

**Examination Regulations of the Department of Applied Computer Science at Fulda University of Applied Sciences for the Master of Science study programme Global Software Development from 22 January 2020, amended on 14 April 2021**

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Table of contents:

Article 1 Study Programme Objectives, Academic Title

Article 2 Access Requirements, Admission

Article 3 Application Documents

Article 4 Standard Duration of Studies, ECTS Credits for the Programme

Article 5 Subsequent Acquisition of ECTS Credits

Article 6 Modules

Article 7 Study Abroad

Article 8 Final Thesis Module: Master's Thesis in Global Software Development

Article 9 Calculation of Module Grades

Article 10 Free Examination Attempt, Grade Improvement, Record of Examination Attempts

Article 11 Calculation of Overall Degree Grade

Article 12 Entry into Force, Transitional Rules

Annex 1: Curriculum Structure

Annex 2: Module Descriptions

Annex 3: Internship Regulations

**Article 1 Study Programme Objectives, Academic Title**

- (1) Global Software Development involves the design and implementation of complex software systems in a team that may be spread across different locations around the world. This study programme aims to equip graduates with the skills needed to work successfully as part of a team and to potentially head such teams in the future. Fundamental to students' individual preparation for these career roles is to experience time spent abroad. Furthermore, in addition to specialist technical knowledge at various levels, ranging from infrastructure to mobile front-end, you will in particular learn methodological principles and their application as part of an intercultural team. The study programme's sound academic foundation and its practical orientation enable students to solve problems independently, to recognise recurring concepts and to execute and reflect on their actions in a methodologically sound manner.

- (2) The Master's examination for the Global Software Development study programme is intended to ensure that graduates have acquired advanced specialist knowledge, can successfully tackle both practical and fundamental problems and have the ability to develop and apply academic methodologies and findings.
- (3) Students graduating from the study programme are awarded a Master of Science degree (abbreviation: MSc).

### **Article 2 Access Requirements, Admission**

- (1) The access requirements are:

A completed university degree in computer science or closely-related discipline at a German university or at a comparable university abroad. German standards require that this completed degree lasts at least seven semesters and is worth 210 ECTS credit points. This means that applicants with a degree completed abroad must prove that their degree is equivalent to at least three-and-a-half years of a German study programme.

If applicants acquired a qualifying degree at a German or international higher education institution worth only 180 ECTS credits, an additional 30 ECTS credits must be earned during the Master's study programme.

The grade average of the qualifying degree must be 2.5 or better, or 75% of the maximum attainable overall grade.

An aptitude test conducted by the Department of Applied Computer Science provides proof of the applicant's suitability for the subject. This expertise includes adequate competencies from the field of applied computer science, such as programming, algorithms and data structures, software engineering and databases, as well as from application areas such as communication systems, media informatics, enterprise applications or embedded systems. Applicants who have a university degree from a country where ECTS standards apply can be exempted from taking this aptitude test. This decision is taken by the head of the study programme.

Certified English language proficiency, usually verified by a TOEFL test (minimum test score requirements: computer-based 213 points; paper-based 550 points; internet-based 85 points).

Alternatively, an IELTS test with a band score of 6.5 and higher is also accepted.

- (2) Admission to the study programme is in the summer and winter semesters.

### **Article 3 Application Documents**

The following documents are required to apply:

- One-page curriculum vitae in tabular format including one passport photo (4cm x 5cm)
- Proof of English language proficiency
- If required, proof of German language proficiency
- Secondary school-leaving certificate
- First-degree certificate stating academic title attained
- Transcript of records for first degree with full listing of all subjects studied and grades attained therein (incl. explanation of awarding university's grading system).

#### **Article 4 Standard Duration of Studies, ECTS Credits for the Programme**

The programme has a standard duration of three semesters, during which students are required to earn a total of 90 ECTS credit points (credits)

#### **Article 5 Subsequent Acquisition of ECTS Credits**

- (1) Students must provide evidence that they have made up any original ECTS credits deficit in line with Article 2(2) by the time they complete the study programme. Students who choose the Master's Internship module (AI5119) in order to make up their ECTS credits deficit must complete this module prior to taking the Master's Thesis in Global Software Development (AI5117) module.
- (2) Article 5 in its current version regulates the subsequent acquiring of ECTS credits unless this is regulated in Article 7 (Study Abroad). Article 5 thus applies to students who are required to make up a ECTS credit deficit but who are not obliged to undertake a further period of study abroad.
- (3) Students can make up an ECTS credits deficit via the Additional Courses (AI4001) module. This involves taking Department of Applied Computer Science modules worth 30 ECTS credits which meaningfully complement their studies to date in terms of the qualification they are working towards. This route requires sufficient German language proficiency (DSH2 level). Students should choose courses in consultation with the study programme heads.
- (4) Students who do not meet the requirements stated in Article 3 for taking a module due to inadequate German language proficiency can, in the third semester, instead take the Master's Internship module (AI5119) working in-house at a company, organisation or research institution in Germany. To be eligible for the Master's Internship module (AI5119), students must have already successfully completed modules worth a total of 40 ECTS credits. The Master's Internship module (AI5119) as a rule encompasses 20 weeks. During this period, students are to be employed for the same number of working hours as a full-time employee. Periods of absence during the internship must be made up for subsequently. The details in this respect are defined in the Internship Regulations (Annex 3).
- (5) Furthermore, students who do not fulfil the requirements for taking modules in accordance with section (3) because they lack the required German language skills can obtain the required level of certified language proficiency by taking language courses worth 30 ECTS credits as part of the German Language module (AI5118).
- (6) Combining the alternatives mentioned in sections 4 and 5 is ruled out.

#### **Article 6 Modules**

- (1) The study programme includes the modules Cloud Computing (AI5029), Big Data and NoSQL Databases (AI5025), Model-Driven Development (AI5084), Reconfigurable Computing (AI5100), Programming Paradigms (AI5055), Building Web and Mobile Apps (AI5036), Distributed Applications (AI5109), Global Distributed Software Development (AI5088), Machine Learning (AI5031), Parallel Programming (AI5085), Test-Oriented Development (AI5086), Intercultural Communication and Scientific Work (SK5900), Master's Thesis in Global Software Development (AI5117) and one elective module (see Section 3).

In addition, two modules from those listed above – excluding Intercultural Communication and Scientific Work (SK5900) and the Final Thesis Module (AI5117) – can each be replaced by another module from the list of elective modules (see Section 3).

Students subsequently acquiring ECTS credits in accordance with Article 3 (2) also take one of the following modules: Intercultural Study of Computer Science (AI5092), Additional Courses (AI4001), German Language (AI5118) or Master's Internship (AI5119).

- (2) The structure of the curriculum is set out in Annex 1.
- (3) Students choose one module from the following list of elective modules:
  - Intercultural Project Management (SK5901)
  - Software Development Project (AI5094)
  - Research Project (AI5016)
  - Special Topic in Global Software Development (AI5095)
  - Advanced Big Data (AI5122)
  - Cryptography – Theory and Application (AI5046)
  - User-Centered Development (AI5083)

#### **Article 7 Study Abroad**

- (1) All students who have not already completed at least one semester abroad as part of a Bachelor's degree programme must complete a period of study at a university in a non-German speaking country or, in order to make up the 30 ECTS credits deficit, shall take the Master's Internship module (AI5119) in the form of an internship abroad. If admission to this Master's programme was granted on the basis of a Bachelor's degree awarded by a university in a non-German-speaking country, no further period of study abroad is required.
- (2) Students who are required to complete a period of study abroad in accordance with Article 2(2) regarding the subsequent acquisition of required ECTS credits and in line with section 1 above, shall do so by completing the Intercultural Study of Computer Science (AI5092) module, generally in the third semester. In this case, the third semester as scheduled in the curriculum becomes the fourth semester.
- (3) Students who are not required by Article 2(2) to make up any ECTS credits but who are required by Article 7(1) to complete a period of study abroad shall generally complete their period of study abroad in the ordinarily scheduled second or third semester.
- (4) Further details are specified in the separate regulations issued by the Department of Applied Computer Science for the period of study abroad.

