

Information on the
Master Program in Computer Science
according to FPO 2021

Department of Electrical Engineering and Computer Science

as at February 19, 2024

Contents

1	Introduction	2
2	Compulsory and Core Modules	4
2.1	Compulsory Modules	4
2.2	Core Modules	5
3	Specialization Embedded Systems	6
3.1	Introduction: What are Embedded Systems?	6
3.2	Job Profiles in the Field of Embedded Systems	6
3.3	Structure of the Study Program with Specialization in Embedded Systems	6
3.4	Sample Study Plans	10
3.5	Further Information	11
4	Specialization Visual Computing	13
4.1	Introduction: What is Visual Computing?	13
4.2	Job Profiles in the Field of Visual Computing	13
4.3	Structure of the Study Program with Specialization in Visual Computing	14
4.4	Sample Study Plans	17
4.5	Further Information	19
5	Important Organizational Information	20
5.1	Enrollment in Courses	20
5.2	Examinations and Study Achievements	21
5.3	Choice of Specialization	23
5.4	Choice of Elective Modules	23
5.5	Master Thesis	24
5.6	Additional Required Examinations	24
5.7	Recognition of Credits	25
5.8	Times of Absence, Compensation for Disadvantages and Hardship Cases	25
6	Module Descriptions	26

1 Introduction

This document provides you with assistance for successful Master studies in Computer Science at the University of Siegen. In particular, it presents the structure and elective courses of the program in detail.

The Master's program in Computer Science is roughly divided into a compulsory, a core and a specialization area:

- The compulsory area (60 CP) includes an overview of current research topics in the Department ETI (Electrical Engineering and Computer Science), instruction in scientific work, project work, and master thesis.
- In the core area (24 CP), four modules must be chosen in which key areas of computer science are treated in depth.
- The specialization area (36 LP) allows the acquisition of deeper or more advanced knowledge in one of the following fields, depending on the chosen specialization:
 - Embedded Systems: technical (hardware-related) computer science, embedded systems.
 - Visual Computing: computer graphics, image processing, visualization, pattern recognition, machine learning, computer vision.
 - Complex and Intelligent Software Systems: software engineering, intelligent systems, pattern recognition.
 - Medical Informatics: medical fundamentals, informatics applications in medicine.

The first two of these specialization areas can be studied entirely in English.

The program is designed to be studied full-time within four semesters, with the fourth semester devoted to the master thesis.

The modules to be studied consist of one or more courses (e.g. laboratory or lecture and exercise hours) and are completed with one or more achievements (study achievements and/or examinations). The courses you want to attend in a semester and the study achievements and examinations you want to take in that semester must each be registered via the campus management system, called *unisono*, within a specified period of time, see section 5.

The time required for a module is expressed in credit points (CP). One CP corresponds to a workload of approx. 25-30 hours, which includes participation in the courses, preparation and follow-up work, preparation for examinations, and the completion of study achievements and examinations. As a rule, modules amounting to 30 CP should be studied per semester. The entire study program thus has 120 CP.

As an aid for planning your studies, the following sections of this document summarize, for each individual specialization, which modules are mandatory to study and which can be selected additionally. In order to simplify your time planning, it is indicated for each module in which semester it is offered, in which semester it is recommended to take it and whether other modules are a prerequisite in terms of content. In addition, you will also find exemplary study plans.

Section 5 additionally compiles important information on the organizational process of your studies.

Note that because only the specializations 'Embedded Systems' and 'Visual Computing' can be studied in English, this version of the document only discusses these two specializations. For a complete discussion of all specializations, please turn to the German version of this guide.

Please also note that no guarantee can be given for the correctness of the information in this document and that the document may also takes into account changes to the examination regulations that are already planned but not yet officially adopted. **Legally binding is exclusively the information in the examination regulations**, which you can find on the websites of the Examination Office for Computer Science, among others. If you notice any errors in this document, please report them to roland.wismueller@uni-siegen.de.

Explanation of Module Tables

Tables of modules to be studied or selected are frequently presented below. They always have the following structure:

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
...
4INFMA002	Cutting Edge Research	6	W	1	2	...
...

The first column indicates the university-wide unique module number for the module. This number is used e.g. in the campus management system to identify the module as well as the associated study achievements and examinations.¹ The stored hyperlink leads you directly to the module description in the campus management system unisono (please select the tab 'Contents' there; however the descriptions are mainly in German).

The column 'Sem.' indicates in which semester the module is offered (S = summer semester, W = winter semester, E = every semester, I = irregular).

The columns 'S.Wi.' and 'S.Su.' indicate the semester(s) in which the module is recommended to be taken. The column 'S.Wi.' applies to a study start in the winter semester, the column 'S.Su.' to a study start in the summer semester.

In the last column, the numbers of the modules are listed, which are a content-related prerequisite for the named module, i.e. which should be studied beforehand. The hyperlink also leads to the module description.

¹Courses, however, have their own numbering system from which the module affiliation is not apparent.

2 Compulsory and Core Modules

2.1 Compulsory Modules

There are a total of four compulsory modules in the Master's program in Computer Science:

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA002	Cutting Edge Research	6	W	1	2	
4INFMA001	Scientific Working	9	W/E	1/2	2/3	
4INFMA003	Project Work	15	E	2/3	2/3	
4INFMA004	Master Thesis Computer Science	30	E	4	4	

- The module 'Cutting Edge Research' is a lecture series in which all computer science chairs of the department present their research foci. This module serves as orientation for the choice of topics for the seminar (within the module 'Scientific Working'), the project work, as well as the master thesis.
- In the module 'Scientific Working', the basics of scientific working and good scientific practice are first taught in a block course at the end of the winter semester.

The second part of the module consists of a seminar which should be attended in the next semester (or the semester after). In this seminar, participants are required to autonomously prepare and deliver a presentation and a seminar paper on a given topic. Seminars are offered independently and simultaneously by the different chairs.

