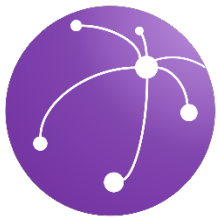

IS:link

Information Systems Student Exchange Network

Course Catalog

Dear Students,

This catalog provides an overview of English-taught courses available to incoming and exchange students. It includes undergraduate and graduate modules from various degree programs within the Faculty of Computer Science, offering students the flexibility to customize their studies according to their academic background and interests.

When selecting courses, please ensure that all prerequisites are met and that schedules do not conflict. Final course selection must be coordinated with the home university and confirmed in consultation with the faculty's academic coordinator.

The Faculty of Computer Science is based on two campuses, Duisburg and Essen. Depending on course choices, students may study at one campus or combine courses from both locations. During the semester, a shuttle bus service conveniently connects the two campuses, with detailed Information on routes and schedules available on the university's shuttle service webpage.

Further information on the faculty's degree programs, including module handbooks and examination regulations, can be found on the official Faculty of Computer Science web site. An overview of the faculty's departments and research areas is also available online at: https://www.uni-due.de/computer-science/scientific-fields.php

In addition to the courses listed in this catalog, students may also consider suitable modules offered by other faculties, such as Engineering or Mathematics, depending on their academic profile and interests.
The university-wide course catalog and current course offerings can be accessed via the LSF portal: https://campus.uni-due.de

We strongly encourage students to review these resources carefully before finalizing their study plans to ensure that they have the most current information.

Please note that all course information is subject to change. Final details regarding schedules, teaching formats, and assessments are provided by the respective lecturers.

Winter Semester Courses A – Z

- Advanced Image Synthesis
- Agile Project Management
- Cloud, Web & Mobile
- Digital Ideation and Entrepreneurial Design
- Distributed Systems
- Entrepreneurship with Purpose
- IS Research Fundamentals
- Organizational Behavior
- Responsible Artificial Intelligence
- Secure Software Systems (Sichere Software Systeme)
- Systemnahe Informatik (Systems Programming)

Summer Semester Courses A – Z

- Business & IT Consulting (BITC)
- Computer Graphics
- Cooperation Systems
- Data Science: Concepts and Practice
- Digital Innovation Management
- Disruptive Innovation & Moonshot Design
- Game Architecture and Design
- Intelligent Learning Environments
- Interactive Systems (Interaktive Systeme)
- Internet of Things: Protocols and System Software
- Managing Digital Transformation
- Pervasive Computing
- Scientific Visualization
- Strategic Planning of IS (SPIS)
- Towards Sustainable Futures with AI

Irregular / Every Semester

- Advanced Topics in Embedded Systems (irregular)
- Empirical Methods for Software Engineers (every semester)
- Intelligent User Interfaces (IUI) (irregular)

Advanced Image Synthesis

Master / Graduate level – 6 ECTS
Winter Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Dr. Jens Krüger

Course Description

This course introduces advanced methods for image synthesis and real-time 3D graphics. Students learn how to generate and render complex virtual environments and photorealistic images using GPU-accelerated pipelines, shader programming, and graphics APIs (OpenGL, DirectX). Topics include lighting and shading, reflections, refractions, shadows, global illumination, ambient occlusion, high dynamic range imaging, and terrain/material rendering. Practical applications in games, film, and virtual/augmented reality illustrate how these techniques are used in modern graphics engines.

Learning Outcomes

After completing this course, students will be able to:

- explain advanced concepts and algorithms used in modern image synthesis and computer graphics,
- understand the architecture and role of GPUs in real-time rendering,
- apply shader-based techniques for lighting, shading, reflection, and shadowing,
- analyze and compare real-time and global illumination methods,
- understand how modern graphics engines generate complex 3D worlds for interactive applications.