#### **Article 8 Final Thesis Module: Master's Thesis in Global Software Development**

- (1) The Master's Thesis in Global Software Development (AI5117) module consists of a Master's thesis and a Colloquium (Viva voce).
- (2) The period of time allowed for the Master's Thesis is six months. This period can, at the request of the student, be extended once by up to four weeks by the first examiner.
- (3) The first examiner for the thesis must be a professor in the Department of Applied Computer Science.

### **Article 9 Calculation of Module Grades**

- (1) Grades are awarded for all modules except Intercultural Study of Computer Science (AI5092), Additional Courses (AI4001), German Language (AI5118) and Master's Internship (AI5119).
- (2) No grade is awarded for the Colloquium (Viva voce) in the Master's Thesis in Global Software Development (AI5117) module. The grade obtained for the Master's Thesis is therefore the grade for the whole module.
- (3) If the modules Intercultural Study of Computer Science (AI5092), Additional Courses (AI4001), German Language (AI5118) or Master's Internship (AI5119) as well as the Colloquium (Viva voce) in the Master's Thesis in Global Software Development module (AI5117) are completed successfully, students receive the assessment statement "completed successfully".

### **Article 10 Free Examination Attempt, Grade Improvement, Record of Examination Attempts**

- (1) Up to two module examinations taken in the first two semesters can be deemed as not counting as examinations taken if the student failed them on their first attempt ("Free Attempt"), or if they passed the examinations but wish to retake them to try and better their grade (Grade Improvement). The higher of the grades attained shall be declared the official grade. Article 20(3) of the General Provisions for Examination Regulations (ABPO) 2018 shall apply accordingly. The General Provisions for Examination Regulations do not apply to the Master's Thesis in Global Software Development (AI5117) module.
- (2) Failed examination attempts and credits for coursework and examinations in identical modules from other study programmes are taken into account in the final grade.

### **Article 11 Calculation of Overall Degree Grade**

- (1) The study programme is deemed to have been successfully completed by students if they at least receive the assessment "sufficient" ("ausreichend") for all modules that the degree programme requires them to take.
- (2) The overall degree grade is calculated as the weighted arithmetic mean of the ECTS credits attained in the modules.

### **Article 12 Entry into Force, Transitional Rules**

- (1) These Examination Regulations enter into force on 1 October 2020.
- (2) Students already enrolled on the Global Software Development study programme before these Examination Regulations come into force will by default complete their studies in line with the previously applicable Examination Regulations of 17.10.2018, amended on 22.01.2020. This option will lapse at the end of the winter semester 2022/2023. Previously completed modules and credits acquired will then be recognised in accordance with a recognition scheme adopted by the Departmental Council. It is possible for students to voluntarily change to these new examination regulations upon request.

## Annex 1: Curriculum Structure

### Curriculum for students pursuing a seven-semester first degree, module overview with forms of examination

Module ID	Module	Type of examination
	<b>Semester 1 (Summer)</b>	
AI5029	Cloud Computing	Written assignment or written examination
AI5025	Big Data and NoSQL databases	Written examination or project work
AI5084	Model-Driven Development	Portfolio or written examination
AI5100	Reconfigurable Computing	Written examination or oral interview
AI5055	Programming Paradigms	Written examination or term paper
	Elective module <ul style="list-style-type: none"> <li>• Intercultural Project Management (SK5901)</li> <li>• Software Development Project (AI5094)</li> <li>• Special Topic of Global Software Development (AI5000)</li> <li>• Research Project (AI5016)</li> <li>• Advanced Big Data (AI5122)</li> <li>• Cryptography – Theory and Application (AI5046)</li> <li>• User-Centered Development (AI5083)</li> </ul>	Project work or presentation  Presentation  Project work or written examination or presentation  Project work or written assignment  Portfolio  Written examination or oral interview  Portfolio
	<b>Semester 2 (Winter)</b>	
AI5036	Building Web and Mobile Apps	Portfolio
AI5109	Distributed Applications	Written examination or oral interview
AI5088	Global Distributed Software Development	Project work or presentation
AI5031	Machine Learning	Written examination
AI5085	Parallel Programming	Term paper or oral interview
AI5086	Test-Oriented Development	Term paper or written examination

	<b>Semester 3 (Summer)</b>	
AI5117	Master's Thesis in Global Software Development	Term Paper and Colloquium (Viva voce)
SK5900	Intercultural Communication and Academic Research	Portfolio or presentation

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**Curriculum for students doing a six-semester first degree, module overview with forms of examination**

Module ID	Modules	Type of examination
	<b>Semester 1 (Summer)</b>	
AI5029	Cloud Computing	Written assignment or written examination
AI5025	Big Data and NoSQL databases	Written examination or project work
AI5084	Model-Driven Development	Portfolio or written examination
AI5100	Reconfigurable Computing	Written examination or oral interview
AI5055	Programming Paradigms	Written examination or term paper
	Elective module <ul style="list-style-type: none"> <li>• Intercultural Project Management (SK5901)</li> <li>• Software Development Project (AI5094)</li> <li>• Special Topic of Global Development (AI5000)</li> <li>• Research Project (AI5016)</li> <li>• Advanced Big Data (AI5122)</li> <li>• Cryptography – Theory and Application (AI5046)</li> <li>• User Centered Development (AI5083)</li> </ul>	Project or presentation Presentation Project work or written examination or presentation Project work or written assignment Portfolio Written examination or oral interview Portfolio
	<b>Semester 2 (Winter)</b>	
AI5036	Building Web and Mobile Apps	Portfolio
AI5109	Distributed Applications	Written examination or oral interview
AI5088	Global Distributed Software Development	Project or presentation
AI5031	Machine Learning	Written examination
AI5085	Parallel Programming	Term paper or oral interview
AI5086	Test-Oriented Development	Term paper or written examination



	<b>Semester 3/4 (Summer)</b>	
	<p>Modules for subsequent acquisition of 30 ECTS credits:</p> <ul style="list-style-type: none"> <li>• Master's Internship (AI5119) (3rd Semester)</li> <li>• Additional Courses (AI4001)</li> <li>• German Language (AI5118)</li> <li>• Intercultural Study of Computer Science (AI5092)</li> </ul>	<p>Report</p> <p>Refer to the module description for the chosen modules</p> <p>Dependent on modules offered</p> <p>The examination formats depend on which modules are offered by the university abroad.</p>
	<b>Semester 3/4 (Summer)</b>	
AI5117	Master's Thesis in Global Software Development	Term Paper and Colloquium (Viva voce)
SK5900	Intercultural Communication and Academic Research	Portfolio or presentation

**Annex 2: Module descriptions**

Compulsory modules .....	11
AI5029    Cloud Computing .....	11
AI5025    Big Data and NoSQL databases .....	13
AI5084    Model-Driven Development.....	15
AI5100    Reconfigurable Computing.....	17
AI5055    Programming Paradigms.....	19
AI5036    Building Web and Mobile Apps .....	20
AI5109    Distributed Applications.....	21
AI5088    Global Distributed Software Development.....	22
AI5031    Machine Learning .....	23
AI5085    Parallel Programming.....	24
AI5086    Test-Oriented Development .....	25
SK5900    Intercultural Communication and Academic Research.....	26
AI5117    Master's Thesis in Global Software Development.....	27
Elective modules .....	28
SK5901    Intercultural Project Management.....	28
AI5094    Software Development Project.....	29
AI5095    Special Topic in Global Software Development.....	30
AI5016    Research Project.....	31
AI5122    Advanced Big Data.....	32
AI5046    Cryptography - Theory and Application .....	34
AI5083    User-Centered Development.....	35
Modules to make up 30 ECTS credits deficit.....	37
AI5119    Master's Internship .....	37
AI4001    Additional Courses .....	38
AI5118    German Language.....	39
AI5092    Intercultural Study of Computer Science .....	40

