logischen, abstrakten, analytischen und Akribie: Kommunikationsfähigkeit: Zeit	cherche; Eigenständiges Arbeiten mit en /issenschaftliche Methodik; Grundsätze und überzeugenden (schriftlichen und m , Konzepten und Ergebnissen und zu de d konzeptionellen Denken und formaler /	glischsprachiger Fachliteratur; guter wissenschaftlicher Praxis; ıündlichen) Darstellung von ren Dokumentation; Fertigkeit zum Argumentation; Qualitätsbewußtsein,
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)	
Conditions: Module Introduction to Theory of Comp	outation (INF-0110) - recommended	Credit Requirements: Bestehen der Modulprüfung
Frequency: each summer semester	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Theorie Mode of Instruction: seminar Language: German Contact Hours: 2	verteilter und paralleler Systeme (Ba	chelor)

Die Themen des Seminars werden jedes Mal neu festgelegt und aktuellen Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Examination

Seminar Theorie verteilter und paralleler Systeme (Bachelor)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0445: Seminar Softw	are and Artificial Intelligence for	4 ECTS/LP
Production Systems (Bachelor)	licenz in der Preduktion (Pachalor)	
Version 1.0.0 (since SoSe23)		
Person responsible for module: Prof. D	r. woirgang Reif	
Learning Outcomes / Competences: After completion of the seminar, studer techniques and technologies in the field	nts are able to understand basic problem d of Internet security and independently	is, concepts, methods, procedures, learn new such concepts.
They have the working techniques, cor clearly and comprehensibly in speech also be able to recognize the logical str	nmunication skills and ability to use appr and writing and to discuss topics from the ructures of reasoning and argumentation	ropriate media to present this field e mentioned field critically. They will and use them.
The participants are able to formulate of understand how to structure a presenta the core messages and convey them in	clearly and understandably and to presen ation in a clear and comprehensible way n a comprehensible way.	nt specialist knowledge freely. They and how to focus the presentation on
The students understand how to prese manage to focus a presentation to a sp	nt themselves and how to work with com pecific target group and to motivate the a	imon presentation media. They udience.
Soft Skills:		
 Enterature research Independently work with English Analytical competence Working methodical Principles of good scientific pract Ability to present (written and ora to document them Ability to think logically, abstractly Awareness for quality aspects Communication skills Time management 	technical literature tice I) ideas, concepts and results in a comp y, analytically and conceptually and to ar	rehensible and convincing manner and rgue precisely
Workload:		
Total: 120 h		
30 h seminar (attendance)	(colf ctudy)	
		1
Conditions:		
none		
Frequency: irregular	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Internet	Security	

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

The specific topics of the seminar deal with the security of computer systems on the Internet and they change from year to year to adapt to current developments.

Literature:

Depends on the concrete topic.

Assigned Courses:

Seminar zu Software und Künstliche Intelligenz in der Produktion (Bachelor) (seminar)

Examination

Seminar Internet Security

written/oral exam / length of examination: 45 minutes work period for assignment: 3 months

Test Frequency:

when a course is offered

Module INF-0447: Seminar on Co Seminar zu nebenläufigen Systemen (Dincurrent Systems (Bachelor)	4 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. E	Dr. Robert Lorenz	
Learning Outcomes / Competences: After attending the seminar, the studer methods, procedures, techniques, and individual seminar topic.	: hts can independently work out and analy technologies from the field of digital ethi	/se advanced problems, concepts, cs and evaluate them in relation to the
Participants possess scientific method comprehensibly in speech and writing field critically and argumentatively.	ology, communication skills, and the abili and to discuss and evaluate scientifically	ity to present a special topic clearly and challenging topics from the named
Furthermore, they learn to recognise to oriented manner. The participants can They understand how to structure a tal focus on essential messages and conv apply chains of argumentation and sol confidently deal with common present target group, apply various moderation Key qualifications: Presentation tech	pogical structures of thinking and argumen formulate clearly and comprehensibly ar lk that is clear and easy to follow. Additio yey them in a comprehensible way, even ution strategies in the event of disruptions ation media and use them interactively. To a techniques, and keep their audience en niques: literature research: principles of d	tation and use them in a goal- ind present subject content freely. nally, the students know how to with complex content. They skilfully s. The students understand how to They manage to gear a talk to a specific gaged even over a longer period.
solution approaches, procedures, tech	niques, and technologies from different p	points of view.
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of presentations (self-	-study)	
Conditions: Module Computer Science 1 (INF-009 Module Computer Science 2 (INF-009 Module Discrete structures and logic (I	7) - recommended 8) - recommended INF-0266) - recommended	Credit Requirements: Passing the module examination
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module	<u>`</u>	

Part of the Module: Seminar Digital Ethics (Bachelor)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

ECTS Credits: 4.0

Contents:

The topics change over time, in order to reflect up-to-date developments

Literature:

Literature depends on the chosen topic

Examination Seminar Digital Ethics (Bachelor) written/oral exam Test Frequency: when a course is offered

Module INF-0449: Practical Modu design" (Bachelor Program) Praktikum Leichtbau für Bachelor	Ile "leightweight	8 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. D	r. Christoph Ament	
Learning Outcomes / Competences: After completing the practical course "I knowledge in this field. They understar field of measurement and control engir Students are able to analyze the behave diagram of systems) and use this to cre signal processing and design a model- They also have the ability to work and and findings.	Measurement and Control Engineering", ad basic concepts, methods, procedures, neering in order to apply them in develop vior of dynamic systems experimentally (eate models for numerical simulations. T based controller and put them into opera communicate as a team to discuss probl	students have detailed and up-to-date techniques and technologies in the ment projects. e.g. record a step response or a Bode hey can apply methods for sensor tion in a closed loop system. ems in the field and to present issues
Workload: Total: 240 h 90 h internship / practical course (atter	idance)	
150 h studying of course content throu	gh exercises / case studies (self-study)	
Conditions: Empfohlen: die erfolgreiche Teilnahme Regelungstechnik bzw. Mess- und Reg	an der Vorlesung Systemdynamik und gelungstechnik	
Frequency: each summer semester	Recommended Semester: from 4.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Parts of the Module

Part of the Module: Praktikum Leichtbau für Bachelor

Mode of Instruction: internship Language: German

Contact Hours: 6

ECTS Credits: 8.0

Contents:

n the practical course, 3 to 4 experiments are offered on each of the following topics:

Basics of scientific computing in Matlab, especially treatment of dynamic systems in Matlab and Simulink Sensor signal processing, experimental analysis and identification of dynamic systems Design and realization of control systems

Each group works on a computer with the software package Matlab. A microcontroller board is connected via a USB connection, on which algorithms for signal processing and control can be executed and which is used for the measurement of signals and control of the track at runtime. If necessary, different tracks are connected to the board for the respective experiments.

Lehr-/Lernmethoden:

Praktikumsversuche in Kleingruppen.

Literature:

Wird bezogen auf das Projektthema während des Praktikums mitgeteilt.

Assigned Courses:

Praktikum Leichtbau für Bachelor (internship)

Examination

Praktikum Leichtbau für Bachelor portfolio exam Test Frequency: when a course is offered

Module INF-0452: Seminar Dia Seminar Diagnostische Sensorik (B	agnostic Sensing (Bachelor)	4 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Pro	f. Dr. Sebastian Zaunseder	<u> </u>
Learning Outcomes / Competence Nach dem Besuch des Seminars sin Methoden, Verfahren, Techniken ur erarbeiten und zu verstehen. Sie verfügen über die Arbeitstechnil um ein spezielles Thema in Wort ur genannten Gebiet kritisch und argun Denkens und Argumentierens erker Die Teilnehmenden können klar und Vortrag klar und nachvollziehbar zu verständlich zu vermitteln. Die Studierenden verstehen es, prä Sie schaffen es, einen Vortrag auf er verschiedene Moderationstechniker	es: nd die Studierenden in der Lage, grundlege nd Technologien auf dem Gebiet der Diagno ken, Kommunikationsfähigkeit und Fähigke nd Schrift klar und verständlich zu präsentie mentativ zu diskutieren. Außerdem können nnen und zielführend einsetzen. d verständlich formulieren und Fachinhalte strukturieren und den Vortrag auf wesentlic sent aufzutreten und souverän mit gängige eine bestimmte Zielgruppe auszurichten und nanzuwenden	ende Problemstellungen, Konzepte, ostischen Sensorik selbstständig zu it zum Einsatz entsprechender Medien, ren und Themenstellungen aus dem sie die logischen Strukturen des frei vortragen. Sie verstehen es, einen che Botschaften auszurichten und diese n Präsentationsmedien umzugehen. d den Zuhörer zu motivieren und
Schlüsselqualifikationen: Literatu Analytisch-methodische Kompetenz Fertigkeit der verständlichen, sicher (praktischen oder theoretischen) Ide logischen, abstrakten, analytischen Akribie; Kommunikationsfähigkeit; Z	rrecherche; Eigenständiges Arbeiten mit er r; Wissenschaftliche Methodik; Grundsätze en und überzeugenden (schriftlichen und n een, Konzepten und Ergebnissen und zu de und konzeptionellen Denken und formaler Zeitmanagement	nglischsprachiger Fachliteratur; guter wissenschaftlicher Praxis; nündlichen) Darstellung von eren Dokumentation; Fertigkeit zum Argumentation; Qualitätsbewußtsein,
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term pap	ers (self-study)	-
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Diag Mode of Instruction: seminar	nostische Sensorik (Bachelor)	

Language: German / English

Contact Hours: 2

ECTS Credits: 4.0

Contents:

Die Themen des Seminars werden jedes Mal neu festgelegt und aktuellen Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Assigned Courses:

Seminar Diagnostische Sensorik (Bachelor) (seminar)

Examination

INF-8006 Seminar Diagnostische Sensorik (Bachelor) Test Frequency: when a course is offered

Module GEO-4250: Lecture Inte Vorlesung Integrative Geographie	grative Geography	5 ECTS/LP
Version 2.0.0 (since WS22/23) Person responsible for module: Prof.	Dr. Matthias Schmidt	
Contents: The lecture provides an introduction a "third pillar" or "human-environmental geography and human geography are central problem complexes and their classification of integrative geography interactions between space, environm differentiated forms using selected cu	and an overview of the field of integrativ geography"). Basic topics and current e treated with a nexus to space, environ current political and socio-economic relevent in the history of the discipline and current nent and society are presented in their storent case studies.	e geography (also referred to as the research and questions from physical ment and society. Presentation of evance, discussion of relevant questions, ent research landscape. The diverse specific natural and socially regionally
Learning Outcomes / Competences After successfully completing the mod and perspectives of integrative geogra geography, to assess and interpret th	dule, the students have in-depth knowle aphy. They are able to deal critically wit em.	dge of the various approaches, theories h current topics in the field of integrative
Workload: Total: 150 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each winter semester winter semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Part of the Module: Vorlesung Integrative Geographie / Lecture Integrative Geography

Mode of Instruction: lecture Language: German / English

Examination GEO-4250 Integrative Geographie

module exam, module exam

Module GEO-4251: Discourse Analysis Diskursanalyse	
Andreas Benz	
ions of discourse analysis, concrete micr rell as fields of application and case studi	o- and macro-analytical procedures and es of discourse analysis procedures.
ees: odule, the students have in-depth knowle know and master different methods of dis pirical cases.	edge of the theoretical foundations of course analysis and are able to apply
	Credit Requirements: Pass the module exam
Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]
Repeat Exams Permitted: according to the examination regulations of the study program	
	Analysis Andreas Benz ions of discourse analysis, concrete micro rell as fields of application and case studie es: odule, the students have in-depth knowle know and master different methods of disc pirical cases.

Part of the Module: Diskursanalyse / Discourse Analysis

Mode of Instruction: lecture, exercise course, seminar, internship

Language: German / English

Assigned Courses:

Diskursanalyse - Discourse Analysis (exercise course)

Examination

GEO-4251 Diskursanalyse

module exam, Klausur, mündliche Prüfung, Hausarbeit, Übungsaufgabe oder Bericht

Description:

written exam, oral exam, scientific term paper, practice assignment or report

Module GEO-4253: Remote Sensing in Geosciences Geowissenschaftliche Fernerkundung		5 ECTS/LP
Version 2.0.0 (since WS22/23) Person responsible for module:	Prof. Dr. Wolfgang Buermann	
Contents: This module offers students the from different sensor platforms u platforms and sensors are used.	opportunity to master the processes for acq using specific software. Remote sensing geo	uiring, analyzing and interpreting geodata odata from various remote sensing
Learning Outcomes / Competer Students are able to describe an sensor concepts and to adequat and validation strategies in the o knowledge of the necessary soft	ences: and categorize data recorded by remote sens tely evaluate sensor data. In particular, they context of remote sensing. You will also, at le tware solutions and have used this software	ing, to distinguish between different know the typical processing, calibration east in some cases, acquire in-depth in exercises.
Workload: Total: 150 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: annually	Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module	*	

Part of the Module: Geowissenschaftliche Fernerkundung / Remote Sensing in Geosciences

Mode of Instruction: lecture, exercise course, seminar, internship

Language: German / English

Assigned Courses:

Satellitenfernerkundung - Remote Sensing (seminar)

Examination

GEO-4253 Geowissenschaftliche Fernerkundung

module exam, Klausur, Hausarbeit, mündliche Prüfung, Übungsaufgabe oder Bericht

Description:

written exam, scientific term paper, oral exam, practical exercise or report

Module GEO-4254: Modelling in Geowissenschaftliche Modellierung	5 ECTS/LP				
Version 2.0.0 (since WS22/23) Person responsible for module: PD Dr. Andreas Philipp					
Contents: The course includes the programming data preparation, analysis and visualiza using data sets and content-related que	implementation and efficient application ation using the "R" programming environ estions from various sub-areas of geogra	of advanced geoscientific methods for ment. The exercises are carried out aphy and geosciences.			
Learning Outcomes / Competences: After completing the module, the students can also efficiently prepare complex geoscientific data sets independently with the help of advanced programming technology. They are able to independently design problem-related geographic and geoscientific data analyzes and visualizations with the help of R, implement them efficiently in terms of programming and use them appropriately.					
Workload: Total: 150 h					
Conditions: none		Credit Requirements: Pass the module exam			
Frequency: annually usually winter and summer semester	Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]			
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program				

Parts of the Module

Part of the Module: Geowissenschaftliche Modellierung / Modelling in Geosciences

Mode of Instruction: exercise course, internship

Language: German / English

Assigned Courses:

Dicke Luft - Feinstaub, Ozon und Stickoxide verstehen und modellieren - Bad atmosphere - understanding and modeling particulate matter, ozone and nitrogene oxide (exercise course)

Hydrologische Modellierung - Hydrological Modeling (exercise course)

Examination

GEO-4254 Geowissenschaftliche Modellierung

module exam, mündliche Prüfung, Übungsaufgabe oder Bericht

Description:

oral exam, exercise or report

Module GEO-4255: Programming Geowissenschaftliche Programmierung	5 ECTS/LP				
Version 2.0.0 (since WS22/23) Person responsible for module: Prof Dr	r. Christoph Beck				
Contents: The course includes the programming in data preparation, analysis and visualiza using data sets and content-related que	implementation and efficient application ation using the "R" programming environ estions from various sub-areas of geogra	of advanced geoscientific methods for ment. The exercises are carried out aphy and geosciences.			
Learning Outcomes / Competences: After completing the module, the students can also efficiently prepare complex geoscientific data sets independently with the help of advanced programming technology. They are able to independently design problem-related geographic and geoscientific data analyzes and visualizations with the help of R, implement them efficiently in terms of programming and use them appropriately.					
Total: 150 h					
Conditions: none		Credit Requirements: Pass the module exam			
Frequency: annually usually winter and summer semester	Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]			
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program				

Parts of the Module

Part of the Module: Geowissenschaftliche Programmierung / Programming in Geosciences

Mode of Instruction: exercise course, internship

Language: German / English

Examination

GEO-4255 Geowissenschaftliche Modellierung

module exam, mündliche Prüfung, Übungsaufgabe oder Bericht

Description:

oral exam, exercise or report

Module GEO-5122: Geoinformatics 1 10 ECTS/LP Geoinformatik 1 (10LP) 10

Version 2.0.0 (since WS22/23) Person responsible for module: Prof. Dr. Sabine Timpf

Contents:

In GIScience geodata is at the core of many applications. However, geodata can only be interpreted within a specific context where models are needed to produce answers to questions. In fact, the models that are hidden beneath a data collection effort are of as much interest and importance as the models used to derive additional knowledge (such as weather forecast models, models of erosion, models of migration patterns, models of transportation systems or models of wayfinding). Every one of us models every day for everyday purposes. Understanding how this modeling happens and how to make these models better as well as computationally tractable helps to become clearer thinkers and expert modelers in GIScience.

This module introduces the theoretical foundations of modeling from different viewpoints. It also shows how modeling of geographic information adds a temporal component, leading towards simulation models. It then goes on to deal with the issue of modeling complex systems using a specific type of simulation with a software called Netlogo. After becoming proficient in modeling and simulating, there is a need to evaluate the validity and interpret the results of these implemented models. Using a combination of ground-truthing in case studies as well as sensitivity analysis, the advantages but also the limitations of this modeling approach in GIScience.

Learning Outcomes / Competences:

The learning objectives of this module are a critical understanding of the issues of modeling and simulation in GIScience, a proficiency in spatio-temporal modeling using a multi-agent simulation framework, the ability to abstract from a concrete problem and implement the best model for the solution of the problem, the expert knowledge of how to validate and evaluate a simulation model.

Workload:

Total: 300 h

Conditions: none		Credit Requirements: Pass the module exam
Frequency: each winter semester	Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Modelling and Simulation

Mode of Instruction: seminar Language: English Contact Hours: 2 ECTS Credits: 5.0

Part of the Module: Exercises Modelling and Simulation

Mode of Instruction: exercise course Language: English Contact Hours: 2 ECTS Credits: 5.0

Examination

Geoinformatik 1: Modelling and Simulation (MScGI)

project work
Module GEO-5129: Geoinformati Geoinformatik 2	cs 2	10 ECTS/LP
Version 2.0.0 (since WS22/23) Person responsible for module: Prof. Dr. Jukka Krisp		
Contents: Introduction to visual and computer-aid guidance with geodata and mining soft	ed methods of geographic data analysis ware.	. Exercises on the computer under
Learning Outcomes / Competences: After attending this module, the studen visual geodata analysis. You have acqu and approaches. You have developed data and can use this in specific cases evaluate them critically.	ts have become acquainted with comput uired the ability to describe processes wi a functional set of tools for the visual and . You can transfer the results of the assig	ter-aided methods of geoinformatics for ith the help of functional mechanisms alysis and processing of geographic gnment to similar problems and
Workload: Total: 300 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each semester part 1 each semester, part 2 in summer semester	Recommended Semester: 2 3.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Vorlesung/Seminar zu Geodatenanalyse Mode of Instruction: lecture, seminar Language: German / English Contact Hours: 2 ECTS Credits: 5.0		
Assigned Courses: Visual Geodata Mining (VGDM) (seminar)		
Part of the Module: Übung/Seminar zu Geodatenanalyse Mode of Instruction: exercise course, seminar Language: German / English Frequency: each summer semester Contact Hours: 2 ECTS Credits: 5.0		
Assigned Courses:		
Advanced spatial analysis - Advanced spatial analysis (exercise course)		
Examination Geoinformatik 2: Geodatenanalyse (MScGI) portfolio exam, Module exam		

Module GEO-5135: Climate 1 Klima 1		10 ECTS/LP
Version 2.0.0 (since WS22/23) Person responsible for module: Prof Dr. Christoph Beck		
Contents: Basic facts and problem contexts from areas treated with substantial-support content from the special lecture will be	the subject area of climate system and ing reference to this subject area. In the taken up and treated in addition.	climate change or from the research associated accompanying seminar,
Learning Outcomes / Competences: Acquiring basic knowledge on research areas that either directly address the topic of the climate system and climate change or contain a substantial connection to it; problem-oriented treatment of associated questions in short presentations and contributions to discussions.		
Remarks: Lecture with accompanying seminar		
Workload: Total: 300 h		
Conditions: none		Credit Requirements: Pass the module exam
Frequency: each winter semester winter term	Recommended Semester: 1 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Spezialvorlesung

Mode of Instruction: lecture Language: German / English Contact Hours: 2 ECTS Credits: 5.0

Literature:

IPCC (Intergovernmental Panel on Climate Change): Climate Change 2013. The Physical Science Basis. Fifth Assessment Report, Contribution of Working Group I.

Part of the Module: Begleitseminar

Mode of Instruction: seminar

Language: German / English Contact Hours: 2

ECTS Credits: 5.0

Examination

Klima 1

written exam / length of examination: 90 minutes

Module INF-0037: Practical Mod Engineering Praktikum Automotive Software Engin	ule Automotive Software	6 ECTS/LP
Version 1.0.0 (since SoSe13) Person responsible for module: Prof.	Dr. Bernhard Bauer	
Learning Outcomes / Competences After participating in the practical cour problems of higher complexity in the f methods and tools of model-based de and interdisciplinary knowledge and s able to develop concepts, methods, te are able to apply innovative approach and make their scientific contribution the ability to research literature and th goals, and critically evaluate, classify, understandably.	s: se Automotive Software Engineering, the ield of development and validation of drivi evelopment of embedded systems. The stu- kills, such as control engineering, driving echniques, and technologies of the mention es in solving problems. This enables then to the field. In addition, students have the e scientific methodology to discuss problem combine, present and document intermed	students understand practical ng assistance systems with current udents acquire in-depth subject-specific physics, and mathematics. They are and field in research projects and in to link up with international research teamwork and communication skills, teams in the area, define intermediate diate results and innovative ideas
Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with English-language technical literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management		
Workload: Total: 180 h 90 h internship / practical course (atte 90 h studying of course content throu	ndance) gh exercises / case studies (self-study)	
Conditions: Empfohlen wird die Teilnahme an ein Seminare.	em der beiden links aufgeführten	
Module Seminar Basics of Software E (INF-0027) - recommended Module Seminar Basics of Software E (MA) (INF-0040) - recommended	ingineering for Automotive Systems (BA)	
Frequency: irregular (usu. winter semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum Auto Mode of Instruction: internship	motive Software Engineering (MA)	

Language: German

Frequency: each winter semester

Contact Hours: 6

Contents:

In the automotive practical course, participants learn how various selected functions within vehicles can be simulated and analyzed. The necessary theoretical foundations are laid for working on the experimental task in a two-day introductory course. The anti-lock braking system (ABS) model is treated on control units during the initial period. Among other things, the participants will get to know the modeling tool combination "Matlab/Simulink", which is frequently used in the automotive environment, and the graphical simulation and analysis tool "CarMaker" and gain a practical insight into the functioning of FlexRay bus systems.

After the introductory course, the model of an ACC (Adaptive Cruise Control) system will be created, simulated, and verified in groups of two to three participants.

Literature:

depending on the subject

Examination

Praktikum Automotive Software Engineering (MA)

oral exam / length of examination: 30 minutes

Test Frequency:

when a course is offered

Module INF-0042: Project Module Software Methodologies for Distributed Systems Projektmodul Softwaremethodiken für verteilte Systeme	10 ECTS/LP
Version 1.0.0 (since SoSe13) Person responsible for module: Prof. Dr. Bernhard Bauer	,
Learning Outcomes / Competences: After participating in the project module, students understand problems of higher complexity in the field of software methodologies for distributed systems and have in-depth specialist knowledge and skills there. They are able to develop concepts, methods, procedures, techniques, and technologies of the mentioned field in research projects and are able to apply innovative approaches in solving problems. This enables them to link up with international research and make their scientific contribution to the field. In addition, students have the teamwork and communication skills,	

goals, and critically evaluate, classify, combine and present intermediate results and innovative ideas.

Key qualifications: Ability to think logically, analytically, and conceptually; Independent work with literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Skill of working in teams and understanding team processes; Principles of good scientific practice; Project management skills; Scientific methodology;

Workload:

Total: 300 h

15 h seminar (attendance)

285 h internship / practical course (self-study)

Conditions:		
none		
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module:
	1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
1	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Projektmodul Softwaremethodiken für verteilte Systeme

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Current research topics at the Software Methodology for Distributed Systems Lab

Literature:

Provided for the respective topics.

Assigned Courses:

Oberseminar zu Softwaremethodik für verteilte Systeme

Examination

Project acceptance, presentation, final report

internship

Test Frequency:

when a course is offered

Module INF-0058: Seminal Masters	r Algorithms and Data Structures for	4 ECTS/LP
Seminar Algorithmen und Datenstrukturen für Master		
Version 1.5.0 (since SoSe13) Person responsible for module	: Prof. Dr. Torben Hagerup	
Learning Outcomes / Compe Upon completion of the semina demanding original scientific te will understand how to select m communicate them, either in w	tences: Ir, the students will be able to independently ac xts, evaluate the readings in a critical way, and neaningful topics, structure a presentation, focu riting or orally, in an interesting and motivating	quire algorithm-related contents from place them in a wider context. They s on the essential messages and manner, within a given time frame.
Key Qualifications: Capability of logical, analytical, convincing arguments; literatur solutions, processes, and techn skills; time management.	and conceptual comprehension for a critical ar e research and independent work with English niques from different perspectives; quality awar	alysis of technical issues with technical literature; ability to evaluate eness; meticulousness; communication
Workload: Total: 120 h 90 h preparation of written term 30 h seminar (attendance)	n papers (self-study)	
Conditions: Familiarity with basic algorithm course "Informatik III") will be h	s and data structures (as imparted, e.g., by the ighly useful.	
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Mode of Instruction: seminar Language: German	Algorithms and Data Structures	

Contact Hours: 2

Contents:

Current and classical topics from the field of Algorithms and Data Structures are studied, using original literature.

Literature:

Selected scientific articles.

Examination

Written paper and oral presentation.

seminar

Module INF-0059: Project Mo Projektmodul Theoretische Inform	dule Theoretical Computer Science	10 ECTS/LP
Version 1.0.0 (since SoSe13)		
Person responsible for module: Pi	rof. Dr. Torben Hagerup	
Learning Outcomes / Competen After successful participation in the complexity in the field of Theoretic procedures, and techniques in res way, the students acquire good pr Furthermore, they will be able to o that enables them to discuss issue solution proposals critically and pr Key Qualifications: Logical, analytical, and conceptua	e project module, the students will be able to cal Computer Science. They will possess the rearch projects, and to apply innovative meth erequisites for autonomous scientific work a communicate and conduct literature research es of Theoretical Computer Science; they can esent own approaches.	o understand problems of increased e skills to develop concepts, methods, nods in solving arising problems. In this and for linking to international research. In and have a scientific methodology an define intermediate goals, evaluate sness; independent work; time
management; self-contained litera practice.	ture research; work with English technical li	terature; fundamentals of good scientific
Workload: Total: 300 h 285 h internship / practical course 15 h seminar (attendance)	(self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Project Mod Mode of Instruction: internship	ule Theoretical Computer Science	

Language: German

Contact Hours: 1

Contents:

Collaboration on current research topics.

