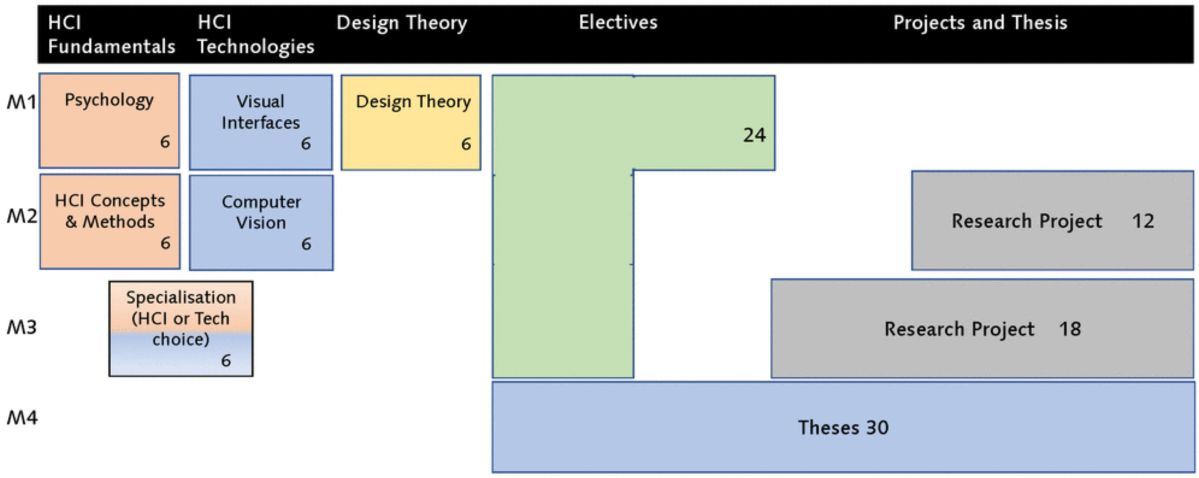
Modulkatalog Master Human-Computer Interaction

The Master's degree course in HCI lasts 4 semesters and comprises 120 credit points. The module plan shows all modules contained in the program. The module plan follows the Society of Computer Science's recommendation of so-called *Type 2 degree programmes where students need to have pre-education from a relevant bachelor program*.

The profile of this master program results from its focus on two main areas (HCI Fundamentals und HCI Technologies) that contain a total of 4 modules: Psychology, HCI Concepts & Methods, Visual Interfaces, Computer Vision, a Specialization Modul within these two areas, as well as a Design Theory Modul. In addition, within the freely configurable Electives module, students can focus or broaden out. The research projects enable to expand relevant specialist skills, but can also cover interdisciplinary projects. They further serve as a means of developing further key competences such as teamwork, project management and presentation skills. The final stage of the program (and of the course of studies) is thedefence of the Master's theses.

The courses relating to each module may, depending on needs and capacity to offer classes be expanded with further courses suitable for the module focus.



Module:

- Psychology (HCI-PSY) (6 ECTS)
- HCI Concepts & Methods (HCI-CME) (6 ECTS)
- Visual Interfaces (HCI-VISI) (6 ECTS)
- Computer Vision (HCI-COVI) (6 ECTS)
- Specialization (HCI-SPEC) (6 ECTS)
- Design Theory (HCI-DT) (6 ECTS)
- Wahlbereich (Electives) (HCI-ELEC) (24 ECTS)
- Forschungsprojekt I-II (HCI-RP1/ -RP2) (30 ECTS)
- Mastermodul/Theses (HCI-MT) (30 ECTS)

Title	Psychology	Module number	HCI-PSY

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
	Annual	Weekly over the course of one semester	6	180, thereof 45 h In-class study, 30h course work, 80h Self-study, 25h Exam & preparation	English	Prof. Jan Ehlers

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human Computer Interaction	Basic knowledge of HCI at bachelor level from a suitable previous degree	Problem-based groupwork with results to be documented in (empirical) reports. The final assessment of theoretical and methodological knowledge is covered by a written exam. Exam duration: 20-30 minutes (oral) or 90-120 minutes (written). Language: English

Target qualifications

The students will acquire a profound understanding of human interaction with modern ubiquitous computing systems. They will learn about quality attributes that constitute good usability/user experience and will know how to carry out reasonable design decisions during iterative development. Special emphasis will be put on human factors. The students will be able to draw upon theories from cognitive psychology and will learn to apply their knowledge on usability research or physiological computing systems. They will gain a broad understanding of psychophysiological concepts and learn to characterize individual user states by determining levels of cognitive workload or states of affective processing. Building on this, they will develop the ability to improve interactive systems and to create customized solutions that ensure optimal accessibility for different user groups.

Furthermore, students will receive fundamental knowledge to conceive experimental designs for empirical studies. They will develop awareness for confounding variables and be able to reflect upon test environments, group compositions and teaching effects. They will learn to quantify psychological, physiological and behavioural parameters and acquire knowledge to carry out statistical analyses. They will be able to fully evaluate empirical results, discuss them against the backdrop of the relevant literature and document findings adequately.

Content

Example contents are:

- Research methods in Physiological Computing (i.e. Eye-tracking, Cognitive Pupillometry, EEG, cardiovascular measures)
- Mental status determination & Body scheme extensions
- Brain-Computer Interfaces (P300-, SSVEP- & ERD/ERS-based approaches) & Biofeedback (techniques & interfaces)
- Neuroadaptive Interfaces, Neuroprosthetics
- Principles of Embodiment
- Signal analysis: Time series analyses & frequency analyses
- Usability engineering & testing: Theories & methods
- Human factors: Psychological, physiological & motor determinants
- Interaction/participatory design, accessibility & (specific) user groups
- Experimental designs (field & lab studies)
- Quantitative data analyses: descriptive & inferential statistical methods

Teaching and learning forms / Didactic concept
Lectures are complemented with practical labs that relate to concrete and application-oriented topics covered during classes. Lab work is carried out in small groups, supervised by academic staff and supported by regular feedback. It requires a structured and independent work behaviour from each student by simultaneously promoting collaborative skills as well as cross-cultural competences. In particular, students process small empirical research questions by developing scientific hypotheses and conceiving experimental designs. They are required to deal with technical and methodological challenges during the collection of both psychological as well as physiological data and to statistically evaluate the results. Findings are to be reflected against the backdrop of relevant literature and to be documented in joint lab reports. Aim is to develop a profound understanding of the capabilities of psychophysiological measures, the difficulties of operational definitions and the limits of empirical testing. Project work is distributed across the module, selected findings are referred back to during the classes. The final assessment of classes in this module is covered by a written exam. Classes in this module consist of 2 SWS of lecture and 1 SWS practical session per week during the semester..
Special information

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)
The module consists of the following courses, of which one needs to be completed:	(Lecture + Practical Sessions)
- Physiological Computing (Jun.-Prof. Ehlers)	2+1 SWS / 6 ECTS
- Usability Engineering & Testing (Jun.-Prof. Ehlers)	2+1 SWS / 6 ECTS

Title	HCI Concepts and Methods	Module number	HCI-CME

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
	Annual	Weekly over the course of one semester	6	180, thereof 34 h In-class study, 34h Self-study, 112h coursework	English	Prof. Eva Hornecker

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human Computer Interaction	Basic knowledge of HCI at bachelor level from a suitable previous degree	Project- and problem-based coursework. Assessment via a set of assignments (assessed as one piece) Language: English

Target qualifications

The students will master core methods and theories for understanding and analysing human interaction with technology, in particular regarding novel technologies. They will know how to apply core HCI principles and methods to novel (and real-world) problems and tasks, and will have developed an understanding of how system design decisions and technology aspects impact people's lives, regarding functionality, usability and user experience and the wider use context, including effects regarding social and societal consequences of technology. Students will be able to conduct user studies and to follow user-centered design principles, to adapt and adjust these techniques and methods in light of the given problem and use context, and to justify research method, design and implementation choices. They will understand and be able to discuss complex HCI issues from the research literature for emerging areas of human-computer interaction, and will be able to engage with the literature and to acquire other methods independently.