You can find the individual offers in the campus management system unisono (see section 5.1) if you open the module 'Scientific Working' in the compulsory section. You will then see which chairs offer a seminar in the respective semester. In general, there is a (mandatory) preliminary meeting for the seminar in one of the first lecturing weeks, in which the individual topics are presented and assigned. The seminar presentations generally take place in a block event towards the end of the lecture period.

- Within the scope of the 'Project Work' you will work in a team on a more complex, practical task from a research project of the organizer over a period of two semesters (typically in the second and third semester). In addition to purely technical skills, teamwork and independent project management also play an important role in the project work.

Just like the seminar, the project work is also offered independently by the individual chairs. Here, too, you can find the offers by opening the module in the unisono system. Ideally, you should get together in advance to form a group of students with about 3-6 participants who have similar interests, since the project work is usually carried out by a group of students. In exceptional cases, individual students may also carry out a project work, provided that they are closely involved in a group of researchers.

If you do not find a suitable offer in a semester, please do not hesitate to ask the lecturers directly (see website)!

- The master thesis usually takes up the last semester of study. Here you have to show that you are capable of independently solving a given task with a scientific claim and presenting your solution in written and oral form. Please note that you can **not** find offers for master theses via unisono. Please inform yourself about topic offers directly on the websites of the lecturers (see website) or also by contacting the lecturers. Further information, in particular concerning the registration, can be found in the section 5.5.

2.2 Core Modules

To deepen the basic knowledge in the field of computer science, there is a catalog of core modules in the Master's program, from which four modules must be chosen:

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA020	Software Engineering II	6	S	2	1,3	
4INFMA021	Modeling and Animation	6	W	1,3	2	
4INFBA022	Embedded Systems	6	S	2	3	
4INFMA023	Computer Architecture II	6	W	1,3	2	
4INFMA024	Parallel Processing	6	W	1,3	2	
4INFMA025	Computer Networks II (in German)	6	S	2	1,3	
4INFMA026	Advanced Logic	6	S	2	1,3	
4INFMA028	Algorithmics I	6	W	1,3	2	
4INFMA029	Database Systems II	6	S	2	1,3	

The choice of modules is free, with only one exception: In the specialization 'Visual Computing' the module 4INFMA021 'Modeling and Animation' must be chosen as one of the core modules. As an aid to decision-making, the sections 3 and 4 indicate which core modules are particularly recommended for the respective specializations.

If you would like to study extra modules from the above catalog in addition to the four core modules that must be chosen, you may study a maximum of two more modules as part of the specialization. More about this in the sections 3 and 4.

3 Specialization Embedded Systems

3.1 Introduction: What are Embedded Systems?

Embedded systems are computers that are integrated into a technical context. They can be found in countless application areas and are ubiquitous today. Examples are the transportation sector (e.g. automobile, airplane, railroad), the medical sector, the energy sector, industrial automation and home automation. In addition, embedded systems are also a component of consumer electronics and household appliances.

Embedded systems have led to breakthrough advances in functionality, safety, energy efficiency, environmental protection, and convenience. Today's premium vehicles, for example, contain up to 100 controllers and 90% of innovations in the automotive industry are based on electronics and embedded systems. Embedded systems range from simple devices with a single microcontroller to complex distributed systems that can be networked both locally and over large geographical distances.

Embedded systems often have high requirements for real-time capability, reliability, security and functional safety. Even if individual components fail, the correct services of the overall system must continue to be provided. In general, the overall system must therefore be more reliable than its underlying components. This can be achieved by suitable fault tolerance mechanisms. In an aircraft with 'fly-by-wire' technology, for example, the correct functioning of the embedded system is essential for control and safety. In contrast to conventional control systems, the actuators (electric motors, hydraulics) are controlled exclusively by electrical signals from the embedded systems. Similarly, the embedded system in an autonomous vehicle, which is responsible for sensing the environmental conditions and controlling the vehicle, must function correctly in all situations to prevent hazards to the occupants and the environment.

3.2 Job Profiles in the Field of Embedded Systems

The field of embedded systems deals with the architecture, design, validation, implementation, operation and maintenance of computers, networks, sensors and actuators in monitoring, steering or control functions. Embedded systems represent an interdisciplinary field in which engineering issues, especially from electrical engineering and information technology, interact with computer science. This knowledge is needed almost everywhere in research and development in industry and at universities, so graduates in the field of embedded systems face excellent career prospects.¹

3.3 Structure of the Study Program with Specialization in Embedded Systems

The study program with the specialization Embedded Systems includes compulsory modules on scientific working, modules with insights into current research projects at the University of Siegen, a project work, and a master thesis. Topics from different areas of embedded systems can be chosen (e.g. Networked Embedded Systems, Ubiquitous Computing, Embedded Software, Hardware Architectures, Embedded AI).

The core modules serve to deepen the computer science-oriented competences from the bachelor's degree, whereby modules on Embedded Systems, Computer Architectures and Computer Networks are particularly recommended.

The specialization modules are used for specialization based on the respective interests. The module catalog Embedded Systems offers modules on application areas, development methods, reliability, hardware, and software for embedded

¹Reference: Informationstechnische Gesellschaft im VDE, Gesellschaft für Informatik - GI/ITG-Empfehlungen. Curriculum für Bachelor- und Masterstudiengänge Technische Informatik. Fachbereich Technische Informatik. 2018. In German.

systems.

In addition, up to two specialization modules from other specializations can be selected.