Literature:

Scientific papers, manuals.

Assigned Courses:

Oberseminar Theoretische Informatik

Examination

Oral presentation and written paper.

Module INF-0072: Project Mo Projektmodul Organic Computing	dule Organic Computing	10 ECTS/LP
Version 1.0.0 (since SoSe14) Person responsible for module: Prof. Dr. Jörg Hähner		
Learning Outcomes / Competent After participating in the project mo Computing" and have deeper spec procedures, techniques and techno methods in solving problems. This contribution to the field. In addition literature and the scientific method evaluate, classify, combine and pre	ces: odule, the students understand problems of l ialist knowledge and skills in this area. They ologies of the mentioned field in research pr enables them to connect to international res , students have the teamwork and communi ology to discuss problems in the field, define esent intermediate results and innovative ide	higher complexity in the field of "Organic can develop concepts, methods, ojects and are able to apply innovative search and make their own scientific cation skills, the ability to research e intermediate goals, and critically eas.
Key qualifications : Ability to think English. Understandable, confiden Communication skills; Skill of work practice; Project management skill	logically, analytically and conceptually; Inde t and convincing presentation of ideas, conc ing in teams and understanding team proce s; Scientific methodology.	ependent work with literature in cepts and results; Quality awareness; sses; Principles of good scientific
Workload: Total: 300 h 285 h internship / practical course 15 h seminar (attendance)	(self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Projektmodu Mode of Instruction: internship Language: German / English Contact Hours: 1	Il Organic Computing	
Contents: Collaboration on current resear	ch topics.	
Literature: Depending on the topic to be w • Paper • Book • Handbook	rorked on:	
Assigned Courses:		

Oberseminar Organic Computing

Examination

Presentation and final report.

Module INF-0080: Project Mod	ule Databases and Information	10 ECTS/LP
Projektmodul Datenbanken und Informationssysteme		
Version 1.6.0 (since SoSe14)		J
Person responsible for module: Prof	. Dr. Peter Michael Fischer	
Learning Outcomes / Competence	25:	
After participating in the project mod databases and information systems develop concepts, methods, procedu are able to apply innovative methods make their own scientific contribution the ability to research literature and goals, and critically evaluate, classify Key Skills: Skill in logical, analytical, Intelligible, confident, and persuasive skills; Skill in working in teams and u management skills; Scientific metho	ule, students understand problems of high and have deeper professional knowledge a ures, techniques and technologies of the m is in solving problems. This enables them to to the field. In addition, students have the the scientific methodology to discuss probl- y, combine and present intermediate result and conceptual thinking; Independent wor e presentation of ideas, concepts, and resu understanding team processes; Principles of dology.	er complexity levels in the field of and skills there. They are able to nentioned field in research projects and o connect to international research and e teamwork and communication skills, ems in the field, define intermediate s and innovative ideas. k with English-language literature; ults; Quality awareness; Communication of good scientific practice; Project
Workload:		
Total: 300 h		
15 h seminar (attendance)		
285 h internship / practical course (s	elf-study)	
Conditions:		
Module Database Systems (INF-007	(3) - recommended	
Module Search Engines (INF-0077)	s (INF-0277) - recommended	
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
1	according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Projektmodul	Datenbanken und Informationssysteme	
Mode of Instruction: internship		
Language: German / English		
Contact Hours: 1		
Contents:		
work on current research topics		
Current research articles of	n the tonic of databases and Rig Data	
	in the topic of uatabases and big Data	

Manuals

Assigned Courses:

Oberseminar Datenbanken und Informationssysteme

Examination

Software acceptance, presentation, final report

Module INF-0088: Bayesian Networks 5 ECTS/LP Bayesian Networks 5		
Version 1.1.0 (since WS15/16) Person responsible for module: Prof.	Dr. Rainer Lienhart	<u></u>
Learning Outcomes / Competences Bayesian networks are one of the most this module, participants will understa and be able to apply them to many pre- intelligent agents, automated diagnos Bayesian networks and analyse and e promotes logical, analytical and conce evaluations using Bayesian networks.	st versatile statistical machine learning months nd and deepen their understanding of the actical problems in a variety of disciplines tic systems and medical systems. Studen evaluate cross-disciplinary problems in thi eptual thinking skills. Students will be able	ethods. After successfully completing core principles of Bayesian networks These include robotics, web search, its will be able to understand and apply s context. Participation in this module to produce scientifically meaningful
Key qualifications: advanced mathem models; interdisciplinary knowledge; o systematic further development of des	atical-formal logic; implementation of sub development and implementation of soluti sign methods; ability to solve problems ur	ject-specific solution concepts in on strategies for complex problems; nder practical boundary conditions.
Remarks: INF-0263 and this module cannot be	attended at the same time.	
Total: 150 h 15 h studying of course content using 60 h studying of course content throug 15 h studying of course content using 30 h exercise course (attendance) 30 h lecture (attendance)	provided materials (self-study) gh exercises / case studies (self-study) literarture (self-study)	
Conditions: none		
Frequency: irregular (usu. summer semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Bayesian Netwo Mode of Instruction: lecture Language: German Contact Hours: 2	orks (Vorlesung)	
Contents: 1. Basics of Probability Theory 2. Example: Bayesian Network 3. Inference	based Face Detection	

- 4. Influence Diagrams
- 5. Parameter Learning
- 6. Example: probabilistic Latent Semantic Analysis (pLSA)

Literature:

- Richard E. Neapolitan. Learning Bayesian Networks. Prentice Hall Series in Artifical Intelligence, 2004. ISBN 0-13-012534-2
- Daphne Koller, Nir Friedman. Probabilistic Graphical Models: Principles and Techniques. The MIT Press, 2009. 978-0262013192

Assigned Courses:

Bayesian Networks (lecture)

Part of the Module: Bayesian Networks (Übung)

Mode of Instruction: exercise course

Language: German

Contact Hours: 2

Assigned Courses:

Übung zu Bayesian Networks (exercise course)

Examination

Bayesian Networks (Examination) written exam / length of examination: 90 minutes
Test Frequency: each semester
Description: The examination can be taken every semester during the examination period.

Module INF-0093: Probabilistic Robotics Probabilistic Robotics	5 ECTS/LP
Version 1.0.0 (since SoSe14)	
Person responsible for module: Prof. Dr. Rainer Lienhart	

Learning Outcomes / Competences:

After successful participation in this module, participants understand basics and in-depth issues and algorithms of robotics (e.g. recursive state estimation, Gaussian and non-parametric filters, Kalman filters, motion and localisation, perception, mapping, SLAM) from a probabilistic point of view and can apply learned concepts to complex, practice-relevant tasks. Students can analyse and evaluate problems in this context. Participation in this module promotes skills in logical, analytical and conceptual thinking in the field of probabilistic robotics. Students can select suitable methods from the concepts learned in a targeted manner, apply them confidently and transfer them to new problems, including those from other disciplines. The module imparts competencies for recognising current research and significant technological developments in this field.

Key qualifications: advanced mathematical-formal logic; implementation of subject-specific solution concepts; interdisciplinary knowledge; development and implementation of solution strategies for complex problems; systematic further development of design methods; ability to solve problems under practical boundary conditions.

Workload:

Total: 150 h

30 h exercise course (attendance)

30 h lecture (attendance)

15 h studying of course content using provided materials (self-study)

60 h studying of course content through exercises / case studies (self-study)

15 h studying of course content using literarture (self-study)

Conditions:		
none		
Frequency: irregular (usu. summer semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Probabilistic Robotics (Lecture)

Mode of Instruction: lecture

Language: German

Contact Hours: 2

Contents:

- 1. Introduction to Probabilistic Robotics
- 2. Recursive State Estimation
- 3. Gaussian Filters
- 4. Nonparametric Filters
- 5. Robot Motion
- 6. Robot Perception
- 7. Mobile RobotLocalization: Markow and Gaussian
- 8. Mobile Robot Localization: Grid and MonteCarlo
- 9. Occupancy Grid Mapping
- 10. SLAM

Literature:

Sebastian Thrun, Wolfram Burgard, Dieter Fox. Probabilistic Robotics. Springer Verlag.

Part of the Module: Probabilistic Robotics (Tutorial)

Mode of Instruction: exercise course

Language: German

Contact Hours: 2

Examination

Probabilistic Robotics (Examination)

written exam / length of examination: 90 minutes

Test Frequency:

each semester

Description:

The examination can be taken every semester during the examination period.

Module INF-0095: Seminar Multir	nedia Computing & Computer	4 ECTS/LP
Seminar Multimedia Computing (MA)		
Version 1.0.0 (since SoSe14)		
Person responsible for module: Prof. D	r. Rainer Lienhart	
Learning Outcomes / Competences:		
After attending the seminar, the studen	ts can independently work out and analy	vse advanced problems, concepts,
methods, procedures, techniques, and	technologies from the field of multimedia	a computing and computer vision (e.g.
image and video processing, machine I	earning, and image and video search) a	nd evaluate them in relation to the
individual seminar topic.		
Participants possess scientific methodo	ology, communication skills, and the abili	ty to present a special topic clearly and
comprehensibly in speech and writing a	and to discuss and evaluate scientifically	challenging topics from the named
field critically and argumentatively.		
Furthermore, they learn to recognise lo	gical structures of thinking and argumen	tation and use them in a goal-
oriented manner. The participants can	formulate clearly and comprehensibly an	d present subject content freely.
I ney understand how to structure a tail	that is clear and easy to follow. Addition	hally, the students know how to
apply chains of argumentation and solu	tion strategies in the event of disruption	The students understand how to
confidently deal with common presenta	tion media and use them interactively. T	bey manage to gear a talk to a specific
target group, apply various moderation	techniques, and keep their audience en	gaged even over a longer period.
Key qualifications: Presentation techr	niques; literature research; principles of c	good scientific practice; evaluating
solution approaches, procedures, techr	niques, and technologies from different p	oints of view.
Workload:		
Total: 120 h		
90 h preparation of written term papers	(self-study)	
30 h seminar (attendance)		
Conditions:		
none		
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	
Parts of the Module	·	

Part of the Module: Seminar Multimedia Computing (MA)

Mode of Instruction: seminar

Language: German

Frequency: each summer semester

Contact Hours: 2

Contents:

The concrete topic of the seminar from the wide-ranging field of multimedia is determined anew each year and adapted to current trends.

Literature:

current research literature

Assigned Courses:

Seminar über Multimedia und Maschinelles Sehen (Master) (seminar)

Examination Presentation and written paper seminar Test Frequency: when a course is offered

Module INF-0096: Project Module Projektmodul Multimedia Computing	Multimedia Computing	10 ECTS/LP
Version 1.0.0 (since SoSe14) Person responsible for module: Prof. D	r. Rainer Lienhart	
Learning Outcomes / Competences: After participating in this project module computing (e.g. image, video, and audie (object detection, people detection, hun there. They can develop concepts, meth research projects and can apply innova research and make their scientific contr skills, the ability to research literature, th goals, and critically evaluate, classify, c Key qualifications: Ability to think logic Comprehensible, confident and convinc Communication skills; Ability to work in Project management skills; Scientific m	e, students understand problems of high o processing as well as image, video, ar nan pose estimation) and have more in- hods, procedures, techniques, and techn tive methods in solving problems. This e ibution to the field. In addition, students he scientific methodology to discuss pro combine, and present intermediate result cally, analytically and conceptually; Inde cing presentation of ideas, concepts, and teams and understand team processes; ethodology.	er complexity in the field of multimedia and audio search) and computer vision depth specialist knowledge and skills mologies in the mentioned field in enables them to connect to international have teamwork and communication blems in the field, define intermediate its and innovative ideas. pendent work with specialist literature; d results; Quality awareness; principles of good scientific practise;
Total: 300 h 285 h internship / practical course (self- 15 h seminar (attendance)	-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Project Module Multimedia Computing

Mode of Instruction: internship

Language: German

Frequency: as needed

Contact Hours: 1

Contents:

The specific task from the wide-ranging field of multimedia and machine vision (image, video and audio processing, object recognition, search in image, video and audio material) is designed individually for each student every year.

Literature:

Literature references will be announced at the beginning of the course.

Assigned Courses:

Oberseminar Multimedia Computing

Examination

Software presentation; elaboration with software documentation; explanation of source code (code review) internship

Module INF-0108: Project Module Teaching Professorship	10 ECTS/LP
Projektmodul Lehrprofessur für Informatik	
Version 1.0.0 (since SoSe14)	
Person responsible for module: Prof. Dr. Robert Lorenz	

Learning Outcomes / Competences:

After participating in this project module, students understand problems of higher complexity in the fields of *concurrent systems*, *petri nets* or *process mining* and have more in-depth specialist knowledge and skills there. They can develop concepts, methods, procedures, techniques, and technologies in the mentioned field in research projects and can apply innovative methods in solving problems. This enables them to connect to international research and make their scientific contribution to the field. In addition, students have teamwork and communication skills, the ability to research literature, the scientific methodology to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine, and present intermediate results and innovative ideas.

Key qualifications: Ability to think logically, analytically and conceptually; Independent work with specialist literature; Comprehensible, confident and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Principles of good scientific practise; Project management skills; Scientific methodology.

Workload:

Total: 300 h 15 h seminar (attendance) 285 h internship / practical course (self-study)

Conditions: Basic knowledge in the research fields <i>nets</i> or <i>process mining</i>	of concurrent systems, petri	
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Projektmodul Lehrprofessur für Informatik

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Collaboration on current research topics of the group

Literature:

- J. Desel, W. Reisig, G. Rozenberg: Lectures on Concurrency and Petri Nets, Springer, Lecture Notes in Computer Science 3098, 2004
- Wil M. P. van der Aalst: Process Mining. Data Science in Action. Springer, 2016.

Assigned Courses:

Oberseminar zu Lehrprofessur für Informatik

Examination

Projektmodul Lehrprofessur für Informatik

Module INE-0136: Seminar Softw	are- and Systems Engineering	
(Master)	are and bystems Engineering	4 2010/21
Seminar Software- und Systems Engin	eering (Master)	
Version 1.1.0 (since SoSe14) Person responsible for module: Prof. D	r. Wolfgang Reif	
Learning Outcomes / Competences: After successful completion of the semi advanced problems, concepts, method systems engineering.	nar, students are able to understand, to s, procedures, techniques and technolog	learn, to analyse and evaluate gies in the field of software and
They known the scientific methods, cor specific topic clearly and comprehensib the aforementioned field critically. They argumentation and use them.	nmunication skills and the ability to use a ly in speech and writing and to discuss o will also be able to recognize the logica	appropriate media to present a challenging scientific topics from I structures of reasoning and
The participants are able to formulate c understand how to structure a presenta the core messages and convey them in	learly and understandably and to preser tion in a clear and comprehensible way a comprehensible way even for comple	nt specialist knowledge freely. They and how to focus the presentation on x and advanced subjects.
Die Studierenden verstehen es, präsen und diese interaktiv einzusetzen. Sie so Zuhörer auch bei längeren Vortragsdau	t aufzutreten und souverän mit gängiger chaffen es, einen Vortrag auf eine bestim iern zu motivieren und verschiedene Mo	n Präsentationsmedien umzugehen nmte Zielgruppe auszurichten und den derationstechniken anzuwenden.
The students understand how to preser They manage to focus a presentation to knowledge of moderation techniques to	nt themselves and how to deal confident o a specific target group and to motivate o guide a discussion.	ly with common presentation media. the audience and they have working
Soft Skills:		
 Literature research Independently work with English Analytical competence Working methodical Principles of good scientific pract Ability to present (written and ora to document them Ability to think logically, abstractly Awareness for quality aspects Communication skills Time management Evaluation of solution approaches 	technical literature ice I) ideas, concepts and results in a comp r, analytically and conceptually and to ar s, procedures, techniques and technolog	rehensible and convincing manner and gue precisely gies from different points of view
Workload:		
Total: 120 h	/ W / I)	
90 n preparation of written term papers 30 h seminar (attendance)	(Self-Study)	
Conditions:		
none		
Frequency: irregular (usu. winter semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Software- und Systems Engineering (Master)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

The topics of the seminar deal with current trends in Software and Systems Engineering on the level of graduate students. The topics change from year to year and are regulary adapted to reflect new developments.

Literature:

Depends on the concrete topic.

Examination

Seminar Software- und Systems Engineering (Master)

written/oral exam / length of examination: 45 minutes

work period for assignment: 3 months

Test Frequency:

when a course is offered

Module INF-0137: Project Module Software- and Systems	10 ECTS/LP
Engineering	
Projektmodul Software- und Systems Engineering	
Version 1.1.0 (since SoSe14)	

Person responsible for module: Prof. Dr. Wolfgang Reif

Learning Outcomes / Competences:

After participating in the project module, students understand problems of higher complexity from the field of software and systems engineering and have more in-depth knowledge and skills. They are able to develop concepts, methods, techniques and technologies of the mentioned field in research projects and are able to apply innovative methods in solving problems. This enables them to connect to international research and make their own scientific contribution to the field. In addition, students have teamwork and communication skills, the ability to research literature and the scientific methodology to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine and present intermediate results and innovative ideas.

Soft Skills:

- Skill in logical, analytical and conceptual thinking.
- · Ability to work independently with technical literature, including English literature
- · Clear, confident and convincing presentation of ideas, concepts and results
- Awareness for quality aspects
- · Communication skills
- · Ability to work in teams and understand team processes
- Principles of good scientific practice
- · Competencies in project management
- Research methodology

Workload:

Total: 300 h 285 h internship / practical course (self-study) 15 h seminar (attendance)

Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Project Module Software- and Systems Engineering

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Contribution to current research projects of the chair for Software Engineering

Literature:

Depends on the project: Scientific papers, system documentation, books, ...

Assigned Courses:

Oberseminar Software- und Systems Engineering

Examination

Project Module Software- and Systems Engineering Project Presentation

practical exam / work period for assignment: 2 months

Test Frequency:

when a course is offered

Module INF-0149: Practical Mode Praktikum Eingebettete Systeme	ule Embedded Systems	5 ECTS/LP
Version 2.2.0 (since SoSe20)		
Person responsible for module: Prof. [Dr. Sebastian Altmeyer	
Learning Outcomes / Competences		
Over the course of the semester, stude	ents develop a complete embedded syste	em as a coherent semester
assignment. A core task of the course	is to analyse the characteristics and reco	ognize the functionality of
microcontrollers and peripherals based	on data sheets and specifications. The	students will have the opportunity
to assemble the components needed f	or an assignment and to define suitable i	nterfaces. Due to the required
development and implementation on a	microcontroller, the students apply the c	oncepts learned directly in practice.
The focus is on the interaction with ser	nsors and actuators as well as on the cor	mmunication with other parts of the
system. To this end, they will identify a	ind apply different types of flow control. E	During the lab, students learn to plan
complex assignments, design solution	s and test and evaluate their functionality	 The exchange among the students the results achieved
Students acquire competencies in the	following areas at an advanced practice	
independent work with microcontrollers	s data sheets and specifications interfac	sing of analog and digital peripherals
design and modelling of embedded so	ftware with state charts and their implem	entation in code. Further focus is on
the configuration of sequential interfac	es as well as scheduling and task-based	programming.
Schlüsselqualifikationen:	-	
Ability to understand and document ide	eas, concepts and results;	
Consciousness of quality, meticulousn	ess;	
Project-related work and time manage	ment;	
selection and correct application of application	propriate methods;	
ability to expand existing knowledge in	dependently;	
Self-reflection		
Workload:		
Total: 150 h		
90 h studying of course content throug	h exercises / case studies (self-study)	
60 n internship / practical course (atter	idance)	
Conditions:		
Knowledge in C-Programming.		
Frequency: irregular (usu. summer	Recommended Semester:	Minimal Duration of the Module:
semester)	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
4	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum Einge	bettete Systeme	
Mode of Instruction: internship		
Language: German / English		

Contact Hours: 4

Contents:

The practical course "Embedded Systems" aims to learn the challenges of programming embedded systems. The central platform is a development board that offers a microcontroller as well as various sensors, actuators, displays and interfaces for further peripherals. The programming is done in C without the application of hardware abstraction layers and the created programs are supposed to read out different sensors and set corresponding actuators. In particular, the challenges of embedded systems, such as the timing of the software as well as working with data sheets, are to be learned. Towards the end of the course, the basic knowledge acquired at the beginning will be deepened and already existing sub-components will be assembled into a more complex embedded system.

Literature:

- Zhu, Yifeng: Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, Third Edition, E-Man Press LLC, 2017
- White, Elecia: Making Embedded Systems, O'Reilly Media Inc., 2012
- Marwedel, Wehmeyer: Eingebettete Systeme, Springer Verlag, Heidelberg, 2007

Examination

Praktikum Eingebettete Systeme practical exam

odule Human-Centered Multimedia Aultimedia	10 ECTS/LP
Prof. Dr. Elisabeth André	
nces: nodule, students understand problems of hi deeper expertise and skills there. They are nologies of the mentioned field in research is enables them to connect to international on, students have the teamwork and commu odology to discuss problems in the field, def present intermediate results and innovative al. analytical, and conceptual thinking: Inde	gher complexity in the field of "Human- able to develop concepts, methods, projects and are able to apply innovative research and make their own scientific unication skills, the ability to research ine intermediate goals, and critically ideas.
rking in teams and understanding team pro- ills; Scientific methodology;	pts, and results; Quality awareness; cesses; Principles of good scientific
e (self-study)	
Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Repeat Exams Permitted: according to the examination	
	Odule Human-Centered Multimedia Aultimedia Prof. Dr. Elisabeth André nces: nodule, students understand problems of high deeper expertise and skills there. They are a nologies of the mentioned field in research is enables them to connect to international r in, students have the teamwork and commundology to discuss problems in the field, defi present intermediate results and innovative i al, analytical, and conceptual thinking; Indep ind persuasive presentation of ideas, conce rking in teams and understanding team proceills; Scientific methodology; e (self-study) Recommended Semester: from 1. Repeat Exams Permitted: according to the examination

Part of the Module: Project Module Human-Centered Multimedia

Mode of Instruction: internship

Language: German

Contact Hours: 1

Contents:

Collaborate on current research topics.

Literature:

Literature references will be given at the beginning of the module depending on the topic.

Assigned Courses:

Oberseminar Human-Centered Multimedia

Examination

Project Module Human-Centered Multimedia

Module INF-0182: Practical Module Multimodal Real Time Signal Processing Praktikum Multimodale Echtzeitsignalverarbeitung	8 ECTS/LP
Version 1.0.0 (since SoSe13) Person responsible for module: Prof. Dr. Elisabeth André	
Learning Outcomes / Competences: After successful participation in this module, students are familiar with the basic	c concepts of signal processing and

After successful participation in this module, students are familiar with the basic concepts of signal processing and machine learning. They are able to translate technical solution concepts into programs and models and master the selection and safe application of suitable methods. During the internship, they also learn to plan larger project tasks (development of software modules) in small teams, to solve them according to a self-developed project plan and to discuss the results appropriately in plenary sessions and present them as a team. The ability to evaluate suitable methods in a scientifically meaningful way, to develop the methods and algorithms independently and to implement them technically is also particularly encouraged.

Key qualifications: Advanced knowledge of signal processing and machine learning, skill in analyzing and structuring complex computer science problems, skill in developing and implementing solution strategies for complex problems, understanding of team processes, skill in working in teams, self-reflection; acting responsibly in the face of inadequacy and conflicting interests, quality awareness, meticulousness.

Workload:

Total: 240 h

90 h internship / practical course (attendance)

150 h studying of course content through exercises / case studies (self-study)

Conditions: Programming experience		
Module Foundations of Multimedia I (IN Module Foundations of Multimedia II (IN	F-0087) - recommended NF-0166) - recommended	
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Multimodal Real Time Signal Processing

Mode of Instruction: internship

Language: German

Contact Hours: 6

Contents:

The specific task from the wide field of multimodal real-time signal processing is designed every year.

Literature:

Literature references will be announced at the beginning of the semester depending on the topic.

Examination

Practical Module Multimodal Real Time Signal Processing

Module INF-0183: Practical Mod Praktikum Spieleprogrammierung	ule Game Programming	8 ECTS/LP
Version 1.0.0 (since SoSe13) Person responsible for module: Prof. [Dr. Elisabeth André	
Learning Outcomes / Competences After successful participation in this me are able to plan larger project tasks in to discuss and present the results app concepts into programs and models at the knowledge of the way of thinking a learn to evaluate various components the methods and algorithms independ presentation of ideas and concepts, co analytical and conceptual thinking are Key qualifications: Skill in confident a and language of application-relevant of lead teams; skill in comprehensible pro- independently; ability to contribute to s awareness, meticulousness.	: odule, students understand the essenti small teams, to solve them according t ropriately in plenary sessions. They are nd master the selection and safe applic and the language of application-relevan of a game in a scientifically meaningful ently and to implement them technically omprehensible presentation and docum also particularly promoted in this conte and persuasive presentation of ideas a lisciplines; understanding of team proce esentation and documentation of result science; competence in recognizing sig	al concepts of game development. They o a self-developed project plan and e able to translate technical solution ation of suitable methods. They have t disciplines. During the internship, they way using suitable methods, to develop way using suitable methods, to develop an and convincing mentation of results as well as logical, xt. and concepts; knowledge of the thinking esses; skill in working in teams; ability to s; ability to expand existing knowledge mificant technical developments; quality
Workload: Total: 240 h 90 h internship / practical course (atter 150 h studying of course content throu	ndance) Igh exercises / case studies (self-study)
Conditions: Module Foundations of Game Program	nming (INF-0179) - recommended	
Frequency: each winter semester	Recommended Semester: from 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Game Programming

Mode of Instruction: internship

Language: German

Contact Hours: 6

Contents:

A game is to be developed within the internship. The content focus of the internship is determined each year.

Literature:

References will be announced at the beginning of the semester.