In addition, social and general transferable skills are trained via group work in the classes based on concrete problems and tasks. The class includes reflection on ethical issues related to e.g. study design and societal consequences of novel technology design.

Content

Example contents are:

- HCI research methods (qualitative and quantitative, i.e. lab studies, ethnography, field studies)
- The 'waves' of HCI theory and their relation to methods
- History of HCI and interface technologies (paradigms and theory trends)
- Ethical issues in HCI research and Usability (informed consent, privacy rights, effects of technology on society)
- Modern User Interfaces for Ubicomp Systems
- User-Centered Design for Development of Novel Technologies, e.g. UbiComp
- Societal, Ethical and User-Research Issues for Novel Technologies
- Role of the use context

Teaching and learning forms / Didactic concept

Classes in this module consist of 2 SWS of lecture and 1 SWS practical session per week during the semester.

Lectures and practical sessions are combined with individual and group-based study related to theoretical and practical aspects of the contents. Practical sessions include project-oriented work based on concrete problems (problem-based learning approach) and student presentations. Assignments require students to apply methods and approaches in practical empirical research projects, to apply theoretical concepts to practical problems and tasks, and to work with and critically reflect on the literature.

As a large part of this module focuses on conveying method skills and competencies, the class is assessed solely via practical coursework. Smaller group tasks done in parallel to lectures train methods and core concepts. A final individual assignment (submitted as a written report of 5-10 pages in the style of an academic publication) requires the integration and application of course contents and skills in addressing a complex problem.

Academic staff and doctoral students provide supervision and feedback. Students further engage in group work and thus train team work on practical projects.

Special information

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)
The module consists of the following courses, of which one needs to be completed:	(Lecture + Practical Sessions)
- HCI theory and research methods (Prof. Hornecker)	2+1 SWS / 6 ECTS
- Ubiquitous Computing (UbiComp) (Prof. Hornecker)	2+1 SWS / 6 ECTS

Title	**Visual Interfaces**	**Module number**	**HCI-VISI**

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
1+2	Each semester	Weekly over the course of one semester	6	180, thereof 45h in-class study, 90h self-study and coursework, 45h exam preparation	English	Prof. Bernd Fröhlich

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human-Computer Interaction	Basic knowledge of HCI and computer graphics at bachelor level from a suitable previous degree	Coursework in combination with a final exam (written or oral). Exam duration: 30-45 minutes (oral) or 90-150 minutes (written). Language: English

Target qualifications

This module lets students choose either a course on 2D visualization and the corresponding interaction techniques (visualization course) or on the visualization of 3D environments and virtual reality interfaces (virtual reality course).

The virtual reality course enables students to understand the requirements, challenges and successful designs of 3D user interfaces, master the basics of scenegraph representations, and have an overview of virtual and augmented reality software and hardware technology and systems. They are capable of designing, implementing and evaluating virtual reality applications involving three-dimensional interfaces and displays.

In the visualization course students acquire mathematical, algorithmic and technical knowledge about methods and procedures for the visual representation of measured, simulated or collected data and the corresponding interaction techniques. They are able to analyse new visualization problems and select the appropriate techniques, adapt them, implement efficient and effective solutions and evaluate the resulting visualization system.

In addition, social and general transferable skills are trained via group work in the lab classes based on concrete problems and tasks.

Content

Core topics in Visualization are:

- Visualization and interaction techniques for multi-attribute, graph-based, cartographic, set-based, textual and time-series data
- Concepts and techniques for visualizing volumetric scalar and vector-based data

Core topics in Virtual Reality are:

- 3D perception and viewing
- Scenegraph representations
- 3D user interfaces
- 3D display technology

Teaching and learning forms / Didactic concept

Lectures and practical lab sessions combined with individual and group-based work related to theoretical and practical aspects of the contents. Practical sessions can include project-oriented and lab work based on concrete problems (problem-based learning approach).

Various approaches presented in lectures will be studied, in part practically through labs and assignments. Lab classes focus on implementing, testing and evaluating the visualization approaches presented during the lectures. Postdoctoral researchers, doctoral students and teaching assistants are supervising the students. They are available for intensive discussions and immediate feedback.

This module conveys method skills and theoretical and practical backgrounds, which are assessed via an oral or written exam, and through a larger, final assignment including group presentations. Practical skills and implementation competencies are assessed via coursework.

Classes in this module consist of 2 SWS of lecture and 2 SWS practical session per week during the semester.

Special information

Lectures / courses included in the module (optional)	ECTS credit points (optional)
The module consists of the following courses, of which one needs to be completed:	(Lecture + Practical Sessions)
- Virtual Reality (Prof. Fröhlich)	2+2 SWS / 6 ECTS
- Visualization (Prof. Fröhlich)	2+2 SWS / 6 ECTS

Title	**Computer Vision**	**Module number**	**HCI-COVI**

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
1+2	Each semester	Weekly over the course of one semester	6	180, thereof 45h in-class study, 30h project work, 75h self-study, 30h exam preparation	English	Prof. Volker Rodehorst

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human-Computer Interaction	Basic knowledge of computer science at bachelor level	Successful completion of exercises and project. Final examination: 90-120 minutes (written exam)

Target qualifications

The module gives an introduction to advanced concepts of image processing, image analysis and object recognition as well as spatially related problems.

The goal of the course Image Analysis and Object Recognition is to understand the principles, methods and applications of computer vision from image processing to image understanding. Students should be able to solve computer vision problems and to formalize and generalize their own solutions. They should understand the proposed image analysis methods to compare different proposals for object recognition systems, to make well-informed decisions about the preferred proposal and, if necessary, to find their own solutions to given computer vision problems.

The course Spatial Information Systems (GIS) enable students to formalize their own solutions by applying the concepts of geospatial data acquisition, organization, analysis and presentation. Students will be able to realize the conceptual design and realization of a GIS, the collection of subject-specific geospatial data as well as the application for location-based services, geo-marketing and strategic site planning in order to address problems of spatial information systems and their application to digital media.

Students should develop an understanding of the current state of research. With appropriate supervision, students should be able to tackle research problems.

Content

See course descriptions

Teaching and learning forms / Didactic concept

Lectures with exercises and a small project; The lectures provide the theoretical background that is exemplary applied in mandatory computer exercises and an individual project. The course is assessed via a final written exam.