**Compulsory modules:**

<b>AI5029 Cloud Computing</b>				
<b>Department code:</b>	<b>Module name in German:</b> Cloud Computing			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 1 AIM (2017): Semester 2	<b>Frequency of</b> AI, GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Compulsory module AIM: Compulsory module (Embedded Systems, Inter- net Engineering)	<b>Academic</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<p><b>Learning outcomes:</b></p> <p><b>Knowledge:</b> Cloud Computing has led to a wide array of new usage and operation strategies for IT services over recent years. Students will learn the fundamental principles of cloud-based services, required virtualisation solutions and their deployment.</p> <p><b>Skills:</b> Students will be able to design and implement cloud services as well as use in-house cloud infrastructures. Students will gain insight into the current state of the art of research in this field and will acquire the skills needed to engage in their own research in the field.</p> <p><b>Competencies:</b> Students will be able to evaluate and develop cloud-based services in terms of flexible deployment, scalability, security and data protection. Students will also be able to analyse the costs of using cloud services in their own projects and design suitable IT sourcing models.</p>			
<b>2</b>	<p><b>Module content:</b></p> <ul style="list-style-type: none"> <li>• Fundamentals: History of cloud computing, system requirements for cloud computing systems, virtualisation</li> <li>• Cloud computing: taxonomy, evolution, characteristics</li> <li>• Service models: IaaS, PaaS, SaaS</li> <li>• Deployment models: public cloud, private cloud</li> <li>• Reference architectures: technical realisation, layer models</li> <li>• Use cases and practical implementation: compute/storage/network cloud, apps</li> <li>• Migration and integration strategies: cloud federation, hybrid/multi cloud</li> <li>• Cloud computing from the perspective of users and operators: IT sourcing, cost/benefit</li> <li>• Limits of the cloud: risks, security, data privacy</li> <li>• Outlook: future developments, alternatives</li> </ul>			
<b>3</b>	<p><b>Teaching and learning methods:</b> 2 SWS seminar 2 SWS internship</p>			
<b>4</b>	<p><b>Module language:</b> German or English</p>			
<b>5</b>	<p><b>Pre-requisites for studying this module:</b> Required: none Recommended: Programming, computer networks, virtualisation techniques and operating systems</p>			
<b>6</b>	<p><b>Type of examination:</b> Written assignment or written examination</p>			

<b>7</b>	<b>Assessment methods:</b> Graded
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination
<b>9</b>	<b>Other remarks:</b> None

translation; legally non-binding

<b>AI5025 Big Data and NoSQL Databases</b>				
<b>Department code:</b>		<b>Module name in German:</b> BigData und noSQL Datenbanken		
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 1 GSD (2018/ 2020): Semester 1	<b>Frequency of</b>  AIM: Winter semester GSD: Summer semester	<b>Duration:</b>  1 semester
<b>Module type:</b> AIM Compulsory module (Business IT) GSD: Compulsory module		<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>	
<b>1</b>	<b>Learning outcomes:</b> Students will demonstrate an understanding of the restrictions inherent in established relational database systems. Further applications and use cases will be examined in more detail based on individual examples, for which appropriate architectural strategy will be developed. Students will receive hands-on training on the application of the fundamental components of the Hadoop ecosystem. The programme examines advanced new approaches in the Big Data and NoSQL setting. On completing the module, students will be able to identify and evaluate Big Data and NoSQL use cases. They will have gained an understanding of the ecosystem and acquired the applied skills needed in using and implementing the fundamental components.			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>Advanced functions of relational databases (transactions, consistency, backup &amp; recovery, replication)</li> <li>Advanced motivation (requirements, environment, use cases)</li> <li>Hierarchical and unstructured data</li> <li>Basic concepts / architecture (scalability, failover, etc.)</li> <li>Hadoop fundamentals: HDFS (Hadoop Distributed File System)</li> <li>MapReduce and programming (hands-on)</li> <li>Hadoop integration</li> <li>Enterprise environment: Scoop, Flume, etc.</li> <li>Hadoop scripting: Hive (&amp; Pig)</li> <li>Hadoop administration (Oozie, Zookeeper, Cloudera / Hortonworks)</li> <li>New tools in the Hadoop ecosystem (Tableau, Pentaho, etc.)</li> <li>Real-time applications: Apache Spark</li> <li>Other approaches: XML databases (MarkLogic), time series (Influx), graph databases (Neo4J), Exadata</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Database Technologies			
<b>6</b>	<b>Type of examination:</b> Written examination or project work			
<b>7</b>	<b>Assessment methods:</b> Graded			

<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Student must pass module examination
<b>9</b>	<b>Other remarks:</b> None

translation; legally non-binding

<b>AI5084 Model-Driven Development</b>				
<b>Department code:</b>		<b>Module name in German:</b> Modellgetriebene Entwicklung		
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours		<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b> GSD: Summer semester
<b>Duration:</b> 1 semester		<b>Module type:</b> GSD: Compulsory module		
<b>Academic level:</b> Master's degree		<b>Suitability of module:</b>		
<b>1</b>	<p><b>Learning outcomes:</b> Students will demonstrate an understanding of the process of model-driven development. This includes in particular the development and customisation of relevant tools. Students will be able to follow the historical paradigm shift, from the idea that everything is an object to the more abstract idea that everything is a model. They will be able to identify areas of application for model-driven development.</p> <p>Specifically, they will be able to:</p> <ul style="list-style-type: none"> <li>• explain the importance of precision and completeness of models</li> <li>• define and work with domain-specific languages</li> <li>• develop model transformations and code generators</li> <li>• apply and implement refactorings throughout the entire development process</li> <li>• work with complex language specifications as a reference</li> </ul>			
<b>2</b>	<p><b>Module content:</b></p> <ul style="list-style-type: none"> <li>• Unified Modelling Language (UML) and Object Constraint Language (OCL)</li> <li>• Concepts for domain-specific adaptation of a modelling language (e.g. UML profiles)</li> <li>• Definition of concrete and abstract syntax of visual and textual domain-specific languages (metamodelling and EBNF)</li> <li>• Concepts and frameworks for implementing model transformations</li> <li>• Concepts and frameworks for code generation</li> <li>• Usage and implementation of refactorings in the context of constraints, models and code</li> <li>• Standards informing the changing and serialisation of models</li> <li>• Possible applications of model-driven development (e.g. in application development for re-configurable hardware)</li> </ul>			
<b>3</b>	<p><b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship</p>			
<b>4</b>	<p><b>Module language:</b> German or English</p>			
<b>5</b>	<p><b>Pre-requisites for studying this module:</b> Required: none Recommended: Experience in modelling (UML, E/R or process modelling); basic knowledge of formal languages; sound knowledge of object-oriented programming in Java and object-oriented design</p>			
<b>6</b>	<p><b>Type of examination:</b> Portfolio or written examination</p>			
<b>7</b>	<p><b>Assessment methods:</b> Graded</p>			
<b>8</b>	<p><b>Requirements for awarding ECTS credits:</b> Students must pass module examination</p>			