3.3.1 Compulsory Modules (60 CP)

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA002	Cutting Edge Research	6	W	1	2	
4INFMA001	Scientific Working	9	W/E	1/2	2/3	
4INFMA003	Project Work	15	E	2/3	2/3	
4INFMA004	Master Thesis Computer Science	30	E	4	4	

3.3.2 Core Modules (24 CP)

A total of four modules must be selected from the following catalog. For the specialization ‘Embedded Systems’, the modules marked with an asterisk (*) are particularly recommended.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA020	Software Engineering II	6	S	2	1,3	
4INFMA021	Modeling and Animation	6	W	1,3	2	
4INFBA022	Embedded Systems*	6	S	2	3	
4INFMA023	Computer Architecture II*	6	W	1,3	2	
4INFMA024	Parallel Processing	6	W	1,3	2	
4INFMA025	Computer Networks II (in German)*	6	S	2	1,3	
4INFMA026	Advanced Logic	6	S	2	1,3	
4INFMA028	Algorithmics I	6	W	1,3	2	
4INFMA029	Database Systems II	6	S	2	1,3	

3.3.3 Specialization Modules (36 CP)

In the optional specialization modules, technological components (e.g. FPGAs, memory technologies) for the implementation of embedded systems are studied in depth. In addition, modules with techniques and methods relevant for the design are offered (e.g. Operations Research as a basis for design space exploration, Reliability of Technical Systems). Since many embedded systems are realized as distributed systems, modules on industrial communication and communication security are also available. Further modules provide the bridge to application areas, e.g. industrial and ubiquitous systems.

Modules of at least 24 CP must be selected from the catalog ‘Embedded Systems’ (see following table), for the remaining modules a free selection from all specialization catalogs as well as from the catalog ‘Core Modules’ is possible. In the sense of a clear focus, however, it is recommended to also select these modules from the Embedded Systems area.

Modules in the Catalogue Embedded Systems (24-36 CP)

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA100	Development of Embedded Systems using FPGAs	6	W	1,3	2	
4INFMA101	Lab Ubiquitous Systems	6	E	1-3	1-3	
4INFMA102	Storage Technologies	6	S	2	1,3	

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA103	StartUp Entrepreneurship	6	S	2	1,3	4ETMA200
4INFMA104	Selected Topics of Computer Architectures	6	I	1-3	1-3	
5DMTBA19	Telematics - Multimedia	6	W			
5DBHSBA10	Telematics - Technologies and Applications	6	S			
4ETMA256	Communications and Information Security II	6	S	2	1,3	
4ETMA200	Signals and Systems I	6	W	1,3	2	
4ETMA201	Signals and Systems II	6	S	2	3	
4ETMA160	Reliability of Technical Systems	6	S	2	1,3	
4ETMA159	Assembly and Interconnection Technology (in German)	6	S	2	1,3	
4ETMA303	Digital IC Design	6	S	2	1,3	
4ETMA355	Microsystem Fabrication & Test	6	W	1,3	2	
4MBMAEX006	Operations Research	6				
4ETMA105	Process Automation (in German)	6	S	2	1,3	
4ETMA151	Industrial Communications (in German)	6	S	2	1,3	
4ETMA165	Industrial Information und Communication Systems	6	W	1,3	2	

Freely Selectable Modules (0-12 CP)

In case of special interest, a maximum of two modules (totaling a maximum of 12 CP) may be chosen from other specializations or from the catalog of core modules.²

In the following table all selectable modules of the other specializations are listed. It is recommended to choose the modules marked with an asterisk (*) which are clearly related to Embedded Systems. In principle, the other modules can also be selected; however, it is explicitly not recommended to select the modules printed in gray.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA204	Deep Learning*	6	W	1,3	2	4INFMA028
4INFMA300	Algorithmics II*	6	S	2	3	
4INFMA301	Model Checking*	6	W	1,3	2	
4INFMA305	Ubiquitous Computing*	6	E	1-3	1-3	
4INFMA307	Advanced Programming in C++*	6	S	2	1,3	
4INFMA308	Theoretical Computer Science (in German)*	6	W	1,3	2	
4INFMA310	Recent Advances in Operating Systems and Distributed Systems*	6	I	1-3	1-3	
4INFMA201	GPU Programming	6	I ³	1-3	1-3	4ETMA250
4INFMA202	Scientific Visualization	6	W	1,3	2	
4INFMA203	Statistical Learning Theory	6	S	2	1,3	
4INFMA205	Recent Advances in Machine Learning	6	S	2	1,3	
4INFMA212	Unsupervised Learning	6	I ⁴	1-3	1-3	
4ETMA257	Introduction to Compressive Sensing	6	W	3	-	
4INFBA302	Complexity Theory I	6	W	3,5	4,6	
4INFMA304	Complexity Theory II	6	I	1-3	1-3	4INFBA302

²see section 3.3.2. Of course, only modules that have not already been chosen as core modules may be selected

³Currently no longer offered.

⁴Currently no longer offered.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA312	Recommender Systems	6	W ⁵	1,3	2	4INFBA302
4INFMA313	Quantum Complexity Theory	6	S	2	1,3	
5DMTBA04	Medical Technology	6	S			
5MDSMA02	Medical Technology in Depth (in German)	6	W	1,3	2	
5DBHSBA15	Data Science in Medicine	6				
4INFMA200	Rendering	6	S	2	1,3	4INFBA020
4INFMA206	Convex Optimization for Computer Vision	6	S	2	1,3	
4INFMA207	Numerical Methods for Visual Computing	6	W	1,3	2	
4INFMA208	Machine Vision	6	S	2	1,3	
4INFBA033	Lab Computer Graphics	6	W	5	4	
4INFMA210	Virtual Reality	6	S	2	1,3	
4INFMA211	Higher Level Computer Vision	6	I ⁶	1-3	1-3	
4ETMA250	Computational Imaging	6	W	1,3	2	
4ETMA252	Topics in Computational Imaging	6	S	2	3	
5DBHSBA02	Human Function II	9	S			
5DBHSBAEX02	Internship Clinic	3				
5BMTBA18	Immunology	6	W			
2PSYBA08	General Psychology II (in German)	9	W			
5DMTBA09	Safety in Medical Applications	9	W			
3HCIMA001	Humans & Technology	9	W			

⁵Due to a sabattical, the module will presumably not be offered in WiSe 24/25.

⁶Currently no longer offered.