Special information

See course descriptions.

Lectures / courses included in the module (optional)	ECTS credit points (optional)
The module consists of the following courses, of which one needs to be completed:	(Lecture + Practicals + Project)
• Image Analysis and Object Recognition (Prof. Rodehorst)	2+1+1 SWS / 6 ECTS
• Spatial Information Systems (GIS) (Prof. Rodehorst)	2+1+1 SWS / 6 ECTS

Title	Specialization	Module number	HCI-SPEC

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
1+2	Every semester	Weekly over the course of one semester	6	180h Distribution of workload, depends on course chosen	English	Prof. Eva Hornecker

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human Computer Interaction	See module descriptions for further requirements, if any. Depending on course selected, basic knowledge of computer science at bachelor level or basic knowledge of HCI at bachelor level.	See module descriptions (Psychology, HCi Concepts & Methods, Visual Interfaces, Computer Vision) Language: English

Target qualifications

Students shall acquire in-depth knowledge of specialist topics in HCI, focusing either on fundamental methods and concepts, or on more technological aspects. Courses from the following mandatory module areas are also open to the Specialization module: Psychology, Visual Interfaces, HCI Concepts & Methods and Computer Vision. The student can pick one such course, that has not been taken for any of the above modules.

In addition, social and general transferable skills are often trained via group work in these courses based on concrete problems and tasks.

Content

Example contents are:

- HCI research methods (qualitative and quantitative, i.e. lab studies, ethnography, field studies)
- Usability engineering and testing
- Virtual Reality Technologies
- Information Visualization
- Image Analysis
- Physiological Computing

See course descriptions.

Teaching and learning forms / Didactic concept

Classes in this module consist of one 90-minute lecture and one 45-minute practical session per week during the semester. Unless otherwise specified in the description of a component course: lectures and practical sessions combined with individual and group-based studies related to theoretical and practical aspects of the course contents.

Practical sessions can include project-oriented and laboratory work based on concrete problems. Assignments require students to apply methods and approaches as well as theoretical concepts to practical problems and tasks, and to work with and critically reflect on the literature. Theoretical aspects can include reading, understanding and presenting recent publications. Postdoctoral researchers, doctoral students and teaching assistants supervise students and are available for intensive discussion and feedback.

Special information

This module requires taking another course from the module catalogue for Psychology, Visual Interfaces, HCI Concepts & Methods and Computer Vision, that has not been used towards the transcript of records otherwise.

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)

In this module, students take one additional course from the catalogue of options from the HCI fundamentals and HCI technology areas. The options are: - Physiological Computing - Usability Engineering and Testing - HCI Theory and Methods - UbiComp (Ubiquitous Computing) - Virtual Reality - Visualization - Image Analysis and Object Recognition - Spatial Information Systems (GIS)	(Lecture + Practicals + Project) 2+1 SWS / 6 ECTS 2+1 SWS / 6 ECTS 2+1 SWS / 6 ECTS 2+1 SWS / 6 ECTS 2+2 SWS / 6 ECTS 2+2 SWS / 6 ECTS 2+1+1 SWS / 6 ECTS 2+1+1 SWS / 6 ECTS

Title	**Design Theory**	**Module number**	**HCI-DT**

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
	Every semester	Weekly over the course of one semester	6	180h, thereof: 34h in-class study; 34h self-study; 112h exam preparation and assignment/s	English	Prof. Jan Willmann

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human Computer Interaction Open to other master courses of the Bauhaus-Universität Weimar, including the Faculty of Art and Design and the Faculty of Architecture and Urbanism	Abitur or equivalent	Final exam and/or assignment/s (both written) in combination with weekly exercises. Passing the exercise successfully is a requirement for the exam and/or the assignment/s. Exam duration: 90-120 minutes; Final assignment: Scientific essay, 4.000-6.000 words.

Target qualifications

The module provides students with a fundamental introduction in the theory and history of contemporary design cultures, focusing particularly on digital practices and their wider implications for the design professions. As such, students become acquainted with relevant approaches and discourses in design history, design theory and design research, and will learn to critically reflect on current design concepts, methods and techniques, and to work with respective literature and other knowledge resources. When having successfully attended the semester, students are able a) to oversee, b) to critically reflect and to understand, and, ultimately, c) to contextualize emerging design practices, and to transfer gained knowledge towards own studies and projects.

Content

The module addresses key paradigms and approaches of emerging design practices. It includes a wide range of historical and theoretical perspectives, bringing forward a comprehensive overview and detailed understanding of relevant concepts, methods and discourses. Of particular importance are the history of design and the history of cultural technologies as well as contemporary design theory and design research (1990 to present). In this, the course takes a cross-disciplinary approach, bringing forward specific knowledge and methods from the field of design history, design theory and design research, but, at the same time, also connecting to related areas, such as art, media and architecture. Core topics are

- Origins of modern calculus
- Beginnings of the Information Age
- Rise of computer industry and networks
- Warfare ideologies and cybernetic technologies
- Advent of Artificial Intelligence
- Hacker culture and home computer turn
- Digital design thinking and design exploration
- Digitized materiality and design virtualization
- End of authorship
- Open source and digital labour
- Politics of smart home and smart cities
- Digital sustainability

In this, the module allows students to acquire a broad overview and in-depth insight into current digital theories and practices, including respective historical, technological, cultural and political contexts. The course structure for both courses available in this module allows addressing essential media and literature resources, as well as specific methodological knowledge (historiographical research, grounded-theory, critical thinking, speculative design, mixed-methods, ethnographical perspectives etc.).

Teaching and learning forms / Didactic concept

Classes consist of a) weekly lectures (online and/or analogue) (2 SWS), and b) corresponding weekly exercises (online and/or analogue), and c) additional weekly consultations (online) (1 SWS). The exercise supplements the lecture, discussing additional case studies and literature, and prepares the students for the exam (including quizzes and multiple-choice exercises). This integrated approach allows to address a wide range of design historical/theoretical topics, but also to sharpen and to contextualize them from a methodological and practical perspective. The exercise sessions foster the active engagement of students and give the opportunity for addressing individual topics and questions. Moreover, the course offers an additional repetitorium (before the exam phase).

Special information

Literature (selection):

- Greg Lynn, The Archeology of the Digital, Berlin, 2013.
- Dennis P. Doordan, Design History – An Anthology, Cambridge/MA., 1996.
- Mario Carpo, The Alphabet and Algorithm, Cambridge/MA., 2010.
- Manuel Castells, The Rise of the Network Society, Chichester, 2010.
- Charlie Gere, Digital Culture, London, 2002.
- Ray and Charles Eames, A Computer Perspective, Cambridge/MA., 1973.
- Nicholas Negroponte, Being Digital, New York, 1995.
- Steven Levy, Hackers: Heroes of the Computer Revolution, Garden City, 1984.