9	<b>Other remarks:</b> None
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<b>AI5100 Reconfigurable Computing</b>				
<b>Department code:</b>	<b>Module name in German:</b> Reconfigurable Computing			
<b>Workload:</b> 150 hrs, made up of 54 contact hours 96 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> AIM (2017): Semester 2/3 GSD (2020): Semester 1	<b>Frequency of module:</b> AIM: Winter or summer semester GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> AIM: Elective module (Embedded Systems, Internet Engineering) GSD: Compulsory module	<b>Academic</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Reconfigurable computing systems, through the massive parallelism they provide, offer a powerful platform for the realisation of computationally intensive applications in embedded systems as well as in data centres. On this course, students will learn the structure and functionality of computing systems containing reconfigurable hardware units and implement concrete applications for these systems. Upon successful completion of this course, students will be able to <ul style="list-style-type: none"> <li>• evaluate the design of heterogeneous reconfigurable computing systems with CPU and FPGA components,</li> <li>• understand algorithms of high-level synthesis (HLS) and hardware/software code design,</li> <li>• break down a given problem into hardware and software parts,</li> <li>• design reconfigurable logic using HLS,</li> <li>• implement the communication interfaces between hardware and software, and</li> <li>• influence the design space of the HLS accordingly to meet given objectives.</li> </ul>			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>• Design of modern reconfigurable computing systems such as System-On-Chips (SoCs), which include both CPUs and FPGA</li> <li>• FPGA design using High-Level Synthesis (HLS)</li> <li>• Important algorithms of HLS (scheduling, allocation binding)</li> <li>• System design using hardware/software codesign</li> <li>• Important algorithms of hardware/software codesign</li> <li>• Design space exploration</li> <li>• HLS design using C/C++ as an example</li> <li>• Execution of a specific project using hardware/software codesign and HLS</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Digital technology and computing systems			
<b>6</b>	<b>Type of examination:</b> Written examination or oral interview			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			

9	<b>Other remarks:</b> None
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translation; legally non-binding

<b>AI5055 Programming Paradigms</b>				
<b>Department code:</b>		<b>Module name in German:</b> Programmierparadigmen		
<b>Workload:</b> 150 hrs, made up of 54 contact hours 96 self-study hours		<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b> GSD: Summer semester
<b>Module type:</b> GSD: Compulsory module		<b>Academic level:</b> Master's	<b>Suitability of module:</b>	
<b>1</b>	<b>Learning outcomes:</b> Students will be able to distinguish between different programming paradigms and make well-founded choices for given problems. They can identify and use the different varieties of type systems, polymorphism and functional constructs in new programming languages. They will be able to implement an interpreter for a simple functional language (in particular: polymorphic type inference). They will be able to explain the fundamental concepts of logic programming and thus solve simple logical problems (e.g. Sudoku).			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>• Functional programming concepts</li> <li>• Recursion versus Iteration</li> <li>• Different types of polymorphism (parametric, subtype, ad hoc)</li> <li>• Continuation-passing style</li> <li>• Monads</li> <li>• Hindley-Milner type inference</li> <li>• Implementation of an interpreter for a small functional language</li> <li>• Unification</li> <li>• Logic programming</li> <li>• Backtracking, cut points</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Object-oriented programming, procedural programming			
<b>6</b>	<b>Type of examination:</b> Written examination or term paper			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5036 Building Web and Mobile Apps</b>				
<b>Department code:</b>	<b>Module name in German:</b> Building Web and Mobile Apps			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 2/3 GSD (2018/ 2020): Semester 2	<b>Frequency of module:</b> AIM: Winter or summer semester GSD: Winter semester	<b>Duration:</b>  1 semester
<b>Module type:</b> AIM: Elective module (Media Informatics) GSD: Compulsory module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will acquire knowledge of modern mobile and web applications through cross-platform tools and frameworks. They will also learn how to programme web apps and native apps. Further topics covered include using HTML5 technologies in mobile-optimised web apps, asynchronous APIs, device sensors, etc. as well as appropriate server-side technologies.			
<b>2</b>	<b>Module content:</b> The advancements of web technologies have led to websites evolving into complex web applications. There is currently a convergence of application platforms, while the ever-increasing use of mobile devices, such as smartphones and tablets, leads to a divergence of system platforms. This course therefore teaches students application development in mobile operating systems and covers the following topics: <ul style="list-style-type: none"> <li>• Desktop vs. web applications</li> <li>• Web framework concepts</li> <li>• Web APIs</li> <li>• Frameworks for creating mobile apps</li> <li>• Testing and debugging using emulators</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Good knowledge of programming			
<b>6</b>	<b>Type of examination:</b> Portfolio			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5109 Distributed Applications</b>				
<b>Department code:</b>	<b>Module name in German:</b> Verteilte Anwendungen			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2020): Semester 2	<b>Frequency of module:</b> GSD (2020): Winter semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD (2020): Compulsory module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> This module aims to equip students with sound knowledge and understanding of distributed software systems, including in particular distributed web applications and enterprise applications. The module is also designed to teach the role played by application architectures and the importance of application integration as a central function of applied computer science. Students will gain a thorough understanding of the requirements of complex distributed systems alongside a sound understanding of the role of modern middleware and distribution strategies. On this course students will: <ul style="list-style-type: none"> <li>• acquire knowledge of the key architectures for distributed applications and be able to draw comparisons between them.</li> <li>• acquire knowledge of various techniques and programming languages for server-side development</li> <li>• be able to assess the importance of software architecture for SOA and EAI</li> <li>• be able to design an appropriate software architecture for a distributed sample application</li> </ul>			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>• Architectures of distributed web-based applications</li> <li>• Roles, objectives and functions of middleware</li> <li>• Current middleware services and architecture designs. The module deals with different middleware designs/concepts (for example, Corba as an initial approach, distributed object models, messaging, queuing, publish/subscribe, peer-to-peer) and communication paradigms (for example, request/reply, multicast communication).</li> <li>• Web services, microservices and service-oriented architecture</li> <li>• Modern programming languages for server-side development</li> <li>• Frameworks and design templates for distributed applications</li> <li>• Application servers</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Good knowledge of programming in Java or C, fundamentals of software engineering			
<b>6</b>	<b>Type of examination:</b> Written examination or oral interview			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination, and must have actively participated in and successfully completed the internship			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5088 Global Distributed Software Development</b>				
<b>Department code:</b>	<b>Module name in German:</b> Konzeption und Implementierung verteilter Anwendungen in globalen Entwicklerteams			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 2	<b>Frequency of module:</b> GSD: Winter semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Compulsory module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> On completing this module, students will have acquired sound knowledge of how to design and implement a distributed (web) application in a global setting. They will demonstrate an understanding of how to work with team members from different cultural backgrounds who are located in different locations and time zones. Students will be able to apply software engineering and programming techniques to create applications that fulfil customer requirements. They will become familiar with current tools and techniques that support distributed development in teams.			
<b>2</b>	<b>Module content:</b> Students will undertake a group project to learn about and implement key aspects of software engineering in an environment that simulates globally distributed software development companies. They will assume the typical roles of Developer, Technical Lead and Manager. The module provides a thorough and advanced overview of practical methods and tools used in software engineering, as well as its organisational, team-oriented and communication aspects. Particular emphasis is placed on iterative, incremental, agile and user-centred design methods, as well as on global software engineering in which teams are geographically and culturally disparate. The fundamentals of intellectual property, licensing, digital rights management, copyright and software development ethics are discussed in this module. This project provides an integrative experience in the project organisation and teamwork involved in software, thus complementing the students' core skills in computer science.			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS Internship Project with accompanying practical work in a laboratory; presentations by guests and students			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Good knowledge of programming in Java or Python, knowledge of JavaScript and HTML			
<b>6</b>	<b>Type of examination:</b> Project work or presentation			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5031 Machine Learning</b>				
<b>Department code:</b>	<b>Module name in German:</b> Machine Learning			
<b>Workload:</b> 150 hrs, made up of 54 contact hours 96 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 3 GSD (2018/ 2020): Semester 2	<b>Frequency of module:</b>  AIM, GSD: Winter semester	<b>Duration:</b>  1 semester
<b>Module type:</b> GSD: Compulsory module AIM: Compulsory module (Data Science)	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will master the mathematical and conceptual fundamentals of the statistical theory of learning. They will demonstrate an understanding of several common learning algorithms and will be able to apply them in practice (using suitable standard libraries). They will demonstrate knowledge of the challenges that arise in the practical application of object and pattern recognition and will be able to master the key approaches to solving these. They will be able to understand current academic developments and applications in the field of Deep Learning.			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>• Reflections on and historical overview of the subject of machine intelligence</li> <li>• Mathematical and conceptual fundamentals of machine learning</li> <li>• Pattern recognition and object detection</li> <li>• Support-vector machines</li> <li>• Neural networks</li> <li>• Deep Learning</li> <li>• Unsupervised learning</li> <li>• Incremental learning processes</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 1 SWS internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Good knowledge of C/C++			
<b>6</b>	<b>Type of examination:</b> Written examination			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination and regularly submit practice assignments			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5085 Parallel Programming</b>				
<b>Department code:</b>		<b>Module name in German:</b> Parallelverarbeitung		
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 2 GSD (2018/ 2020): Semester 2	<b>Frequency of module:</b>  AIM, GSD: Summer semester	<b>Duration:</b>  1 semester
<b>Module type:</b> AIM, GSD: Compulsory module		<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>	
<b>1</b>	<b>Learning outcomes:</b> The students will be proficient in the techniques for programming parallel processes on multi-core / multi-processor systems as well as in heterogeneous, distributed systems. After completing the module, students will be able to develop solutions for given problems independently. Assignments are mainly implemented in the C programming language under Linux. Students will gain experience in the development of parallel programs with OpenMP and MPI.f			
<b>2</b>	<b>Module content:</b> Present-day problems (for example weather or earthquake forecasting, crash test simulations, development of new drugs or chemical compounds, search engines of web service providers) require immense computing and storage power which generally can only be provided by supercomputers and/or networked computers. For this hardware to be used efficiently, parallelised programs must be used. This module teaches some techniques for creating parallel programs. <ul style="list-style-type: none"> <li>• Basic principles and concepts</li> <li>• OpenMP</li> <li>• Message Passing Interface (MPI)</li> <li>• Possibly also GPGU programming</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship Seminar-type tuition with integrated practical tutorials and practical work in a laboratory			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Excellent knowledge of C programming, knowledge of Linux			
<b>6</b>	<b>Type of examination:</b> Term paper or oral interview			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			