3.4 Sample Study Plans

3.4.1 Start of Study in Winter Semester

	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)
3 LP	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Project Work (part 2) (4INFMA003)	Master's Thesis Computer Science (4INFMA004)
6 LP	Scientific Working (lecture) (4INFMA001)	Project Work (part 1) (4INFMA003)	Specialization Module	
9 LP	Core Module			
12 LP				
15 LP	Specialization Module			
18 LP	Core Module	Specialization Module		
21 LP	Specialization Module			
24 LP				
27 LP	Specialization Module			
30 LP	Specialization Module			
33 LP				

	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)	
3 LP	Cutting Edge Research (4INFMA002)	Project Work (part 1) (4INFMA003)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)	
6 LP	Scientific Working (lecture) (4INFMA001)		Project Work (part 2) (4INFMA003)		
9 LP					
12 LP	Core Module	Core Module	Specialization Module		
15 LP	Core Module	Core Module			Specialization Module
18 LP					
21 LP					
24 LP	Specialization Module	Specialization Module	Specialization Module		
27 LP					
30 LP					
33 LP					

3.4.2 Start of Study in Summer Semester

	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)
3 LP	Core Module	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)
6 LP				
9 LP	Core Module	Scientific Working (lecture) (4INFMA001)	Project Work (part 2) (4INFMA003)	
12 LP				
15 LP	Core Module	Project Work (part 1) (4INFMA003)	Specialization Module	
18 LP				
21 LP	Specialization Module	Core Module	Specialization Module	
24 LP	Specialization Module	Specialization Module	Specialization Module	
27 LP				
30 LP				

	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)
3 LP	Core Module	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)
6 LP		Scientific Working (lecture) (4INFMA001)	Project Work (part 2) (4INFMA003)	
9 LP	Project Work (part 1) (4INFMA003)			
12 LP		Specialization Module	Specialization Module	
15 LP	Specialization Module			
18 LP		Specialization Module	Specialization Module	
21 LP	Specialization Module			
24 LP		Specialization Module	Specialization Module	
27 LP	Specialization Module			
30 LP		Specialization Module	Specialization Module	

3.5 Further Information

If you still have questions that are not answered here, please feel free to directly contact us:

	Prof. Dr. Roman Obermaisser
Raum:	H-E 009
Tel.:	0271 / 740-3332
E-Mail:	roman.obermaisser@uni-siegen.de

The safest way is to communicate by e-mail.

4 Specialization Visual Computing

4.1 Introduction: What is Visual Computing?

Visual Computing (VC) is an increasingly important part of our ever more visual world. Wherever images are processed in a commercial or media product, there is visual computing behind it. On the one hand, more and more information is being acquired with (image) sensors, which requires efficient evaluation and assessment of this data by humans and machines. Examples of this are autonomous driving, the steering and control of complex (production) processes or quality control. On the other hand, digitalization often requires the generation of virtual, image-based representations in order to make the variety of information accessible to humans. For example, visual representations play an important role for product development from design to technical planning and production to maintenance, but also for computer games or medical diagnostics. Visual computing was and is also one of the driving forces in the further development of machine learning and artificial intelligence, which thus belong to the methodological core areas of visual computing.

A technical definition:

Visual computing deals with both the acquisition, processing and analysis of image data (image analysis) and the generation of images from data (image synthesis).

Requirements of Visual Computing

The fascination of dealing with images is a strong motivating factor for dealing with visual computing. One could put the course of studies under the motto

‘What you see is what you want!’

because this names not only the fascination but also the challenges at the same time. Image synthesis and image analysis in many cases require an understanding and a model of the real world. For example, virtual objects can only be visualized if their shape (geometry) and appearance (material) are accurately described. Conversely, statements about the content of an image require suitable mathematical models, which can be used, for example, to answer the question of the presence of certain objects in the image.

Accordingly, an extended mathematical ‘toolbox’ is required, based on the classical disciplines of computer science, such as data structures and programming languages. In the master’s program, this includes not only the basic mathematical disciplines (linear algebra, analysis and statistics/stochastics) but also fundamental knowledge of image processing, computer graphics and machine learning.

4.2 Job Profiles in the Field of Visual Computing

The basic techniques for image analysis and synthesis, which are necessary for the development and integration of systems for concrete application processes, are the focus of the job profile in visual computing. The main career paths are in image processing, computer vision, computer graphics, and machine learning.

In **image processing** (Fig. 4.1), the focus is on the recognition of relevant information and content of images and videos. The relevant parts of the image have e.g. to be extracted, recognized and measured. The fields of activity can be roughly divided into industrial and scientific image processing. Already established fields of work in industry are e.g. production control and automation, quality control, security and surveillance technology, earth exploration, medical image processing and pattern recognition.

The sensing of complex environments, e.g. for the control of autonomous systems or for the digital registration of real objects, is the central focus of the field of **machine vision** / **computer vision**. Such systems are used, for example,

in the automotive industry (driver assistance systems) or in medicine (stereoscopic endoscopy). A special case of machine vision is the recognition of human gestures and facial expressions for **Human-Computer Interaction**, which is, for example, the prerequisite for the safe operation of (partially) autonomous vehicles or robots.



Figure 4.1: Segmentation of a spine in a magnetic resonance (MR) image.

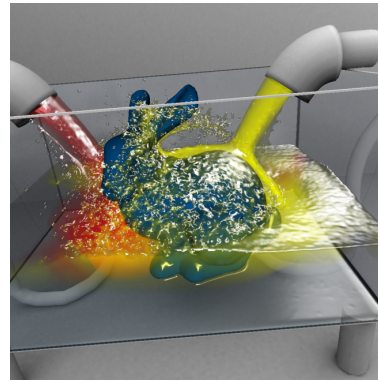


Figure 4.2: Visualization of a complex fluid simulation.

The focus of **image synthesis** (Fig. 4.2) is the (interactive) creation of images from computer-internal data. These data to be visualized usually originate from measurements (e.g. medicine, geology or astronomy), simulations (e.g. plant engineering, automotive or aircraft industry) or directly from image analysis (e.g. product design, film or television industry). The main focus of image synthesis is on visualization for the presentation of complex data from medicine and in engineering sciences, the creation of virtual simulations for design, planning and function checking e.g. of factory plants, automobiles or airplanes, as well as the realization of programs for the creation and editing of digital media ranging from photo and film/video to interactive media such as learning or video games.