(Further up-to-date literature recommendations will be announced in the course catalogue of each semester)

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)
The module consists of the following courses, of which one needs to be completed:	(Lecture + Exercise Sessions)
- Design Theory: Digital Culture I - An Introduction for the Design Professions (Winter Semester) (Prof. Willmann)	2+1 / 6 ECTS
- Design Theory: Digital Culture II - An Introduction for the Design Professions (Summer Semester) (Prof. Willmann)	2+1 / 6 ECTS

Title	Electives	Module number	HCI-ELEC

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
	Every semester	Weekly over the course of a semester	24	720h	English	Prof. Eva Hornecker

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human Computer Interaction	Bachelor degree in a relevant field for HCI	Varies, depending on choice of specific courses taken. Language: English (German courses may also be selected) The resulting grade of the module is calculated as the weighted mean of the grades obtained in the component courses, weighted by the courses' ECTS credits.

Target qualifications

Students acquire in-depth knowledge of specialized HCI topics and broaden their knowledge of HCI-related areas. Depending on the chosen classes, through taking courses from other disciplines, such as media studies or design/arts disciplines, students gain exposure to different disciplinary cultures and styles of working, methodologies and approaches, as well as first-hand experience of working in interdisciplinary teams. Students can further improve their English, or, in the case of non-native speakers, German.

This module enables students to create their personal profile and to specialise in relevant sub-areas of HCI or neighbouring disciplines.

Content

Electives can be freely chosen from

- all courses offered within the Master program of Computer Science for Digital Media and Master in HCI (courses not utilized for other modules yet)
- courses from other study degrees at BUW, this includes courses and projects from the Faculty of Arts and Design, Architecture and Urbanistics, Civil Engineering, as well as study programs in product design, media arts/design, media studies, media management, civil engineering, as well as media management, media studies
- language courses (English and German) with up to 7 ECTS
- projects with relation to HCI offered by other study programs can be used towards the Electives module
- on special request, interdisciplinary courses e.g. from the University of Jena or Erfurt may also be taken.

The 24 ECTS can be accumulated out of (allowed) courses of any size.

Teaching and learning forms / Didactic concept

Teaching and learning forms as well as didactic concepts will depend on the individual choice of courses, and may range from lectures and practical sessions over project work and seminars.

Special information

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)

Title	Research Project I / II	Module number	HCI-RP1 / -RP2

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
1 or 2 or 3	Every semester	Over the course of one semester	RP I: 12 / RP II: 18	360/540, thereof 45h in organized meetings/ classes and 315/495h Self-study	English	Respective professorship

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human-Computer Interaction Open to other M.Sc. students of collaborating professorships.	RP I: Basic knowledge of HCI and computer science at bachelor level from a suitable previous degree or 1st semester of study. RP II: Advanced knowledge of HCI, from first 2 semesters of study or from a related bachelor degree	Completion of a body of work and its documentation, usually in the form of a scientific report. Specific criteria for evaluation will be announced in the course catalogue and at the beginning of the individual project. Quality of the presentation, results achieved, autonomy in work and creativity are important factors.

Target qualifications

Depending on the type of project, students have gained practical experience with the design, implementation and evaluation of software systems and their user interfaces or have practical experience of designing, planning and running user studies within particular domains or related to specific user interface technologies.

Participants refine their presentation skills via independent literature research based on current publications and presentations on the various aspects and milestones of the project. An evaluation and documentation of the results in the form of a scientific report completes the project. As a result of various types of activities involving presentations, participants have experience presenting and explaining their work in oral and written form, following academic standards. They understand the importance of project management and organisation for complex projects and are accustomed to acquiring new skills and knowledge in self-study. Students have engaged with literature on the topic area of the project.

Projects require considerable autonomy from students and train social and general transferable skills via group work and independent research (team work, self-organisation, project management).

Content

Depends on individual topic

Within the project, students work on research topics in close collaboration with the supervising professors and their research assistants. In many cases, the projects focus on the design, implementation and evaluation of software systems and their user interfaces with a particular emphasis on team work. Projects may also focus on designing, planning and running user studies within particular domains or related to specific user interface technologies.

Projects will often produce a body of practical work or a working system, and a scientific report, or may predominantly result in a larger scientific report.

Teaching and learning forms / Didactic concept

Projects confront students with complex problems of scientific relevance and require as well as train autonomy and creativity as well as problem-solving skills and team work. They are at the core of the Bauhaus tradition of teaching.

Typically, project teams meet once a week with the supervising professors and their research assistants. The majority of effort consists of autonomous self-study, frequently done in teams. Projects can be interdisciplinary, with mixed teams.

Special information

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)

Title	Master Thesis Module	Module number	HCI-MT

Semester (optional)	Frequency	Interval and duration	ECTS credit points	Workload	Language(s)	Module coordinator(s)
4	Every semester	Anytime, 5 months	30 (24 written thesis, 6 defence)	900h, thereof 700h self-study, 20h in meetings with the supervisor, and 180h for the defence and its preparation (1h for the defence itself)	English	Respective professorship

Type and Usability of module	Formal requirements for participation	Examination requirements
M.Sc. Human-Computer Interaction	At least 60 ECTS of the HCI master have to be successfully completed. English proficiency at C1 level (CERT).	Written thesis in the style of a scientific publication (weight 75%) and a related defence (weight 25%)

Target qualifications
In the thesis, the students prove their ability to perform independent scientific work in the area of HCI on an adequately challenging topic within a given timeframe. They utilize established HCI methods or adapt existing approaches while adhering to standards of scientific work. They are given the opportunity to develop, refine and realize their own ideas and work critically with the literature.

Content
Depends on individual topic

Teaching and learning forms / Didactic concept
Largely independent research with regular intermediate reporting and consultation with the supervisor.

Special information
The final thesis is the most important part of the module and describes the results as well as the path that led to these results. The thesis should be written in the style of a scientific publication, whereby the student's own contribution to the results should be clearly evident. The evaluation of the thesis comprises a grade for the written thesis (weight 75%) and a combined grade for the presentation and the related defence (weight 25%).

Lectures / courses included in the module (optional)	SWS / ECTS credit points (optional)

Attachment

Course Catalogue

Physiological Computing - Psychology, Specialization
Usability Engineering and Testing - Psychology, Specialization

HCI Theory and Methods - HCI Concepts and Methods, Specialisation
UbiComp (Ubiquitous Computing) - HCI Concepts and Methods, Specialisation

Virtual Reality – Visual Interfaces, Specialisation
Visualization - Visual Interfaces, Specialisation

Image Analysis and Object Recognition – Computer Vision, Specialisation
Spatial Information Systems (GIS) - – Computer Vision, Specialisation

Design Theory: Digital Culture I - An Introduction for the Design Professions – Design Theory
Design Theory: Digital Culture I - An Introduction for the Design Professions – Design Theory