Examination

Practical Module Game Programming

Module INF-0217: Practical Module Autonomous Driving Praktikum Autonomes Fahren	10 ECTS/LP
Version 2.0.0 (since WS21/22)	

Person responsible for module: Prof. Dr. Bernhard Bauer Prof. Dr. Lars Mikelsons

Learning Outcomes / Competences:

After participating in the practical course on autonomous driving, students will be able to solve practical problems of high complexity in conceptual design, development, and safeguarding of highly automated/autonomous vehicles using current methods and tools of model-based development. The students acquire in-depth subject-specific and interdisciplinary knowledge and skills, for example, from hardware-related computer science, software engineering, and the underlying driving physics and mathematics. They are able to develop concepts, methods, procedures, techniques, and technologies of the mentioned field in research projects and are able to apply innovative approaches in solving problems. This enables them to link up with international research and make their scientific contribution to the field. In addition, students have the teamwork and communication skills, the ability to research literature and the scientific methodology to discuss problems in the area, define intermediate goals, and critically evaluate, classify, combine, present and document intermediate results and innovative ideas understandably.

Key qualification: Ability to think logically, analytically, and conceptually; Independent work with English-language specialist literature; Understandable, confident, and convincing presentation of ideas, concepts, and results; Quality awareness; Communication skills; Ability to work in teams and understand team processes; Project management skills.

Remarks:

The practical course is offered alternately by the two chairs mentioned above.

Workload:

Total: 300 h

150 h internship / practical course (attendance)

150 h studying of course content through exercises / case studies (self-study)

Conditions:

Participation in one of the two seminars is recommended.

Frequency: each semester	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
10	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Praktikum Autonomes Fahren

Mode of Instruction: internship

Language: German / English

Contact Hours: 10

Contents:

In this practical course, the participants learn how various selected partial aspects of autonomous driving can be implemented, simulated, and analyzed.

In addition, the participants will get to know, among other things, development tools frequently used in the automotive environment.

After an introductory course, the participants will implement autonomous driving functions in small groups with the help of the tools mentioned.

The developed results are finally demonstrated and evaluated.

Assigned Courses:

Praktikum über Autonomes Fahren (internship)

Examination

Praktikum Autonomes Fahren

portfolio exam

Test Frequency:

when a course is offered

Module INF-0227: Seminar Datab	ase Systems Master	4 FCTS/I P
Seminar Datenbanksysteme für Master	r	4 2010/21
Version 1.0.0 (since SoSe16)		
Person responsible for module: Prof. D	r. Peter Michael Fischer	
Learning Outcomes / Competences:		
After attending the seminar, students a	re able to independently develop, analyz	e and evaluate advanced problems,
concepts, methods, procedures, techni	ques and technologies in the field of data	abase systems in relation to the
individual seminar topic from the mentio	oned field.	
They have the scientific methodology, o	communication skills and ability to use a	ppropriate media to present a specific
topic in a clear and understandable ma	nner, both verbally and in writing, and to	critically and argumentatively discuss
and evaluate scientifically challenging t	opics from the named field. They will als	o be able to recognize the logical
The participants can formulate clearly	tion and use them in a goal-oriented mai	nner.
how to structure a lecture in a clear and	and comprehensible way and how to focus	the lecture on essential messages
and convey them in a comprehensible	way even in the case of complex conter	the rectare of essential messages
argumentation and solution strategies i	n the event of disruptions.	
The students understand how to prese	nt themselves and how to deal confident	ly with common presentation media
and to use them interactively. They ma	nage to gear a lecture to a specific targe	t group and to motivate the listener
even during longer lecture durations an	d to apply various moderation technique	9S.
Key qualifications: Literature research;	Independent work with English-language	e specialist literature; Analytical-
methodical competence; Scientific methodical	hodology; Principles of good scientific pr	actice; Skill in the comprehensible,
confident and convincing (written and c	oral) presentation of (practical or theoretic	cal) ideas, concepts and results and
for their documentation; Skill in logical,	abstract, analytical and conceptual think	king and formal argumentation; Quality
awareness, meticulousness; Communi	cation skills; Time management; Evaluat	tion of approaches, procedures,
techniques and technologies from different points of view.		
Workload:		
Total: 120 h		
90 h preparation of written term papers (self-study)		
30 h seminar (attendance)		
Conditions:		
Module Database Systems (INF-0073)	- recommended	
Frequency: irregular (usu. summer	Recommended Semester:	Minimal Duration of the Module:
semester)	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	
Parts of the Module		

Part of the Module: Seminar Datenbanksysteme für Master

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

Current research contributions from the field of "Databases and Information Systems".

Literature:

Current research contributions

Assigned Courses:

Seminar Datenbanksysteme für Master (seminar)

Examination

L

lecture and written elaboration

seminar

Module INF-0240: Seminar Inform	nation Systems Master	4 ECTS/LP
Version 1.0.0 (since WS16/17)		
Person responsible for module: Prof. D	r. Peter Michael Fischer	
Person responsible for module: Prof. Dr. Peter Michael Fischer Learning Outcomes / Competences: After attending the seminar, students are able to independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques and technologies in the field of information systems related to the individual seminar topic from the mentioned field. They have the scientific methodology, communication skills and ability to use appropriate media to present a specific topic in a clear and comprehensible manner, both verbally and in writing, and to critically and argumentatively discuss and evaluate scientifically challenging topics from the named field. They will also be able to recognize the logical structures of reasoning and argumentation and use them in a goal-oriented manner. The participants can formulate clearly and comprehensible way and how to focus the lecture on essential messages and convey them in a comprehensible way, even in the case of complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and how to deal confidently with common presentation media and to use them interactively. They manage to gear a lecture to a specific target group and to motivate the listener even during longer lecture durations and to apply various moderation techniques. Key qualifications: Literature research; Independent work with English-language specialist literature; Analytical- methodical competence; Scientific methodology; Principles of good scientific practice; Skill in the comprehensible, confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and for their documentation; Skill in logical, abstract, analytical and conceptual thinking and formal argumentation; Quality awareness, meticulousness; Communication skills; Time management; Evaluation of approaches, procedures,		
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term papers	(self-study)	
Conditions: Module Database Systems (INF-0073)	- recommended	
Frequency: irregular (usu. winter semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Informa Mode of Instruction: seminar	tionssysteme für Master	

Language: German / English

Contact Hours: 2

Contents:

Current research contributions from the field of "Databases and Information Systems".

Literature:

Current research contributions

Examination Lecture and written elaboration seminar

Module INF-0247: Practical Modu Praktikum für Produktionsinformatik (V	ule on Digital Manufacturing /ertiefung)	6 ECTS/LP
Version 1.0.0 (since SoSe17)		
Person responsible for module: Prof. I	DrIng. Johannes Schilp	
Learning Outcomes / Competences		
Students work through the digital prod	uct development process in small groups	using an industry-related example.
They are able to independently analyz	e engineering tasks and develop solution	concepts. The knowledge from the
engineering fundamentals is deepened	d by application examples. You will be ab	le to use selected CAx programs
(CATIA V5, PlantSim, FreeCAD) for th	e development of a product. The practica	al course provides an introduction to the
following topics:		
1. CAD design		
2. FEM analysis		
3. topology optimization		
4. production planning		
5. mathematical optimization		
Key qualifications: Teamwork and com	munication skills, structured and conscie	ntious work, application-oriented
problem solving, result evaluation and		
-documentation, weighing of solutions,	ability to think logically, analytically and	conceptually, ability to think abstractly.
Workload:		
Total: 180 h		
10 h preparation of presentations (self	-study)	
40 h preparation of written term papers	s (self-study)	
10 h lecture (attendance)		
60 h internship / practical course (atter	ndance)	
60 h studying of course content through exercises / case studies (self-study)		
Conditions:		
Grundkenntnisse in CATIA V5 empfeh	lenswert	
Frequency: each winter semester	Recommended Semester:	Minimal Duration of the Module:
		1 semester[s]
Contact Hours:	Popost Exame Pormittadi	
	Repeat Exams Fermined.	
4	regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum für Pi	oduktionsinformatik (Vertiefung)	
Mode of Instruction: internship		
Language: German		
Contact Hours: 4		

ECTS Credits: 6.0

Contents:

Students work in small groups on application-oriented tasks on topics in the industrial environment.

The time schedule of this internship will be announced in Digicampus.

Examination

Praktikum für Produktionsinformatik (Vertiefung)

Module INF-0250: Practical I Praktikum Reinforcement Learnin	Module Reinforcement Learning	8 ECTS/LP
Version 1.3.0 (since SoSe17) Person responsible for module: P	rof. Dr. Elisabeth André	
Learning Outcomes / Competer After successful participation in the They are able to plan larger project and to discuss and present the re- concepts into programs and mode methods. They have the knowled the internship, they learn to evalue to develop the methods and algor convincing presentation of ideas a logical, analytical and conceptual Key qualifications: Skill in confid and language of application-relevel lead teams; skill in comprehensib independently; ability to contribute awareness, meticulousness.	nces: is module, students understand the essent ct tasks in small teams, to solve them acco sults appropriately in plenary sessions. You els and are proficient in the selection and co ge of the way of thinking and the language ate learning components in a scientifically unit rithms independently and to implement ther and concepts, comprehensible presentation thinking are also particularly promoted in the dent and persuasive presentation of ideas a ant disciplines; understanding of team proc le presentation and documentation of resul e to science; competence in recognizing signal	ial concepts of reinforcement learning. rding to a self-developed project plan a are able to translate technical solution onfident application of appropriate of application-relevant disciplines. During meaningful way using suitable methods, in technically. The skills of confident and in and documentation of results, as well as his context. and concepts; knowledge of the thinking resses; skill in working in teams; ability to ts; ability to expand existing knowledge gnificant technical developments; quality
Workload: Total: 240 h 150 h studying of course content 90 h internship / practical course	through exercises / case studies (self-study (attendance)	()
Conditions: Programming experience		
Frequency: irregular	Recommended Semester: from 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination	

Parts of the Module

Part of the Module: Practical Module Reinforcement Learning

Mode of Instruction: internship

Language: German

Contact Hours: 6

Contents:

The specific task from the field of "reinforcement learning" is designed anew each semester.

Examination

Practical Module Reinforcement Learning

practical exam

Description:

Exception summer term 2020: practical exam

Module INF-0251: Seminar Artificial Intelligence Seminar Artificial Intelligence	4 ECTS/LP	
Version 1.0.0 (since SoSe17) Person responsible for module: PD Dr. Jonghwa Kim		
Contents:		
The seminar will take place as a block seminar at the end of June for summer term or mid-December for winter term.		
The topic area for this seminar will be redefined annually, taking into account new trends in "Artificial Intelligence and		
Intelligent Systems".		

Learning Outcomes / Competences:

After attending the seminar, students are able to independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques and technologies in the field of "Artificial Intelligence and Intelligent Systems" in relation to the individual seminar topic from the mentioned field. They have the scientific methodology, communication skills and ability to use appropriate media to present a specific topic clearly and comprehensibly, both verbally and in writing, and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively. They will also be able to recognize the logical structures of reasoning and argumentation and use them in a goal-oriented manner. The participants can formulate clearly and comprehensibly and present specialist content freely. They understand how to structure a lecture in a clear and comprehensible way and how to focus the lecture on essential messages and convey them in a comprehensible way, even in the case of complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and how to deal confidently with common presentation media and to use them interactively. They manage to gear a lecture to a specific target group and to motivate the listener even during longer lecture durations and to apply various moderation techniques.

Key qualifications: Evaluation of approaches, procedures, techniques and technologies from different points of view; literature research; independent work with English-language technical literature; analytical-methodical competence; scientific methodology; principles of good scientific practice; skill in the comprehensible, confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and in documenting them; skill in logical, abstract, analytical and conceptual thinking and formal argumentation; quality awareness, meticulousness; communication skills; time management.

Workload:

Total: 120 h 30 h seminar (attendance)

90 h preparation of written term papers (self-study)

Conditions:		Credit Requirements:
none		Passing the module exam
Frequency: usu. at least once per acad. year	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Artificial Intelligence

Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 4.0

Contents:

The seminar will take place as a block seminar at the end of June for summer term or mid-December for winter term. The topic area for this seminar will be redefined annually, taking into account new trends in "Artificial Intelligence and Intelligent Systems".

Literature:

current research literature

Examination

Seminar Artificial Intelligence

written/oral exam
Module INF-0272: Intelligent Sig Intelligente Signalanalyse in der Media	nal Analysis in Medicine ^{zin}	5 ECTS/LP		
Version 1.1.0 (since WS17/18) Person responsible for module: Prof. Dr. Björn Schuller				
Learning Outcomes / Competences				
Knowledge: The students learn the principal concepts of sequential signal processing, signal source separation, and feature extraction and information reduction exemplified by medically relevant audio and bio signals. They further gain insight into machine learning principles such as learning dynamics and context as is needed for many intelligent signal analysis tasks. They will learn about different problems and solutions in the analysis of a variety of signals relevant in the context of health care, wellbeing, and general medical signals analysis. Students will get to know the mindset of modern machine learning, computer-aided health care, and get to know ethical implications.				
Skills: The students will be able to choose appropriate algorithms of signal processing and machine intelligence, further develop these, design new solutions, and apply these to a broad range of medical signal analysis problems. They will practice to think logically and conceptionally in order to select appropriate solutions to a given task. Students will be able to recognise important technical developments in the field of signal processing, machine learning and e-Health/m-Health.				
Competences: The students are able to characterise, judge on the quality and suitability, and design suited algorithmic solutions for intelligent signal analysis with a focus on medical signals. They are further able to realise the learnt concepts in programs and machine learning models. Participants will be able to analyse and structure complex and practice-oriented problems in the field of m-Health and e-Health and to find suitable and state-of-the-art solutions. They know how to make scientifically meaningful evaluations of proposed systems. They will further learn how to document and present results in a reasonable and meaningful way.				
Key skills: Formal methods; Knowled Systematical advancement of design to to find solutions for practical problems research.	ge of advantages and disadvantages of d ools; Ability to work in teams; Knowledge ; Ability to work autonomously; Quality aw	ifferent design alternatives; of workflows and processes; Ability vareness; Scientific working; Literature		
Workload:				
Total: 150 h				
30 h exercise course (attendance)				
30 h lecture (attendance)				
60 h studying of course content throug	h exercises / case studies (self-study)			
15 h studying of course content using	literarture (self-study)			
15 h studying of course content using	provided materials (self-study)	15 h studying of course content using provided materials (self-study)		
Conditions: Credit Requirements: Knowledge of basic mathematic lectures should be present. Bestehen der Modulprüfung				
Conditions: Knowledge of basic mathematic lectur	es should be present.	Credit Requirements: Bestehen der Modulprüfung		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular	es should be present. Recommended Semester: from 1.	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours:	es should be present. Recommended Semester: from 1. Repeat Exams Permitted:	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours: 4	es should be present. Recommended Semester: from 1. Repeat Exams Permitted: according to the examination	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours: 4	es should be present. Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours: 4 Parts of the Module	es should be present. Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours: 4 Parts of the Module Part of the Module: Intelligente Sign	es should be present. Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		
Conditions: Knowledge of basic mathematic lectur Frequency: irregular Contact Hours: 4 Parts of the Module Part of the Module: Intelligente Sign Mode of Instruction: lecture	es should be present. Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]		

Contact Hours: 2

Topics: Basics of Signal Processing, Signal Source Separation, Data Acquisition and Annotation, Audio-Visual Feature Extraction, Machine Learning, e-Health, m-Health, Ethics, Python, Machine Learning Toolkits.

Literature:

Björn Schuller: "Intelligent Audio Analysis", Signals and Communication Technology, Springer, ISBN: 978-3642368059, 2013.

Part of the Module: Intelligente Signalanalyse in der Medizin (Übung)

Mode of Instruction: exercise course Language: English Frequency: irregular (usu. summer semester) Contact Hours: 2

Examination

Intelligente Signalanalyse in der Medizin

written exam / length of examination: 90 minutes

Module INF-0273: Practical Wellbeing Praktikum Mobile Sensing for Fi	Module Sensing for Fitness and tness and Wellbeing	5 ECTS/LP
Version 1.0.0 (since WS17/18) Person responsible for module:	Prof. Dr. Björn Schuller	
Learning Outcomes / Competer Students learn to realise concep They learn how to acquire signa recognition on mobile devices. A complex problems in the field ar	ences: Its and models of sensing health- and fitness Is from different modalities and sensors and Ifter participation in the Praktikum, students I Ind to select suitable and state-of-the-art appr	-related parameters on smart devices. to implement algorithms of pattern know how to analyse and structure baches to their solution.
Participants are trained in their a their knowledge to a practical ta- using appropriate methods. The learning. All knowledged obtaine participation, students will be ab related tools, and intelligent sign	analytical and conceptional skills as well as ir sk. They learn how to make scientifically mea y will know the mindset of two different fields ed during the Praktikum is applied in practice le to recognise important technical evolution al analysis.	practical programming skills to transfer aningful assessments of their system software development and machine oriented tasks. Furthermore, after in the field of sensors, mobile apps and
Students will work in teams and summarise, present and docume	organise their work and task distribution in a ent results in a reasonable way	n autonomous way. They will learn how to
Key skills: Formal methods; Me advantages and disadvantages work in teams, Understanding of for practical problems; Ability to	ethods for software development and abstract of different design alternatives; Systematical f team management; Knowledge of workflow work autonomously; Quality Awareness.	tion; Versioning tools; Knowledge of advancement of design tools; Ability to s and processes; Ability to find solutions
Workload: Total: 150 h 60 h internship / practical course 90 h studying of course content	e (attendance) through exercises / case studies (self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Practical M Mode of Instruction: internship Language: English Frequency: each winter semest	Nodule Sensing for Fitness and Wellbeing	

Contact Hours: 4

Research in the field of m-Health is focussed on the design and development of sensors, systems, and applications to recognise, interpret and simulate human states w.r.t. fitness, health, and wellbeing. In this Praktikum, students will experience in designing relevant systems, which are using modalities originating from different sensors, such as, vital signs, audio, speech, and video. In small teams, they will implement and evaluate an application running on a smart device.

Literature:

To be announced by the lecturer

Examination

Practical Module Sensing for Fitness and Wellbeing

practical exam

Module INF-0274: Seminar Embe and Wellbeing (Master) Seminar Embedded Intelligence for He	dded Intelligence for Health Care	4 ECTS/LP
Version 1.0.0 (since WS17/18) Person responsible for module: Prof. D	r. Björn Schuller	
 Learning Outcomes / Competences: After attending the seminar, students will be able to autonomously acquire and understand advanced problem statements, concepts, methods, approaches, techniques, and technologies in the field of Embedded Intelligence for Health Care and Wellbeing. They possess the scientific techniques, communication skills, and the ability to employ suitable media, to present understandingly a special topic in spoken and written, and to discuss and evaluate scientifically challenging themes from the field in a critical way. Furthermore, they can recognise logical structures of thinking and debating and employ them constructively. Participants can express themselves in a clear and understandable way and present scientific topics. They understand how to structure a talk, to focus it - also given a complex content - on the essential messages, and to communicate them in a suitable way. The lines of arguments and strategies in case of disturbances are applied by the students. Students know how to perform energetically, to cope with the presentation media and to use them interactively. They manage to orient a talk toward a certain audience, to motivate the listeners also over a longer duration, and to employ different methods of moderation. Key skills: Fundamentals of good scientific practice; Analytical-methodological competency; Time management; Literature research; Self-contained work with English technical literature; Communication skills; Ability to present (in written and spoken) practical and theoretical ideas in an understandable, confident, and convincing way; Writing a 		
Quality awareness.		
Workload: Total: 120 h 90 h preparation of written term papers (self-study) 30 h seminar (attendance)		
Conditions: Credit Requirements: none Bestehen der Modulprüfung		Credit Requirements: Bestehen der Modulprüfung
Frequency: irregular	Recommended Semester: from 5.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Part of the Module: Seminar Embedded Intelligence for Health Care and Wellbeing (Master)

Mode of Instruction: seminar Language: German / English

Contact Hours: 2

In the seminar Embedded Intelligence for Health Care and Wellbeing, recent research works in this field are going to be discussed. This comprises both the acquisition of data through sensors and (e.g., microphones or electrodes) and the analysis and the modelling of the data. One important aspect is also the practicability of modern deep learning methods. Health Care and Wellbeing applications reach from tracking of health states (e.g., epilepsy or depression) to personal assistance services.

The participating students will work on a certain aspect, supervised by a research associate of the chair. They will summarise their results in a written report and an oral presentation.

Topics: E-Health, M-Health, Sensor Signal Analysis, Vital Signs, Big Data.

Literature:

Wird vom Dozenten oder der Dozentin bekannt gegeben

Examination

Seminar Embedded Intelligence for Health Care and Wellbeing (Master) written/oral exam

Module INF-0275: Project Module Health Care and Wellbeing Projektmodul Embedded Intelligence for	e Embedded Intelligence for	10 ECTS/LP
Version 1.1.0 (since WS17/18) Person responsible for module: Prof. D	r. Björn Schuller	
Learning Outcomes / Competences: After participating in the project module embedded systems and intelligent sign have in-depth specialist knowledge and and technologies in the area mentioned problems. This enables them to tie in w In addition, the students have the team methodology to discuss problems in the combine and present intermediate resu Key Qualifications: Ability to think log specialist literature; understandable and communication skills; team collaboration practice; project management skills; sc	e, the students understand problems of h al analysis, especially for applications in d skills there. They can develop concepts d in research projects and are able to ap with international research and make thei and communication skills, the ability to e field, to define intermediate goals, as w lts and innovative ideas. ically, analytically and conceptually; Inde d convincing presentation of ideas, conc on skills and understanding of team proce- ientific methodology; software developm	igher complexity in the field of medical and sports informatics, and s, methods, procedures, techniques ply innovative methods to solve r own scientific contribution in this field. research literature and the scientific well as to critically evaluate, classify, ependent work with English-language tepts and results; quality awareness; esses; principles of good scientific tent and testing.
Workload: Total: 300 h 285 h internship / practical course (self- 15 h seminar (attendance)	-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Projektmodul Embedded Intelligence for Health Care and Wellbeing

Mode of Instruction: internship

Language: German / English

Contact Hours: 1

Contents:

Autonomous collaboration on current research topics.

Literature:

Scientific publications; manuals; is provided by the chair.

Assigned Courses:

Oberseminar Embedded Intelligence for Health Care and Wellbeing

Examination

Projektmodul Embedded Intelligence for Health Care and Wellbeing

practical exam

Module INF-0277: Analyzing Mass Analyzing Massive Data Sets	sive Data Sets	8 ECTS/LP
Version 1.2.0 (since SoSe18) Person responsible for module: Prof. Dr. Peter Michael Fischer		
Learning Outcomes / Competences: After attending the course, students will techniques, and technologies for analyz	l be able to understand and evaluate the zing massively large data sets. Possible	concepts and methods, procedures, content includes:
 Fundamentals of information retrieval Similarity search and clustering Analysis of data streams and temporal data Web graphs: Link analysis and social networks Dynamic networks and information diffusion Recommender systems and online advertising Computational methods for massive data sets 		
Students will also be able to implement technical solution concepts for analyzing large data sets in programs. Key Skills: Ability to think logically, analytically and conceptually, weigh up approaches to solutions, acquire abstraction skills; subject-specific in-depth knowledge; implement subject-specific solution concepts in programs and models; knowledge of the advantages/disadvantages of design alternatives and evaluation in the respective application context; selection and confident application of suitable methods; ability to make scientifically meaningful evaluations using suitable methods; ability to solve problems under practical boundary conditions; competence in		
Workload:	, 	
Total: 240 h		
30 h studying of course content using li	terarture (self-study)	
90 h studying of course content through	n exercises / case studies (self-study)	
30 h studying of course content using p	rovided materials (self-study)	
30 h exercise course (attendance)		
Conditions:		
Module Database Systems (INF-0073)	- recommended	
Module Discrete structures for compute	r science (INF-0109) - recommended	
Module Computer Science 3 (INF-0111) - recommended		
Frequency: irregular (usu. summer	Recommended Semester:	Minimal Duration of the Module:
semester)	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
6	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Analyzing Massive Data Sets (Vorlesung)		
Mode of Instruction: lecture		

Language: English

Contact Hours: 4

Contents:

The lecture covers basic concepts for the analysis of massively large data sets such as information extraction, similarity search, clustering, link and network analysis

as well as their implementation.

Literature:

- Mining of Massive Datasets. J. Leskovec, A. Rajaraman, J.D. Ullman. Cambridge UniversityPress, 2014
- D. Easley, J. Kleinberg.Networks, Crowds, and Markets: Reasoning About a Highly Connected World.Cambridge University Press, 2010.
- R. Baeza-Yates, B. Ribeiro-Neto: Modern Information Retrieval

Weitere Literatur wird in der Vorlesung bekannt gegeben

Assigned Courses:

Analyzing Massive Data Sets (lecture)

Part of the Module: Analyzing Massive Data Sets (Übung)

Mode of Instruction: exercise course Language: English / German

Contact Hours: 2

Assigned Courses:

Übung zu Analyzing Massive Data Sets (exercise course)

Examination

Analyzing Massive Data Sets

written exam / length of examination: 90 minutes

Module INF-0279: Music Informatics	5 ECTS/LP
Music Informatics	

Version 1.3.0 (since SoSe18)

Person responsible for module: Prof. Dr. Björn Schuller

Learning Outcomes / Competences:

Knowledge: The course Music Informatics presents the fundamental concepts of music theory and the music language and its representation in the visual, symbolic, and acoustic domain. Several digital formats for music symbolic representation, such as Music XML, MEI, Kern**, and MIDI protocol, as well as open source tools such as LilyPond and Csound will be introduced. Machine learning principles and techniques with applications in music information retrieval and computational musicology will be practically applied. Students will learn about different problems and solutions in the analysis of symbolic and acoustic music data. Students will get to know the mindset from both sides, the musicological and the computer scientist perspective.

Skills: The students will understand the basic principles of music theory and its representation in digital language, being able to analyse, interpret, and create musical samples in a variety of symbolic formats and programming languages. They will learn to apply machine learning procedures, such as feature extraction and pattern recognition, to music information retrieval problems, such as key detection and music-score synchronisation, amongst other. After participation, students will know how to advance existing concepts and approaches in the field of music informatics and data analysis. Furthermore, they will be able to recognise important technical developments in the field of data science and signal processing.

Competences: By integrating basic principles of music theory, its representation in digital language, and machine learning techniques, the students will be able to identify new problems and solutions in the field of music information retrieval considering a variety of musical styles and genres. The students are able to characterise, judge on the quality and suitability, and design suited algorithmic solutions for music data analysis in both the symbolic and the audio domain.