Prerequisites

No formal prerequisites.
Basic knowledge of 3D computer graphics is recommended.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.cgvis.de

Agile Project Management
Master / Graduate level – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Ralf Plattfaut

Course Description
This course introduces the principles and practices of Agile Project Management. Students explore agile methodologies such as Scrum and Kanban, compare them with traditional project management approaches, and analyze their theoretical foundations. The course addresses scaling agile methods to organizational contexts and discusses frameworks such as SAFe and LeSS. Through interactive elements, including short presentations and case discussions, students learn how to apply agile tools and techniques in real-world project settings and evaluate agile transformation processes.

Learning Outcomes
After completing this course, students will be able to:

- define and explain agility in the context of project management,
- compare agile and traditional project management approaches,
- apply agile methods and tools such as Scrum, Kanban, user stories, and planning techniques,
- plan, manage, and evaluate agile projects in interdisciplinary teams,
- reflect on challenges of agile transformation in organizations.

Prerequisites
Basic knowledge of traditional project management is recommended but not mandatory.

Assessment
The final grade is composed of:

- Written exam (50%)
- Seminar paper (30%)
- Presentation / lightning talk (20%)

Chair: https://tm.ris.uni-due.de

Further Information
Detailed module information can be found in the official module handbook: https://www.ris.uni-due.de/studium/studienorganisation/ordnungen-und-dokumente-master/

Cloud, Web & Mobile
Bachelor / Undergraduate level – 6 ECTS
Winter Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Torben Weis
Language: German (partly English)

Course Description
This course covers theoretical and practical aspects of cloud computing and cloud-based applications. It is structured into two parts: The first part introduces algorithms, architectures, and programming models for cloud systems from both the cloud provider and application developer perspectives, with a focus on scalable and reliable cluster-based infrastructures. The second part focuses on front-end technologies and their integration with cloud applications, including web technologies and mobile platforms. Practical exercises allow students to implement and experiment with the presented concepts.

Learning Outcomes
After completing the course, students will be able to:

- understand architectures and algorithms for scalable and reliable cloud infrastructures,
- develop applications for cloud platforms,
- explain cloud service and cost models and assess suitable application domains,
- apply web and mobile front-end technologies to make cloud applications accessible to end users.

Prerequisites
No formal prerequisites

Assessment
Written exam

Chair: https://www.vs.uni-due.de

Digital Ideation and Entrepreneurial Design (Course formerly named "Sustainable Digital Entrepreneurship")

Master / Graduate level – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Hannes Rothe

Course Description
This course introduces the foundations of digital entrepreneurship and sustainable innovation with a focus on digital ideation and entrepreneurial design. In a practice-oriented setting, students work in teams on real-world challenges provided by external partners. Applying design thinking and design-oriented research methods, they identify and assess relevant problem spaces, develop innovative solution concepts, and evaluate entrepreneurial opportunities. The course emphasizes opportunity design, effectuation logic, and decision-making under uncertainty in startup-like environments.

Learning Outcomes
After completing the course, students will be able to:

- apply design thinking and design-oriented research methods to develop innovative digital solutions,
- identify and evaluate entrepreneurial opportunities in uncertain environments,
- work effectively in startup teams and manage collaborative innovation processes,
- develop and assess sustainable digital business concepts,
- present and justify entrepreneurial decisions to different target audiences.

Prerequisites
Basic knowledge of information systems, digital entrepreneurship, and sustainability (SDGs) is recommended.

Assessment

- Individual assignment – 40%
- Group case study project involving methods of design-oriented research – 60%

Chair: https://sust.ris.uni-due.de

Distributed Systems

Master / Graduate level – 6 ECTS
Winter Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Dr.-Ing. Torben Weis

Course Description

This course introduces the fundamental concepts, architectures, and protocols of distributed systems. It examines how distributed systems are designed and how independent components communicate and coordinate across networks. The course starts with core mechanisms for distributed communication, including serialization techniques, remote procedure calls, and distributed objects. Building on this foundation, students study essential algorithms and mechanisms such as clock synchronization, transactions, replication, consistency models, and global state management. Through a combination of theoretical foundations and practical exercises, students develop a deeper understanding of the challenges and design trade-offs involved in building reliable and scalable distributed systems.