Course Title	**Physiological Computing**
Coordinator	Jun.-Prof. Dr. Jan Ehlers
Assigned Module(s)	Psychology, Specialization
Formal requirements for participation	Basic knowledge of HCI at bachelor level from a suitable previous degree
Examination requirements	Submission of lab reports as a prerequisite to attend the written exam. Group work during small laboratory experiments requires students to apply the acquired theoretical and methodological knowledge. Overall aim is to determine cognitive/affective states on basis of selected psychological and physiological variables, to create references and to test the validity of these measures. Therefore, students need to conceive experimental designs, deal with aspects of measurement technology and critically reflect upon operational definitions. Empirical findings are to be evaluated statistically, discussed in accordance with literature findings and documented in lab reports.
Specific target qualifications	The course introduces theories and methods of physiological computing. The students will acquire basic knowledge on the human central and peripheral nervous system; they will be familiar with the idea of user-state representations and computer systems that dynamically adapt to changes in implicit information which underly our psychological conditions (level of mental workload, states of affective processing). The students will learn about the psychophysiological concept of bodily arousal and develop a broad understanding of non-invasive recording devices and sensor technologies (e.g. video-based eye-tracking, EEG recordings). They will be able to differentiate between features of various physiological measures, including electrophysiological patterns (EEG), thermoregulatory responses (skin conductivity, skin temperature), cardiovascular changes (heart-rate variabilities), oculomotor reactions (gaze movements, cognitive pupillometry) and muscle activity (grip force). During mental status determination, students will be able to reasonably balance between physiological and psychological measures, to combine them and to select adequate methods depending on research objectives and psychological constructs. Also, students gain the ability to quantify physiological sample data records via time series and frequency analyses, evaluate relevant features statistically (response latencies, gradients, amplitudes, recovery times) and discuss the results against the backdrop of current models and theories. Furthermore, students will know sensorimotor principles that constitute our body scheme and will be familiar with established techniques to connect the brain/body to a machine through extending boundaries of the nervous system (Brain-Computer Interfaces, Bio-/Neurofeedback). They will know the concept of embodiment, be able to critically reflect upon possibilities and limitations of neuroadaptive interfaces and be aware of the application possibilities of recent developments in Neuroprothetics. Lectures are complemented with labs that provide opportunity to independently collect and analyse physiological activity. Standardised scenarios and controlled experimental settings enable students to apply the acquired knowledge and reflect upon measuring (in)accuracies, artifacts, individual reaction patterns and habituation effects.
Contents	• Physiological computing: Theories & methods • The central & peripheral nervous system • Mental status determination: Cognitive & affective user states • Sensorimotor activity & body scheme (extensions) • Eye-tracking: Gaze analysis & Cognitive Pupillometry • EEG (spontaneous rhythms, event-related potentials) & Brain-Computer Interfaces • (Neuro)adaptive Interfaces & Neuroprothetics • Muscle activity, grip force & pressure measurement • Skin conductance, skin temperature & cardiovascular measures • Biofeedback: Theories & applications • Measuring devices & sensor technology • Signal analysis: Time series analysis, frequency analysis

Introductory Literature	• Picard, R. W. (2000). Affective computing. MIT press. • Fairclough, S. H. (2010). Physiological computing: interfacing with the human nervous system. In Sensing emotions (pp. 1-20). Springer, Dordrecht. • Fairclough, S. H., & Gilleade, K. (Eds.). (2014). Advances in physiological computing. Springer Science & Business Media.

Course Title	Usability Engineering and Testing
Coordinator	Jun.-Prof. Dr. Jan Ehlers
Assigned Module(s)	Psychology, Specialization
Formal requirements for participation	Basic knowledge of HCI at bachelor level from a suitable previous degree
Examination requirements	Submission of written study reports as a prerequisite to attend the written exam. Group work addresses selected problems from the field of Usability Engineering and testing and requires students to apply the acquired theoretical and methodological knowledge during different practical tasks. In particular, students need to draw on their skills from the Usability Engineering Lifecycle by designing user-centered interaction concepts during iterative developmental phases. Good usability/user experience needs then to be tested by applying user-studies featuring carefully selected evaluation techniques. Results are to be analyzed statistically and documented by reflecting it against relevant findings in literature.
Specific target qualifications Contents Introductory Literature	Students are introduced to theories and methods in the field of usability engineering to acquire a profound understanding of human interaction with modern ubiquitous computing systems. They learn about quality attributes that constitute good usability, in order to carry out design decisions during iterative development and to be able to improve interactive systems. Special emphasis is put on human factors, students will be able to draw on theories from cognitive psychology, they will develop awareness for social-design-related challenges and gain the ability to create customized solutions that ensure optimal accessibility for various user groups. To assess interactive systems for usability and user experience, students are given insights into the methodology of usability testing. They learn to weight the advantages and disadvantages of different evaluation techniques, adapt them against the backdrop of context-specific challenges and to apply appropriate implementation choices. Furthermore, students gain fundamental knowledge to develop scientific hypotheses, to conceive and design experimental studies and to independently perform quantitative data analyses (both descriptive and inferential) on the basis of parametric/non-parametric statistical procedures. Lectures are accompanied by labs that link theoretical knowledge with application-oriented tasks. Addressing selected problems of Usability engineering/testing in both laboratory and naturalistic settings, students will apply the acquired knowledge and learn to critically reflect upon test environments, group compositions as well as confounding variables. • Usability and User Experience (UX) • Usability heuristics • Human factors: Psychological, physiological & motor determinants • Usability Engineering: Prerequisites & requirements • Usability Engineering: Theories & methods • The Usability Engineering Lifecycle • Interaction/participatory design, accessibility & (specific) user groups • Dark patterns & hostile design/architecture • Usability Testing: Theories & methods • Study designs, experimental procedures & sampling • Quantitative data analyses - descriptive & inferential statistical methods Field experiments & lab studies • Nielsen, J. (1994). Usability engineering. Morgan Kaufmann. • Dumas, J. S., Dumas, J. S., & Redish, J. (1999). A practical guide to usability testing. Intellect books. • Hartson, R., & Pyla, P. S. (2012). The UX Book: Process and guidelines for ensuring a quality user experience. Elsevier.

Course Title	**HCI Theory and Methods (previously: Advanced HCI: HCI Theory and Methods)**
Coordinator	Prof. Dr. Eva Hornecker
Assigned Module(s)	HCI Concepts and Methods, Specialisation
Formal requirements for participation	Basic knowledge of HCI at bachelor level from a suitable previous degree
Examination requirements	Submission of practical project- and problem-based coursework in combination with presentations and technical discussions. Group assignments require students to apply methods and approaches in practical empirical research projects, to apply theoretical concepts to practical problems and tasks, and to work with and critically reflect on the literature. A final, individual assignment consists of a larger individual project (an empirical study), where students are to apply the learned skills and knowledge to a self-chosen problem area and to report on their study in the style of an academic publication.
Specific target qualifications	Students should have an understanding of the difference between quantitative and qualitative methods. They should master core HCI qualitative research methods for understanding and analysing human interaction with technology and know relevant HCI theories. They should be aware of how the role of theory in HCI has expanded from the early days of human factors and mathematical modeling of behaviour to include explanatory and generative theories, which reflect influences from fields such as design, sociology and ethnography. Students should know how to apply core HCI methods to novel (and real-world) problems and tasks. Students should be able to run studies using appropriate data gathering or evaluation techniques and methods, in particular, qualitative methods (e.g. interviews, observation, contextual enquiry, diary studies), to adapt and adjust these in light of the given research question and use context, and to justify research method and study design. They should understand and be able to discuss complex HCI issues from the research literature for emerging areas of human-computer interaction and be able to engage with the literature and acquire other methods independently. With appropriate supervision, students should be able to tackle research problems. In addition, social and general transferable skills are trained via group work in the classes, based on concrete problems and tasks.
Contents	Example contents are: • Role of Theory in HCI, the History of HCI theory and Method Use • General Styles of HCI Research Methods (qualitative and quantitative) • Experimental Study Design and Statistical Analysis • Interviews, Questionnaires, Observational Methods and other approaches • Ethnography and Field Studies • Data Analysis for Qualitative Studies
Special information	Introductory Literature: • Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. Research Methods in Human-computer Interaction. Wiley • Judith S. Olson, Wendy A. Kellogg (eds.) Ways of Knowing in HCI. Springer 2014 • Yvonne Rogers. HCI Theory. Classical, Modern, and Contemporary. Morgan & Claypool Publishers 2012 • Ann Blandford, Dominic Furniss, Stephann Makri. Qualitative HCI Research. Going behind the scenes. Morgan and Claypool Publishers 2016