<b>AI5086 Test-Oriented Development</b>				
<b>Department code:</b>		<b>Module name in German:</b> Test-orientierte Entwicklung		
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours		<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 2	<b>Frequency of module:</b> GSD: Winter semester
<b>Module type:</b> GSD: Compulsory module		<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>	
<b>1</b>	<p><b>Learning outcomes:</b> Students will become familiar with different test methodologies, how they are used in different product development processes (traditional V-model and agile software development) and which soft skills are necessary to successfully incorporate tests into the product development cycle. After completing the course, students will be able to evaluate the different test methods, use them and explain their contribution to increasing system / software quality.</p> <p>In the accompanying internship, the most important methodologies are put into practice through case studies.</p>			
<b>2</b>	<p><b>Module content:</b> The success of software development projects relies on choosing a methodology suitable for creating the software and achieving high quality through static and dynamic testing, the models (in model-driven environments) and the usability of the HCI. This module focuses on the testing methodologies needed in traditional (heavy-weight) development environments with testing stages (from unit testing to acceptance testing) and agile development environments with continuous integration.</p> <p>Basic principles and concepts (in accordance with the International Software Testing Qualifications Board - ISTQB)</p> <ul style="list-style-type: none"> <li>• Test-driven development (TDD)</li> <li>• Functional and non-functional tests</li> <li>• Static and dynamic test methods</li> <li>• Cost-effective definition of test strategies</li> <li>• Metrics for test management and software quality</li> <li>• Evaluation of test strategies with CMMI (Capability Maturity Model Integration), SPICE (Software Process Improvement and Capability Determination) and TPI (Test Process Improvement)</li> </ul>			
<b>3</b>	<p><b>Teaching and learning methods:</b> 2 SWS seminar 2 SWS Internship</p>			
<b>4</b>	<p><b>Module language:</b> German or English</p>			
<b>5</b>	<p><b>Pre-requisites for studying this module:</b> Required: none Recommended: Programming skills in C, basic knowledge of software engineering</p>			
<b>6</b>	<p><b>Type of examination:</b> Term paper or written examination</p>			
<b>7</b>	<p><b>Assessment methods:</b> Graded</p>			
<b>8</b>	<p><b>Requirements for awarding ECTS credits:</b> Students must pass module examination</p>			
<b>9</b>	<p><b>Other remarks:</b> None</p>			

<b>SK5900 Intercultural Communication and Academic Research</b>				
<b>Department code:</b>	<b>Module name in German:</b> Interkulturelle Kommunikation und wissenschaftliches Arbeiten			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 3/4	<b>Frequency of module:</b> GSD: Winter or summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Compulsory module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will demonstrate an understanding of the relevance of cultural differences in the conceptions, organisation and processes of communication. They will gain knowledge of the current theories of intercultural communication and be able to reflect on their own cultural framing as well as the cognitive and emotional backgrounds when dealing with other people. They will be able to deal with cultural differences in a productive and appreciative manner. They will be able to analyse the findings of Scientific Workin the field and apply these methods to their own work.			
<b>2</b>	<b>Module content:</b> Relevance of intercultural communication in modern theories of intercultural communication <ul style="list-style-type: none"> <li>• Training concepts for developing intercultural competency</li> <li>• Cultural differences in work-related forms of communication (negotiation, presentation, moderation, customer-expert relationship)</li> <li>• In-depth academic research, discussion and presentation</li> <li>• Working with academic literature</li> <li>• Citation techniques and the important issue of plagiarism</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS practical tutorial (if necessary, with online elements)			
<b>4</b>	<b>Module language:</b> English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: none			
<b>6</b>	<b>Type of examination:</b> Portfolio or presentation			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5117 Master's Thesis in Global Software Development</b>				
<b>Department code:</b>	<b>Module name in German:</b> Abschlussmodul Master Global Software Development			
<b>Workload:</b> 750 hrs	<b>ECTS credits:</b> 24+ 1 (Term paper + Colloquium (Viva voce))	<b>Semester:</b> GSD (2018/2020): Semester 3/4	<b>Frequency of module:</b> GSD: Winter and summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Compulsory module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> The Master's thesis is a final piece of assessed written work required to complete the degree. The thesis should demonstrate that students are able to work independently on and coherently present a problem from the Global Software Development specialism within a given time period using academic methods.			
<b>2</b>	<b>Module content:</b> Dependent upon the topic selected			
<b>3</b>	<b>Teaching and learning methods:</b> The student is supervised by a professor from Fulda University of Applied Sciences who will provide guidance on the subject examined and methodology employed in the thesis.			
<b>4</b>	<b>Module language:</b> German, or in a different language subject to agreement with the professor acting as supervisor.			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: 55 ECTS credits earned in modules from the curriculum for the first and second semesters; and the Master's Internship if this module is chosen in order to make up a 30 ECTS credits deficit in accordance with Article 2 (1)(2) of the Examination Regulations 2020 (PO2020) or Article 2 (1)(3) of the Examination Regulations 2018 (PO2018) Recommended: Successful completion of all modules taken in the 1st and 2nd semesters			
<b>6</b>	<b>Type of examination:</b> Term paper (final thesis in the form of the Master's thesis) and Colloquium (Viva voce)			
<b>7</b>	<b>Assessment methods:</b> Master's thesis: graded Colloquium (Viva voce): ungraded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examinations (Colloquium (Viva voce) and Term paper)			
<b>9</b>	<b>Other remarks:</b> The Colloquium takes place following submission of the Master's thesis. Should the date of the Colloquium fall within the administrative period of the next semester, the Colloquium may also take place in parallel with the Master's thesis, subject to agreement with the professor acting as supervisor for the thesis.			