Learning Outcomes

After completing the course, students will be able to:

- explain key concepts, architectures, and communication mechanisms of distributed systems,
- apply fundamental algorithms such as logical and physical clocks, synchronization, and transactions,
- analyze consistency, replication, and coordination challenges in distributed environments,
- evaluate design choices and trade-offs in distributed system architectures,
- apply theoretical concepts to practical distributed system problems.

Prerequisites

No formal prerequisites.
Basic knowledge of computer science concepts is recommended.

Assessment

- Written exam **or** oral examination
  (The examination format is announced at the beginning of the course.)

Chair: https://www.vs.uni-due.de

Entrepreneurship with Purpose

Bachelor / *Undergraduate level* – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Hannes Rothe

Course Description

This course explores entrepreneurship to create social, societal, and ecological impact alongside economic value. Students examine different forms of entrepreneurship, such as social entrepreneurship and intrapreneurship, and reflect on how personal values and purpose influence entrepreneurial activities. Using frameworks such as the United Nations Sustainable Development Goals (SDGs), the Business Model Canvas, and Theory U, students develop and refine purpose-driven business ideas. The course is highly interactive and emphasizes teamwork, reflection, and hands-on experimentation to address real-world sustainability challenges.

Learning Outcomes

After completing the course, students will be able to:

- Reflect on their personal values and align them with entrepreneurial and professional goals.
- Develop purpose-driven solutions to social and ecological challenges.
- Apply ideation methods and tools to develop business ideas addressing social or ecological challenges.
- Demonstrate leadership, teamwork, and communication skills in collaborative settings.
- Translate entrepreneurial competencies into professional and societal contexts.

Prerequisites

Basic knowledge of the Business Model Canvas is recommended.

Assessment

Presentation with discussion

Chair: https://sust.ris.uni-due.de

IS Research Fundamentals

Master / Graduate level – 3 ECTS
Winter Semester – Campus Essen
Format: Lecture
Lecturer: Prof. Dr. Frederik Ahlemann

Course Description

This course introduces the fundamental theoretical and methodological foundations required to design, conduct, and communicate research in Information Systems. The course focuses on the core elements of research, including the selection of research topics, the use of theories, and the application of appropriate research methods. Students learn how theories help structure research problems and how different methodological approaches can be used to generate valid and reliable results. Through lectures, readings, and discussions, students develop the skills necessary to conceptualize, conduct, and critically evaluate scientific research projects.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental concepts of scientific thinking and the research process in Information Systems,
- identify and formulate relevant research topics and research questions,
- apply appropriate theories to analyze and structure research problems,
- select and justify suitable research methods for IS research,
- critically evaluate academic literature and research designs,
- communicate research ideas and results in a clear and academically sound manner.

Prerequisites

Basic knowledge of information systems, strategic management, and project management is recommended.

Assessment

- Final written examination covering the learning objectives of the lecture

Chair: https://sitm.ris.uni-due.de

Organizational Behavior

Bachelor / *Undergraduate level* – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Frederik Ahlemann

Course Description

This course introduces the core concepts and theories of organizational behavior and their relevance for managing people, teams, and organizations. It examines behavior at the individual, group, and organizational level, with a particular focus on change processes in IT-intensive organizations. Students learn how factors such as motivation, leadership, group dynamics, and organizational culture influence decision-making and performance. The course combines theoretical foundations with case studies and practical applications related to IT project management and organizational change.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental concepts and theories of organizational behavior,
- analyze individual, group, and organizational behavior in organizational contexts,
- discuss strengths and limitations of key organizational behavior theories,
- apply organizational behavior concepts to challenges in IT project and IT management,
- derive management recommendations for organizational change situations,
- apply theoretical knowledge to practical management problems.

Prerequisites

Basic knowledge of business administration and information systems is recommended.