4.3 Structure of the Study Program with Specialization in Visual Computing

In addition to the general mathematical and computer science competencies of a computer science bachelor's program, such as linear algebra (vector calculus), analysis (differential and integral calculus), and algorithmic and data technical concepts, as well as practical programming experience, the master's specialization Visual Computing builds on **specific prior knowledge from the field of visual computing**. Specifically, these include knowledge of theory and practice in computer graphics and digital image processing, as well as basic concepts of machine learning.

The master's program in the specialization Visual Computing itself offers a broad and very flexible choice of advanced modules in the areas of computer vision, computer graphics and machine learning. In addition to that, there are no specialization-specific structures or requirements.

4.3.1 Compulsory Modules (66 CP)

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA002	Cutting Edge Research	6	W	1	2	
4INFMA001	Scientific Working	9	W/E	1/2	2/3	
4INFMA003	Project Work	15	E	2/3	2/3	
4INFMA004	Master Thesis Computer Science	30	E	4	4	
4INFMA021	Modeling and Animation	6	W	1,3	2	

4.3.2 Core Modules (18 CP)

A total of three modules must be selected from the following catalog. For the specialization ‘Visual Computing’, the modules marked with an asterisk (*) are particularly recommended.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA020	Software Engineering II	6	S	2	1,3	
4INFBA022	Embedded Systems	6	S	2	3	
4INFMA023	Computer Architecture II	6	W	1,3	2	
4INFMA024	Parallel Processing*	6	W	1,3	2	
4INFMA025	Computer Networks II (in German)	6	S	2	1,3	
4INFMA026	Advanced Logic	6	S	2	1,3	
4INFMA028	Algorithmics I	6	W	1,3	2	
4INFMA029	Database Systems II	6	S	2	1,3	

4.3.3 Specialization Modules (36 CP)

The specialization modules offer the possibility to deepen the two core topics of visual computing, image synthesis (computer graphics) and/or image analysis (image processing), and if necessary to link them with the aspects of machine learning.

Modules amounting to at least 24 CP must be selected from the catalog ‘Visual Computing’ (see table below), for the remaining modules a free selection from all specialization catalogs as well as from the catalog ‘Core Modules’ is possible. In the sense of a clear focus, however, it is recommended to select these modules from the Visual Computing area as well.

Modules in the Catalogue Visual Computing (24-36 CP)

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA200	Rendering	6	S	2	1,3	
4INFMA201	GPU Programming	6	I ¹	1-3	1-3	
4INFMA202	Scientific Visualization	6	W	1,3	2	
4INFMA203	Statistical Learning Theory	6	S	2	1,3	
4INFMA204	Deep Learning	6	W	1,3	2	
4INFMA205	Recent Advances in Machine Learning	6	S	2	1,3	
4INFMA206	Convex Optimization for Computer Vision	6	S	2	1,3	
4INFMA207	Numerical Methods for Visual Computing	6	W	1,3	2	
4INFMA208	Machine Vision	6	S	2	1,3	
4INFBA033	Lab Computer Graphics	6	W	5	4	
4INFMA210	Virtual Reality	6	S	2	1,3	4INFBA020
4INFMA211	Higher Level Computer Vision	6	I ²	1-3	1-3	
4INFMA212	Unsupervised Learning	6	I ³	1-3	1-3	
4ETMA250	Computational Imaging	6	W	1,3	2	
4ETMA252	Topics in Computational Imaging	6	S	2	3	
4ETMA257	Introduction to Compressive Sensing	6	W	3	-	4ETMA250

¹Currently no longer offered.

²Currently no longer offered.

³Currently no longer offered.

Freely Selectable Modules (0-12 CP)

In case of special interest, a maximum of two modules (totaling a maximum of 12 CP) may be chosen from other specializations or from the catalog of core modules.⁴

In the following table all selectable modules of the other specializations are listed. It is recommended to choose the modules marked with an asterisk (*) which are clearly related to Visual Computing. In principle, the other modules can also be selected; however, it is explicitly not recommended to select the modules printed in gray.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4INFMA300	Algorithmics II*	6	S	2	3	4INFMA028
4INFMA305	Ubiquitous Computing*	6	E	1-3	1-3	
5DBHSBA15	Data Science in Medicine*	6				
4INFMA100	Development of Embedded Systems using FPGAs	6	W	1,3	2	4ETMA200
4INFMA101	Lab Ubiquitous Systems	6	E	1-3	1-3	
4INFMA102	Storage Technologies	6	S	2	1,3	
4INFMA103	StartUp Entrepreneurship	6	S	2	1,3	
5DMTBA19	Telematics - Multimedia	6	W			
5DBHSBA10	Telematics - Technologies and Applications	6	S			
4ETMA256	Communications and Information Security II	6	S	2	1,3	
4ETMA200	Signals and Systems I	6	W	1,3	2	
4ETMA201	Signals and Systems II	6	S	2	3	
4ETMA160	Reliability of Technical Systems	6	S	2	1,3	
4ETMA303	Digital IC Design	6	S	2	1,3	
4MBMAEX006	Operations Research	6				
4ETMA105	Process Automation (in German)	6	S	2	1,3	
4ETMA151	Industrial Communications (in German)	6	S	2	1,3	
4ETMA165	Industrial Information und Communication Systems	6	W	1,3	2	
4INFMA301	Model Checking	6	W	1,3	2	4INFBA302
4INFBA302	Complexity Theory I	6	W	3,5	4,6	
4INFMA304	Complexity Theory II	6	I	1-3	1-3	
4INFMA307	Advanced Programming in C++	6	S	2	1,3	
4INFMA308	Theoretical Computer Science (in German)	6	W	1,3	2	4INFBA302
4INFMA310	Recent Advances in Operating Systems and Distributed Systems	6	I	1-3	1-3	
4INFMA312	Recommender Systems	6	W ⁵	1,3	2	
4INFMA313	Quantum Complexity Theory	6	S	2	1,3	
5DMTBA04	Medical Technology	6	S			
5MDSMA02	Medical Technology in Depth (in German)	6	W	1,3	2	
5DMTBA09	Safety in Medical Applications	9	W			
3HCIMA001	Humans & Technology	9	W			
4INFMA104	Selected Topics of Computer Architectures	6	I	1-3	1-3	
4ETMA159	Assembly and Interconnection Technology (in German)	6	S	2	1,3	

⁴see section 3.3.2. Of course, only modules that have not already been chosen as core modules may be selected

⁵Due to a sabattical, the module will presumably not be offered in WiSe 24/25.