Participants will be able to analyse and structure complex and practice-oriented problems in the field of music informatics and to find suitable solutions, by using state-of-the-art tools and complementary methods, if needed. They know how to make scientifically meaningful evaluations of proposed systems. They will further learn how to document and present results in a reasonable and meaningful way.

Key skills: Computational musicology, Music theory, Digital Music Representation, Basics of Signal Processing, Machine Learning, Music Information Retrieval, Knowledge of advantages and disadvantages of different design alternatives; Systematical advancement of design tools; Ability to work in teams; Knowledge of workflows and processes; Ability to find solutions for practical problems; Ability to work autonomously; Quality awareness; Scientific working; Literature research.

Workload:

Total: 150 h

15 h studying of course content using provided materials (self-study)

60 h studying of course content through exercises / case studies (self-study)

- 15 h studying of course content using literarture (self-study)
- 30 h exercise course (attendance)

30 h lecture (attendance)

Conditions:		Credit Requirements:
Knowledge of basic mathematic lectures should be present		Bestehen der Modulprüfung
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]

Contact Hours:	Popost Exams Pormitted:	
	according to the examination	
4	regulations of the study program	
Parts of the Module		
Part of the Module: Music Informatic	s (Lecture)	
Mode of Instruction: lecture		
Language: English		
Frequency: each summer semester		
Contact Hours: 2		
Contents:		
computational point of view. Music will be evaluated in three domains: visual, symbolic, and acoustic; and for each of them: formats, programming languages, and machine learning tools will be studied. This course will give a basic introduction to music information retrieval and computational musicology by identify problems and solutions for different kinds of musical genres and styles.		
Literature:		
 Meinard Müller: "Fundamentals of Music Processing: Audio, Analysis, Algorithms, Applications." Springer, ISBN: 978-3-319-21944-8, 2015. 		
 Björn Schuller: "Intelligent Au 978-3642368059, 2013. 	dio Analysis", Signals and Communicatio	on Technology, Springer, ISBN:
Part of the Module: Music Informatic	s (Tutorial)	
Mode of Instruction: exercise course		
Language: English		
Frequency: each summer semester		
Contact Hours: 2		

Examination

Music Informatics

written exam / length of examination: 90 minutes

Module INF-0284: Practical Mod	ule Mobile Application	5 ECTS/LP
Praktikum Mobile Application Development		
Version 1.0.0 (since SoSe18)		<u> </u>
Person responsible for module: Prof. I	Dr. Björn Schuller	
Learning Outcomes / Competences Students learn to realise concepts and how to acquire data and signals from o signal analysis on mobile devices. After complex problems in the field and to s Participants are trained in their analytic their knowledge to a practical task. The	: I models of mobile application developme different sensors and to implement algorit er participation in the Praktikum, students elect suitable and state-of-the-art approa cal and conceptional skills as well as in p ev learn how to make scientifically mean	ant on the Android platform. They learn thms of pattern recognition and data/ know how to analyse and structure ches to their solution. ractical programming skills to transfer
their knowledge to a practical task. They learn how to make scientifically meaningful assessments of their system using appropriate methods. They will know the mindset and thinking of application development and software engineering. All knowledged obtained during the Praktikum is applied in practice-oriented tasks. Furthermore, after participation, students will be able to recognise important technical evolution in the field of sensors, mobile apps and related tools, and smart devices.		
Students will work in teams and organ summarise, present and document res	ise their work and task distribution in an a sults in a reasonable way.	autonomous way. They will learn how to
Key skills: Formal methods; Methods advantages and disadvantages of diffe work in teams, Understanding of team for practical problems; Ability to work a	for software development and abstractio erent design alternatives; Systematical ac management; Knowledge of workflows a autonomously; Quality Awareness.	n; Versioning tools; Knowledge of Ivancement of design tools; Ability to and processes; Ability to find solutions
Workload:		
Total: 150 h		
60 h internship / practical course (atten 90 h studying of course content through	ndance) ih exercises / case studies (self-study)	
Conditions: Credit Requirements: Programming skills in Java are required. Bestehen der Modulprüfung		Credit Requirements: Bestehen der Modulprüfung
Frequency: irregular (usu. summer semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum Mobi Mode of Instruction: internship	le Application Development	

Language: English

Contact Hours: 4

In the Praktikum Mobile Application Development, students will develop software for the Android platform in groups of 2-4 students.

Students will get to know and to program several groups of Android devices, e.g., mobiles and wearables, and respective sensors. They will familiarise with the Android Studio IDE, the according toolchain and the code management tool Gi.

Topics: Java, Android, App development, UI design, Audio Player, Map and Location, Camera control, Mobile devices, Intelligent signal processing, Wearables.

Literature:

The literature is going to be announced by the lecturers during the course.

Examination

Praktikum Mobile Application Development

practical exam

Module INF-0291: Practical Modu Praktikum Selbstlernende Systeme	ule Self-Learning Systems	8 ECTS/LP
Version 1.2.0 (since WS18/19)		
Person responsible for module: Prof. L	or. Jorg Hanner	
Learning Outcomes / Competences: After participating in the practical course, the students are able to understand and solve problems (of higher complexity) in the field of "machine learning methods". They can compare and classify different methods and apply them independently to concrete examples from practice. Students can evaluate intelligent systems in terms of the algorithmic solution and are further familiar with procedures for evaluating the performance of an intelligent system. They are also able to plan larger project tasks (development of software modules) in small teams, to solve them according to a self-developed project plan and to discuss the results appropriately in the plenum and present them as a team. Furthermore, they can recognise and classify significant technical developments in the field of "machine learning".		
Key qualifications:		
 Skill in analysing and structuring com strategies. 	plex computer science problems, skills ir	n developing and implementing solution
- Competence to combine different sub	oject areas	
- Presentation and documentation of (o	own) results	
- Analytical methodical competence		
- Ability to work productively and purpo	osefully in a team	
- Meticulous work		
- Interdisciplinary knowledge		
- Systematic further development of de	esign models	
- Time management skills		
- Independent literature research on related topics		
- Principles of good scientific practice		
Workload: Total: 240 h 225 h internship / practical course (self 15 h (attendance)	f-study)	
Conditions: Credit Requirements:		Credit Requirements:
Recommended: Module Organic Computing II (INF-0066), programming Passing the module exam		Passing the module exam
experience, ability to work in a team Module Organic Computing II (INE-0066) - recommended		
Frequency: each semester	Recommended Semester	Minimal Duration of the Module:
	from 2.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Praktikum Selbstlernende Systeme

Mode of Instruction: internship

Lecturers: Prof. Dr. Jörg Hähner

Language: German

Contact Hours: 2 ECTS Credits: 8.0

ECTS Credits. 0.

Contents:

In the practical module Self-Learning Systems, students learn about different methods from the field of machine learning and, above all, implement them themselves. The necessary theoretical foundations are laid in an introductory course and then applied in small groups to concrete practical examples.

Literature:

current scientific papers

Assigned Courses:

Praktikum zu Selbstlernende Systeme (internship)

Examination

Praktikum Selbstlernende Systeme

portfolio exam, combination of practical and written-oral exam

Description:

written submission, software acceptance, final presentation

Module INF-0293: Advanced Deep Learning Advanced Deep Learning	8 ECTS/LP
Version 1.0.0 (since WS18/19)	

Person responsible for module: Prof. Dr. Rainer Lienhart

Learning Outcomes / Competences:

After participating in the practical module, students have detailed and up-to-date knowledge in the field of machine learning, can identify significant technical developments and can implement a complete pipeline for multimodal data processing with deep neural networks. They can precisely describe and discuss problems and results in the field and apply learned concepts and methods to similar problems in machine learning. In addition, the students analyse advanced concepts, methods, procedures, techniques and technologies from the field of machine learning to apply them in research projects, transfer them to current industry-related tasks and actively participate in them. The students learn to transfer scientifically challenging topics in the field of machine learning to other research questions and, building on this, to work out a complex project in group work. They also have the teamwork and communication skills to discuss problems in the field, to discuss, describe and present questions and interim results. In addition, students can conduct detailed experiments and assess, compare and check results for plausibility.

Key qualifications:

Advanced mathematical-formal methodology; Translating subject-specific solution concepts into programs and models; Methods for developing larger software systems, construction of abstractions and architectures; Interdisciplinary knowledge; Systematic further development of design methods; Skill of confident and convincing presentation of ideas and concepts; Understanding of team processes; Skill of working in teams; Ability to lead teams; Familiarity with procedures and processes in the application environment of computer science; Skill of solving problems under practical boundary conditions; Self-reflection; Responsible action against the background of inadequacy and conflicting interests; Ability to expand existing knowledge independently; Quality awareness, meticulousness

Workload:

Total: 240 h

30 h studying of course content using provided materials (self-study)

30 h studying of course content using literarture (self-study)

120 h studying of course content through exercises / case studies (self-study)

20 h lecture (attendance)

40 h exercise course (attendance)

Conditions:		Credit Requirements:
Fundamental knowledge in computer vision (basic studies lectures		Passing the portfolio examination
"Multimedia Grundlagen 1", "Grundlagen der Signalverarbeitung und des		
Maschinellen Lernens", "Multimedia Grundlagen 2" as well as master's		
lectures "Multimedia 2" and "Machine Learning and Computer Vision")		
Frequency: each winter semester	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
6	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Advanced Deep Learning (Lecture) Mode of Instruction: lecture Language: German Contact Hours: 2

- Deep Learning in general
- Deep Convolutional Neural Networks
- Transfer Learning
- Recurrent Neural Networks / LSTM Networks
- Natural Language Processing
- Multimodal Fusion (Vision+Language)
- Application: Image Captioning

Part of the Module: Advanced Deep Learning (Tutorial)

Mode of Instruction: exercise course

Language: German

Contact Hours: 4

Examination

Advanced Deep Learning

portfolio exam, The final grade is made up of assessed exercise sheets and an assessed team project.

Test Frequency:

when a course is offered

Module INF-0294: Speech Pathology Speech Pathology	5 ECTS/LP
Version 1 1 0 (since WS18/19)	

Person responsible for module: Prof. Dr. Björn Schuller

Learning Outcomes / Competences:

Knowledge: The students learn concepts relating to signal processing, speech production, phonetics, speech and language pathology, speech analysis, feature extraction, denoising and information reduction as exemplified through the analysis of automated voice pathology detection. They further gain insight into machine learning principles, with a particular focus on deep learning solutions, as is needed to diagnose a range of different voice pathologies. They will learn about different problems and solutions in the analysis of a variety of speech, relevant in the context of health care and wellbeing.

Skills: The students will be able to choose appropriate algorithms of signal processing and machine intelligence, further develop these, design new solutions, and apply these to the task of voice pathology detection. They will know how to analyse and structure complex problems in the field, to employ suitable approaches to solve them, and to transfer knowledge to similar tasks. After participation in the course, they will be able to implement approaches and models into programs. Students will be able to assess developed systems in a scientific way. Important technical evolution and novelties in the fields of speech analysis and medical machine learning will be recognised by them.

Competences: The students are able to characterise, judge on the quality and suitability, and design suited algorithmic solutions for intelligent signal analysis with a focus on voice pathology detection. They are further able to present and document results in a reasonable and meaningful way.

Key skills: Formal methods; Knowledge of advantages and disadvantages of different design alternatives; Systematical advancement of design tools; Ability to work in teams; Knowledge of workflows and processes; Ability to find solutions for practical problems; Ability to work autonomously; Quality awareness; Scientific working; Literature research.

Workload:

Total: 150 h

60 h studying of course content through exercises / case studies (self-study)

15 h studying of course content using literarture (self-study)

15 h studying of course content using provided materials (self-study)

30 h exercise course (attendance)

30 h lecture (attendance)

Conditions:		Credit Requirements:
Knowledge of basic mathematic lectures should be present.		Bestehen der Modulprüfung
Frequency: irregular (usu. summer semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Speech Pathology (Vorlesung) Mode of Instruction: lecture

Language: English

Frequency: each winter semester

Contact Hours: 2

The course "Pathological Speech" will give an introduction to models of speech production (e.g., source-filter models) with a focus on aspects that are relevant to pathologies and their recognition using automated methods of signal processing and machine learning. Moreover, students learn about robust feature extraction, modern methods of machine learning and machine intelligence, and implementation of such systems on devices

Topics: Speech production; Phonetics; Speech and language pathology; Signal processing; Natural language processing; Speech analysis; Feature extraction; Machine learning; Deep learning; Denoising; Information reduction; Healthcare.

Literature:

- Björn Schuller, Anton Batliner: "Computational Paralinguistics: Emotion, Affect and Personality in Speech and Language Processing", Wiley, ISBN: 978-1119971368, 2013.
- Further literature is going to be announced during the lecture.

Part of the Module: Speech Pathology (Übung)

Mode of Instruction: exercise course

Language: English

Frequency: each winter semester

Contact Hours: 2

Examination

Speech Pathology

written exam / length of examination: 90 minutes

Module INF-0296: Practical Mod Praktikum Interactive Machine Learni	lule Interactive Machine Learning	8 ECTS/LP
Version 1.0.0 (since WS18/19) Person responsible for module: Prof.	Dr. Elisabeth André	
Learning Outcomes / Competences After successful participation in this m They are able to translate domain-spe of suitable methods. In addition, they competencies in the areas of teamwo processing of project tasks and their in the mindset and language of the rese	is indule, students are familiar with basic co acific solution concepts into models and m will gain an insight into current work in the rk and communication skills as well as se ndependent project planning. In the conte arch field is fostered through the discussion	ncepts of interactive machine learning. naster the selection and safe application e research area. Furthermore, If-organization are taught through the ext of these project tasks, knowledge of on and presentation of project results.
Key qualifications: Conversion of tec consolidation; interdisciplinary knowle knowledge of the mindset and langua of practice-relevant tasks; familiarity w science; ability to present and docume independently; competence in recogn	chnical solution concepts into programs a dge; ability to make scientifically meaning ge of application-relevant disciplines; abil with procedures and processes in the app ent results in a comprehensible manner; a izing significant technical developments.	nd models; subject-specific gful evaluations using suitable methods; ity to work in teams; knowledge lication environment of computer ability to expand existing knowledge
Workload: Total: 240 h 90 h internship / practical course (atte 150 h studying of course content throu	ndance) ugh exercises / case studies (self-study)	
Conditions: Programming experience		
Frequency: each winter semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module	·	·
Part of the Module: Practical Modul	e Interactive Machine Learning	

Language: German

Contact Hours: 6

Examination

Practical Module Interactive Machine Learning

practical exam

Module INF-0297: Practical Mod Praktikum Prozessorbau	dule Processor Design	5 ECTS/LP
Version 2.0.0 (since SoSe20) Person responsible for module: Prof. Dr. Sebastian Altmeyer Dr. Martin Frieb		
Learning Outcomes / Competences: Students acquire competencies in the following areas at an advanced, practical but scientific level: design process for digital circuits, circuit logic and gates, physical principles of electronic components, description of hardware with a hardware description language.		
First, students learn how to link logic design process and apply it directly ir implement it independently using the and disadvantages of schematic and variant. Furthermore, they combine s the components of their self-built mic based on the clock frequency achieve a complex task, to solve it according appropriately in a plenary session.	gates and build a half-adder and a full-add n a practical way by designing their own RI hardware description language VHDL. To textual hardware description and can deci ynchronous and asynchronous processes roprocessor. Finally, students evaluate the ed and the hardware effort required. In a fi to a self-developed sound project plan and	der. They understand the digital circuit ISC-V processor. They model and do this, they learn the advantages ide when it makes sense to use which to achieve a good interaction of e efficiency of their implementation nal project phase, they learn to plan d to discuss and present the results
Key qualifications: Skill in presenting and documenting ideas, concepts and results in a comprehensible manner; quality awareness, meticulousness; project-bound work and time management; selection and confident use of appropriate methods; ability to expand existing knowledge independently; self-reflection.		
Workload: Total: 150 h 90 h studying of course content throu 60 h internship / practical course (atte	gh exercises / case studies (self-study) endance)	
Conditions: Module Foundations of Technical Computer Science (INF-0138) - recommended Module Processor Architecture (INF-0147) - recommended		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Praktikum Proz	zessorbau	

Mode of Instruction: internship

Language: German / English

Contact Hours: 4

Contents:

The course "Processor Design" presents methods of logical design of digital circuits, starting with the abstract description in a hardware description language (such as VHDL) up to the physical implementation on transistor level. In the practical part of the course, hardware design is illustrated using the example of a five-stage processor pipeline. The result is an executable processor developed in VHDL for an FPGA prototype board.

Literature:

- Uwe Brinkschulte, Theo Ungerer, Mikrocontroller und Mikroprozessoren, Springer Verlag, Heidelberg, dritte Auflage 2010
- John L. Hennessy, David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann, 5. Auflage, 2011

Examination

Praktikum Prozessorbau

practical exam

Module INF-0307: Model-Based I Software Systems Modellbasierte Entwicklung und Analys	Development and Analysis of	6 ECTS/LP
Version 1.1.0 (since SoSe19)	r. Bernhard Bauer	1
Model-based development and analysi through automation and reuse. In the o development of software systems. The evaluate current technologies and stan participants build up skills for analyzing subsystems, configurations, or entire a concentual thinking skills and can system	s of software systems deal with increase ourse, participants learn to apply and co y develop in-depth, subject-specific solu dards for MDSD and analyze their appli and structuring complex IT problems in pplications from models. In doing so, the matically develop and assess solutions	ng software production efficiency ompare methods for the model-driven ation concepts for MDSD. They can cability in practice-relevant tasks. The the generation of infrastructure code, ey develop logical, analytical, and to problems
Key qualification: Interdisciplinary know communication skills; ability to expand procedures and processes in the applic quantitative principles; ability to presen	viedge; competence in networking differ existing knowledge independently; qual cation environment of computer science t and document results in an understan	ent subject areas; teamwork and ity awareness; familiarity with ; knowing and understanding formal dable way.
Workload:		
Total: 180 h		
23 h studying of course content using I	iterarture (self-study)	
22 h studying of course content using p	provided materials (self-study)	
30 h exercise course (attendance)		
45 h lecture (attendance)		
60 h studying of course content throug	n exercises / case studies (self-study)	
Conditions: Due to overlaps, the previous course "I must not have been taken.	Nodel-Driven Software Development"	
Frequency: irregular (usu. summer semester)	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 5	Repeat Exams Permitted: according to the examination	

Parts of the Module

Part of the Module: Modellbasierte Entwicklung und Analyse von Software Systemen (Vorlesung)

regulations of the study program

Mode of Instruction: lecture

Language: German

Contact Hours: 3

Contents:

Model-based development and analysis of software systems are concerned with increasing software production efficiency through automation and reuse. Infrastructure code, subsystems, configurations, or entire applications are generated from models.

Literature:

- slides
- Pohl et al. Software Product Line Engineering: Foundations, Principles, and Techniques
- Kleppe et al: MDA explained
- Hitz et al: UML@Work
- Further literature in the lecture

Part of the Module: Modellbasierte Entwicklung und Analyse von Software Systemen (Übung)

Mode of Instruction: exercise course Language: German Contact Hours: 2

Examination

Modellbasierte Entwicklung und Analyse von Software Systemen

oral exam / length of examination: 30 minutes

Test Frequency:

when a course is offered

Module INF-0308: Software-intersive Systeme	nsive Systems	6 ECTS/LP
Version 1.2.0 (since SoSe19) Person responsible for module: Prof.	Dr. Bernhard Bauer	
Learning Outcomes / Competences Students can create (K3), evaluate (K technical solution concepts into mode can describe the advantages and disc application context (K6). Problems ca (K5) and realized (K3). Furthermore, enterprise architectures and know the name practice-relevant issues in enter for architecture creation and evaluation enterprise architectures. They have the Key qualification: Competence to netre ability to expand existing knowledge in understandable way: practical experies	S: (6), and document software architecture als and know methods for developing su advantages of design alternatives (K4) a in be identified independently (K4), and they have developed skills for the analyse concepts and procedures for creating s erprise architectures (K1). They can sele on. The students know modeling language the competence to recognize significant to work different subject areas; ability to wo independently; quality awareness; skill to appear and professional qualification.	es. For this purpose, they can transfer ch abstractions and architectures. They and evaluate them in the respective solutions can be designed systematically sis and structuring of problems in such architectures. The students can act and confidently apply suitable methods ges and patterns to create software and technical developments. ork in a team and communicate; o present and document results in an
Workload: Total: 180 h 22 h studying of course content using 23 h studying of course content using 45 h lecture (attendance) 60 h studying of course content throu 30 h exercise course (attendance)	provided materials (self-study) literarture (self-study) gh exercises / case studies (self-study)	
Conditions: The previous course "Software Archit Management" and the course "Softwa Devices" must not have been taken o	ectures and Enterprise Architecture are-intensive Systems and Medical lue to overlaps.	
Frequency: each winter semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 5	Repeat Exams Permitted: according to the examination	

Parts of the Module

Part of the Module: Software-intensive Systeme (Vorlesung)

Mode of Instruction: lecture

Language: German

Contact Hours: 3

Contents:

The lecture content includes patterns, modelling techniques and the evaluation of software architectures. Furthermore, the area of enterprise architecture management is addressed.

Literature:

- Bass et al: Software Architecture in Practice
- Clements et al: Documenting Software Architectures
- Clements et al: Evaluation of Software Architectures
- Kopetz: Real-Time Systems

Part of the Module: Software-intensive Systeme (Übung) Mode of Instruction: exercise course Language: German

Contact Hours: 2

Examination

Software-intensive Systeme

oral exam / length of examination: 30 minutes

Test Frequency:

when a course is offered

Echtzeitsysteme	stems	8 ECTS/LP
Version 1.7.0 (since WS19/20) Person responsible for module: Prof. Dr. Sebastian Altmeyer		1
Learning Outcomes / Competences The lecture imparts basic and advance systems, but especially in the areas of on the current state of research and w systems at a scientific level.	: ed knowledge of real-time systems as the f automotive, aerospace and robotics. Th rill enable students to further engage with	ey occur in almost all embedded e theoretical foundations will be based the topic of embedded real-time
The lecture will provide students with t real-time requirements. Students will le timing behavior with respect to possible real-time schedules and their verificati detail about the specifics of single-cor- classify processors based on their suit real-time behavior and real-time behavior	the ability to distinguish and classify diffe earn to apply, compare, and critically and le certification of timing behavior. This ind on. The lecture will also cover different p e and multi-core processors in the real-tin tability for real-time systems and to inves vior analysis.	rent embedded systems based on their alyze current methods for validation of cludes the optimization and selection of rocessor types, and will go into more me domain. Students will be able to tigate the impact of design decisions or
The course material will be exemplified students using a simple real-time system	d by case studies from the automotive ar em.	nd aerospace fields and applied by the
Key qualifications: Analytical-method solutions to exercise problems; skill in expand existing knowledge independe against a background of inadequacy a	dical competence, consideration of appro presenting and documenting results in a ently; quality awareness, meticulousness; and conflicting interests.	aches to solutions, presentation of comprehensible manner; ability to self-reflection; responsible action
NA7		
Workload: Total: 240 h 30 h studying of course content using 90 h studying of course content throug 30 h studying of course content using 60 h lecture (attendance) 30 h exercise course (attendance)	literarture (self-study) gh exercises / case studies (self-study) provided materials (self-study)	
Workload: Total: 240 h 30 h studying of course content using 90 h studying of course content throug 30 h studying of course content using 60 h lecture (attendance) 30 h exercise course (attendance) Conditions: none	literarture (self-study) gh exercises / case studies (self-study) provided materials (self-study)	
Workload:Total: 240 h30 h studying of course content using90 h studying of course content throug30 h studying of course content using60 h lecture (attendance)30 h exercise course (attendance)30 h exercise course (attendance)Conditions:noneFrequency: irregular (usu. wintersemester)	literarture (self-study) gh exercises / case studies (self-study) provided materials (self-study) Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]

Part of the Module: Echtzeitsysteme (Vorlesung)

Mode of Instruction: lecture Language: German / English

Contact Hours: 4

- WCET Analysis
- Scheduling Analysis
- · Programming of real-time systems
- Processors for real-time systems
- Real-time operating systems
- · Certification of real-time systems

Literature:

- Sanjoy Baruah, Marko Bertogna, Giorgio Buttazzo, Multiprocessor Scheduling for Real-Time Systems, Springer, 2015.
- Giorgio Buttazzo, Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications, Springer, 2011.
- Heinz Wörn, Uwe Brinkschulte, Echtzeitsysteme, Springer Verlag, Berlin/Heidelberg, 2005
- Uwe Brinkschulte, Theo Ungerer, Mikrocontroller und Mikroprozessoren, Springer Verlag, Heidelberg, dritte Auflage 2010

Part of the Module: Echtzeitsysteme (Übung)

Mode of Instruction: exercise course Language: German

Contact Hours: 2

Examination

Echtzeitsysteme

oral exam / length of examination: 20 minutes

Module INF-0314: Seminar IT Infrastructure in Medical	4 ECTS/LP
Information Systems for Master Students	
Seminar IT-Infrastrukturen in der Medizin für Master	

Version 1.0.0 (since SoSe19)

Person responsible for module: Prof. Dr. Frank Kramer

Learning Outcomes / Competences:

After attending the seminar, students are able to independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques and technologies in the field of IT infrastructures for translational medical research in relation to the individual seminar topic from the mentioned field. They have the scientific methodology, communication skills and ability to use appropriate media to present a specific topic in a clear and comprehensible manner, both verbally and in writing, and to critically and argumentatively discuss and evaluate scientifically challenging topics from the named field. They will also be able to recognize the logical structures of reasoning and argumentation and use them in a goal-oriented manner. The participants can formulate clearly and comprehensible way and how to focus the lecture on essential messages and convey them in a comprehensible way, even in the case of complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and how to deal confidently with common presentation media and to use them interactively. They manage to gear a lecture to a specific target group and to motivate the listener even during longer lecture durations and to apply various moderation techniques.

Key Skills: Literature research; Independent work with English-language specialist literature; Analytical-methodical competence; Scientific methodology; Principles of good scientific practice; Skill in the comprehensible, confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and for their documentation; Skill in logical, abstract, analytical and conceptual thinking and formal argumentation; Quality awareness, meticulousness; Communication skills; Time management; Evaluation of approaches, procedures, techniques and technologies from different points of view.

Workload:

Total: 120 h

90 h preparation of written term papers (self-study)30 h seminar (attendance)

Conditions:		Credit Requirements:
none		Passing the module examination
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar IT Infrastructure in Medical Information Systems for Master Students

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

Current topics of IT infrastructures in medicine

Literature:

will be presented in the respective kickoff event.