**Elective Modules:**

<b>SK5901 Intercultural Project Management</b>				
<b>Department code:</b>	<b>Module name in German:</b> Interkulturelles Projektmanagement			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b> GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Elective module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will gain awareness of the particular socio-emotional challenges associated with intercultural project management (IPM). They will acquire knowledge of the relevant theoretical concepts of IPM. They will be able to utilise the benefits of IPM and deal with the problems associated with it.			
<b>2</b>	<b>Module content:</b> Cultural ramifications of <ul style="list-style-type: none"> <li>• team development</li> <li>• team dynamics</li> <li>• leadership</li> <li>• knowledge management</li> <li>• team performance</li> <li>• virtual teams</li> <li>• roles in teams</li> </ul> and the specific application of IPM in software development			
<b>3</b>	<b>Teaching and learning methods:</b> 2 SWS seminar 2 SWS practical tutorial			
<b>4</b>	<b>Module language:</b> English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Knowledge in project management			
<b>6</b>	<b>Type of examination:</b> Project work or presentation			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5094 Software Development Project</b>				
<b>Department code:</b>	<b>Module name in German:</b> Projekt Softwareentwicklung			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b> GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Elective module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will be able to solve a complex software development task as part of a team using modern project management tools. They will demonstrate the ability to apply their existing knowledge as well as to autonomously acquire deeper knowledge. They will be also able to reflect on the methodological approach and the process they have chosen. By working in teams, students improve their communication skills and strategic decision-making and learn to take responsibility.			
<b>2</b>	<b>Module content:</b> The purpose of the project is to draw on the content of the other modules (of the Master's programme) thus allowing the students to deepen their understanding and see the individual elements in a broader context. Students organise themselves into project teams of 7 to 10 people. The teams decide on their internal organisation and processes. They use the Capability Maturity Model (CMM) to monitor and evaluate their processes.			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS Internship Supervised practical work			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Project Management and Software Engineering			
<b>6</b>	<b>Type of examination:</b> Presentation			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5095 Special Topic in Global Software Development</b>				
<b>Department code:</b>	<b>Module name in German:</b> Aktuelles Thema der globalen Software-Entwicklung			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2020/ 2018): Semester 1	<b>Frequency of module:</b> GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Elective module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will expand their expertise in a current topic area of their subject and can apply their knowledge in practical settings.			
<b>2</b>	<b>Module content:</b> Depending on the chosen topic, this will be announced before the start of the semester			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS seminar			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Depending on the chosen topic, this will be announced before the start of the semester			
<b>6</b>	<b>Type of examination:</b> Project work or written examination or presentation			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Student must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5016 Research Project</b>				
<b>Department code:</b>	<b>Module name in German:</b> Forschungsprojekt			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 3 GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b>  AIM: Winter semester GSD: Summer semester	<b>Duration:</b>  1 semester
<b>Module type:</b> AIM: Compulsory module GSD: Elective module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will be able to apply strategies of Scientific Work and assess the quality of academic findings in the context of a specific research objective. Students will be able to derive research questions or hypotheses for a given problem in an academically sound manner. Students will be able to autonomously define their research project. The students will demonstrate the ability to critically reflect on their own working process and interim results in a written form and to draw corrective conclusions based on these reflections that support the achievement of the research objective. The students will be able to select and apply established methods from a field of research that are suitable for achieving both the main research aims as well as the secondary aims of the project. Students will be able to objectively describe, interpret and critically examine the results of their own and other people's research.			
<b>2</b>	<b>Module content:</b> The students will work on a project, the content of which is chosen such that research questions are further deepened and placed in a broader context. The supervising department member will advise the students on project content and assist them in gaining further in-depth academic knowledge and skills necessary for carrying out the project; they will also support the student in completing the project. Organisation and collaboration in project groups is possible, provided that the research topic can be split up suitably and subtasks can be assigned to individual students.			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS Internship			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: academic research			
<b>6</b>	<b>Type of examination:</b> Project work or written assignment			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5122 Advanced Big Data</b>					
<b>Department code:</b>	<b>Module name in German:</b> Advanced Big Data				
<b>Workload:</b> 150 hours, made up of: 55 contact hours 95 self-study hours	<b>ECTS credits:</b> 5				
<b>Semester:</b> AIM (2017): Semester 2/3 GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b> AIM/ GSD: Winter or summer semester				
<b>Duration:</b> 1					
<b>Module type:</b> AIM, GSD: Elective module	<b>Academic level:</b> Master's degree				
<b>Suitability of module:</b>					
<b>1</b>	<p><b>Learning outcomes:</b></p> <p>Substantial advances in computing power have once more made data and data processing a core topic in computer science. The size and complexity of the data generated in business and industry today require an evolved or modified approach: big data alongside the associated technologies and strategies. Students will first learn about the architecture and its associated algorithms, and then implement these in a practical context by building an infrastructure and implementation in various use cases/scenarios. Upon successful completion of this module, students will be able to:</p> <ul style="list-style-type: none"> <li>properly understand the importance of big data and related approaches</li> <li>Gain a fundamental understanding of the components of a big data infrastructure</li> <li>Describe and understand the predominant approaches</li> <li>Perform the initial set-up of a big data infrastructure and analyse and evaluate corresponding architectures</li> <li>Analyse and understand or troubleshoot a big data application problem</li> <li>Apply and configure essential components sufficiently, i.e. also configure and implement interfaces</li> </ul>				
<b>2</b>	<p><b>Module content:</b></p> <ul style="list-style-type: none"> <li>Architectural description of big data infrastructures and important application scenarios</li> <li>Hadoop File System and its components. Applications and practical tutorials</li> <li>MapReduce and YARN as fundamentals/essential components of almost all big data infrastructures</li> <li>Hive, Impala and HCatalog: data storage and modelling as well as corresponding applications</li> <li>Flume as a broker for example for large log infrastructures and various implementations</li> <li>Spark fundamentals: systems for main memory processing</li> <li>Spark with Scala: functional programming with Spark (resilient distributed datasets, aggregation, APIs, algorithms)</li> <li>Optional: newer developments in big data and specific technologies (InfluxDB, Hortonworks Sandbox, Cloudera Enterprise Manager etc.)</li> </ul>				
<b>3</b>	<p><b>Teaching and learning methods:</b></p> <p>2 SWS seminar-type tuition 2 SWS seminar</p>				
<b>4</b>	<p><b>Module language:</b> German/English</p>				
<b>5</b>	<p><b>Pre-requisites for studying this module:</b></p> <table border="1"> <tr> <td>Required:</td> <td>None</td> </tr> <tr> <td>Recommen</td> <td>Big data lecture, Java, Scala (but not mandatory)</td> </tr> </table>	Required:	None	Recommen	Big data lecture, Java, Scala (but not mandatory)
Required:	None				
Recommen	Big data lecture, Java, Scala (but not mandatory)				
<b>6</b>	<b>Type of examination:</b>				