Assessment

- Written exam
- Admission may require passing intermediate tests (details announced at the beginning of the course)

Chair: https://sitm.ris.uni-due.de

Responsible Artificial Intelligence

Master / Graduate level – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Mario Nadj

Course Description

Artificial intelligence is increasingly used in areas such as production, customer service, and business decision-making. While AI systems can automate processes and uncover complex patterns, they can also create significant ethical, social, and legal challenges. This course introduces students to the concept of responsible artificial intelligence and explores how AI systems can be designed and used in a fair, transparent, and accountable way. Students gain a basic understanding of machine learning concepts and examine critical issues such as algorithmic bias, discrimination, explainability, and ethical decision-making. The course takes a holistic perspective and highlights the organizational and regulatory conditions required for the responsible use of AI.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental concepts of machine learning and ethical decision-making,
- discuss different dimensions of AI systems, including issues of bias, discrimination, and explainability,
- explain organizational and regulatory factors relevant for the responsible use of artificial intelligence.

Prerequisites

There are no prerequisites for attending this course.

Assessment

- Written exam
- Optional voluntary tests contributing up to 20% of the exam score (details announced at the beginning of the course)

Chair: https://ai.ris.uni-due.de

Secure Software Systems (Sichere Software Systeme)
Master / Graduate level – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Lucas Davi

Course Description
This course introduces modern software and systems security, covering current research, attack techniques, and defense mechanisms at the application and operating system levels. It addresses security challenges across desktop, mobile, and embedded platforms, with particular emphasis on runtime attacks and software exploits such as buffer overflows and return-oriented programming. Students examine how exploits are constructed and how protection mechanisms including control-flow integrity, memory randomization, sandboxing, and trusted computing can mitigate these threats. Operating system security models are discussed using practical examples and are complemented by hands-on exercises in vulnerability analysis and security hardening.

Learning Outcomes
After completing the course, students will be able to:

- explain major classes of software attacks and corresponding defense mechanisms at application and operating system level,
- analyze vulnerabilities and exploit techniques in modern software systems,
- develop proof-of-concept attacks for vulnerable software systems,
- apply advanced techniques for hardening software against runtime and exploit-based attacks,
- understand hardware-based mechanisms for enforcing software security,
- critically discuss current research challenges in secure software systems.

Prerequisites
Basic knowledge of programming and software engineering is recommended.

Assessment
Written exam or oral examination.
The examination format is announced at the beginning of the course.

Chair: https://www.syssec.informatik.uni-due.de/

Systemnahe Informatik (Systems Programming)
Bachelor / Undergraduate level – 6 ECTS
Winter Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Pedro José Marrón

Course Description
This course introduces systems programming and focuses on software that interacts closely with computer hardware and operating systems. Unlike application-oriented programming, it addresses low-level functionality and the interface between hardware and software.
Students learn how programs are represented and executed at machine level and how core system resources such as memory, processors, and networks are managed. A particular emphasis is placed on writing efficient and reliable software for resource-constrained environments, including embedded systems such as robots, vehicles, and Internet of Things applications. Practical exercises complement the lectures and provide hands-on experience in developing system-level software using the C programming language.

Learning Outcomes
After completing the course, students will be able to:
- develop system-level software using the C programming language,
- understand the interaction between hardware and software in modern computer systems,
- analyze and optimize programs with respect to performance and resource usage,
- apply systems programming techniques in environments with limited computational resources,
- work with fundamental concepts such as memory hierarchy, system-level I/O, networking, and concurrency.

Prerequisites
- Basic knowledge of programming and operating systems is recommended
- Basic knowledge of the C language is required.

Assessment
Written exam or oral examination
The specific examination format will be announced during the course.
Successful participation in the exercises may be required for admission to the final examination.