Assigned Courses:

Seminar IT-Infrastrukturen in der Medizin für Master (seminar)

Examination

Seminar IT Infrastructure in Medical Information Systems for Master Students

written/oral exam

Module INF-0315: Deep Learning	3	5 ECTS/LP	
Deep Learning			
Version 1.4.0 (since SoSe19)			
Person responsible for module: Prof. Dr. Björn Schuller			
Learning Outcomes / Competences	:		
The course Deep Learning covers the	historical and formal fundamentals of Ne	ural Networks, as well as the core	
principles of Machine Learning and da	principles of Machine Learning and data modelling.		
Upon completing the course, students	will have the skills and knowledge to be	able to choose suitable approaches	
and network architectures for specific	tasks and know the pros and cons of des	sign alternatives, as assessed in the	
and systems Furthermore they will be	ave the ability to analyse Deep Neural Ne	etwork-based models and to design	
novel architectures and training metho	ds.	work based medels and to design	
During the course, the participants will	improve their skills in logical, analytical,	and conceptual thinking. Students will	
gain the ability to make scientifically m	eaningful assessments in the field of ma	chine learning and data science using	
appropriate methods. They will get use	ed to the way of thinking and the languag	e of relevant disciplines.	
Moreover, students will gain the ability	to, convincingly, present their developed	ideas and concepts. They will be able	
to apply their new knowledge to praction	cal tasks and solve many real-life probler	ns through the appropriate application	
of machine learning. They will also de	velop the competence to identify significa	int technical developments in the field.	
Key qualifications: analytical skills, d	ata science cross-disciplinary knowledge	e, procedures and processes in creating	
practical systems, ability to present an	a document results in a comprehensible	way, skill to solve problems under	
Workload:			
10tal: 150 h	provided meterials (calf study)		
15 h studying of course content using	literarture (self-study)		
60 h studying of course content through	th exercises / case studies (self-study)		
30 h lecture (attendance)	,		
30 h exercise course (attendance)			
Conditions:		Credit Requirements:	
Knowledge of basic mathematic lectur	es should be present.	Bestehen der Modulprüfung	
Frequency: usu. at least once per	Recommended Semester:	Minimal Duration of the Module:	
acad. year	from 1.	1 semester[s]	
Contact Hours:	Repeat Exams Permitted:		
4	according to the examination		
	regulations of the study program		
Parts of the Module			
Part of the Module: Deep Learning (Vorlesung)		
Mode of Instruction: lecture			
Language: German			
Contact Hours: 2			
Contents:			
Perceptron, Feed-forward Neural N	vetworks, Gradient-based Learning, Back	corporation, Recurrent Neural	
INETWORKS, CONVOLUTIONAL NEURAL NE	etworks, Autoencoders, Transfer Learning	g, Generative Adversarial Nets,	

Attention, Connectionist Temporal Classification, Data Preprocessing, Evaluation, Audio Classification, Object Detection, Natural Language Processing

Literature:

Ian Goodfellow; Yoshua Bengio; Aaron Courville (2016). Deep Learning. Cambridge, Massachusetts: MIT Press.

Further literature is going to be announced during the lecture.

Assigned Courses:

Deep Learning (lecture)

Part of the Module: Übung zu Deep Learning

Mode of Instruction: exercise course

Language: German

Contact Hours: 2

Assigned Courses:

Deep Learning (lecture)

Übung zu Deep Learning (exercise course)

Examination

Deep Learning

written exam / length of examination: 90 minutes

Module INF-0316: Machine Learn Machine Learning and Computer Vision	ing and Computer Vision າ	8 ECTS/LP
Version 1.0.0 (since SoSe19) Person responsible for module: Prof. Dr. Rainer Lienhart		
Learning Outcomes / Competences: After successful participation in this module, students possess advanced knowledge of machine learning (decision trees, neural networks and deep neural networks, hypothesis evaluation, instance-based learning, Bayesian learning, learning theory), data reduction (e.g. principal component analysis), advanced image processing and machine vision and are able to apply them. They can analyse, understand and programmatically implement scientifically complex procedures in the field of multimedia data processing, as well as to appropriately apply the principles learned to new problems. They develop skills in logical, analytical and conceptual thinking in the field of digital signal processing and multimedia data processing.		
Key qualifications : advanced mathematical-formal logic; implementation of subject-specific solution concepts; interdisciplinary knowledge; development and implementation of solution strategies for complex problems; systematic further development of design methods; ability to solve problems under practical boundary conditions.		
Workload: Total: 240 h 30 h exercise course (attendance) 60 h lecture (attendance) 30 h studying of course content using p 90 h studying of course content through 30 h studying of course content using li	provided materials (self-study) n exercises / case studies (self-study) terarture (self-study)	
Conditions: none		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Machine Learning and Computer Vision (Lecture)

Mode of Instruction: lecture

Language: German

Contact Hours: 4

Contents:

The lecture gives a good overview of all aspects of machine learning and machine extraction of information from multimedia data (e.g. "Google Image Search", "Google Goggles"). The learned concepts will be practised, analysed, and evaluated in the exercises using successful examples from practice. At the end of the semester, advanced topics such as object detection and object recognition of faces and people will be covered. The contents of the lecture include: Machine Learning (Decision Tree Learning, Artificial Neural Networks, Bayesian Learning, Discrete Adaboot), Data Reduction (Quantization (K-Means Clustering, Affinity Propagation), Dimensionality Reduction Techniques (PCA, NMF, Random Projection, MDS)) and Image Processing & Computer Vision (Salient Feature Points and Feature Descriptors, Object Detection (Face/Car/People Detection), Object Recognition (Face Recognition), Image Search with pLSA).

Literature:

Literature references will be announced at the beginning of the semester.

Assigned Courses:

Machine Learning and Computer Vision (lecture)

Part of the Module: Machine Learning and Computer Vision (Tutorial)

Mode of Instruction: exercise course

Language: German

Contact Hours: 2

Assigned Courses:

Übung zu Machine Learning and Computer Vision (exercise course)

Examination

Machine Learning and Computer Vision (Exam)

written exam / length of examination: 120 minutes

Test Frequency:

each semester

Description:

The examination can be taken every semester during the examination period.

		1
Module INF-0318: Practice Modu	ale on Simulation of Autonomous	8 ECTS/LP
Praktikum Simulation von autonomen	Fahrzeugen (Vertiefung)	
Version 1.0.0 (since $W(S19/20)$		
Person responsible for module: Prof. [Dr. Lars Mikelsons	
Learning Outcomes / Competences	•	
Subject-related competencies:	•	
After participating in the internship, stu	udents understand problems of higher co	nplexity in the field of simulation of
autonomous vehicles and have deepe	r technical knowledge and skills there. The	ney are able to develop concepts,
methods, procedures, techniques and	technologies of the mentioned field in sm	nall groups and are able to apply
innovative methods in solving problem	is. This enables them to connect to intern	ational research and implement
and the scientific methodology to disc	uss problems in the field, define intermed	iate objectives, and critically evaluate.
classify, combine and present interme	diate results and innovative ideas.	····· ···; · ···· ··· ······· ······ ····· ···· ····
Key Competencies:		
Skill in logical, analytical, and concept	ual thinking; Validation of simulation resu	Its and software modules; Independent
results: Quality awareness: Communic	cation skills: Skill in collaborating in teams	s and understanding team processes.
Principles of good scientific practice; F	Project management skills; Scientific meth	nodology;
Workload:		
Total: 240 h		
90 h internship / practical course (atte	ndance)	
150 h studying of course content throu	ugh exercises / case studies (self-study)	
Conditions:		Credit Requirements:
Good programming skills		Passing the module exam
Helpful: Python, C++, ROS, Game Engines		
Frequency: each winter semester	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
6	according to the examination	
Parts of the Module		
Part of the Module: Practice Model	on Simulation of Autonomous Vehicle	s (Advanced)
Mode of Instruction: internship		
Language: German / English		

Contact Hours: 6

ECTS Credits: 8.0

Contents:

In the practical course, students work in small groups on application-oriented tasks for the simulation of autonomous vehicles. They are allowed to implement and validate individual software modules of a virtual vehicle themselves.

Examination

Practice Model on Simulation of Autonomous Vehicles portfolio exam

Module INF-0319: Interdisciplinary Project Engineering		6 ECTS/LP
Informatics Protetikum Interdioziolioëroo Brojokt Ingoniourioformatik		
Version 1.0.0 (since WS19/20)		
Person responsible for module: Prof. DrIng. Johannes Schilp		
Prof. DrIng. Lars Mikelsons, Prof. DrIng. Christoph Ament		
Learning Outcomes / Competences:		
The students deal with an interdisciplinary task from the field of production informatics, control engineering and		
mechatronics. They use complex processes and techniques, some of which have already been covered theoretically		
in the individual lectures. The practical project is based on a student challenge, such as the Sioux Mechatronics		
Trophy or the James Dyson Award, and is worked on in small groups. The use case requires the evaluation and		
transfer of concepts and methods as well as their interdisciplinary combination.		
The timeline for this practicum will be announced in Digicampus, as will the specific challenge assignment, including		
prerequisites and faculty participation.		
Key Qualifications: Teamwork and communication skills, structured and conscientious work, application-oriented		
problem solving, result evaluation and		
-documentation, consideration of solutions, ability to think logically, analytically and conceptually, ability to think		
abstractly.		
Warkload		
Total: 180 h		
120 h studving of course content through exercises / case studies (self studv)		
60 h internshin / practical course (attendance)		
Conditions:		Credit Requirements:
none		Passing the module exam
Frequency: each summer semester	Recommended Semester:	Minimal Duration of the Module:
		1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
4	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Interdisciplinary Project Engineering Informatics		
Mode of Instruction: internship		
Language: German		
Contact Hours: 4		
ECTS Credits: 6.0		
Contents:		

Students work in small groups on application-oriented tasks on topics in the industrial environment.

Literature:

Will be announced in the respective semester.

Examination

Interdisciplinary Project Engineering Informatics

practical exam
Module INF-0320: Seminar Proce Seminar Process Mining	ess Mining	4 ECTS/LP
Version 1.0.0 (since WS19/20) Person responsible for module: Prof. Dr. Robert Lorenz		
Learning Outcomes / Competences After attending the seminar, the studer methods, procedures, techniques, and the individual seminar topic.	ts can independently work out and analy I technologies from the field of process m	vse advanced problems, concepts, ining and evaluate them in relation to
Participants possess scientific methodology, communication skills, and the ability to present a special topic clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively.		
Furthermore, they learn to recognise logical structures of thinking and argumentation and use them in a goal- oriented manner. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a talk that is clear and easy to follow. Additionally, the students know how to focus on essential messages and convey them in a comprehensible way, even with complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to confidently deal with common presentation media and use them interactively. They manage to gear a talk to a specific target group, apply various moderation techniques, and keep their audience engaged even over a longer period.		
Key qualifications: Presentation tech solution approaches, procedures, tech	niques; literature research; principles of niques, and technologies from different p	good scientific practice; evaluating points of view.
Workload: Total: 120 h 45 h preparation of presentations (self 45 h preparation of written term paper 30 h seminar (attendance)	-study) s (self-study)	
Conditions:		Credit Requirements:
Module Process Mining (INF-0243) - r Frequency: irregular	equired Recommended Semester: from 3.	Passing the module examination Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Proces Mode of Instruction: seminar	s Mining	

Language: German / English

Contact Hours: 2

ECTS Credits: 4.0

Contents:

Current Research Topics in the Field of Process Mining: Process Discovery, Conformance Checking, Enhancement, Preprocessing of logs (clustering, filtering), Handling of Noise, Synthesis based methods, Process Mining and Data Mining, Statistical methods in Process Mining, case studies, tooling.

Das Seminar eignet sich zur Vorbereitung auf Abschlussarbeiten und Projektmodule.

Literature:

Literature depends on the chosen topic

Examination

Seminar Process Mining

written/oral exam / length of examination: 60 minutes

work period for assignment: 2 months

Module INF-0328: Project Module Information Systems Projektmodul IT-Infrastrukturen in der	e IT Infrastructure in Medical	10 ECTS/LP	
Version 1.0.0 (since WS19/20)		<u> </u>	
Person responsible for module: Prof. D	Dr. Frank Kramer		
Learning Outcomes / Competences:			
After participating in the project module, students understand problems of higher complexity in the field of IT infrastructures in translational medical research and have deeper expertise and skills there. They are able to develop concepts, methods, procedures, techniques and technologies of the mentioned field in research projects and are able to apply innovative methods in solving problems. This enables them to connect to international research and make their own scientific contribution to the field. In addition, students have the teamwork and communication skills, the ability to research literature and the scientific methodology to discuss problems in the field, define intermediate goals, and critically evaluate, classify, combine and present intermediate results and innovative ideas. Key Skills: Skill in logical, analytical, and conceptual thinking; Independent work with English-language literature; Intelligible, confident, and persuasive presentation of ideas, concepts, and results; Quality awareness; Communication skills; Skill in working in teams and understanding team processes; Principles of good scientific practice; Project			
Workload: Total: 300 h 285 h internship / practical course (self-study) 15 h seminar (attendance)			
Conditions: none		Credit Requirements: Passing the module examination	
Frequency: each semester	Recommended Semester: from 2.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Project Module IT Infrastructure in Medical Information Systems Mode of Instruction: internship Language: German / English Contact Hours: 1 ECTS Credits: 10.0			
Contents: Current research topics in the field of IT infrastructures in translational medical research.			
Literature: scientific essays, manuals			
Assigned Courses:			
Oberseminar IT-Infrastrukturen für die Translationale Medizinische Forschung			

Examination

Project Module IT Infrastructure in Medical Information Systems

practical exam

Module INF-0331: Seminar Com Seminar Computational Intelligence (putational Intelligence (Master) Master)	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. Dr. Björn Schuller		
Learning Outcomes / Competences After attending the seminar, students statements, concepts, methods, appro They possess the scientific technique understandingly a special topic in spo from the field in a critical way. Further them constructively. Participants can express themselves how to structure a talk, to focus it - als them in a suitable way. The lines of a Students know how to perform energe manage to orient a talk toward a certa different methods of moderation.	will be able to autonomously acquire and baches, techniques, and technologies in t s, communication skills, and the ability to ken and written, and to discuss and evalu more, they can recognise logical structure n a clear and understandable way and pr to given a complex content - on the esser rguments and strategies in case of disturk etically, to cope with the presentation med in audience, to motivate the listeners also	understand advanced problem the field of Computational Intelligence. employ suitable media, to present uate scientifically challenging themes es of thinking and debating and employ resent scientific topics. They understand ntial messages, and to communicate bances are applied by the students. dia and to use them interactively. They o over a longer duration, and to employ
Key qualifications: Fundamentals or management; Literature research; Se to present (in written and spoken) pra Writing a report in the markup language aspects; Quality awareness.	f good scientific practice; Analytical-meth If-contained work with English technical li ctical and theoretical ideas in an understa ge LaTeX; Evaluation of methods, techno	odological competency; Time terature; Communication skills; Ability andable, confident, and convincing way; logies, and solutions w.r.t. different
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term paper	s (self-study)	
Conditions:		Credit Requirements: Bestehen der Modulprüfung
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		·

Part of the Module: Seminar Computational Intelligence (Master)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

Fuzzy Logic, Neural Networks, Evolutionary Computation, Learning Theory, Probabilistic Methods

Literature:

To be announced by the lecturers.

Assigned Courses:

Seminar Computational Intelligence (Bachelor & Master) (seminar)

Examination Seminar Computational Intelligence (Master) written/oral exam

Module INF-0337: Seminar Emb Seminar Embedded Systems (Maste	pedded Systems (Master)	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. Dr. Sebastian Altmeyer		
Learning Outcomes / Competences: After attending the seminar, students are able to independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques and technologies in the field of embedded systems in relation to the individual seminar topic from the named field		
They have the scientific methodology, communication skills and ability to use appropriate media to present a specific topic in a clear and comprehensible manner, both verbally and in writing, and to discuss and evaluate scientifically challenging topics from the aforementioned field in a critical and argumentative manner. They will also be able to recognize the logical structures of reasoning and argumentation and use them in a goal-oriented manner.		
The participants can formulate clearly and comprehensibly and present specialist content freely. They understand how to structure a scientific presentation in a clear and comprehensible way and how to focus the presentation on essential messages and convey them in a comprehensible way, even in the case of complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and how to deal confidently with common presentation media and to use them interactively. They manage to gear a presentation to a specific target group and to motivate the listener even during longer presentation durations and to apply various moderation techniques.		
Key qualifications: Literature research; Independent work with English-language specialist literature; Analytical- methodical competence; Scientific methodology; Principles of good scientific practice; Skill in the comprehensible, confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and for their documentation; Skill in logical, abstract, analytical and conceptual thinking and formal argumentation; Quality awareness, meticulousness; Communication skills; Time management; Evaluation of approaches, procedures, techniques and technologies from different points of view.		
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term pape	rs (self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Embe	dded Systems (Master)	

Mode of Instruction: seminar Language: German / English

Contact Hours: 2

Contents:

In the seminar, topics from the field of embedded systems will be covered. Each seminar participant receives individual literature references, which are then to be supplemented in the course of the seminar by further independently compiled references. The seminar will end with a written paper and a presentation on the topic covered.

Literature:

given individually and self research

Assigned Courses:

Seminar Embedded Systems (Master) (seminar)

Examination

Seminar Embedded Systems (Master)

written/oral exam

Module INF-0340: Project Mo Projektmodul Embedded Systems	odule Embedded Systems	10 ECTS/LF
Version 1.0.0 (since SoSe20) Person responsible for module: P	rof. Dr. Sebastian Altmeyer	
Learning Outcomes / Competer After participating in the project m systems and have more in-depth procedures, techniques and techr methods in solving problems. This contribution to the field. In addition literature and the scientific method evaluate, classify, combine and pro-	odule, students understand problems of hi specialist knowledge and skills there. They hologies of the mentioned field in research is enables them to connect to international in, students have the teamwork and commu dology to discuss problems in the field, def resent intermediate results and innovative	gher complexity in the field of embedded are able to develop concepts, methods, projects and are able to apply innovative research and make their own scientific unication skills, the ability to research ine intermediate goals, and critically ideas.
Key qualifications: Skill in logica literature; Intelligible, confident, ar Communication skills; Skill in worl practice; Project management skil	I, analytical, and conceptual thinking; Inden nd persuasive presentation of ideas, conce king in teams and understanding team pro- Ils; Scientific methodology.	pendent work with English-language pts, and results; Quality awareness; cesses; Principles of good scientific
Workload: Total: 300 h 285 h internship / practical course 15 h seminar (attendance)	(self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Projektmod Mode of Instruction: internship Language: German / English	ul Embedded Systems	

Contact Hours: 1

Contents:

Autonomous collaboration on current research topics.

Literature:

scientific papers, handbooks

Assigned Courses:

Oberseminar Embedded Systems

Examination

Projektmodul Embedded Systems

practical exam

Medule INE 0242: Cominer Divid		
Seminar Digital Health (Master)		4 ECTS/LP
Version 1.0.0 (since SoSe20)		
Person responsible for module: Prof.	Dr. Björn Schuller	
Learning Outcomes / Competences		
After attending the seminar, students statements, concepts, methods, appro- the scientific techniques, communicat a special topic in spoken and written, in a critical way. Furthermore, they ca constructively. Participants can express themselves how to structure a talk, to focus it - als them in a suitable way. The lines of a Students know how to perform energe manage to orient a talk toward a certa different methods of moderation.	will be able to autonomously acquire and baches, techniques, and technologies in t ion skills, and the ability to employ suitabl and to discuss and evaluate scientifically in recognise logical structures of thinking a in a clear and understandable way and pr so given a complex content - on the esser rguments and strategies in case of disturb etically, to cope with the presentation mech in audience, to motivate the listeners also	understand advanced problem he field of Digital Health. They possess le media, to present understandingly challenging themes from the field and debating and employ them resent scientific topics. They understand trial messages, and to communicate bances are applied by the students. dia and to use them interactively. They be over a longer duration, and to employ
Key skills: Fundamentals of good sci Literature research; Self-contained we written and spoken) practical and the report in the markup language LaTeX Quality awareness.	entific practice; Analytical-methodologica ork with English technical literature; Comm pretical ideas in an understandable, confic ; Evaluation of methods, technologies, an	I competency; Time management; nunication skills; Ability to present (in dent, and convincing way; Writing a d solutions w.r.t. different aspects;
Workload:		
Total: 120 h		
30 h seminar (attendance)	<i>(</i> (<i>(</i>))	
90 n preparation of written term papel	s (self-study)	1
Conditions:		
Frequency: each comostor	Pocommondod Somostor:	Minimal Duration of the Medule:
riequency. each semester	from 5.	1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Digital	Health (Master)	

Language: German / English

Contact Hours: 2

Contents:

In the seminar Digital Health, recent research works in this field are going to be discussed. This comprises both the acquisition of data through sensors and (e.g., microphones or electrodes) and the analysis and the modelling of the data. One important aspect is also the practicability of modern deep learning methods. Digital Health applications reach from tracking of health states (e.g., epilepsy or depression) to personal assistance services. The participating students will work on a certain aspect, supervised by a research associate of the chair. They will summarise their results in a written report and an oral presentation.

Topics: E-Health, M-Health, Sensor Signal Analysis, Vital Signs, Big Data.

Literature:

To be announced by the lecturer

Assigned Courses:

Seminar Digital Health (Bachelor & Master) (seminar)

Examination

Seminar Digital Health (Master)

written/oral exam

Module INF-0344: Seminar Softw Systems (MA)	vare Engineering of Distributed	4 ECTS/LP
Version 1.0.0 (since SoSe20) Person responsible for module: Prof. D	Dr. Bernhard Bauer	
Learning Outcomes / Competences:		
After attending the seminar, students can independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques, and technologies in software engineering for distributed systems about the particular seminar topic from the named field. They have the scientific methodology, communication skills, and ability to use appropriate media to present a specific case clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively. Furthermore, they can recognize the logical structures of thinking and argumentation and use them goal-oriented. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a lecture clearly and understandably, focus the study on essential messages, and understandably convey them, even with complex content. They skillfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and confidently deal with joint presentation media and use them interactively. They manage to gear a lecture to a specific target group, motivate the listener even during longer lecture duration and and enclosed and use them interactively.		
Key qualifications: Literature research; independent work with English-language specialist literature; analytical- methodical competence; scientific methodology; principles of good scientific practice; skills in the understandable, confident, and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts, and results and in documenting them; skills in logical, abstract, analytical and conceptual thinking and formal argumentation; quality awareness, meticulousness; communication skills; time management; evaluation of approaches, procedures, techniques, and technologies from different points of view. Translated with www.DeepL.com/Translator (free version) Workload:		
Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)	
Conditions: The previous course "Seminar on Software Engineering of Distributed Systems (MA)" (INF-0039) must not have been taken due to overlaps.		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Softwar Mode of Instruction: seminar Language: German Contact Hours: 2 Contents:	re Engineering verteilter Systeme (MA)
Literature:	s from industry and research.	

Will be presented in the respective kick-off event.

Assigned Courses:

Seminar Software Engineering verteilter Systeme (Master) (seminar)

Examination

Seminar Software Engineering verteilter Systeme (MA)

written/oral exam

Test Frequency: when a course is offered

Module INF-0346: Seminar Aut	comotive Software and Systems	4 ECTS/LP
Seminar Automotive Software and S	Systems Engineering (MA)	
Version 1.0.0 (since SoSe20)		
Person responsible for module: Prof	. Dr. Bernhard Bauer	_
Learning Outcomes / Competence After attending the seminar, student methods, procedures, techniques, a particular seminar topic from the nar to use appropriate media to present and evaluate scientifically challengin can recognize the logical structures formulate clearly and comprehensib clearly and understandably, focus th complex content. They skillfully appl students understand how to present interactively. They manage to gear a	es: s can independently analyze and evaluate nd technologies in Automotive Software & med area. They have the scientific methode a specific case clearly and comprehensibly ng topics from the named field critically and of thinking and argumentation and use the ly and present subject content freely. They e study on important messages, and unde y chains of argumentation and solution stra themselves and confidently deal with joint a lecture to a specific target group, motivate	advanced problems, concepts, Systems Engineering about the blogy, communication skills, and ability / in speech and writing and to discuss argumentatively. Furthermore, they m goal-oriented. The participants can understand how to structure a lecture rstandably convey them, even with ategies in the event of disruptions. The presentation media and use them at the listener even during longer lecture
durations, and apply various modera Key qualifications: Literature researce methodical competence; scientific m confident, and convincing (written and and in documenting them; skills in lo quality awareness, meticulousness; techniques, and technologies from c	ation techniques. ch; independent work with English-languag nethodology; principles of good scientific pri- nd oral) presentation of (practical or theorem ogical, abstract, analytical and conceptual th communication skills; time management; e lifferent points of view. Translated with www	e specialist literature; analytical- actice; skills in the understandable, tical) ideas, concepts, and results hinking and formal argumentation; evaluation of approaches, procedures, w.DeepL.com/Translator (free version)
Workload: Total: 120 h 90 h preparation of written term pap 30 h seminar (attendance)	ers (self-study)	<u> </u>
Conditions: The previous course "Seminar Fundamentals of Software Engineering for Automotive Systems (MA)" (INF-0040) must not have been taken due to overlaps.		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Part of the Module: Seminar Automotive Software and Systems Engineering (MA)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

Current software engineering topics from industry and research.

Literature:

Will be presented in the respective kick-off event.

Examination

Seminar Automotive Software and Systems Engineering (MA)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0348: Seminar Avior Engineering (MA)	nic Software and Systems	4 ECTS/LF
Seminar Avionic Software and System	s Engineering (MA)	
Version 1.0.0 (since SoSe20)		
Person responsible for module: Prof. D	Dr. Bernhard Bauer	
Learning Outcomes / Competences: After attending the seminar, students of methods, procedures, techniques, and seminar topic from the named field. Th appropriate media to present a specific evaluate scientifically challenging topic can recognize the logical structures of can formulate clearly and comprehens lecture clearly and understandably foci in the case of complex content. They s disruptions. The students understand h and use them interactively. They mana longer lecture durations, and apply var Key qualifications: Literature research; methodical competence; scientific met confident, and convincing (written and and in documenting them; skills in logi- guality awareness, meticulousness; co	an independently analyze and evaluate technologies in Avionic Software & Syst ey have the scientific methodology, com case clearly and comprehensibly in spe s from the named field critically and argu- thinking and argumentation and use the ibly and present subject content freely. T us the study on important messages and killfully apply chains of argumentation ar now to present themselves and confident age to gear a lecture to a specific target g ious moderation techniques. independent work with English-language hodology; principles of good scientific pra oral) presentation of (practical or theoret cal, abstract, analytical and conceptual the mmunication skills: time management: e	advanced problems, concepts, tems Engineering about the particular munication skills, and ability to use eech and writing and to discuss and umentatively. Furthermore, they m goal-oriented. The participants They understand how to structure a understandably convey them, even nd solution strategies in the event of tly deal with joint presentation media group, motivate the listener even during e specialist literature; analytical- actice; skills in the understandable, tical) ideas, concepts, and results ninking and formal argumentation; evaluation of approaches, procedures.
techniques, and technologies from diffe	erent points of view. Translated with www	w.DeepL.com/Translator (free version)
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)	
Conditions: The previous course "Seminar Grundla Avionic Systems (MA)" (INF-0041) mu	agen des Software Engineering für st not have been taken due to overlaps.	
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Avionic Mode of Instruction: seminar Language: German	: Software and Systems Engineering (MA)

Contents:

Current software engineering topics from industry and research.