Course Title	**UbiComp (Ubiquitous Computing) (previously: Advanced HCI: UbiComp)**
Coordinator	Prof. Dr. Eva Hornecker
Assigned Module(s)	HCI Concepts and Methods, Specialisation
Formal requirements for participation	Basic knowledge of HCI at bachelor level from a suitable previous degree
Examination requirements	Submission of practical project- and problem-based coursework in combination with presentations and technical discussions. Group assignments require students to apply the learned concepts and methods in practical projects, to apply theoretical concepts to practical problems and tasks, and to work with and critically reflect on the literature. A final assignment consists of a larger individual project (an empirical study), where students are to apply the learned skills and knowledge to a self-chosen problem area and to report on their study in the style of an academic publication.
Specific target qualifications Contents Special information	Students should have an understanding of theoretical, applied and technical foundations of modern ubiquitous computing systems. They should understand how such Ubicomp systems work on a technical level and also understand their societal relevance. They should know about the technical and social-design-related challenges in developing such systems. They should be able critically to assess societal implications and discuss design trade-offs. They should be able to develop concepts for novel UbiComp applications, to determine their technical feasibility, and to reflect critically on their feasibility in an application context. Moreover, they should be able to apply a user-centered approach in the design process of UbiComp applications. Students should understand and be able to discuss complex issues from the HCI and UbiComp research literature for emerging areas of UbiComp. They should be able to engage with, to summarize literature and to critique it. With appropriate supervision, students should be able to tackle research problems. In addition, social and general transferable skills are trained via group work in the classes based on concrete problems and tasks. Contents: • History of Ubicomp Systems • Different Views of UbiComp • Sensing, Tracking and Monitoring Technology, Location Sensing • Interface Types: mobile, tangible, touch interfaces • The Internet of Things • Prototyping and Research Methods in the UbiComp Field • Modern User Interfaces for Ubicomp Systems • Role of the Use Context • User-Centered Design for Development of Novel Technologies, e.g. UbiComp • Societal, Ethical and User-Research Issues for Novel Technologies Introductory Literature: • Ubiquitous Computing Fundamentals. Ed. John Krumm. ISBN: 1420093606. Chapman & Hall/CRC 2009. • Harper, Rodden, Rogers, Sellen (eds.). Being Human: Human-Computer Interaction in the Year 2020. Microsoft Research Ltd 2008 • Rowland et al. Modern User Interfaces for Ubicomp Systems. O'Reilly 2015

<table>
<tr><td>Course Title</td><td>Virtual Reality</td></tr>
<tr><td>Coordinator</td><td>Prof. Dr. Bernd Fröhlich</td></tr>
<tr><td>Assigned Module(s)</td><td>Visual Interfaces, Specialisation</td></tr>
<tr><td>Formal requirements for participation</td><td>Basic knowledge of HCI and Computer Graphics at bachelor level from a suitable previous degree</td></tr>
<tr><td>Examination requirements</td><td>Active participation in the lab class: A score of 50% of the assignments and successful completion of the final project needs to be achieved for admittance to the final exam (oral or written).</td></tr>
<tr><td>Specific target qualifications

Contents

Special information</td><td>The goal of this course is to provide students with the theoretical, technical and applied foundations of modern virtual reality systems, 3D Cinema, stereoscopic gaming and 3D user interfaces.

Students should understand the following concepts, techniques and technical systems:
• Scenegraph technology
• Viewing in 3D
• 3D perception
• Stereoscopic single- and multi-viewer display technology
• Three-dimensional user interfaces and interaction techniques

Students should be able to apply the above concepts, techniques and their knowledge of technical solutions for solving concrete problems. Furthermore, they should be able identify and discuss the main usability factors of 3D interaction techniques, 3D interfaces and 3D display technology.

In order to tackle problems from the virtual reality domain, students should master concepts and approaches such as
• Computing stereoscopic projection parameters for various technical setups
• Designing a scenegraph-based interactive virtual reality application that supports multiple users
• Selecting navigation, selection and manipulation techniques for specific use cases
• Using Fitts's law and the steering law to evaluate the performance of designs in selection and navigation tasks
• Design and parametrization of transfer functions for the different types of sensors and tasks

Students should develop an understanding of the fundamentals and the current state of research in virtual reality and make well-informed decision in this context. They should be able to discuss research problems, implement and adapt current approaches, perform basic evaluations and understand the limitations of the solutions.

In addition, social and general transferable skills are trained via group work in the lab classes based on concrete problems and tasks.

Main contents are:
• Stereoscopic Viewing
• Graphics and Scenegraph Basics
• Viewing Setups in Scenegraphs
• 3D User Interface Basics
• 3D Navigation, selection and manipulation
• 3D Manipulation
• 3D Input Devices
• 3D Display Technology Basics
• Stereoscopic Multi-User Display Technology
• Interaction and Collaboration in Multi-User Virtual Reality
• Introduction to Augmented/Mixed Reality

This course is mostly based on recent research publications. References will be provided throughout the course.</td></tr>
</table>

Course Title	**Visualization**
Coordinator	Prof. Dr. Bernd Fröhlich
Assigned Module(s)	Visual Interfaces, Specialisation
Formal requirements for participation	Basic knowledge of HCI and Computer Graphics at bachelor level from a suitable previous degree.
Examination requirements	Active participation in the lab class: A score of 50% of the assignments and successful completion of the final project needs to be achieved for admittance to the final exam (oral or written).

Specific target qualifications	Within the scope of the module, students develop an understanding of the basic mathematical, algorithmic and technical methods and procedures for the representation of and interaction with measured, simulated or collected data. They can select, adapt, implement and evaluate these for new problems.
	
	• Students are able to abstract at different levels:
	  ○ Problem abstraction: translation of the problem from a specific application domain into the visualization vocabulary.
	  ○ Data abstraction: What is to be visualized?
	  ○ Task abstraction: Why do users want the data visualized?
	• You know a wide range of basic visualization techniques and how they are structured
	  ○ Visual coding: How is the data represented?
	  ○ Interaction techniques: How to customize the view of the data and how to combine different views.
	• Students are able to analyze and abstract data from an application domain and systematically select suitable visualization techniques and combine them with appropriate interaction techniques.
	• They will also be able to apply their knowledge to challenging and more complex problems and assess the scalability of the selected techniques.
	• The lab class enables students to develop, implement and test basic visualization techniques themselves.
	