	Portfolio
7	<b>Assessment methods:</b> Graded
8	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination
9	<b>Other remarks:</b>

translation; legally non-binding

<b>AI5046 Cryptography - Theory and Applications</b>				
<b>Department code:</b>	<b>Module name in German:</b> Kryptografie - Theorie und Anwendung			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b>  5 ECTS	<b>Semester:</b> AIM (2017): Semester 2/3 GSD (2018/ 2020): Semester 1	<b>Frequency of module:</b>  AIM: Winter or summer semester	<b>Duration:</b>  1 semester
<b>Module type:</b> AIM, GSD: Elective module	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will acquire an overview of applications of cryptography in IT systems. In particular, they will demonstrate knowledge of the mathematical basis, theories and modes of operation of cryptographic processes, will be able to evaluate protocols for encryption, authentication and key exchange and implement them for relevant problems in practical settings. They will be familiar with steganographic methodologies of hidden communication.			
<b>2</b>	<b>Module content:</b> <ul style="list-style-type: none"> <li>• Cryptography, cryptanalysis and steganography</li> <li>• Cryptosystems and classification, Shannon's theory, factorisation problem, problem of the discrete logarithm</li> <li>• Theory of cryptographic methods (AES, RSA, ElGamal, Digital Signature Algorithm, Elliptic Curve Cryptosystems)</li> <li>• Key management (session key distribution scheme and key agreement scheme)</li> <li>• Authentication and cryptographic protocols, including on-time password, challenge-response and zero-knowledge protocols</li> <li>• Cryptographically strong hash functions, Merkle-Damgard construction principle, message authentication codes</li> <li>• Theory of steganographic methods</li> <li>• Introduction to steganographic embedding algorithms for different carrier media (images, audio and video)</li> <li>• Current problems in IT security</li> </ul>			
<b>3</b>	<b>Teaching and learning methods:</b> 4 SWS seminar-type tuition			
<b>4</b>	<b>Module language:</b> German			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: none Recommended: Algebraic Basics of Computer Science, IT Security			
<b>6</b>	<b>Type of examination:</b> Written examination or oral interview			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Students must pass module examination			
<b>9</b>	<b>Other remarks:</b> None			

<b>AI5083 User-Centered Development</b>				
<b>Department code:</b>	<b>Module name in German:</b> Benutzerzentrierte Entwicklung			
<b>Workload:</b> 150 hrs, made up of 72 contact hours 78 self-study hours	<b>ECTS credits:</b> 5 ECTS	<b>Semester:</b> GSD (2020/ 2018): Semester 1	<b>Frequency of module:</b> GSD: Summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD (2018): Compulsory module GSD (2020): Elective module	<b>Academic</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<p><b>Learning outcomes:</b> Students are able to recognise and explain the importance of user participation in the system development process. They will</p> <ul style="list-style-type: none"> <li>• be able to integrate principles of user-centred design and evaluation into the development of interactive systems</li> <li>• understand the implications of user requirements on design</li> <li>• understand contextual task analysis and how it can inform development</li> <li>• be able to formulate measurable qualitative and quantitative use objectives and criteria</li> <li>• be able to iteratively design and evaluate a user interface that applies several user-centred design methods</li> <li>• be able to develop prototypes taking into account different interaction modalities and styles</li> <li>• are able to plan, organise and perform evaluations and to analyse and document the results (expert inspection and user studies)</li> </ul> <p>Students will gain experience in group work through collaboration with other team members.</p>			
<b>2</b>	<p><b>Module content:</b> Foundations of</p> <ul style="list-style-type: none"> <li>• Human-computer interaction</li> <li>• Usability engineering, user-centred design process, in particular iterative participatory UI design process</li> <li>• Usability principles and guidelines</li> </ul> <p>process</p> <ul style="list-style-type: none"> <li>• Planning the human-centred process</li> <li>• Understanding and specifying the context of use</li> <li>• Specifying user and organisational requirements</li> <li>• Production of design solutions (prototypes)</li> <li>• Evaluation of the design against requirements</li> <li>• Embedding usability activities into the software engineering life cycle</li> <li>• Different techniques and tools will be used throughout the process.</li> </ul>			
<b>3</b>	<p><b>Teaching and learning methods:</b> 2 SWS seminar-type tuition 2 SWS internship</p>			
<b>4</b>	<p><b>Module language:</b> German or English</p>			
<b>5</b>	<p><b>Pre-requisites for studying this module:</b> Required: none Recommended: Software Engineering</p>			

<b>6</b>	<b>Type of examination:</b> Portfolio
<b>7</b>	<b>Assessment methods:</b> Graded
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Student must pass module examination and regularly participate in the laboratory practical
<b>9</b>	<b>Other remarks:</b> None

translation; legally non-binding

**Modules for the making up of 30 ECTS credits deficit:**

<b>AI5119 Master's Internship</b>				
<b>Department code:</b>	<b>Module name in German:</b> Master-Praxisprojekt			
<b>Workload:</b> 800 hours internship 100 self-study hours	<b>ECTS credits:</b> 30 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 3	<b>Frequency of module:</b> GSD: Winter and summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Module for the making up of ECTS credit deficits in accordance with Article 2 (1) (2) (2020) or (3) (2018)2	<b>Academic level:</b> Master's degree	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> The students will be able to apply the technical and methodological knowledge acquired during the module in a business context. In addition, they will be able to demonstrate their social and intercultural skills in real projects and learn how to adapt to business operational conditions.			
<b>2</b>	<b>Module content:</b> This depends on which area of the company the student works in. The area of the company where the student is assigned should be chosen and specified in the internship agreement so that the student can also write their Master's thesis in this area.			
<b>3</b>	<b>Teaching and learning methods:</b> Supervised practical phase in a company. The practical phase comprises 20 weeks of full-time work.			
<b>4</b>	<b>Module language:</b> German or English			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: Admission accreditation for making up 30 ECTS credits deficit pursuant to Article 2 para. 1 no. 2 (2020) or Article 2 para. 1 no. 3 (2018) AND proof of at least 40 ECTS credits gained from the modules required for the degree Recommended: none			
<b>6</b>	<b>Type of examination:</b> Report			
<b>7</b>	<b>Assessment methods:</b> Graded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Passed module examination, proof of completion of practical phase			
<b>9</b>	<b>Other remarks:</b> Further rules relating to the Master's Internship can be found in the Work Placement Regulation of the Global Software Development Master's study programme.			

<b>AI4001 Additional Courses</b>				
<b>Department code:</b>		<b>Module name in German:</b> Zusätzliche Kurse		
<b>Workload:</b> 900 hrs	<b>ECTS credits:</b> 30 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 3/4	<b>Frequency of module:</b> GSD: Winter and summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Module for making up ECTS credit deficits in accordance with Article 2 (1) (2)		<b>Academic level:</b> Bachelor's degree	<b>Suitability of module:</b>	
<b>1</b>	<b>Learning outcomes:</b> Students will expand and deepen their subject area knowledge by taking modules from the Department of Applied Computer Science study programmes that relate to the degree they are pursuing: see Article 5 Para. 3. The respective learning outcomes can be found in the descriptions of the modules taken.			
<b>2</b>	<b>Module content:</b> Refer to the module description for the chosen modules			
<b>3</b>	<b>Teaching and learning methods:</b> Refer to the module description for the chosen modules			
<b>4</b>	<b>Module language:</b> Dependent on module			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: Admission accreditation for making up 30 ECTS credits deficit, DSH2 Recommended: None			
<b>6</b>	<b>Type of examination:</b> Refer to the module description for the chosen modules.			
<b>7</b>	<b>Assessment methods:</b> Refer to the module descriptions for the chosen modules.			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Refer to the module descriptions for the chosen modules.			
<b>9</b>	<b>Other remarks:</b> Consultation with study programme heads is required when choosing which modules students will take			

<b>AI5118 German Language</b>				
<b>Department code:</b>		<b>Module name in German:</b> Deutschkurse		
<b>Workload:</b> 900 hrs	<b>ECTS credits:</b> 30 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 3/4	<b>Frequency of module:</b> GSD: Winter and summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Module for making up ECTS credit deficits pursuant to Article 2 (1)		<b>Academic level:</b>	<b>Suitability of module:</b>	
<b>1</b>	<b>Learning outcomes:</b> Students will acquire language skills in German on completion of relevant modules, see Article 5 (5)			
<b>2</b>	<b>Module content:</b> Dependent on modules offered			
<b>3</b>	<b>Teaching and learning methods:</b> Dependent on modules offered			
<b>4</b>	<b>Module language:</b> German			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: Admission accreditation for making up 30 ECTS credits deficit Recommended: None			
<b>6</b>	<b>Type of examination:</b> Dependent on modules offered			
<b>7</b>	<b>Assessment methods:</b> Dependent on modules offered			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Dependent on modules offered			
<b>9</b>	<b>Other remarks:</b> The German courses are determined and selected in consultation with the study programme heads.			