Chair: https://www.nes.uni-due.de

Business & IT Consulting (BITC)
Master / Graduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Frederik Ahlemann

Course Description
Business and IT consulting plays a key role in helping organizations address strategic, organizational, and technological challenges. This course provides a structured introduction to the consulting industry and the practical work of management and IT consultants. Students explore how consulting firms operate, how consulting engagements are initiated and managed, and how value is created for clients. The course covers consulting business models, engagement processes, and success factors such as client relationships, project planning, and communication. Through lectures, discussions, and case-based exercises, students gain insight into both the opportunities and challenges of a consulting career.

Learning Outcomes
After completing the course, students will be able to:

- analyze the structure, business models, and core processes of management and IT consulting firms,
- explain key challenges and responsibilities associated with the consultant's role in client organizations,
- prepare basic consulting proposals and project plans for client engagements,
- apply fundamental consulting methods to analyze and solve practical business problems,
- evaluate engagement success and client satisfaction using appropriate metrics,
- critically reflect on alternative consulting approaches and career-related challenges in the consulting industry.

Prerequisites
Solid background in business administration and information systems is recommended.

Assessment
Oral examination
Admission to the exam requires successful completion of course assignments.

Chair: https://sitm.ris.uni-due.de

Computer Graphics

Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Dr. Jens Krüger

Course Description

This course introduces the fundamental principles and algorithms of computer graphics with a focus on the generation and visualization of 2D and 3D scenes. Students learn how geometric objects are modeled, transformed, and rendered, and how color, lighting, and shading influence visual appearance. The course covers both rasterization-based rendering and ray tracing, including acceleration techniques and GPU-based graphics pipelines. By combining theoretical foundations with practical exercises, students gain a solid understanding of how modern graphics systems transform a scene description into a rendered image.

Learning Outcomes

After completing the course, students will be able to:

- distinguish between raster- and vector-based representations,
- model geometric objects using basic primitives and data structures,
- explain color models, lighting, and shading techniques,
- implement basic rendering approaches using rasterization and ray tracing,
- understand the main stages of the graphics pipeline from scene description to image generation,
- analyze the role of GPUs in modern graphics systems.

Prerequisites

No formal prerequisites.
Basic knowledge of mathematics and programming is recommended.

Assessment

- Written exam **or** oral examination
  (The examination format is announced at the beginning of the course.)

Chair: https://www.cgvis.de

Cooperation Systems

Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise (project-based)
Lecturer: Prof. Dr. Michael Prilla

Course Description

This course introduces the principles, concepts, and technologies of computer-supported cooperative work (CSCW). It examines how information systems can support communication, coordination, and collaboration in groups and organizations. Students explore theoretical foundations of human communication and cooperation as well as practical examples of cooperative systems used in real-world contexts. The course also addresses the design, implementation, and evaluation of group-oriented software systems. Practical exercises and project work allow students to apply the acquired knowledge to the analysis and design of cooperation systems.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental concepts and paradigms of computer-supported cooperative work,
- analyze requirements for systems supporting collaboration and social interaction,
- critically discuss and evaluate existing cooperation systems,
- design user interfaces and interaction concepts for group-oriented software,
- apply CSCW concepts to practical case studies and project work.

Prerequisites

No formal prerequisites.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.uni-due.de/interaktivesysteme/

Data Science: Concepts and Practice

Bachelor / Undergraduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with integrated exercise
Lecturer: Prof. Dr. Mario Nadj

Course Description

This course provides a structured and practice-oriented introduction to Data Science, with a strong focus on addressing real-world business challenges. Students are introduced to the complete Data Science lifecycle, covering business and data understanding, data preparation, modeling, evaluation, and deployment, in accordance with established standards and best practices.
Using applied examples, the course presents essential methods and techniques for solving regression, classification, and clustering problems. Emphasis is placed on understanding the strengths and limitations of different approaches and selecting appropriate methods for specific tasks and contexts.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental concepts and core practices of Data Science,
- describe and structure the Data Science lifecycle from problem definition to deployment,
- apply selected analytical methods and evaluate their advantages and limitations,
- solve regression, classification, and clustering problems using appropriate techniques and best practices.

Prerequisites

No formal prerequisites.