	In addition, social and general transferable skills are trained via group work in the lab classes based on concrete problems and tasks.

Contents	Contents:
	• Information visualization
	  ○ Munzner's what-why-how analysis framework
	  ○ Basic interaction techniques
	  ○ Visualization techniques for tabular / multi-attribute data, set-based data, time-series data, trees, graphs, cartographic data, and text
	• Scientific visualization
	  ○ Data types and mathematical basics
	  ○ Isolines and isosurfaces
	  ○ Direct volume rendering using ray casting
	  ○ Multi-resolution methods for volume data
	  ○ Flow visualization

Special information	Introductory literature: • R. Spence: Information Visualization: An Introduction (3rd Edition) • T. Munzner: Visualization Analysis and Design

Course Title	**Image Analysis and Object Recognition**
Coordinator	Prof. Dr.-Ing. Volker Rodehorst
Assigned Module(s)	Computer Vision, Specialisation
Formal requirements for participation	Basic knowledge of computer science at bachelor level
Examination requirements	Successful completion of the exercises. Final written examination.
Specific target qualifications	The course gives an introduction to advanced concepts of image processing, image analysis and object recognition. The goal is to understand principles, methods and applications of computer vision from image processing to image understanding. Students should learn the following topics: • image representation and enhancement • morphological and local filter operators • corner and edge detection • filtering in frequency domain • shape detection with generalized Hough transform and Fourier descriptors • object recognition with Viola-Jones, SIFT-based voting and implicit shape models • segmentation and clustering of image regions • deep learning for visual recognition • pattern recognition methods and strategies Students should be able to apply the above topics to solve computer vision problems. Furthermore, they should appreciate the limits and constraints of the above topics. Students should be able formalize and generalize their own solutions using the above concepts of image processing, image analysis and object recognition. Students should master concepts and approaches such as • application-specific feature extraction • generation, learning and application of models for object recognition • data-driven and model-driven processing strategies in order to tackle computer-vision problems and their application to digital media. They should be able to understand proposed image analysis methods, to compare different proposals for object recognition systems, to make well-informed decisions about the preferred proposal and, if necessary, to find their own solutions to given computer vision problems. Students should develop an understanding of the current state of research in image analysis and object recognition. With appropriate supervision, students should be able to tackle research problems.
Contents	Sample contents are: • Image processing • Feature extraction • Shape detection • Object recognition • Image regions • Machine learning
Special information	Literature: • V. Rodehorst: lecture notes, online. • B. Jähne: Digital image processing, Springer, 2005. • R.C. Gonzalez and R.E. Woods: Digital image processing, Pearson, 2018. • R. Szeliski: Computer vision: algorithms and applications, Springer, 2020. • D. Forsyth and J. Ponce: Computer vision: a modern approach, Pearson, 2012. • R.O. Duda, P.E. Hart and D.G. Stork: Pattern classification, Wiley, 2000. • C.M. Bishop: Pattern recognition and machine learning, Springer 2007.

<table>
<tr><td>Course Title</td><td>Spatial Information Systems (GIS)</td></tr>
<tr><td>Coordinator</td><td>Prof. Dr.-Ing. Volker Rodehorst</td></tr>
<tr><td>Assigned Module(s)</td><td>Computer Vision, Specialisation</td></tr>
<tr><td>Formal requirements for participation</td><td>no specific requirement for this course</td></tr>
<tr><td>Examination requirements</td><td>Successful completion of the exercises.
Final written examination.</td></tr>
<tr><td>Specific target qualifications</td><td>The students can use the topics below to solve spatially related problems. They are able to formalize and generalize their own solutions by applying the concepts of geospatial data acquisition, organization, analysis and presentation. Students will be able to realize the conceptual design and realization of a GIS, the collection of subject-specific geospatial data as well as the application for location-based services, geo-marketing and strategic site planning in order to address problems of spatial information systems and their application to digital media.
They should be able to understand the proposed concepts, to compare different proposals for GIS systems, to make well-informed decisions about the preferred proposal and, if necessary, to find their own solutions to given problems with spatial reference. Students should develop an understanding of the current state of research in spatial information systems. With appropriate supervision, students should be able to tackle research problems.</td></tr>
<tr><td>Contents</td><td>The course covers advanced basics of spatial information systems (GIS), such as acquisition, organization, analysis and presentation of data with spatial reference. The lab classes and the individual project lead to a deeper understanding of GIS workflows, tools and extensions and should turn knowledge into practice. The core topics are:

Acquisition of spatial data

Data types and dimensions of geo-objects
Primary and secondary spatial reference
Coordinate reference systems and map projections
Acquisition of geospatial base data and available online resources

Spatial data management

Object-relational database management systems
Efficient tree-structures for spatial data

Object-oriented data modeling

Graphical GIS modeling in UML
3D city models

Spatial data analysis

Spatial interpolation and analysis of vector-based geo-objects
Route planning and traveling salesperson problem

Presentation of spatial data

Cartographic visualization and generalization

GIS applications
</td></tr>
<tr><td>Special information</td><td>Literature:

V. Rodehorst: lecture notes, online.
M. de Smith, M. Goodchild, D. Longley: Geospatial Analysis, 2009.
R. Bill: Grundlagen der Geo-Informationssysteme, 6. Edition, Wichmann, 2016.
N. Bartelme: Geoinformatik – Modelle, Strukturen, Funktionen, 4. Edition, Springer, 2005.
N. de Lange: Geoinformation in Theorie und Praxis, 2. Edition, Springer, 2006.
</td></tr>
</table>

Course Title	**Image Analysis and Object Recognition**
Coordinator	Prof. Dr.-Ing. Volker Rodehorst
Assigned Module(s)	Computer Vision, Specialisation
Formal requirements for participation	Basic knowledge of computer science at bachelor level
Examination requirements	Successful completion of the exercises. Final written examination.
Specific target qualifications	The course gives an introduction to advanced concepts of image processing, image analysis and object recognition. The goal is to understand principles, methods and applications of computer vision from image processing to image understanding. Students should learn the following topics: • image representation and enhancement • morphological and local filter operators • corner and edge detection • filtering in frequency domain • shape detection with generalized Hough transform and Fourier descriptors • object recognition with Viola-Jones, SIFT-based voting and implicit shape models • segmentation and clustering of image regions • deep learning for visual recognition • pattern recognition methods and strategies Students should be able to apply the above topics to solve computer vision problems. Furthermore, they should appreciate the limits and constraints of the above topics. Students should be able formalize and generalize their own solutions using the above concepts of image processing, image analysis and object recognition. Students should master concepts and approaches such as • application-specific feature extraction • generation, learning and application of models for object recognition • data-driven and model-driven processing strategies in order to tackle computer-vision problems and their application to digital media. They should be able to understand proposed image analysis methods, to compare different proposals for object recognition systems, to make well-informed decisions about the preferred proposal and, if necessary, to find their own solutions to given computer vision problems. Students should develop an understanding of the current state of research in image analysis and object recognition. With appropriate supervision, students should be able to tackle research problems.
Contents	Sample contents are: • Image processing • Feature extraction • Shape detection • Object recognition • Image regions • Machine learning
Special information	Literature: • V. Rodehorst: lecture notes, online. • B. Jähne: Digital image processing, Springer, 2005. • R.C. Gonzalez and R.E. Woods: Digital image processing, Pearson, 2018. • R. Szeliski: Computer vision: algorithms and applications, Springer, 2020. • D. Forsyth and J. Ponce: Computer vision: a modern approach, Pearson, 2012. • R.O. Duda, P.E. Hart and D.G. Stork: Pattern classification, Wiley, 2000. • C.M. Bishop: Pattern recognition and machine learning, Springer 2007.