<b>AI5092 Intercultural Study of Computer Science</b>				
<b>Department code:</b>	<b>Module name in German:</b> Auslandssemester			
<b>Workload:</b> 900 hrs	<b>ECTS credits:</b> 30 ECTS	<b>Semester:</b> GSD (2018/ 2020): Semester 3/4	<b>Frequency of module:</b> GSD: Winter and summer semester	<b>Duration:</b> 1 semester
<b>Module type:</b> GSD: Module for making up ECTS credit deficits pursuant to Article 2 (2)	<b>Academic level:</b>	<b>Suitability of module:</b>		
<b>1</b>	<b>Learning outcomes:</b> Students will acquire deeper knowledge in the field of computer science and learn how this discipline is taught and understood in other cultures. They will gain experience of different styles of teaching and examination. They will acquire a wealth of experience in tackling day-to-day situations and communication approaches in an intercultural environment. They will have the opportunity to reflect on their experiences during their period abroad.			
<b>2</b>	<b>Module content:</b> Students spend one semester at a university in a non-German-speaking country. They take Bachelor programme courses (in the second half of the programme) and sit the relevant examinations.			
<b>3</b>	<b>Teaching and learning methods:</b> The teaching and learning methods depend on the modules offered at the university abroad.			
<b>4</b>	<b>Module language:</b> Dependent upon the language of instruction at the foreign university			
<b>5</b>	<b>Pre-requisites for studying this module:</b> Required: Pursuant to Article 2 (1)(2) of the Examination Regulations, students must earn 30 ECTS credits at Bachelor's degree level and must complete the Study Abroad module pursuant to Article 7 (1).			
<b>6</b>	<b>Type of examination:</b> The examination formats depend on the modules offered by the university abroad.			
<b>7</b>	<b>Assessment methods:</b> Ungraded			
<b>8</b>	<b>Requirements for awarding ECTS credits:</b> Student must pass module examination; written report reflecting on the experience gained in the semester			
<b>9</b>	<b>Other remarks:</b> The choice of university abroad and modules to be taken is made in consultation with the heads of the study programme.			



## **Annex 3: Internship Regulations**

### **Internship Regulations for the Global Software Development Master's Study Programme**

#### **Article 1 General**

- (1) Article 5 of the Examination Regulations for the Global Software Development Master's study programme stipulates that students can make up ECTS credit deficits by completing a Master's Internship. This is arranged and supervised by Fulda University of Applied Sciences.
- (2) If students acquired the qualifying degree that gained them admission to this Master's study programme at a German higher education institution, they shall undertake their Master's Internship working in-house at a company, organisation or research institution abroad.
- (3) If students acquired the qualifying degree that gained them admission to this Master's study programme at a higher education institution abroad, they shall complete their Master's Internship in-house at a company, organisation or research institution in Germany.
- (4) The Master's Internship shall be governed by an agreement concluded between the respective student and the establishment providing the internship (hereinafter, the "Internship Provider").

#### **Articles 2 Objectives and Tasks**

The goals of the Master's Internship are for students to gain experience of the German work environment and to acquire practical skills through work they perform in the field of software development.

#### **Article 3 Status of Students During Internship**

- (1) During the internship, the students remain enrolled as members of Fulda University of Applied Sciences, with all the rights and duties that this status entails.
- (2) Students are not interns within the meaning of the German Vocational Training Act (Berufsbildungsgesetz) and, for the duration of the Master's Internship, are subject neither to the German Works Constitution Act (Betriebsverfassungsgesetz) nor the German Employee Representation Act (Personalvertretungsgesetz).
- (3) Students are obliged to follow the instructions issued by the Internship Provider and its designated officers and to comply with this establishment's rules and regulations, particularly its work rules and accident prevention regulations as well as confidentiality and non-disclosure policies.

#### **Article 4 Duration and Time**

- (1) The Master's Internship comprises a continuous period of twenty weeks spent at the Internship Provider. Students must always make up for any interruptions to or absences from the Internship.
- (2) The Master's Internship is to be undertaken in the third semester of the programme.
- (3) The daily working hours shall amount to the normal working hours of a full-time position at the Internship Provider, but shall be no fewer than 35 hours per week.

### **Article 5 Admission**

Students shall be eligible for the Master's Internship provided they possess documented proof of having completed modules worth 40 ECTS credits that count towards the degree qualification.

### **Article 6 Internship Provider**

- (1) The internship providers are generally proposed by the students themselves. If the student's proposed provider is not approved, the Department (of Applied Computer Science) shall allocate a provider.
- (2) Students should be supervised at the internship provider by someone designated by the provider who is appropriately qualified in the relevant subject area and who works at the provider full-time. This supervisor is responsible for arranging and overseeing the induction of the students in their duties and work areas.

### **Article 7 Supervision by the University (Fulda University of Applied Sciences)**

- (1) The Department of Applied Computer Science's placement office for internships primarily advises the students on formal matters. These include, in particular,
  - (a) the selection and approval of Internship Providers,
  - (b) the verification and confirmation of contractual agreements,
  - (c) the evaluation and verification of proper completion of the Master's Internship,
  - (d) consultation in the event of conflicts between students and supervisors at the partner establishments.
- (2) A member of the Department of Applied Computer Science shall supervise and advise students in all course-related matters connected to the Master's Internship.
- (3) Students are required to report in detail to their supervisor at the University on the progress of their work at the end of each month of the Master's Internship.

### **Article 8 Agreement**

- (1) Prior to the commencement of the Master's Internship, students must sign an Agreement with the Internship Provider. The Internship Agreement must be presented to the placement office for internships for approval. The Master's Internship must be registered prior to the student actually starting the internship.
- (2) The Internship Agreement will specifically define
  - (a) the students' obligation to
    - follow the instructions of the Internship Provider and its appointed officers,
    - diligently perform the duties assigned to them,
    - comply with the Internship Provider's rules and regulations, particularly
    - its work rules and accident prevention regulations as well as confidentiality and non-disclosure policies,
    - to submit by the deadline a chronologically structured report as specified by the University Department detailing the stages of their practical training during the internship (report on the Master's Internship).
  - (b) the Internship Provider's obligation to

- provide the students with proper training in line with the Internship Regulations,
- to devise a work plan in consultation with the University Department supervisor,
- to issue the students with an official certificate confirming the period of time and content of the Master's Internship and to check and sign off the student's required internship report,
- to enable the students to take examinations conducted by the Department of Applied Computer Science,
- to appoint someone as both in-house supervisor and contact person for the University of Fulda.

#### **Article 9 Recognition of Successfully Completed Internship**

- (1) Students request the internship placement office to confirm they have successfully completed their Master's Internship, submitting the report approved by the Department's supervisor and proof of activities completed during the internship.
- (2) If the Internship is recognised as having been successfully completed, the Master's Internship module is assessed as "successfully completed".