Assessment

- Written examination
- In-semester tests may be required as a prerequisite for exam eligibility
- The requirement and format of any in-semester assessments will be announced at the beginning of the course

Chair: https://ai.ris.uni-due.de/profile/

Digital Innovation Management

Bachelor / Undergraduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Mario Nadj

Course Description

Digital technologies such as artificial intelligence, digital platforms, and data-driven systems are fundamentally transforming how organizations operate and compete. This course introduces students to the strategic management of digital innovation and the challenges organizations face in rapidly changing digital environments. Students explore how digital technologies enable new business models, disrupt existing industries, and require new ways of organizing work and decision-making. The course combines theoretical foundations with practical examples to help students understand how digital innovation can be identified, managed, and strategically leveraged within organizations.

Learning Outcomes

After completing the course, students will be able to:

- explain core theories and concepts related to digital technology, digital innovation, and digital strategic management,
- analyze the relationship between digital technologies, individuals, and organizational structures,
- identify and evaluate digital innovation strategies in different organizational contexts,
- apply key concepts of digital innovation management to real-world examples,
- analyze challenges and opportunities arising from digital innovation and digital transformation.

Prerequisites

There are no prerequisites for attending this course.

Assessment

- Written examination
- Optional presentation with discussion (20–30 minutes, announced at the beginning of the course)

Chair: https://ai.ris.uni-due.de

Disruptive Innovation & Moonshot Design

Master / Graduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture
Lecturer: Prof. Dr. Hannes Rothe

Course Description

This course focuses on disruptive innovation and the development of long-term strategies for complex economic, social, and environmental challenges. Students explore how organizations and startups design future business models by combining sustainability with economic success.
The course highlights the role of digital technologies such as artificial intelligence, digital platforms, and augmented reality in driving innovation. Using case studies, design thinking methods, and moonshot principles, students develop and evaluate ambitious innovation strategies within dynamic innovation ecosystems.

Learning Outcomes

After completing the course, students will be able to:

- distinguish between different types of innovation, including incremental, disruptive, and radical innovation,
- apply innovation strategies and structured innovation processes to complex problems and grand challenges,
- analyze the interaction between technology, organization, and problem-solving in innovation contexts,
- compare and evaluate open and closed innovation strategies,
- understand the role of innovation ecosystems and digital entrepreneurship,
- apply moonshot design principles to develop ambitious innovation strategies,
- translate innovation theories into practical approaches for startups and entrepreneurial initiatives.

Prerequisites

No formal prerequisites.

Assessment

- Portfolio (details will be provided during the course)

Chair: https://sust.ris.uni-due.de

Game Architecture and Design

Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Dr. Maic Masuch

Course Description

This course focuses on the design and development of digital games, guiding students through the complete game creation process from initial idea to a fully playable prototype. Students learn core principles of game design, gameplay mechanics, and game architecture, as well as the structure and production processes of digital games. The course combines theoretical foundations with hands-on development in team-based projects. Strong emphasis is placed on creative design, iterative prototyping, playtesting, and the use of agile project management methods commonly applied in the game industry.

Learning Outcomes

After completing the course, students will be able to:

- explain fundamental design principles and architectures of digital games,
- understand the structure and production workflow of game development projects,
- design and develop a playable game prototype in a team,
- apply agile project management methods in a multimedia development context,
- analyze gameplay, game balance, and player experience,
- reflect on industry practices and future trends in interactive entertainment.

Prerequisites

No formal prerequisites.
Interest in game design, interactive media, or software development is recommended.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.uni-due.de/informatik/ecg/index.php

Intelligent Learning Environments
Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise (blended learning, group work)
Lecturer: Prof. Dr. Irene-Angelica Chounta

Course Description
This course explores current research and practice in the field of intelligent learning environments, with a strong focus on artificial intelligence in education. Students examine how intelligent systems can support learning processes through personalization, adaptivity, and data-driven decision-making. The course introduces algorithmic approaches for modeling cognition, knowledge, and learner behavior, and discusses how these models are applied in real educational technologies. Topics are situated at the intersection of AI in Education, learning technologies, and human–computer interaction, and are complemented by hands-on exercises and group work.