No.	Module	CP	Sem.	S.Wi.	S.Su.	Requirements
4ETMA355	Microsystem Fabrication & Test	6	W	1,3	2	
5DBHSBA02	Human Function II	9	S			
5DBHSBAEX02	Internship Clinic	3				
5BMTBA18	Immunology	6	W			
2PSYBA08	General Psychology II (in German)	9	W			

4.4 Sample Study Plans

4.4.1 Start of Study in Winter Semester

	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)
3 LP	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Project Work (part 2) (4INFMA003)	Master's Thesis Computer Science (4INFMA004)
6 LP	Scientific Working (lecture) (4INFMA001)	Project Work (part 1) (4INFMA003)	Specialization Module	
9 LP	Modeling and Animation (4INFMA021)		Specialization Module	
12 LP	Core Module	Core Module	Specialization Module	
15 LP	Core Module	Specialization Module	Specialization Module	
18 LP	Core Module		Specialization Module	
21 LP	Specialization Module			
24 LP				
27 LP				
30 LP				
33 LP				

	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)
3 LP	Cutting Edge Research (4INFMA002)	Project Work (part 1) (4INFMA003)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)
6 LP	Scientific Working (lecture) (4INFMA001)		Project Work (part 2) (4INFMA003)	
9 LP				
12 LP	Modeling and Animation (4INFMA021)	Core Module		
15 LP	Core Module	Core Module	Specialization Module	
18 LP				
21 LP			Specialization Module	
24 LP			Specialization Module	
27 LP		Specialization Module		
30 LP		Specialization Module		
33 LP				

4.4.2 Start of Study in Summer Semester

	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)
3 LP	Core Module	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)
6 LP		Scientific Working (lecture) (4INFMA001)	Project Work (part 2) (4INFMA003)	
9 LP	Project Work (part 1) (4INFMA003)			
12 LP				
15 LP	Core Module			
18 LP				
21 LP	Specialization Module	Modeling and Animation (4INFMA021)	Specialization Module	
24 LP				
27 LP	Specialization Module	Specialization Module	Specialization Module	
30 LP				

	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)
3 LP	Core Module	Cutting Edge Research (4INFMA002)	Scientific Working (seminar) (4INFMA001)	Master's Thesis Computer Science (4INFMA004)
6 LP		Core Module	Scientific Working (lecture) (4INFMA001)	
9 LP	Project Work (part 1) (4INFMA003)			
12 LP		Specialization Module	Core Module	
15 LP	Modeling and Animation (4INFMA021)			
18 LP		Specialization Module	Specialization Module	
21 LP	Specialization Module			
24 LP		Specialization Module	Specialization Module	
27 LP	Specialization Module			
30 LP		Specialization Module	Specialization Module	
33 LP	Specialization Module			Specialization Module

4.5 Further Information

If you still have questions that are not answered here, please feel free to directly contact us:

	Prof. Dr. Michael Möller	Prof. Dr. Andreas Kolb
Raum:	H-A 7106	H-A 7108
Tel.:	0271 / 740-4446	0271 / 740-2404
E-Mail:	michael.moeller@uni-siegen.de	andreas.kolb@uni-siegen.de

The safest way is to communicate by e-mail.

5 Important Organizational Information

This section summarizes important legal and organizational regulations of the program to assist you in starting your studies. However, it does not replace your obligation to inform yourself about the Examination Regulations, the Framework Examination Regulations and the current announcements of the Examination Office!

5.1 Enrollment in Courses

If you wish to study a module in a semester, you must register in the campus management system *unisono* for the courses belonging to that module in good time before the semester begins.¹

Structure of examination regulations - All subject related semesters

Structure of examination regulations - All subject related semesters	Actions	Status
PO - Master Computer Science Embedded Systems (2021-1)		
4INFMA-K1 - Compulsory Subject - rec. S. 1 - 3 - 30.0 Credits		Your actual status: passed Term of the examination: st 2023
4INFMA004 - Master's Thesis Computer Science - rec. S. 4 - Compulsory - 30.0 Credits		Your actual status: passed Term of the examination: st 2023
4INFMA-K2 - Compulsory elective area Core Modules - rec. S. 1 - 24.0 Credits		Your actual status: section started Term of the examination: st 2023
4INFMA020 - Software Engineering II - rec. S. 1 - Core elective - 6.0 Credits		
Module number and name 4INFMA021 - Modeling and Animation - rec. S. 1 - Core elective - 6.0 Credits		
Course number and name 4INFMA021-VG1 - Modeling and Animation (Lecture) - rec. S. 1 - Compulsory		
43Mi16000V - Computer Graphics II - Lecture - rec. S. 1	Apply	
4INFMA021-VG2 - Modeling and Animation (Exercise) - rec. S. 1 - Compulsory		
43Mi16100V - Computer Graphics II - Exercise - rec. S. 1	Apply	
Study achievement 4INFMA021-S - Coursework Modeling and Animation - rec. S. 1 - Compulsory - 2.0 Credits	Apply	
Examination 4INFMA021-P - Examination Modeling and Animation - rec. S. 1 - Compulsory - 4.0 Credits	Apply	

Figure 5.1: View of the curriculum in the campus management system *unisono*

The easiest way to do this is to select 'My Studies / Planner of studies with Module plan' in *unisono*, see fig. 5.1. You will then see a list of all modules. If you click on the '+' for a module, you will see the courses for that module. Courses that are actually offered in the selected semester can be recognized by the '+' on the left side, as well as –

¹There are two registration periods: the first is approximately from 8 to 4 weeks before the semester starts, and the second is approximately from two weeks before until immediately before the semester starts.

only during the enrollment phases – by the button ‘Apply’. If a course (e.g. an exercise in small groups) is offered more than once at different times, you can (and should) select multiple dates when registering. If possible, you will then be assigned to one of the selected dates according to the priority you have indicated in each case.