Course Title	**Spatial Information Systems (GIS)**
Coordinator	Prof. Dr.-Ing. Volker Rodehorst
Assigned Module(s)	Computer Vision, Specialisation
Formal requirements for participation	no specific requirement for this course
Examination requirements	Successful completion of the exercises. Final written examination.
Specific target qualifications	The students can use the topics below to solve spatially related problems. They are able to formalize and generalize their own solutions by applying the concepts of geospatial data acquisition, organization, analysis and presentation. Students will be able to realize the conceptual design and realization of a GIS, the collection of subject-specific geospatial data as well as the application for location-based services, geo-marketing and strategic site planning in order to address problems of spatial information systems and their application to digital media. They should be able to understand the proposed concepts, to compare different proposals for GIS systems, to make well-informed decisions about the preferred proposal and, if necessary, to find their own solutions to given problems with spatial reference. Students should develop an understanding of the current state of research in spatial information systems. With appropriate supervision, students should be able to tackle research problems.

Contents	The course covers advanced basics of spatial information systems (GIS), such as acquisition, organization, analysis and presentation of data with spatial reference. The lab classes and the individual project lead to a deeper understanding of GIS workflows, tools and extensions and should turn knowledge into practice. The core topics are:
	• Acquisition of spatial data
	  • Data types and dimensions of geo-objects
	  • Primary and secondary spatial reference
	  • Coordinate reference systems and map projections
	  • Acquisition of geospatial base data and available online resources
	• Spatial data management
	  • Object-relational database management systems
	  • Efficient tree-structures for spatial data
	• Object-oriented data modeling
	  • Graphical GIS modeling in UML
	  • 3D city models
	• Spatial data analysis
	  • Spatial interpolation and analysis of vector-based geo-objects
	  • Route planning and traveling salesperson problem
	• Presentation of spatial data
	  • Cartographic visualization and generalization
	• GIS applications

Special information	Literature: • V. Rodehorst: lecture notes, online. • M. de Smith, M. Goodchild, D. Longley: Geospatial Analysis, 2009. • R. Bill: Grundlagen der Geo-Informationssysteme, 6. Edition, Wichmann, 2016. • N. Bartelme: Geoinformatik – Modelle, Strukturen, Funktionen, 4. Edition, Springer, 2005. • N. de Lange: Geoinformation in Theorie und Praxis, 2. Edition, Springer, 2006.

Course Title	**Design Theory: Digital Culture I. An Introduction for the Design Professions**
Coordinator	Prof. Dr. Jan Willmann
Assigned Module(s)	Design Theory
Formal requirements for participation	Abitur or equivalent
Examination requirements	Final exam and/or assignment/s (both written) in combination with weekly exercises. Passing the exercise successfully is a requirement for the exam and/or the assignment/s. Exam duration: 90-120 minutes; Final assignment: Scientific essay, 4.000-6.000 words.
Specific target qualifications	The course provides students with a fundamental introduction to the theory and history of contemporary design cultures, focusing particularly on the emergence of digital practices and their wider implications for the design professions. As such, students become acquainted with relevant approaches and discourses in the history of the digital in design, and, as such, will learn to critically reflect on current design concepts, methods and techniques, and to work with respective literature and other knowledge resources. When having successfully attended the semester, students are able a) to oversee, b) to understand and c) to contextualize emerging design practices, and to transfer gained knowledge towards own studies and projects.
Contents	The course offers a historical and thematic overview of digital culture from the 18th up to the 20th century. Thematic lectures about key questions at play during this period are combined with in-depth exercises and analysis of respective literature, projects and discourses. Themes cover the advent and development of modern calculation/tabulating and computing machinery, and related issues such as the emergence of information societies, warfare technologies and mass media; the emergence of programming and computer industries; patterns of dissemination and political influence; the rise of the thinking brain and artificial intelligence, questions of cybernetics and networked infrastructures; hacker culture and the home computer turn, and the democratization of the digital.
Special information	Introductory literature: • Charlie Gere, Digital Culture, London, 2002. • Ray and Charles Eames, A Computer Perspective, Cambridge/MA., 1973. • Marvin Minsky, Seymour Papert, Perceptron, Cambridge/MA., 1969. • Dennis P. Doordan, Design History – An Anthology, Cambridge/MA., 1996. • Steven Levy, Hackers: Heroes of the Computer Revolution, Garden City, 1984. • Stanley Davis, Future Perfect, Reading/MA., 1987. (Further up-to-date literature recommendations will be announced in the course catalogue of each semester)

Course Title	**Design Theory: Digital Culture II. An Introduction for the Design Professions**
Coordinator	Prof. Dr. Jan Willmann
Assigned Module(s)	Design Theory
Formal requirements for participation	Abitur or equivalent
Examination requirements	Final exam and/or assignment/s (both written) in combination with weekly exercises. Passing the exercise successfully is a requirement for the exam and/or the assignment/s. Exam duration: 90-120 minutes; Final assignment: Scientific essay, 4.000-6.000 words.
Specific target qualifications Contents Special information	The course focuses on contemporary design cultures and provides a fundamental overview of the development and transformation of digital practices and their impact for current and future design discourses. In this, students will acquire basic knowledge of contemporary design theory as well as specific methods and instruments of research into design. They will be able to identify the main issues and debates of emerging design practices and will develop a critical reading of current concepts, tools and processes of the digital in design and related disciplines. This includes working with respective media and knowledge resources, such as literature, exhibitions, installations etc. When having successfully attended the semester, students are able a) to identify the main issues and debates of contemporary design practices, b) to use specific tools and methods to draw on theoretical and critical research, and c) to apply the theory of contemporary design cultures for own studies and projects. The course offers a theoretical and thematic overview of digital culture from 20th century to current times. Thematic lectures about key questions at play during this period will be combined with the in-depth exercises and analysis of respective literature, projects and discourses. Themes will cover the theory and practices of digital design and technology, including discourses of design computation, virtual/augmented/mixed reality, internet of things, digital materiality and programmable matter, human-centred design, artificial intelligence, user-experience design, digital property and digital labor, smarts systems and infrastructures, digital sustainability. Introductory literature: • Mario Carpo, The Alphabet and Algorithm, Cambridge/MA., 2010. • Manuel Castells, The Rise of the Network Society, Chichester, 2010. • Neil Gershenfeld, FAB: The Coming Revolution on Your Desktop-from Personal Computers to Personal Fabrication, Cambridge/MA., 2005 • Nicholas Negroponte, Being Digital, New York, 1995. • Howard Rheingold, Virtual Reality, New York, 1991. • Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Chichester, 2014. (Further up-to-date literature recommendations will be announced in the course catalogue of each semester)