Literature:

Will be presented in the respective kick-off event.

Examination

Seminar Avionic Software and Systems Engineering (MA)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0349: Seminar Human-Centered Artificial Intelligence 4 ECTS/LP Seminar Menschzentrierte Künstliche Intelligenz 4 ECTS/LP			
Version 1.0.0 (since SoSe20)			
Person responsible for module: Prof. D	r. Elisabeth André		
Learning Outcomes / Competences:			
After attending the seminar, students a concepts, methods, procedures, techni related to the individual seminar topic fi skills and ability to use appropriate meto verbally and in writing, and to critically a from the named field. They will also be and use them in a goal-oriented manner specialist content freely. They understat focus the lecture on essential message content. They skilfully apply chains of a understand how to present themselves interactively. They manage to gear a le	re able to independently work out, analy ques and technologies in the field of "hu rom the mentioned field. They have the s dia to present a specific topic in a clear a and argumentatively discuss and evalua able to recognize the logical structures of er. The participants can formulate clearly and how to structure a lecture in a clear a s and convey them in a comprehensible argumentation and solution strategies in and how to deal confidently with commo cture to a specific target group and to m	ze and evaluate advanced problems, man-centered artificial intelligence" scientific methodology, communication ind comprehensible manner, both te scientifically challenging topics of reasoning and argumentation r and comprehensibly and present and comprehensible way and how to a way, even in the case of complex the event of disruptions. The students on presentation media and to use them notivate the listener even during longer	
Key qualifications: Literature research; Independent work with English-language specialist literature; Analytical- methodical competence; Scientific methodology; Principles of good scientific practice; Skill in the comprehensible, confident and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts and results and for their documentation; Skill in logical, abstract, analytical and conceptual thinking and formal argumentation; Quality swarpage, metionlogueness; Communication skills; Time management			
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	(self-study)		
Conditions:			
none			
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Comings Human	Contored Artificial Intelligence		
Part of the Module: Seminar Human-	Centered Artificial Intelligence		

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

Topics in the field of "Human-Centered Artificial Intelligence"

Literature:

References will be announced at the preliminary meeting.

Assigned Courses:

Seminar zu Menschzentrierte Künstliche Intelligenz (seminar)

Examination Seminar Human-Centered Artificial Intelligence written/oral exam

Module INF-0364: Seminar Software Engineering in Safety- and Security-Critical Systems (MA) Seminar Software Engineering in sicherheitskritischen Systemen (MA)	4 ECTS/LP
Version 1.0.0 (since WS20/21)	
Person responsible for module: Prof. Dr. Bernhard Bauer	

After attending the seminar, students can independently develop, analyze and evaluate advanced problems, concepts, methods, procedures, techniques, and technologies in software engineering in safety-critical systems and related disciplines about the particular seminar topic from the named field. They have the scientific methodology, communication skills, and ability to use appropriate media to present a specific case clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively. Furthermore, they can recognize the logical structures of thinking and argumentation and use them goal-oriented. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a lecture clearly and understandably, focus on essential messages, and coherently convey them, even with complex content. They skillfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and confidently deal with joint presentation media and use them interactively. They manage to gear a lecture to a specific target group, motivate the listener even during longer lecture durations, and apply various moderation techniques.

Key qualifications: Literature research; independent work with English-language specialist literature; analyticalmethodical competence; scientific methodology; principles of good scientific practice; skills in the understandable, confident, and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts, and results and in documenting them; skills in logical, abstract, analytical and conceptual thinking and formal argumentation; quality awareness, meticulousness; communication skills; time management; evaluation of approaches, procedures, techniques, and technologies from different points of view. Translated with www.DeepL.com/Translator (free version)

Workload:

Total: 120 h

30 h seminar (attendance)

90 h preparation of written term papers (self-study)

Conditions:		
none		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Software Engineering in sicherheitskritischen Systemen (MA)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

Current software engineering topics from industry and research.

Literature:

Will be presented in the respective kick-off event.

Assigned Courses:

Seminar Software Engineering in sicherheitskritischen Systemen (Master) (seminar)

Examination

Seminar Software Engineering in sicherheitskritischen Systemen (MA)

written/oral exam

Test Frequency:

when a course is offered

Module INF-0367: Advanced Mac Vision	hine Learning and Computer	5 ECTS/LP
Version 1.0.0 (since WS20/21)		
Person responsible for module: Prof. Dr. Rainer Lienhart		
Learning Outcomes / Competences: After successful participation in this mo (support vector machines and deep net network architectures and systems) and implement scientifically complex process appropriately apply the principles learner thinking in the field of machine learning Key qualifications : advanced mathem implementation of technical solution co solution strategies of complex problems	dule, students have in-depth advanced I ural networks and their basic building blo d can apply these. They can analyse, un dures in the field of image, text, video an ed to new problems. They develop skills and vision. atical-formal logic; critical reading and a ncepts; interdisciplinary knowledge; deve s; systematic further development of des	knowledge of machine learning ocks) and machine vision (deep neural iderstand and programmatically d signal processing, as well as to in logical, analytical and conceptual nalysis of scientific publications; elopment and implementation of sign methods; skills in solving problems
under practical boundary conditions		
Workload: Total: 150 h 30 h lecture (attendance) 60 h studying of course content through 30 h exercise course (attendance) 15 h studying of course content using li 15 h studying of course content using p	n exercises / case studies (self-study) terarture (self-study) provided materials (self-study)	
Conditions: Kenntnisse in maschinellem Lernen und maschinellem Sehen (Master- Vorlesung INF-0092 "Multimedia II" bzw. INF-0316 "Machine Learning and Computer Vision")		Credit Requirements: Bestehen der Modulprüfung
Frequency: each winter semester	Recommended Semester: from 2.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Advanced Machine Learning and Computer Vision (Lecture)

Mode of Instruction: lecture

Language: German

Contact Hours: 2

Contents:

The lecture gives an in-depth insight into all aspects of machine learning and machine vision. The concepts learned will be practiced, analyzed and evaluated in the exercises using successful real-world examples. The contents of the lecture include: support vector machines, basic building blocks of deep neural networks (layer structures, normalization, attention mechanisms), as well as current reference architectures and systems for image, text, video processing and their combination with further sensor signals.

Literature:

Will be announced at the beginning of the semester.

Part of the Module: Advanced Machine Learning and Computer Vision (Tutorial)

Mode of Instruction: exercise course Language: German Contact Hours: 2

Examination

Advanced Machine Learning and Computer Vision (Examination)

written exam / length of examination: 90 minutes

Test Frequency:

each semester

Description:

The examination can be taken every semester during the examination period.

Algorithms	5 ECTS/LP
r. Tobias Mömke	
l topics in the field of approximation algo ns; improve the ability to abstract and sy	rithms; acquiring powerful stematically solve optimization
erstanding of mathematical formalisms; ding of powerful mathematical tools	ability to identify core properties of
h exercises / case studies (self-study) iterarture (self-study) provided materials (self-study)	
ta Structures (e.g., "INF-0111: er Science (e.g., "INF-0110: Einführung	
Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Repeat Exams Permitted: according to the examination regulations of the study program	
	Algorithms Dr. Tobias Mömke Il topics in the field of approximation algo ns; improve the ability to abstract and sy erstanding of mathematical formalisms; a ding of powerful mathematical tools h exercises / case studies (self-study) iterarture (self-study) provided materials (self-study) ta Structures (e.g., "INF-0111: er Science (e.g., "INF-0110: Einführung Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program

Parts of the Module

Part of the Module: Approximation Algorithms (Vorlesung)

Mode of Instruction: lecture Language: German / English

Contact Hours: 2

Contents:

Given an NP-hard optimization problem, how well can it be approximated in polynomial time? It is exciting and challenging to understand the approximability of fundamental optimization problems. This course mainly focuses on upper bounds, i.e., designing efficient approximation algorithms.

In this course, we will study several classes of problems, such as packing problems, network design, and graph problems. We will cover central algorithmic techniques for designing approximation algorithms, including greedy algorithms, dynamic programming, linear and semi-definite programming, and randomization.

Literature:

- David P. Williamson and David B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press.
- Vijay V. Vazirani, Approximation Algorithms, Springer.

Part of the Module: Approximation Algorithms (Übung)

Mode of Instruction: exercise course Language: English / German

Contact Hours 2

Examination

Approximation Algorithms

written exam / length of examination: 120 minutes

Module INF-0374: Project Me Projektmodul Resource Aware Al	odule Resource Aware Algorithmics gorithmics	10 ECTS/LP
Version 1.0.0 (since WS20/21) Person responsible for module: P	rof. Dr. Tobias Mömke	
Learning Outcomes / Competer After attending this research mod medium difficulty in the area of re date topics within the area and ca deep concepts, methods, tools ar the technical abilities, they train th discurss and present technical top	nces: ule, the students are able to understand algo source aware algorithmics.They have acquir an actively participate in research projects. Fu and technologies and can apply the acquired k heir team and communication skills, the ability pics.	prithmic problems and solutions of ed a detailed understanding of up-to- urthermore, they understand some nowledge in research projects. Besides y to perform literature research and to
Key Qualifications: Ability to per English language; ability to prese high-quality results; communication clean scientific practices	form analytical and logic thinking; self-suffici- nt results and ideas in form of understandabl on skills; ability to work with a team and to un	ent work with scientific literature in e and inspiring presentations; aim for iderstand team processes; respect for
Workload: Total: 300 h 285 h internship / practical course 15 h seminar (attendance)	e (self-study)	
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Projekt Mod Mode of Instruction: internship Language: German / English	dule Resource Aware Algorithmics	

Contact Hours: 1

Contents:

Autonome Mitarbeit an aktuelle Forschungsthemen.

Literature:

wissenschaftliche Papiere, Handbücher

Assigned Courses:

Oberseminar Resource Aware Algorithmics

Examination

Projekt Module Resource Aware Algorithmics

portfolio exam

		7
Module INF-0379: Practical Mode	ule Simulation of Cyber-Physical	6 ECTS/LP
Systems Proktikum Simulation outor physicolo	r Sustano	
	- Systeme	
Version 1.0.0 (since SoSe21)		
Person responsible for module: Prof. I	Dr. Lars Mikelsons	
Learning Outcomes / Competences	:	
Subject-related competences:		
After successful participation in this mo	odule, students will be able to apply adva	anced methods of simulation to use
virtual prototypes for model-based dev	elopment of mechatronic systems. They	know methods for different application
areas along the development process	and interpret their result.	
Methodological competencies:		
Students are able to evaluate different	simulation methods for different applicat	tion areas. They are also able to select
and independently apply suitable simu	lation methods depending on the simula	tion purpose.
Interdisciplinary competencies:		
Students are able to solve certain engi	ineering problems with the help of inform	ation technology. They can use
abstractions of physical systems and a	apply them in combination with information	on technology methods for the
development of mechatronic systems.		
Key Competencies:		
Advanced skill in answering engineerir	ng questions, particularly in the area of m	nechatronic systems design,
using virtual prototypes; selection and	application of advanced simulation meth	ods; assessment and analysis of
mathematical models.		
Workload:		
Total: 180 h		
90 h internship / practical course (atter	ndance)	
90 h studying of course content throug	h exercises / case studies (self-study)	
Conditions:		Credit Requirements:
Attendance of the course Mechatronic	s and/or object-oriented methods of	Passing the module exam
modeling and simulation.	,	3
Frequency: each summer semester	Recommended Semester:	Minimal Duration of the Module:
requency. each summer semester	from 4	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
6	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Praktical Module	e Simulation of Cyber-Physical Syster	ns
Mode of Instruction: internship		
Lecturers: Prof. Dr. Lars Mikelsons		
Language: German / English		

Contact Hours: 6

Contents:

Nowadays, the development of mechatronic systems is generally model-based. In doing so, the application of simulation in practice often encounters the following challenges:

- · How do I improve a physical model when measurements become available?
- How do I know how much I can trust my model?
- · How do I combine simulation of physical systems with virtual control units?
- · How can I even use simulation to investigate the safety of the real system?

In this lab, students will learn methods for answering these (and other) questions and apply what they learn through hands-on exercises. Experts from industrial practice are brought in for some parts of the course.

Assigned Courses:

Praktikum Simulation cyber-physischer Systeme (internship)

Examination

Praktical Module Simulation of Cyber-Physical Systems

portfolio exam / length of examination: 30 minutes

Module INF-0380: Digital Health Digital Health

Version 1.0.0 (since SoSe21) Person responsible for module: Prof. Dr. Björn Schuller

Learning Outcomes / Competences:

Knowledge: Digital health is the use of information and communication technology for disease prevention and treatment. Students will get to know the key concepts, definitions, and technologies in the field of digital health. They will get insights into acceptability and usability of digital health applications in the context of various diseases such as depression, multiple sclerosis, and autism spectrum disorder. They will learn strategies for collecting medically-relevant data of various modalities, e.g., recording speech data using microphones or tracking heart rate via wearables. They will then learn about principal concepts of intelligent biosignal processing and analysis including feature extraction and machine learning in the context of healthcare applications. Finally, students will be made familiar with current and potential future implications of intelligent biosignal analysis to the health sector as well as sensitised to related ethical and data privacy aspects.

Skills: Students will be familiar with the basic concepts of digital health and its fields of application in modern healthcare. Students will be able to select appropriate methodology or design new approaches to be applied to a broad range of health-related signal processing and analysis tasks. Moreover, they will practice logical and conceptual thinking and combine knowledge of state-of-the-art technology and medical requirements in order to develop solutions for real-world scenarios in a healthcare context.

Competences: Students are prepared to work closely with healthcare professionals in interdisciplinary research and intervention projects. Students are able to plan and carry out medical data collections for health-related biosignal analysis tasks under consideration of ethical principles and data privacy regulations. They can cope with tools to extract meaningful information from the collected data. Furthermore, they know how to characterise and judge on the quality and suitability of existing approaches as well as design new intelligent biosignal processing and analysis solutions for healthcare applications. They are further able to realise the learnt concepts in programs and know how to make scientifically meaningful performance evaluations of the proposed systems.

Key skills: Formal methods; Knowledge of advantages and disadvantages of different design alternatives; Systematical advancement of design tools; Ability to work in teams; Knowledge of workflows and processes; Ability to find solutions for practical problems; Ability to work autonomously; Quality awareness; Scientific working; Literature research.

Workload:		
Total: 150 h		
30 h exercise course (attendance)		
60 h studying of course content through exercises / case studies (self-study)		
30 h lecture (attendance)		
15 h studying of course content using I	iterarture (self-study)	
15 h studying of course content using p	provided materials (self-study)	
Conditions:		Credit Requirements:
Basic knowledge of mathematics as well as interest in healthcare applications		Bestehen der Modulprüfung
should be present.		
Frequency: irregular (usu. summer	Recommended Semester:	Minimal Duration of the Module:
semester)	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
4	according to the examination	
	regulations of the study program	

Parts of the Module

Part of the Module: Digital Health (Vorlesung)

Mode of Instruction: lecture

Language: English

Contact Hours: 2

Contents:

Public health, personalised medicine, usability, Internet of Things, digital health interventions, self-tracking, digital biomarker, medical data acquisition, wearables, digital signal processing, signal enhancement, feature extraction, machine learning, ethics, and data privacy.

Literature:

Panesar, A (2019): Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes. Coventry, UK: Apress.

Assigned Courses:

Digital Health (lecture)

Part of the Module: Digital Health (Übung)

Mode of Instruction: exercise course

Language: English

Contact Hours: 2

Assigned Courses:

Übung zu Digital Health (exercise course)

Examination

Digital Health

written exam / length of examination: 90 minutes

Module INF-0383: Algorithms Algorithmen für Big Data	for Big Data	5 ECTS/LP
Version 1.0.0 (since SoSe21) Person responsible for module: Pro	of. Dr. Tobias Mömke	
Learning Outcomes / Competend Development and understanding of amounts of data such that not all of mathematical tools to analyze algo systematic manner.	es: central copetences in algorithm design for s them can be accessed without restrictions; rithms; improvement of copetences in abstra	situations, where there are large aquisition of knowledge of act thinking and analyzing problems in a
Key Qualifications: Ability to dever core properties of algirthmic proble	lop an intuitive understanding of mathemations; deep understanding of useful mathemations;	cal formalisms; ability to identify the ical tools
Workload: Total: 150 h 30 h exercise course (attendance) 30 h lecture (attendance) 15 h studying of course content usi 60 h studying of course content thr 15 h studying of course content usi	ng provided materials (self-study) ough exercises / case studies (self-study) ng literarture (self-study)	
Conditions: Basic knowledge in algorithms and (INF-0111)) and in probability theor (MTH-6040)).	data structures (for example Informatik 3 y (for example Stochastik für Informatiker	
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Mode of Instruction: lecture

Language: German / English

Contact Hours: 2

Contents:

In modern data processing, we increasingly have the problem that there are large quantities of data which con only be stored on cheap and slow mass storage media. Algorithmically, this poses the problem that at each point in time, we can only access a snapshot of the data, for example in a sequential manner. In the course, we study algorithms that despite such limitations provably yield high quality results.

Literature:

Wissenschaftliche Papiere, Surveys, Skripte

Assigned Courses:

Algorithmen für Big Data (lecture)

Part of the Module: Algorithms for Big Data (exercise)

Mode of Instruction: exercise course

Language: English / German

Contact Hours: 2

Assigned Courses:

Übung zu Algorithmen für Big Data (exercise course)

Examination

Algorithms for Big Data

written exam / length of examination: 90 minutes

Module INF-0385: Seminar Reso Seminar Resource Aware Algorithmics	urce Aware Algorithmics (Master)	4 ECTS/LP
Version 1.0.0 (since SoSe21) Person responsible for module: Prof. D	or. Tobias Mömke	<u> </u>
Learning Outcomes / Competences: After attending the seminar, the studer techniques in a self-sufficient manner.	ts are able to understand basic algorithr	nic concepts, methods, tools and
They have acquired communication skills, knowledge about work processes and the use of media to present a specific scientific topic both as a talk and in writte form.		
The participants have learned to express techical contents in a sturctured, understandable and inspiring manner. They have learned to confidently stand in front of the audience, using state of the art presentation tools and media. They are able to tailor the talk to the respective audience.		
Key Qualifications: Literature research; work with scientific literature in English language; analytic copetences; clean scientific practice; ability to present techincal content in confident, understandable and structured manner (both in written and spoken form); abstract, logical and analytical thinking; ability to argue formally; aim for high quality; communication skills; time management.		
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term papers	s (self-study)	
Conditions: Credit Requirements: Good knowledge of content taught in mathematical Bachelor classes such as "Mathematik für Informatiker 1" and "Diskrete Strukturen und Logik." Passing of the module exam Knowledge about algorithms and data structures (Informatik 3) is useful. Credit Requirements:		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Resour Mode of Instruction: seminar Language: German / English Contact Hours: 2	ce Aware Algorithmics (Master)	

Contents:

The topics of the seminar are related to research in resource aware algorithmics. The precise topics change over time, in order to reflect up-to-date developments.

Literature:

Depending on the topic of the seminar.

Assigned Courses:

Seminar Resource Aware Algorithmics (Master) (seminar)

Examination

Seminar Resource Aware Algorithmics (Master)

written/oral exam

Module INF-0398: Software-intensive Systems and Medical 6 ECTS/LP Products 0		
Products		
Software-intensive Systeme und Medizinprodukte		
Version 1.0.0 (since WS21/22)		
Person responsible for module: Prot. Dr. Bernhard Bauer		
Learning Outcomes / Competences:		
Students can create (K3), evaluate (K6), and document software architectures.		
To this end, they can transfer technical solution concepts into models and know methods for developing such		
abstractions and architectures.		
Such abstractions and architectures. They can describe the advantages and disadvantages of design alternatives (K4)		
(K4) and can evaluate them in the respective application context (K6). Problems can be identified independently (K4).		
and solutions can be designed systematically (K5) and realized (K3).		
Furthermore, they have basic knowledge of creating medical software according to the particular requirements		
for conformity assessment. Based on the European Medical Device Regulation (MDR), students learn how to		
implement the required software life cycle process according to IEC 62304 and IEC 82304, the requirements for		
software requirement management, the link between (agile) software development and the documentation obligation,		
requirements regarding safety and security.		
Key qualifications: Competence in networking different specialist areas; teamwork and communication skills; ability		
to expand existing knowledge independently; quality awareness; ability to present and document results in an		
understandable way; practical experience and professional qualifications.		
Workload:		
Total: 180 h		
23 h studying of course content using literarture (self-study)		
22 h studying of course content using provided materials (self-study)		
60 h studying of course content through exercises / case studies (self-study)		
45 h lecture (attendance)		
30 h exercise course (attendance)		
Conditions:		
The previous course "Software Architectures and Enterprise Architecture		
Management" and the course "Software-intensive Systems" must not have		
been taken due to overlaps.		
Frequency: each winter semesterRecommended Semester:Minimal Duration of the Module:		
from 1. 1 semester[s]		
Contact Hours: Repeat Exams Permitted:		
5 according to the examination		
regulations of the study program		
Parts of the Module		
Part of the Module: Software-intensive Systeme und Medizingrodukte (Vorlesung)		

Mode of Instruction: lecture

Language: German

Contact Hours: 3

Contents:

The lecture content includes patterns, modelling techniques and the evaluation of software architectures. Furthermore, the development of medical devices is dealt with.

Literature:

- Bass et al: Software Architecture in Practice
- Clements et al: Documenting Software Architectures
- · Clements et al: Evaluation of Software Architectures
- Richard N. Taylor, Nenad Medvidovic, and Eric M. Dashofy; Software Architecture: Foundations, Theory, and Practice
- BSI Empfehlungen für Medizinprodukte
- ZVE Empfehlungen für Medizinprodukte

Part of the Module: Software-intensive Systeme und Medizinprodukte (Übung)

Mode of Instruction: exercise course Language: German Contact Hours: 2

Examination

Software-intensive Systeme

oral exam / length of examination: 30 minutes

Test Frequency:

when a course is offered

Module INF-0400: Knowledge Re Knowledge Representation in Biomedi	presentation in Biomedicine cine	5 ECTS/LP
Version 1.2.0 (since WS21/22) Person responsible for module: Prof. D Dr. Zaynab Hammoud	or. Frank Kramer	
Learning Outcomes / Competences: analytical and logical thinking, skill to s document results in a comprehensible with books and scientific literature, tear	olve complex problems under practical c way, procedures and processes in creat mwork	onditions, ability to present and ing practical systems, individual work
Workload: Total: 150 h 30 h (self-study) 30 h studying of course content throug 30 h studying of course content using l 30 h exercise course (attendance) 30 h lecture (attendance)	h exercises / case studies (self-study) iterarture (self-study)	
Conditions: none		Credit Requirements: Passing the module exam
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Knowledge Representation in Biomedicine

Mode of Instruction: lecture Language: English Contact Hours: 2

ECTS Credits: 3.0

Contents:

The course Knowledge representation in Biomedicine covers the different aspects and forms used to model biomedical knowledge. During this course, students will acquire logical and analytical skills. They will study different forms of knowledge such as terminologies, ontologies, controlled vocabulary, thesaurus and much more. Furthermore, they will learn the different between these types and will be able to develop new solutions and implement them using RDF, XML or UMLS formats. They will inspect practical examples of knowledge forms used in biomedicine.