Please note that the registration for the courses of a module is completely independent from the registration for study achievements and examinations. So please do not forget to register separately for the study achievements and examinations.

5.2 Examinations and Study Achievements

Most modules are completed with an **examination**. Examinations are graded and can only be repeated to a limited extent (see section 5.2.1). The grade of the examination, weighted by the CP number of the module, is used for computing the final grade of the transcript. In the Master’s program, examinations are often conducted as oral examinations, the dates of which can be arranged individually with the examiner. In addition, however, there are also written examinations (in paper-based or electronic form) in some modules during the lecture-free period, term papers or laboratory reports. Finally, the master thesis (see section 5.5) also represents an examination achievement.

As a rule, study achievements (also called ‘course work’) are completed during the semester and can be repeated as often as required if they are not passed. They may be graded, but the grade is not part of the final grade on the transcript. In some modules, e.g. in many laboratory courses, there is only a study achievement, in others there may be one or more study achievements in addition to an examination. In this case, all achievements must be completed in order to successfully pass the module. In some cases, passing the study achievement is also a prerequisite for registration/admission to the examination (so-called ‘examination prerequisite’, sometimes also called ‘preliminary examination’). However, the study achievement does not have to be completed in the same semester as the examination.

Which examination and/or study achievements must be completed for a module, and whether an examination prerequisite is required, can be found in the authoritative module descriptions in the FPO-M Informatik. A list of all modules with prerequisite examinations can additionally be found in §9, section 3 of the FPO-M Informatik. Please note that the official document is in German, however, there is an unofficial English translation.

5.2.1 Repetition of Examinations

Within the standard period of study, if you fail an examination at the first attempt or are not satisfied with the grade, you can have this attempt subsequently evaluated as a **free attempt** for up to three examinations. In this case, you can take the exam again (in the case of written exams at the next offered date, in the case of oral exams within 6 months), in which case the better result counts.

You can **retake** an examination that you have failed a maximum of two times **in the regular way** (i.e. without counting any free attempts). The third and last attempt for written examinations of modules offered by the department ETI² will thereby take the form of an oral examination, unless you explicitly do not wish to do so.

The following applies to the **master thesis**: You can return the topic only once within the first four weeks of the processing period. In case of non-passing, the master thesis can be repeated at most once.

If you should **ultimately fail** a module, the following regulations apply:

- If it is a compulsory module (modules 4INFMA001 to 4INFMA003) or the master thesis, you cannot continue your studies.
- If it is an elective module, you can choose a substitute module twice in total. If necessary, there is also the one-time possibility to change the specialization.

²that is, for modules whose module number begins with ‘4INF’ or ‘4ET’.

5.2.2 Registration for Examinations

In order to take an examination, it is **mandatory** to register in advance and **in due time**. Registration for **written** examinations must take place **at least 14 days before the examination date**, and for **oral** examinations **at least 7 days before the examination date**. The deadlines are **hard**; without timely registration you will not be allowed to take the exam!

Note that for exams on imported **modules from other programs**³ other deadlines may apply. In these cases, please contact the Examination Office of the offering study program for information.

Registration for exams is usually done via the campus management system *unisono* (exceptions see below) using the button ‘Apply’, which is displayed to the right of the exam during the registration period, see fig. 5.1. If you open the sub-items for the study achievements or examinations, you will see important additional information on the achievements, in particular the **registration deadlines**, see fig. 5.2. Upon successful registration, you will receive a message via the unisono system. If the registration is not successful, please contact the Examination Office immediately.

The screenshot displays two exam entries in the *unisono* system. The top entry is for '4INFBA004-S - Coursework Object-oriented and Functional Programming' (rec. S. 2 - Compulsory - 3.0 Credits). It includes an 'Apply' button and a red circle highlighting the deadlines: 'Enrollment was feasible from 10/1/23 12:00 AM until 1/5/24 11:59 PM' and 'Disenrollment feasible from 10/1/23 12:00 AM until 1/5/24 11:59 PM'. The bottom entry is for '4INFBA004-P - Examination Object-oriented and Functional Programming' (rec. S. 2 - Compulsory - 6.0 Credits). It also includes an 'Apply' button and a red circle highlighting the deadlines: 'Enrollment feasible from 11/20/23 12:00 AM until 1/25/24 11:59 PM' and 'Disenrollment feasible from 11/20/23 12:00 AM until 2/1/24 3:15 PM'. Both exams list examiners: 'Univ.-Prof. Dr. rer. nat. Möller, Michael' and 'Dr.-Ing. Hoffmann, Andreas Univ.-Prof. Dr. Van Laerhoven, Kristof'. The bottom exam also specifies the date, time, and room: 'Thursday, 2/8/24 from 15:15 to 17:15 P8-C 101'.

Figure 5.2: Registration and information on study achievements and examinations in *unisono*

For **oral exams**, please arrange an individual exam appointment with the examiner **after** registering in *unisono*. Note that registering for an oral exam in a particular semester means that you must also take the exam in that semester, otherwise the exam will be considered failed at the end of the semester! Therefore, you have to deregister in time (i.e. at least 8 days before the end of the semester) if necessary (see section 5.2.4).

Remember that for modules that require a study achievement as a prerequisite for the examination, registration for the examination is only possible if you have already successfully completed this study achievement.

Registration **via the Examination Office** is required for:

- **Free attempts:** Please use the provided form.
- **Third attempts:** Please also use the provided form. Since the third attempt at the exam will be oral, please be sure to indicate that it is a third attempt when making the appointment with the examiner. **Additional required examinations (see 5.6):** Please also use the provided form for this. The examinations are usually conducted orally.
- **Master thesis:** Please register this with the appropriate form, which you must complete together with your master thesis supervisor.

³identifiable by a module number that does not begin with ‘4INF’ or ‘4ET’.