Literature:

- Handbuch der Medizinischen Informatik, Thomas M. Lehmann, 2. Auflage, 2014
- Biomedizinische Ontologie: Wissen strukturieren für den Informatik-Einsatz, Ludger Jamsem, Barry Smith (Hrsg.), 2008

Part of the Module: Übung zu Knowledge Representation in Biomedicine

Mode of Instruction: exercise course

Language: English Contact Hours: 2 ECTS Credits: 2.0

Examination Knowledge Representation in Biomedicine portfolio exam
		r
Module INF-0407: Seminar Digita	I Ethics (Master)	4 ECTS/LP
Seminar Digitale Etnik (Master)		
Version 1.0.0 (since WS21/22)		
U Person responsible for module: Prof. U	r. Robert Lorenz	
Learning Outcomes / Competences:		
After attending the seminar, the studen	ts can independently work out and analy	se advanced problems, concepts,
individual seminar topic.		S and evaluate them in relation to the
Participants possess scientific methodr	ploav communication skills and the abili	ty to present a special topic clearly and
comprehensibly in speech and writing a	and to discuss and evaluate scientifically	challenging topics from the named
field critically and argumentatively.		
Furthermore, they learn to recognise lo	gical structures of thinking and argumen	tation and use them in a goal-
oriented manner. The participants can	formulate clearly and comprehensibly an	d present subject content freely.
They understand how to structure a tall	k that is clear and easy to follow. Addition	nally, the students know how to
focus on essential messages and conv	ey them in a comprehensible way, even	with complex content. They skilfully
apply chains of argumentation and solu	Ition strategies in the event or disruptions	 The students understand now to bey manage to gear a talk to a specific.
target group, apply various moderation	techniques, and keep their audience en	gaged even over a longer period.
Kev qualifications: Presentation techr	niques: literature research; principles of c	rood scientific practice: evaluating
solution approaches, procedures, techr	niques, and technologies from different p	oints of view.
Workload:		
Total: 120 h		
30 h seminar (attendance)		
90 h preparation of presentations (self-	study)	
Conditions:		Credit Requirements:
none		Passing the module examination
Frequency: irregular	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
2	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Seminar Digital Ethics (Master)		
Mode of Instruction: seminar		

Language: English / German Contact Hours: 2

ECTS Credits: 4.0

Contents:

The topics of the seminar change over time, in order to reflect up-to-date developments

Literature:

Literature depends on the chosen topic

Examination

Seminar Digital Ethics (Master)

presentation / length of examination: 45 minutes

Module INF-0408: Extremal Combinatorics	pinatorics	5 ECTS/LP
Version 1.0.0 (since SoSe22) Person responsible for module: Prof. Dr. Tobias Mömke		
Learning Outcomes / Competences: Being able to prove mathematical claim the skills of analyzing performance of a	ns using counting, pigeonhole princple a Igorithms; enhancing the skills of mathe	nd the probabilistic method; improving matical thinking
Workload: Total: 150 h 30 h exercise course (attendance) 15 h studying of course content using p 15 h studying of course content using li 60 h studying of course content through 30 h lecture (attendance)	provided materials (self-study) terarture (self-study) n exercises / case studies (self-study)	
Conditions: Basic knowledge in mathematics, in pa Basic knowledge in graph theory is reco	rticular linear algebra is necessary. ommended.	
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Extremal Combin Mode of Instruction: lecture Language: English Contact Hours: 2	natorics (Vorlesung)	
Contents: How many people do you need to invite for your party, in order to have 3 strangers or a group of 3 friends? If 10 people have keys to a safe, how many locks are necessary to make sure any 5 of them can open it? What is the dictator paradox, and should you be worried about it? This course provides an introduction to extremal combinatorics, which helps us to find answers to the questions above.		
Literature:		
Part of the Module: Extremal Combin Mode of Instruction: exercise course Language: English Contact Hours: 2	natorics (Übung)	
Examination		

Extremal Combinatorics

oral exam / length of examination: 45 minutes

Module INF-0409: Cyber Security	y .	6 ECTS/LP
Version 1.0.0 (since SoSe22) Person responsible for module: Prof. Dr. Bernhard Bauer		
Learning Outcomes / Competences: Students can create (K3), evaluate (K6 software architectures. To this end, they can transfer technica and know methods for developing secu- security alternatives (K4) and evaluate independently (K4) and solutions syste developed skills for analyzing and stru procedures for creating such architectu- secure software development process. They can select and safely apply suita know concepts and technologies for de competence to recognize significant ter Key qualification: Competence to netw	5), and document security aspects in the I solution concepts into development pro ure software. They can describe the adva- them in the respective application conte ematically designed (K5) and implemente cturing the problems of security architect ures. Students can name practice-relevan- es (K1). They can select suitable methods ble methods for creating and evaluating seveloping secure software and security a chnical developments.	software development process and cesses and IT architectures antages and disadvantages of xt (K6). Problems can be identified ed (K3). Furthermore, they have ures and know the concepts and nt issues in security architectures and ls for security architectures. The students rchitectures. They have the
ability to communicate; ability to expar document results understandably; prac	nd existing knowledge independently; qua ctical experience and professional aptitud	ality awareness; ability to present and le.
Workload: Total: 180 h 23 h studying of course content using literarture (self-study) 22 h studying of course content using provided materials (self-study) 60 h studying of course content through exercises / case studies (self-study) 45 h lecture (attendance) 30 h exercise course (attendance)		
Conditions:		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 5	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Cyber Security (Mode of Instruction: lecture	Vorlesung)	

Language: German

Contact Hours: 3

Contents:

The lecture content includes security standards, secure software development lifecycles, as well as security architectures, and their evaluation in respective technology contexts. and the evaluation of security architectures.

Literature:

Slides

- A. Deane, A. Kraus: The Official (ISC)2 CISSP CBK Reference
- · Further literature in the lecture on specific topics

Assigned Courses:

Cyber Security (lecture)

Part of the Module: Cyber Security (Übung)

Mode of Instruction: exercise course

Language: German

Contact Hours: 2

Assigned Courses:

Übung zu Cyber Security (exercise course)

Examination

Cyber Security

oral exam / length of examination: 30 minutes

Test Frequency:

Module INF-0410: Gesture-Based Communication in Human- Computer Interaction Gesture-Based Communication in Human-Computer Interaction	8 ECTS/LP
Version 1.0.0 (since SoSe22) Person responsible for module: Prof. Dr. Elisabeth André	
Learning Outcomes / Competences:	

After successful participation in this module, students understand the essential concepts of gesture-based communication in human-computer interaction. They are able to translate technical solution concepts into programs and models and master the selection and application of suitable methods. They have the knowledge of the way of thinking and the language of application-relevant disciplines. Within the framework of the lecture, they learn to evaluate learning components in a scientifically meaningful way using suitable methods, to develop the methods and algorithms independently and to implement them technically. Particularly promoted in this framework are also the skills for confident and convincing presentation of ideas and concepts, comprehensible presentation and documentation of results, as well as logical, analytical and conceptual thinking.

Key qualifications: Advanced mathematical formal methodology, skill in analyzing and structuring complex computer science problems, skill in developing and implementing solution strategies for complex problems, understanding of team processes, skill in collaborating in teams, self-reflection; acting responsibly in the face of inadequacy and conflicting interests, quality awareness, meticulousness.

Workload:

Total: 240 h

120 h studying of course content through exercises / case studies (self-study)

15 h studying of course content using literarture (self-study)

15 h studying of course content using provided materials (self-study)

60 h exercise course (attendance)

30 h lecture (attendance)

Conditions: none		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Gesture-Based Communication in Human-Computer Interaction (Lecture)

Mode of Instruction: lecture

Language: English

Contact Hours: 2

Contents:

HCI methods and principles, Interaction design, Nonverbal communication, Gestures, Gesture recognition systems, Collaboration, Applied computer vision, Ubiquitous computing

Part of the Module: Gesture-Based Communication in Human-Computer Interaction (Exercise Course)

Mode of Instruction: exercise course

Language: English

Contact Hours: 4

Examination Gesture-Based Communication in Human-Computer Interaction portfolio exam

Module INF-0418: Practical Module Conversational AI: Virtual Assistants and Chatbots Praktikum Conversational AI: Virtual Assistants and Chatbots	5 ECTS/LP
Version 1.1.0 (since SoSe22) Person responsible for module: Prof. Dr. Elisabeth André	
Learning Outcomes / Competences: Students are familiar with methods and techniques of interaction design and e After successful participation, they will have the necessary knowledge to anal	engineering for health care applications. yze application scenarios according

to the guidelines of the user-centered design process and to design software solutions tailored to the target group. They are able to translate current interaction paradigms and design guidelines into models and programs for novel interaction devices, as well as to independently familiarize themselves with the necessary technologies. Furthermore, they are able to apply practice-relevant evaluation methods to assess the quality of the created software prototype. They are able to plan larger project tasks in small teams, solve them according to a self-developed project plan and discuss the results appropriately in plenary sessions and present them as a team.

Key qualifications: Skill in confident and persuasive presentation of ideas and concepts; knowledge of the mindset and language of application-relevant disciplines; understanding of team processes; skill in collaborating in teams; skill in leading teams; skill in presenting and documenting results in a comprehensible manner; ability to expand existing knowledge independently; ability to contribute to science; competence in recognizing significant technical developments; quality awareness, meticulousness.

Workload:

Total: 150 h

90 h studying of course content through exercises / case studies (self-study)

60 h internship / practical course (attendance)

Conditions:		
none		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Practical Module Interaction Design and Engineering for Health Care Applications Mode of Instruction: internship

Language: English

Contact Hours: 4

Contents:

The specific assignment for student projects is designed each year.

Literature:

Literature references will be announced at the beginning of the semester depending on the topic.

Examination

Practical Module Interaction Design and Engineering for Health Care Applications practical exam

Module INF-0422: Seminar Organic Computing (Master)	nic Computing (Master)	4 ECTS/LP
Version 1.0.0 (since WS22/23) Person responsible for module: Prof. Dr. Jörg Höhner		
Learning Outcomes / Competences		
After attending the seminar, the stude procedures, techniques and technolog relation to the individual seminar topic	nts are able to independently work out ad lies in the fields of organic computing and from the named field.	vanced problems, concepts, methods, I to analyse and evaluate them in
They possess the scientific methodolo special topic clearly and comprehensil topics from the named field critically a thinking and argumentation and use th	gy, communication skills and ability to us oly in speech and writing and to discuss a nd argumentatively. Furthermore, they ca nem in a goal-oriented manner.	e appropriate media to present a and evaluate scientifically challenging n recognise the logical structures of
Participants can formulate clearly and structure a presentation clearly and re way, even with complex content. They disruptions.	comprehensibly and present specialist co asonable and how to focus on essentials skilfully apply lines of argument and solu	ontent freely. They understand how to and convey those in a comprehensible ation strategies in the event of
The students understand how to prese them interactively. They manage to ge and apply various moderation techniqu	ent themselves and confidently deal with o ear a talk to a specific target group, motiva- ues.	common presentation media, using ate the listener even during longer talks
Key qualifications: Literature research; independent work with English-language specialist literature; Analytical-methodical competence; scientific methodology; principles of good scientific practice; Ability to describe and document (practical and theoretical) ideas, concepts and results in a comprehensible, confident and convincing manner (written and oral); Ability to think logically, abstractly, analytically and conceptually and to argue formally; Quality awareness, meticulousness; Communication skills; Time management; Evaluation of approaches, procedures, techniques and technologies.		
Workload: Total: 120 h 30 h seminar (attendance)		
Conditions: none		
Frequency: each semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: Repeat Exams Permitted: 2 according to the examination regulations of the study program		
Parts of the Module		
Part of the Module: Seminar Organic Computing (Master) Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 4.0		
Contents: The topics of the seminar are determined each year and adapted to current trends.		
Literature:		

Literature depending on the current topics: scientific papers or books.

Assigned Courses:

Seminar Organic Computing (Master) (seminar)

Examination

Presentation and written paper.

written/oral exam

Module INF-0424: Seminar Machine Learning (MA)	4 ECTS/LP
Seminar Machine Learning (MA)	

Version 1.0.0 (since WS22/23)

Person responsible for module: Prof. Dr. Bernhard Bauer

Learning Outcomes / Competences:

After attending the seminar, the students are able to independently work out, analyze and evaluate advanced problems, concepts, methods, procedures, techniques, and technologies in the field of Medical Information Sciences concerning the particular seminar topic from the named field. They have the scientific methodology, communication skills, and ability to use appropriate media to present a specific case clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively. Furthermore, they can recognize the logical structures of thinking and argumentation and use them goal-oriented. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a lecture clearly and understandably, focus the study on important messages, and convey them in a comprehensible way, even with complex content. They skillfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to present themselves and confidently deal with joint presentation media and use them interactively. They manage to gear a lecture to a specific target group, motivate the listener even during longer lecture durations, and apply various moderation techniques.

Key qualifications: Literature research; independent work with English-language specialist literature; analyticalmethodical competence; scientific methodology; principles of good scientific practice; skills in the understandable, confident, and convincing (written and oral) presentation of (practical or theoretical) ideas, concepts, and results and in documenting them; skills in logical, abstract, analytical and conceptual thinking and formal argumentation; quality awareness, meticulousness; communication skills; time management; evaluation of approaches, procedures, techniques, and technologies from different points of view. Translated with www.DeepL.com/Translator (free version)

Workload:

Total: 120 h

90 h preparation of written term papers (self-study)

30 h seminar (attendance)

Conditions:		
none		
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Machine Learning (Seminar)

Mode of Instruction: seminar

Language: German

Contact Hours: 2

Contents:

This seminar will cover the basics of Medical Information Sciences. Various topics are to be worked on, which are to serve as a basis for a subsequent practical course.

Literature:

Will be presented at the respective kick-off event.

Assigned Courses:

Seminar Machine Learning (Master) (seminar)

Examination

Presentation and written paper

written/oral exam

Test Frequency:

		· · · · · · · · · · · · · · · · · · ·	
Module INF-0427: Deep Ubiquito	us and Wearable Computing for	8 ECTS/LP	
Healthcare	ting for Llockhoore		
Deep Obiquitous and Wearable Compt			
Version 1.0.0 (since WS22/23)			
Person responsible for module: Prof. D	r. Elisabeth André		
Learning Outcomes / Competences:			
Students are familiar with methods and	techniques of interaction design and en	gineering for health care applications.	
After successful participation, they will	have the necessary knowledge to analyz	e application scenarios according	
to the guidelines of the user-centered d	lesign process and to design software so	plutions tailored to the target group.	
They are able to translate current intera	action paradigms and design guidelines i	into models and programs for novel	
interaction devices, as well as to indepe	endently familiarize themselves with the	necessary technologies. Furthermore,	
they are able to apply practice-relevant	evaluation methods to assess the qualit	y of the created software prototype.	
They are able to plan larger project tas	ks in small teams, solve them according	to a self-developed project plan and	
discuss the results appropriately in pler	hary sessions and present them as a tea	m.	
Key qualifications: Skill in confident a	nd persuasive presentation of ideas and	concepts; knowledge of the mindset	
and language of application-relevant di	sciplines; understanding of team proces	ses; skill in collaborating in teams;	
skill in leading teams; skill in presenting	g and documenting results in a comprehe	ensible manner; ability to expand	
existing knowledge independently; abili	ty to contribute to science; competence	in recognizing significant technical	
developments; quality awareness, meti	culousness.		
Workload:			
Total: 240 h	Total: 240 h		
15 h studying of course content using provided materials (self-study)			
15 h studying of course content using li	terarture (self-study)		
120 h studying of course content throug	gh exercises / case studies (self-study)		
30 h lecture (attendance)			
60 h exercise course (attendance)			
Conditions:			
Programming experience			
Frequency: each winter semester	Recommended Semester:	Minimal Duration of the Module:	
	from 1.	1 semester[s]	
Contact Hours:	Repeat Exams Permitted:		
6	according to the examination		
	regulations of the study program		

Parts of the Module

Part of the Module: Practical Module Interaction Design and Engineering for Health Care Applications

Mode of Instruction: lecture

Language: English

Frequency: each summer semester

Contact Hours: 2

Contents:

The specific assignment for student projects is designed each year.

Literature:

Literature references will be announced at the beginning of the semester depending on the topic.

Part of the Module: Deep Ubiquitous and Wearable Computing for Healthcare (Exercise Course) Mode of Instruction: exercise course Language: English

Contact Hours: 4

Examination

Practical Module Interaction Design and Engineering for Health Care Applications

portfolio exam

Module INF-0428: Practical Module Programming Parallel Embedded Systems Praktikum Programming Parallel Embedded Systems	5 ECTS/LP
Version 1.0.0 (since WS22/23) Person responsible for module: Prof. Dr. Sebastian Altmeyer	
Learning Outcomes / Competences:	

The students analyse the particular requirements of embedded systems and optimise the software they develop regarding the available resources and mandatory time limits. They create parallel applications for embedded systems in an industry-typical programming language. The emerging problems of implementing multithreaded applications are identified and suitable solutions for those are developed. Different data structures for use in parallel applications are classified, their implementations are reviewed, and the performance is evaluated. Debugging and code-analysis techniques are applied, and different optimisation possibilities are investigated.

The students apply the skills they learned in projects, building parallel applications independently. Further, the performance of the developed software is evaluated, and analysed regarding the project requirements.

Key qualifications: Analytical and methodological competence; selection and confident use of appropriate methods; ability to expand existing knowledge independently; skill in presenting and documenting ideas, concepts and results in a comprehensible manner; self-reflection

Workload:

Total: 150 h

90 h studying of course content through exercises / case studies (self-study)

60 h internship / practical course (attendance)

Conditions: None Frequency: irregular (usu. winter semester) Recommended Semester: Minimal Duration of the Module: from 1. 1 semester[s] Contact Hours: Repeat Exams Permitted: according to the examination regulations of the study program

Parts of the Module

Part of the Module: Praktikum Programming Parallel Embedded Systems

Mode of Instruction: internship

Language: German / English

Contact Hours: 4

Contents:

In the practical module, essential techniques to develop software projects in an industry-typical programming language are investigated, as well as methods for code-analysis, and for testing and debugging. Special focus is on programming parallel and concurrent applications with tasks and threads for single- and multi-core processors, and on programming with GPGPUs. Platform-independent programming is demonstrated on different systems, from 8 bit microcontrollers to 64 bit workstations, while the effects of the instruction set architecture on the performance of the software are analysed, and the resulting potential performance optimisations are evaluated. After the introduction into the essential features of the programming language, the typically used tools, was well as relevant parallel data structures, the students implement a parallel application in a larger project.

Examination

Praktikum Programming Parallel Embedded Systems

practical exam

Module INF-0436: Project Ma Projektmodul Quantenalgorithme	odule Quantum Algorithms	10 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. Dr. Jakob Siegfried Kottmann		
Learning Outcomes / Competer Nach der Teilnahme am Projektm Gebiet der Quantenalgorithmen u Konzepte, Methoden, Verfahren, entwickeln und sind fähig, innova möglich, an die internationale For Gebiet zu leisten. Darüber hinaus Fähigkeit zur Literaturrecherche u diskutieren, Zwischenziele zu def einzuordnen, zu kombinieren und	nces: nodul verstehen die Studierenden Problems und verfügen dort über tiefergehende Fachk Techniken und Technologien des genannte tive Methoden bei der Lösung von Problem rschung anzuknüpfen und ihren eigenen wis sverfügen die Studierenden über die Team- und die wissenschaftliche Methodik, um Pro inieren, sowie Zwischenergebnisse und inn I zu präsentieren.	tellungen höherer Komplexität auf dem enntnisse und Fähigkeiten. Sie können n Gebiets in Forschungsprojekten en anzuwenden. Dadurch ist es ihnen ssenschaftlichen Beitrag auf diesem und Kommunikationsfähigkeit, die blemstellungen auf dem Gebiet zu ovative Ideen kritisch zu bewerten,
Schlüsselqualifikationen: Fertigkeit zum logischen, analytischen und konzeptionellen Denken; Eigenständige Arbeit mit englischsprachiger Fachliteratur; Verständliche, sichere und überzeugende Präsentation von Ideen, Konzepten und Ergebnissen; Qualitätsbewußtsein; Kommunikationsfähigkeit; Fertigkeit der Zusammenarbeit in Teams und Verstehen von Teamprozessen; Grundsätze guter wissenschaftlicher Praxis; Projektmanagementfähigkeiten; Wissenschaftliche Methodik		
Workload: Total: 300 h 15 h seminar (attendance) 285 h internship / practical course	e (self-study)	
Conditions: none		Credit Requirements: Bestehen der Modulprüfung
Frequency: as needed	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: Repeat Exams Permitted: 1 according to the examination regulations of the study program		
Parts of the Module		
Part of the Module: Projektmoo Mode of Instruction: internship Language: English / German	lul Quantenalgorithmen	
Contents: Mitarbeit an aktuellen Forschu	ungsthemen	
Literature: Aktuelle Forschungsbeiträge		
Assigned Courses:		

Oberseminar Quantenalgorithmik

Examination

Projektmodul Quantenalgorithmen

practical exam

Test Frequency:

Module INF-0439: Seminar Quant Seminar Quantum Algorithms (Master)	tum Algorithms (Master)	4 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. Dr. Jakob Siegfried Kottmann		
Contents: Im Seminar werden die Inhalte aus der Vorlesung "Quantum Algorithms" vertieft. Der parallele Besuch der Vorlesung wird empfohlen. Spezifische Themen orientieren sich an aktueller Forschung. Hierbei werden in der Vorlesung aufgegriffene Anwendungsbeispiele und Themenfelder vertieft oder neue Themenfelder erschlossen. Das Seminar eignet sich als Vorbereitung einer Abschlussarbeit im Bereicht der Quantenalgorithmik.		
Legnet sich als Vorbereitung einer Abschlussarbeit im Bereicht der Quantenalgorithmik. Learning Outcomes / Competences: Nach dem Besuch des Seminars sind die Studierenden in der Lage, weiterführende Problemstellungen, Konzepte, Methoden, Verfahren, Techniken und Technologien auf dem Gebiet der Quantenalgorithmen selbstständig zu erarbeiten, zu analysieren und bezogen auf das individuelle Seminartherma aus dem genannten Gebiet zu bewerten. Sie verfügen über die wissenschaftliche Methodik, Kommunikationsfähigkeit und Fähigkeit zum Einsatz entsprechender Medien, um ein spezielles Thema in Wort und Schrift klar und verständlich zu präsentieren und wissenschaftlich anspruchsvolle Themenstellungen aus dem genannten Gebiet kritisch und argumentativ zu diskutieren und zielführend einsetzen. Die Teilnehmenden können klar und verständlich formulieren und Fachinhalte frei vortragen. Sie verstehen es, einen Vortrag klar und nachvollziehbar zu strukturieren und auch bei komplexen Inhalten den Vortrag auf wesentliche Botschaften auszurichten und diese verständlich zu vermitteln. Argumentationsketten und Lösungsstrategien bei Störungen wenden sie gekonnt an. Die Studierenden verstehen es, präsent aufzutreten und souverän mit gängigen Präsentationsmedien umzugehen und diese interaktiv einzusetzen. Sie schaffen es, einen Vortrag auf eine bestimmte Zielgruppe auszurichten und den Zuhörer auch bei längeren Vortragsdauern zu motivieren und verschiedene Moderationstechniken anzuwenden. Schlüsselqualifikationen: Literaturrecherche; Eigenständiges Arbeiten mit englischsprachiger Fachliteratur; Analytisch-methodische Kompetenz; Wissenschaftliche Methodik; Grundsätze guter wissenschaftlicher Praxis; Fertigkeit der verständlichen, sicheren und überzeugenden (schriftlichen und mündlichen) Darstellung von (praktischen oder theoretischen) Ideen, Konzepten und Ergebnissen und zu deren Dokumentation; Fertigkeit zum logischen, abstrakten, analytischen und konzeptionellen Denken und formaler Argumentation;		
Workload: Total: 120 h 90 h preparation of written term papers (self-study) 30 h seminar (attendance)		
Conditions: Credit Requirements: none Bestehen der Modulprüfung		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	

Parts of the Module

Part of the Module: Seminar Quantum Algorithms (Master)

Mode of Instruction: seminar

Language: English / German

Contact Hours: 2

Contents:

Die Themen des Seminars werden jedes Mal neu festgelegt und aktuellen Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Assigned Courses:

Seminar Quantum Algorithms (Master) (seminar)

Examination

Seminar Quantum Algorithms (Master)

written/oral exam

Test Frequency:

Module INF-0440: Quantum Algo Quantum Algorithms	rithms	5 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. D	Dr. Jakob Siegfried Kottmann	
Learning Outcomes / Competences: Die Studierenden erwerben Grundken zu erklären und Ihre Verwendung in al Strukturen aus dem Bereich der Quant beschreiben und potentielle Anwendur Sie in der Lage quantenalgorithmische übersetzen. Die Studierenden haben fr und variationellen Heuristiken. Sie sind identifizieren, zu analysieren und zu be	ntnisse in der Quantenalgorithmik und s gorithmischen Strukturen zu beschreibe tenalgorithmik, wie die Suche, Fouriertra ngsgebiete bestimmen und vergleichen. Ansätze zu konstruieren und in diskrete undiertes Basiswissen in grundlegender d in der Lage quantenalgorithmische Ele ewerten.	ind in der Lage fundamentale Prinzipien n. Sie können etablierte algorithmische ansform, und Phasenabschätzung, Nach Besuch der Veranstaltung sind e Operationen auf Qubitsysteme zu n quantenalgorithmische Strukturen emente in gegenwärtiger Literatur zu
Schlüsselqualifikationen: Abstraktion Denken; Eigenständiges Erarbeiten vo Funktion von Quantenrechnern; Grund	nsfähigkeit; Sicherer Umgang mit mathe n algorithmischen Lösungsansätzen; G Isätze guter wissenschaftlicher Praxis;	matischen Strukturen; Algorithmisches rundlegendes Verständnis für die
Workload: Total: 150 h 60 h studying of course content throug 15 h studying of course content using 15 h studying of course content using 30 h exercise course (attendance) 30 h lecture (attendance)	h exercises / case studies (self-study) literarture (self-study) provided materials (self-study)	
Conditions: Grundkenntnisse in linearer Algebra w	erden empfohlen.	Credit Requirements: Bestehen der Modulprüfung.
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 4	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		

Mode of Instruction: lecture

Language: English / German

Contact Hours: 2

Contents:

Foundations of Quantum Information Processing:

- qubits and their representation
- · BraKet notation and necessary structures from linear algebra
- · operations on qubits: circuits and gates

Quantum Algorithms

- quantum search and amplitude amplification
- · quantum fourier transform and it's applications
- quantum simulation
- · variational quantum algorithms
- differentiable quantum algorithmic procedures
- quantum heuristics
- · usecases from current day research

Literature:

Basics of Quantum Information/Quantum Computation:

• Michal Nielsen; Isaac Chuang: Quantum Computation and Quantum Information

Basics of quantum mechanics:

- Richard P. Feynman; Robert B. Leighton; Matthew Sands: Feynman-Vorlesungen über Physik: Band III, Quantenmechanik
- original scripts are online: https://www.feynmanlectures.caltech.edu/info/

Overview over variational quantum algorithms:

- https://doi.org/10.1103/RevModPhys.94.015004
- https://doi.org/10.1038/s42254-021-00348-9

More on quantum algorithms:

 http://theory.caltech.edu/~preskill/ph229/ (chapter 5 provides a good summary of the well-known "traditional" quantum algorithms)

Assigned Courses:

Quantum Algorithms (lecture)

Part of the Module: Quantum Algorithms (Übung)

Mode of Instruction: exercise course

Language: English

Contact Hours: 2

Assigned Courses:

Übung zu Quantum Algorithms (exercise course)

Examination

Quantum Algorithms

oral exam / length of examination: 25 minutes

Test Frequency:

Praktikum Natural Language Process	dule Natural Language Processing	5 ECTS/LP
Version 1.0.0 (since SoSe23)]
Person responsible for module: Prof. Dr. Björn Schuller		
Learning Outcomes / Competences	s:	
The Natural Language Processing (N	ILP) Praktikum is focussed on the practica	al application of machine learning, in
particular, deep learning methods to t	textual data.	
After completing the Praktikum, stude	ents will have acquired an understanding	of the different challenges when
dealing with natural language text dat	ta. They will have an overview over the m	ost important problems in NLP and the
considerable recent progress in this fi	ield as facilitated by large Language Mod	els. They have gained insight into the
inner workings, advantages and disad	dvantages of state-of-the-art models and	first experiences in applying them to
address various problems.		
During this hands-on course, the stud	dents will strengthen their abilities in analy	tical thinking and programming.
They will deepen their knowledge of r	machine learning and will be able to trans	fer and connect their knowledge
to the domain of textual data. Student	ts will gain the prerequisites necessary to	keep up with current and future
developments in this highly dynamic a	and impactful field, being able to weigh th	e merits and downsides of
contemporary NLP methods.		
Key qualifications: analytical skills, kn	nowledge about machine learning for NLP	, relating existing knowledge to a
Key qualifications: analytical skills, kn specific application domain, ability to	nowledge about machine learning for NLP present and document results in a compr	r, relating existing knowledge to a ehensible way, skill to solve problems
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness,	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload:	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness,	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness,	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, f 	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t 	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions:	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t endance) ngh exercises / case studies (self-study)	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements:
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t endance) igh exercises / case studies (self-study)	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t endance) rendance) recommended Recommended Semester:	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module:
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter semester)	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t endance) redance) recommended Recommended Semester: from 1.	r, relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter semester) Contact Hours:	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, t endance) igh exercises / case studies (self-study) recommended Recommended Semester: from 1. Repeat Exams Permitted:	 relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter semester) Contact Hours: 4	nowledge about machine learning for NLP present and document results in a compr tion, quality awareness, meticulousness, r endance) igh exercises / case studies (self-study) recommended Recommended Semester: from 1. Repeat Exams Permitted: according to the examination	 relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter semester) Contact Hours: 4	nowledge about machine learning for NLP present and document results in a comprision, quality awareness, meticulousness, tendance) andance) and exercises / case studies (self-study) recommended Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	 P. relating existing knowledge to a ehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]
Key qualifications: analytical skills, kn specific application domain, ability to under practical conditions, self-reflect Workload: Total: 150 h 60 h internship / practical course (atte 90 h studying of course content throu Conditions: Module Deep Learning (INF-0315) - r Frequency: irregular (usu. winter semester) Contact Hours: 4 Parts of the Module	nowledge about machine learning for NLP present and document results in a comprision, quality awareness, meticulousness, tendance) endance) igh exercises / case studies (self-study) recommended Recommended Semester: from 1. Repeat Exams Permitted: according to the examination regulations of the study program	 P. relating existing knowledge to a rehensible way, skill to solve problems teamwork Credit Requirements: Bestehen der Modulprüfung Minimal Duration of the Module: 1 semester[s]

Mode of Instruction: internship

Language: English

Contact Hours: 4

Contents:

Neural Networks, Machine Learning, Word Embeddings, Transformers, Transfer Learning, Finetuning, Text Preprocessing, Text Classification, Natural Language Generation, Few-Shot Learning

Literature:

Wird vom Dozenten / von der Dozentin bekannt gegeben

Assigned Courses:

Praktikum Natual Language Processing (internship)

Examination Praktikum Natural Language Processing practical exam

Module INF-0443: Seminar on Th	eory of distributed and parallel	4 ECTS/LP	
Systems (Master) Seminar Theorie verteilter und paralleler Systeme (Master)			
Version 1.0.0 (since SoSe23)			
Person responsible for module: Prof. D	r. Kirstin Peters		
Learning Outcomes / Competences:			
Nach dem Besuch des Seminars sind o	die Studierenden in der Lage, weiterführe	ende Problemstellungen, Konzepte,	
Methoden, Verfahren, Techniken und T	echnologien auf dem Gebiet der Theorie	e verteilter und parallier Systeme	
Selbststandig zu erarbeiten, zu analysie	eren und bezogen auf das individuelle Se	eminarthema aus dem genannten	
Sie verfügen über die wissenschaftliche	e Methodik, Kommunikationsfähigkeit un	d Fähigkeit zum Einsatz	
entsprechender Medien, um ein spezie	lles Thema in Wort und Schrift klar und v	verständlich zu präsentieren und	
wissenschaftlich anspruchsvolle Theme	enstellungen aus dem genannten Gebiet	kritisch und argumentativ zu	
diskutieren und zu bewerten. Außerder	n können sie die logischen Strukturen de	es Denkens und Argumentierens	
erkennen und zielführend einsetzen.			
Die Teilnehmenden können klar und ve	erständlich formulieren und Fachinhalte f	rei vortragen. Sie verstehen es, einen	
Vortrag klar und nachvollziehbar zu stru	ukturieren und auch bei komplexen Inha	lten den Vortrag auf wesentliche	
Botschaften auszurichten und diese ve	rständlich zu vermitteln. Argumentations	ketten und Lösungsstrategien bei	
Störungen wenden sie gekonnt an.	, , , , ,		
Die Studierenden verstenen es, prasen	it aufzutreten und souveran mit gangiger	Prasentationsmedien umzugenen	
Zubörer auch bei längeren Vortragsdau	uero zu motivieren und verschiedene Mo	inne zieigruppe auszunchien und den	
Schlusselqualifikationen: Literaturred	cherche; Eigenstandiges Arbeiten mit en	glischsprachiger Fachliteratur;	
Analytisch-methodische Kompetenz; W	Vissenschaltliche Methodik; Grundsatze	juter wissenschaltlicher Praxis;	
(praktischen oder theoretischen) Ideen	Konzepten und Ergebnissen und zu de	ren Dokumentation: Fertigkeit zum	
logischen, abstrakten, analytischen und	d konzeptionellen Denken und formaler A	Argumentation: Qualitätsbewußtsein.	
Akribie; Kommunikationsfähigkeit; Zeitr	nanagement; Bewertung von Lösungsar	nsätzen, Verfahren, Techniken und	
Technologien unter unterschiedlichen Gesichtspunkten			
Workload:			
Total: 120 h			
90 h preparation of written term papers	(self-study)		
30 h seminar (attendance)			
Conditions:		Credit Requirements:	
none		Bestehen der Modulprüfung	
Frequency: each summer semester	Recommended Semester:	Minimal Duration of the Module:	
Frequency. each summer semester	from 1	1 semester[s]	
	Repeat Exams Permitted:		
according to the examination			
regulations of the study program			
Parts of the Module			
Part of the Module: Seminar Theorie	verteilter und paralleler Systeme (Ma	ster)	
Mode of Instruction: seminar			
Language: German	Language: German		

Frequency: irregular

Contact Hours: 2

Contents:

Die Themen des Seminars werden jedes Mal neu festgelegt und an aktuelle Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Examination

Seminar Theorie verteilter und paralleler Systeme (Master)

written/oral exam

Test Frequency:

Module INF-0444: Seminar Generative Künstliche Intellice	rative Artificial Intelligence	4 ECTS/LP
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. D	r. Elisabeth André	
Learning Outcomes / Competences:	,	
After attending the seminar, students a concepts, methods, procedures, techni relation to the individual seminar topic is skills and ability to use appropriate meta and in writing, and to discuss and evaluargumentatively. They will also be able them in a goal-oriented manner. The procontent freely. They understand how to lecture on essential messages and corr They skilfully apply chains of argument understand how to present themselves interactively. They manage to gear a lecture durations and to apply various in Key qualifications: Literature researct	re able to independently work out, and ques and technologies in the field of " from the mentioned field. They have the dia to present a specific topic clearly a uate scientifically challenging topics front to recognize the logical structures of articipants can formulate clearly and con- order structure a lecture in a clear and com- avey them in a comprehensible way, et ation and solution strategies in the even and how to deal confidently with com- acture to a specific target group and to moderation techniques. h; Independent work with English-lang	alyze and evaluate advanced problems, Generative Artificial Intelligence" in the scientific methodology, communication and comprehensibly, both verbally for the named field critically and reasoning and argumentation and use comprehensibly and present specialist uprehensible way and how to focus the ven in the case of complex content. ent of disruptions. The students mon presentation media and to use them motivate the listener even during longer uage specialist literature; Analytical-
methodical competence; Scientific met confident and convincing (written and c for their documentation; Skill in logical, awareness, meticulousness; Communi	hodology; Principles of good scientific oral) presentation of (practical or theor abstract, analytical and conceptual th cation skills; Time management.	practice; Skill in the comprehensible, etical) ideas, concepts and results and inking and formal argumentation; Quality
Workload: Total: 120 h 30 h seminar (attendance) 90 h preparation of written term papers	s (self-study)	
Conditions: none		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Seminar General Mode of Instruction: seminar Language: German / English Contact Hours: 2	tive Artificial Intelligence	

Contents:

Topics in the field of "Generative Artificial Intelligence"

Literature:

References will be announced at the preliminary meeting.

Assigned Courses:

Seminar Generative Künstliche Intelligenz (seminar)

Examination Seminar Generative Artificial Intelligence written/oral exam

Module INF-0446: Seminar Softw Production Systems (Master) Seminar Software und Künstliche Intel	rare and Artificial Intelligence for	4 ECTS/LP	
Version 1.0.0 (since SoSe23) Person responsible for module: Prof. Dr. Wolfgang Reif			
Learning Outcomes / Competences: After successful completion of the sem advanced problems, concepts, method systems engineering.	inar, students are able to understand, to s, procedures, techniques and technolog	learn, to analyse and evaluate gies in the field of software and	
They known the scientific methods, communication skills and the ability to use appropriate media to present a specific topic clearly and comprehensibly in speech and writing and to discuss challenging scientific topics from the aforementioned field critically. They will also be able to recognize the logical structures of reasoning and argumentation and use them.			
The participants are able to formulate of understand how to structure a presenta the core messages and convey them in	The participants are able to formulate clearly and understandably and to present specialist knowledge freely. They understand how to structure a presentation in a clear and comprehensible way and how to focus the presentation on the core messages and convey them in a comprehensible way even for complex and advanced subjects.		
Die Studierenden verstehen es, präsent aufzutreten und souverän mit gängigen Präsentationsmedien umzugehen und diese interaktiv einzusetzen. Sie schaffen es, einen Vortrag auf eine bestimmte Zielgruppe auszurichten und den Zuhörer auch bei längeren Vortragsdauern zu motivieren und verschiedene Moderationstechniken anzuwenden.			
The students understand how to present themselves and how to deal confidently with common presentation media. They manage to focus a presentation to a specific target group and to motivate the audience and they have working knowledge of moderation techniques to guide a discussion.			
Soft Skills:			
 Literature research Independently work with English Analytical competence Working methodical Principles of good scientific pract Ability to present (written and ora to document them Ability to think logically, abstract Awareness for quality aspects Communication skills Time management Evaluation of solution approache 	technical literature tice I) ideas, concepts and results in a comp y, analytically and conceptually and to ar s, procedures, techniques and technolog	rehensible and convincing manner and gue precisely gies from different points of view	
Workload: Total: 120 h 90 h preparation of written term papers 30 h seminar (attendance)	s (self-study)		
Conditions: none			
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		

Parts of the Module

Part of the Module: Seminar Software und Künstliche Intelligenz in der Produktion (Master)

Mode of Instruction: seminar

Language: German / English

Contact Hours: 2

Contents:

The topics of the seminar deal with current trends in Software and Systems Engineering on the level of graduate students. The topics change from year to year and are regulary adapted to reflect new developments.

Literature:

Depends on the concrete topic.

Assigned Courses:

Seminar zu Software und Künstliche Intelligenz in der Produktion (Master) (seminar)

Examination

Seminar Software und Künstliche Intelligenz in der Produktion (Master)

written/oral exam / length of examination: 45 minutes

work period for assignment: 3 months

Test Frequency:

Module INF-0448: Seminar on Concurrent Systems (Master) Seminar zu nebenläufigen Systemen (Master)		4 ECTS/LP	
Version 1.0.0 (since SoSe23)			
Person responsible for module: Prof. Dr. Robert Lorenz			
Learning Outcomes / Competences: After attending the seminar, the students can independently work out and analyse advanced problems, concepts, methods, procedures, techniques, and technologies from the field of digital ethics and evaluate them in relation to the individual seminar topic			
Participants possess scientific methodology, communication skills, and the ability to present a special topic clearly and comprehensibly in speech and writing and to discuss and evaluate scientifically challenging topics from the named field critically and argumentatively.			
Furthermore, they learn to recognise logical structures of thinking and argumentation and use them in a goal- oriented manner. The participants can formulate clearly and comprehensibly and present subject content freely. They understand how to structure a talk that is clear and easy to follow. Additionally, the students know how to focus on essential messages and convey them in a comprehensible way, even with complex content. They skilfully apply chains of argumentation and solution strategies in the event of disruptions. The students understand how to confidently deal with common presentation media and use them interactively. They manage to gear a talk to a specific target group, apply various moderation techniques, and keep their audience engaged even over a longer period.			
Key qualifications: Presentation tec solution approaches, procedures, tec	nniques; literature research; principles of nniques, and technologies from different p	good scientific practice; evaluating points of view.	
Workload: Total: 120 h 90 h preparation of presentations (self-study) 30 h seminar (attendance)			
Conditions: Credit Requirements: Module Process Mining (INF-0243) - recommended Passing the module examination			
Frequency: irregular	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: 2	Repeat Exams Permitted: according to the examination regulations of the study program		
Parts of the Module			
Part of the Module: Seminar Digital Ethics (Master) Mode of Instruction: seminar Language: English / German Contact Hours: 2 ECTS Credits: 4.0			
Contents: The topics of the seminar change over time, in order to reflect up-to-date developments			
Literature:	Literature:		

Literature depends on the chosen topic

Assigned Courses:

Seminar zu Secure Coding (seminar)

Examination

Seminar Digital Ethics (Master)

written/oral exam

Test Frequency:

Module INF-0450: Clinical I	Research Data Management	5 ECTS/LP
Klinisches Forschungsdatenma	nagement	
Version 1.0.0 (since SoSe23)		
Person responsible for module:	Prof. Dr. Frank Kramer	
Yevgeniia Ignatenko		
Learning Outcomes / Competer	ences:	
Die Studierenden erwerben ein	Grundverständnis des Datenlaufkreis in de	r klinischen Forschung;
Anwendungsverständnis von Er	stellen von Formularen für Patientenumfrag	gen; Fähigkeit zur selbstständigen
Konzipierung und Erstellen eine	s minimalen Datensatzes und eigener FHIF	R- Ressource für eine medizinische Studie;
Praktisches Verständnis Extrakt	tions-, Transformations- und Ladeprozesser	n bei der Datenbereitstellung für die
Forschung; Evaluation und Aus	wertungsmöglichkeiten der erhobenen Date	en durch Machbarkeitsabfragen.
Darüber hinaus erweitern sie ihr	re Kompetenzen in den Bereichen Team- u	nd Kommunikationsfähigkeit sowie
Selbstorganisation durch die Be	arbeitung von Aufgaben.	
Schlüsselqualifikationen: Ferf	igkeit zum logischen, analytischen und kon	zeptionellen Denken; Eigenständiges
Arbeiten mit Lehrbüchern und w	vissenschaftlicher Fachliteratur, Konfiguratio	on und Anwendung der bereitgestellten
Softwaretools; Problemlösungsk	kompetenz.	
Workload:		
Total: 150 h		
30 h lecture (attendance)		
30 h exercise course (attendanc	ce)	
15 h studying of course content	using literarture (self-study)	
60 h studying of course content	through exercises / case studies (self-study	/)
15 h studying of course content	using provided materials (self-study)	
Conditions:		Credit Requirements:
Module IT Infrastructure in Medi	ical Information Systems (INF-0312) -	Passing the module exam
recommended		
Frequency: irregular	Recommended Semester:	Minimal Duration of the Module:
	from 1.	1 semester[s]
Contact Hours:	Repeat Exams Permitted:	
4	according to the examination	
	regulations of the study program	
Parts of the Module		
Part of the Module: Klinisches	s Forschungsdatenmanagement (Vorles	ung)
Mode of Instruction: lecture	-	
Language: German / English		

Contact Hours: 2

Contents:

Die Vorlesung behandelt aktuelle Themen im Kontext von Forschungsdatenmanagement.

Dazu zählen folgende Inhalte:

- Einführung in das Forschungsdatenmanagement
- Datenmanagementplan
- Der Lebenszyklus von Forschungsdaten
- ETL
- Datenverarbeitung, Datenanalyse und -Visualisierung
- Metadaten
- Datenspeicherung und -archivierung. Forschungsdaten-Repositorien
- Rechtliche Grundlagen

Literature:

- Handbuch der Medizinischen Informatik, Thomas M. Lehmann, 2. Auflage, 2014
- Biomedizinische Ontologie: Wissen strukturieren für den Informatik-Einsatz, Ludger Jamsem, Barry Smith (Hrsg.), 2008

Assigned Courses:

Klinisches Forschungsdatenmanagement (lecture)

Part of the Module: Klinisches Forschungsdatenmanagement (Übung)

Mode of Instruction: exercise course

Language: German / English

Contact Hours: 2

Assigned Courses:

Übung zu Klinisches Forschungsdatenmanagement (exercise course)

Examination

Klinisches Forschungsdatenmanagement portfolio exam Test Frequency: when a course is offered

Module INF-0453: Seminar Diagr Seminar Diagnostische Sensorik (Mas	nostic Sensing (Master) ter)	4 ECTS/LP	
Version 1.0.0 (since SoSe23)			
Person responsible for module: Prof. Dr. Sebastian Zaunseder			
Person responsible for module: Prof. Dr. Sebastian Zaunseder Learning Outcomes / Competences: Nach dem Besuch des Seminars sind die Studierenden in der Lage, grundlegende Problemstellungen, Konzepte, Methoden, Verfahren, Techniken und Technologien auf dem Gebiet der Diagnostischen Sensorik selbstständig zu erarbeiten und zu verstehen. Sie verfügen über die Arbeitstechniken, Kommunikationsfähigkeit und Fähigkeit zum Einsatz entsprechender Medien, um ein spezielles Thema in Wort und Schrift klar und verständlich zu präsentieren und Themenstellungen aus dem genannten Gebiet kritisch und argumentativ zu diskutieren. Außerdem können sie die logischen Strukturen des Denkens und Argumentierens erkennen und zielführend einsetzen. Die Teilnehmenden können klar und verständlich formulieren und Fachinhalte frei vortragen. Sie verstehen es, einen Vortrag klar und nachvollziehbar zu strukturieren und den Vortrag auf wesentliche Botschaften auszurichten und diese verständlich zu vermitteln. Die Studierenden verstehen es, präsent aufzutreten und souverän mit gängigen Präsentationsmedien umzugehen. Sie schaffen es, einen Vortrag auf eine bestimmte Zielgruppe auszurichten und den Zuhörer zu motivieren und verschiedene Moderationstechniken anzuwenden. Schlüsselqualifikationen: Literaturrecherche; Eigenständiges Arbeiten mit englischsprachiger Fachliteratur; Analytisch-methodische Kompetenz; Wissenschaftliche Methodik; Grundsätze guter wissenschaftlicher Praxis;			
logischen, abstrakten, analytischen un Akribie; Kommunikationsfähigkeit; Zeit	logischen, abstrakten, analytischen und konzeptionellen Denken und formaler Argumentation; Qualitätsbewußtsein, Akribie: Kommunikationsfähigkeit: Zeitmanagement		
Workload: Total: 120 h 90 h preparation of written term papers (self-study) 30 h seminar (attendance)			
Conditions: none		Credit Requirements: Bestehen der Modulprüfung	
Frequency: irregular	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]	
Contact Hours: Repeat Exams Permitted: 2 according to the examination regulations of the study program			
Parts of the Module			
Part of the Module: Seminar Diagno Mode of Instruction: seminar Language: German / English Contact Hours: 2 ECTS Credits: 4.0	stische Sensorik (Master)		

Contents:

Die Themen des Seminars werden jedes Mal neu festgelegt und aktuellen Entwicklungen angepasst.

Literature:

Abhängig vom gewählten Thema

Assigned Courses:

Seminar Diagnostische Sensorik (Master) (seminar)

Examination

Seminar Diagnostische Sensorik (Master) Test Frequency: when a course is offered

Modulo INE 0454: Practical Modu	up Diagnostic Sonsing (Master)	
Praktikum Diagnostische Sensorik (Ma	ister)	10 ECT3/EF
Version 1.0.0 (since SoSe23)		
Person responsible for module: Prof. Dr. Sebastian Zaunseder		
Learning Outcomes / Competences:		
Students acquire in-depth knowledge with respect to a specific topic related to medical sensing or sensor data analysis.		
Methodological competencies:		
Students are able to plan, organize and perform research independently. They can select, understand and condense scientific literature. They acquire deepened knowledge on complex algorithmic solutions as it concerns its theoretical background and its practical implementation. Students are familiar with statistical methods and have the skills to apply them in practice		
Cross-disciplinary competencies:		
The acquired competencies are basis f works.	for familiarization with novel topics and b	asic requirement for other scientific
Key qualifications:		
Ability to think logically, analytically, and conceptually; independent research using textbooks, scientific works, manuals, and documentation; presentation of ideas, concepts, and results in an understandable, confident, and persuasive manner; awareness of quality; communication skills; ability to work in teams and understand team processes; knowledge of practical tasks		
Workload: Total: 300 h 15 h seminar (attendance) 285 h internship / practical course (self-study)		
Conditions: Credit Requirements: none Bestehen der Modulprüfung		
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]
Contact Hours: Repeat Exams Permitted: 1 according to the examination regulations of the study program		
Parts of the Module		
Part of the Module: Praktikum Diagnostische Sensorik (Master) Mode of Instruction: internship Language: German / English Contact Hours: 1 ECTS Credits: 10.0		

Contents:

Students work on a current research project related to sensing or sensor data analysis. The tasks to be performed by students typically comprise literature review, practical parts (programming, data acquisition, commissioning), (quantitative) evaluation, documentation and presentation. According to the research foci of the professorship, there are different areas for topics to choose from:

- · experimental works related to innovative sensing modalities
- · development and evaluation of methods for intelligent patient monitoring
- · development and evaluation of methods to predict severe complications from multimodal sensor data
- · development and characterization of novel methods for sensor data fusion
- · application of machine learning for sensor data processing

Literature:

Depending on the selected topic

Assigned Courses:

Praktikum Diagnostische Sensorik (Master) (internship)

Examination Praktikum Diagnostische Sensorik (Master) portfolio exam Test Frequency: when a course is offered
Module INF-0455: Project Mod Projektmodul Diagnostische Sensc	dule Diagnostic Sensing	10 ECTS/LP
Version 1.0.0 (since SeSe22)		
Person responsible for module: Pro	of, Dr. Sebastian Zaunseder	
Learning Outcomes / Competence		
Nach der Teilnahme am Projektmo auf dem Gebiet der diagnostischen Fähigkeiten. Sie können Konzepte, in Forschungsprojekten entwickeln anzuwenden. Dadurch ist es ihnen wissenschaftlichen Beitrag auf dies Team- und Kommunikationsfähigke Problemstellungen auf dem Gebiet innovative Ideen kritisch zu bewerte Schlüsselqualifikationen: Fertigk mit englischsprachiger Fachliteratu und Ergebnissen; Qualitätsbewußts Verstehen von Teamprozessen; Gr	dul verstehen die Studierenden Problems Sensorik und verfügen dort über tieferge Methoden, Verfahren, Techniken und Te und sind fähig, innovative Methoden bei o möglich, an die internationale Forschung em Gebiet zu leisten. Darüber hinaus ver eit, die Fähigkeit zur Literaturrecherche un zu diskutieren, Zwischenziele zu definiere en, einzuordnen, zu kombinieren und zu p eit zum logischen, analytischen und konze r; Verständliche, sichere und überzeugen sein; Kommunikationsfähigkeit; Fertigkeit undsätze guter wissenschaftlicher Praxis;	tellungen höherer Komplexität nende Fachkenntnisse und chnologien des genannten Gebiets ler Lösung von Problemen anzuknüpfen und ihren eigenen fügen die Studierenden über die d die wissenschaftliche Methodik, um en, sowie Zwischenergebnisse und räsentieren. eptionellen Denken; Eigenständige Arbeit de Präsentation von Ideen, Konzepten der Zusammenarbeit in Teams und Projektmanagementfähigkeiten;
Wissenschaftliche Methodik	-	• <u>-</u> -
Total: 300 h 285 h internship / practical course (15 h seminar (attendance) Conditions: none	self-study)	Credit Requirements: Bestehen der Modulprüfung
Frequency: each semester	Recommended Semester:	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 1	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Projektmodu Mode of Instruction: internship Language: German / English Contact Hours: 1	I Diagnostische Sensorik	
Contents: Aktuelle Forschungsthemen		
Literature: Wissenschaftliche Aufsätze		
Assigned Courses:		
Oberseminar Diagnostische Sen	sorik	

Examination

Projektmodul Diagnostische Sensorik

practical exam

Test Frequency:

when a course is offered

Module INF-0456: Content Creati	on for Virtual Environments	8 ECTS/LP
Person responsible for module: Prof. D)r. Elisabeth André	
Learning Outcomes / Competences: After successful completion of this mod and integrating 2D/3D graphics and au language of application-relevant discip hand and generatively with procedural the content into applications, to develo of confident and convincing presentation of results, as well as creative, aesthetic promoted within this framework.	dule, students will understand essential of dio for virtual environments. They have lines. Within the framework of the lecture methods and algorithms, taking into acc p algorithms independently and to imple on of ideas and concepts, comprehensib c, musical, logical, analytical and concep	concepts and techniques for making the knowledge of the mindset and e, they learn to create content by count design principles, to integrate ment them technically. The skills le presentation and documentation otual thinking are also particularly
Key Qualifications: Aesthetic, design, and confident application of appropriate complex computer science problems, s understanding of team processes, skill and conflicting interests, quality aware	, artistic, and musical fundamentals, des e methods, interdisciplinary knowledge, skill in developing and implementing solu in working in teams, self-reflection; action ness, meticulousness.	ign of virtual worlds, selection skill in analyzing and structuring ution strategies for complex problems, ng responsibly in the face of inadequacy
Total: 240 h 60 h exercise course (attendance) 30 h lecture (attendance) 15 h studying of course content using p 120 h studying of course content throug 15 h studying of course content using l	provided materials (self-study) gh exercises / case studies (self-study) iterarture (self-study)	
Conditions: none		
Frequency: each summer semester	Recommended Semester: from 1.	Minimal Duration of the Module: 1 semester[s]
Contact Hours: 6	Repeat Exams Permitted: according to the examination regulations of the study program	
Parts of the Module		
Part of the Module: Content Creation Mode of Instruction: lecture Language: German / English Contact Hours: 2	n for Virtual Environments (Lecture)	
Assigned Courses:		
Content Creation for Virtual Environ	ments (lecture)	
Part of the Module: Content Creation Mode of Instruction: exercise course Language: German / English Contact Hours: 4	n for Virtual Environments (Exercise (Course)

Assigned Courses:

Übung zu Content Creation for Virtual Environments (exercise course)

Examination Content Creation for Virtual Environments portfolio exam