In the case of elective modules, registration for the examination is also associated with the mandatory choice of the corresponding module, see section 5.4.

5.2.3 Registration for Study Achievements

Please inform yourself at the beginning of the semester whether and in which form a study achievement (possibly as a prerequisite for the examination) has to be completed in the modules you have taken. You must also register for the study achievement in *unisono* (see fig. 5.1). The **binding registration deadline** is **four to six weeks after the start of lecture period**, the exact date will be announced by the Examination Office.

The registration for a study achievement is not linked to the registration for the corresponding course! This means that registration for the course does not automatically include registration for the study achievement.

In the case of elective modules, however, registration for a study achievement is also linked to the selection of the corresponding module, although in this case the selection can be cancelled, see section 5.4.

If you realize in the course of the semester that you do not want to or cannot complete a course after all, please deregister in good time (at the latest days before the end of the semester).

5.2.4 Cancellation and Withdrawal

If you have registered for an examination, you can cancel your registration up to **7 days** before the start of the examination (exact time!) via *unisono* without giving reasons (button ‘Sign Off’ to the right of the examination).

If you are unable to attend or complete an examination due to illness or another important reason, you must prove the reasons in writing to the Examination Office within three working days of the examination date, e.g. by means of a doctor’s certificate. In this case, please use the Examination Office’s withdrawal form.

If you fall ill while working on your master thesis, please report your incapacity to work immediately to the Examinations Office with a doctor’s certificate. The processing time will then be extended accordingly.

If you have registered in one semester for a study achievement or an oral examination for which no date has (yet) been issued, but do not want to take this study achievement or examination in this semester, please deregister at least 8 days before the end of the semester. Otherwise, the study achievement or examination will be considered as failed at the end of the semester due to non-participation!

5.3 Choice of Specialization

The choice of specialization in the Master’s program is already made at the time of enrollment. It can be changed once upon request via the Examination Office.

5.4 Choice of Elective Modules

Elective modules are all modules that are not compulsory modules, i.e. all modules except 4INFMA001 to 4INFMA004. You can choose these modules according to your personal interest (and, possibly, depending on the chosen specialization).

The choice of a module is made by registering for an examination (see section 5.2.2) or a study achievement (see section 5.2.3) in this module. It is important to note that the choice of module cannot be undone once the first attempt to obtain the examination has been made. Attempts in which you did not participate without an important

reason also count (see section 5.2.4). If, on the other hand, you have ‘only’ made one attempt for the study achievement in a module, you may opt out of the module.

If you finally fail the examination in an elective module, you can choose another module as a substitute. However, this is only allowed twice in total. If it is a module that you have to take in your specialization, you can also change the specialization once.

If you want to register an examination or study achievement for a specialization module in unisono, the system may ask you whether you want to select the module from the module catalog of your respective specialization or as an additional elective module. Please always choose the first option here (module catalog of your respective specialization).⁴

5.5 Master Thesis

In the master thesis, which should usually be done in the last semester of study, you work independently on a given topic within a period of 26 weeks (approx. 6 months) and document the results both in writing and in the form of a presentation.

You can start with the master thesis if you have achieved at least 60 CP in your studies and are not in the last attempt in any examination. If you are looking for a topic for your master thesis, please contact the lecturers independently (via the websites or personally, if necessary). All professors of the Department ETI are admitted as topic providers (first examiners), as well as some professors of other departments or faculties.

The right to issue a master thesis lies exclusively with the university; however, in agreement with the first examiner (and only then!) a master thesis can also be carried out in cooperation with an external company. In this case, please refer to the department’s handout for conducting external theses.

Before you start the work, it must be registered with the Examination Office using the appropriate form. After completion, the work must then be submitted to the Examination Office by the deadline, preferably in person. You have to hand in two copies of the printed and bound thesis text (max. 120 pages), each of them with

- a data carrier with the thesis text as a PDF file as well as all other parts of the thesis that are to be evaluated (i.e. in particular program code created),
- a signed declaration, included in your thesis text, that you have written the work independently.

After handing in the thesis, you still have to give an approx. 20-minute talk followed by a discussion in which you present your work.

5.6 Additional Required Examinations

Your admission to the Master’s degree program may be subject to the condition that you catch up on certain modules from the Bachelor’s degree in Computer Science at the University of Siegen. These additional requirements should be fulfilled in the first two semesters of your Master’s degree course and must be proven at the latest when you register for the Master’s thesis. As a rule, the necessary examinations can be taken orally and are therefore flexible in terms of time. To register, please submit the provided form to the Examination Office.

⁴The query has technical reasons: the examination regulations are mapped in unisono in a way that you have to choose a fixed number of CPs from your respective specialization and you can choose a fixed number of CPs arbitrarily. Therefore, there are often two ways to credit a module. If you always choose the module (as long as this is possible) from the module catalog of your respective specialization, you won’t do anything wrong. Otherwise you might limit your free choice of modules.

5.7 Recognition of Credits

If you have already acquired academic or examination achievements at another university, these can be recognized for your studies upon application, provided that there is no significant difference between the acquired competencies and the corresponding achievements in the Master Computer Science. In such cases, please inform yourself at the Examination Office.

5.8 Times of Absence, Compensation for Disadvantages and Hardship Cases

Your studies will always require you to meet deadlines or to perform achievements in a given time and in a given form. If you have objective reasons why this is not possible for you (e.g. acute or chronic illness or disability, but also maternity leave, parental leave or caring for relatives), please contact the Examination Office, a mentor, or the head of the examination board. We will do our best to support you as far as possible in such cases.

6 Module Descriptions

PDF documents with the detailed module descriptions of all modules of the Computer Science Master can be found in the campus management system unisono (only in German!).

- Specialization Embedded Systems.
- Specialization Visual Computing.

In addition, the links behind the module numbers in this document will lead you directly to the corresponding module description in unisono (please select the tab 'Contents' there; unfortunately, also these descriptions are mainly in German).

You can find module descriptions in English in the unofficial (and probably sometimes a bit outdated) English translation of the examination regulations.