Learning Outcomes
After completing the course, students will be able to:

- explain key concepts and research directions in intelligent learning environments,
- describe algorithmic techniques for modeling learners, cognition, and knowledge,
- analyze and compare different types of AI-supported learning environments,
- understand the role of technology in orchestrating and supporting learning processes,
- critically reflect on ethical aspects such as fairness, transparency, and accountability in AI-based educational systems,
- collaborate in interdisciplinary teams to explore and discuss intelligent learning technologies.

Prerequisites
No formal prerequisites.
Students from both technical and non-technical backgrounds are welcome.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.uni-due.de/colaps/

Interactive Systems (Interaktive Systeme)
Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise
Lecturer: Prof. Dr. Michael Prilla

Course Description
This course covers advanced concepts, methods, and technologies in human–computer interaction and interactive systems. Students learn how to design, implement, and evaluate interactive systems that support effective and intuitive interaction between humans and technology. The course addresses both theoretical foundations and practical approaches, including advanced user interfaces such as tangible, natural, adaptive, and intelligent interfaces. Current topics such as interaction in augmented reality, human–AI interaction, and human–robot interaction are discussed using real-world examples and recent research. Practical exercises focus on analyzing interaction problems and designing suitable solutions.

Learning Outcomes
After completing the course, students will be able to:

- explain key concepts, models, and theories of advanced interactive systems,
- analyze user needs and interaction requirements in real-world scenarios,
- design and implement suitable interaction techniques and user interfaces,
- apply methods from human–computer interaction to solve practical problems,
- critically discuss current developments in areas such as AR, AI-based interaction, and human–robot interaction,
- evaluate interactive systems using appropriate methods and frameworks.

Prerequisites
No formal prerequisites.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.uni-due.de/interaktivesysteme/

Internet of Things: Protocols and System Software

Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture with exercise (programming-based)
Lecturer: Prof. Dr. Gregor Schiele

Course Description

This course provides an in-depth introduction to the Internet of Things (IoT), focusing on the protocols, system software, and architectures required to connect and operate large numbers of embedded devices. Students learn how IoT systems differ from traditional Internet technologies and why specialized communication protocols, data models, and software platforms are required. The course covers both theoretical foundations and practical implementation aspects, with a strong emphasis on device networking and IoT system software. Hands-on exercises allow students to program and experiment with real IoT hardware and platforms.

Learning Outcomes

After completing the course, students will be able to:

- explain core concepts, architectures, and challenges of Internet of Things systems,
- analyze differences between IoT technologies and classical Internet systems,
- understand and apply IoT communication protocols such as CoAP, MQTT, and low-power networking standards,
- work with data models and data management approaches for IoT systems,
- design and implement basic IoT applications using embedded devices and system software,
- evaluate emerging trends and future developments in IoT systems.

Prerequisites

Basic knowledge of communication networks or Internet technologies is recommended.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.uni-due.de/es/en/en_home.php

Managing Digital Transformation

Master / *Graduate level* – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Ralf Plattfaut

Course Description

Digital transformation has become a central challenge for organizations across all industries. This course focuses on understanding and managing digital transformation beyond purely technological change. Students learn how digital transformation differs from traditional change initiatives and IT-enabled organizational transformation. The course introduces key concepts, frameworks, and tools for transforming business models, products, services, and business processes. Through lectures, case studies, and interactive discussions, students gain the ability to analyze digital transformation processes and apply their knowledge to other large-scale transformations, such as sustainability or demographic change.

Learning Outcomes

After completing the course, students will be able to:

- explain the key building blocks and drivers of digital transformation,
- distinguish between digital transformation, organizational change, and IT-enabled transformation,
- apply tools and frameworks to digitally transform business models, products, services, and processes,
- analyze digital transformation processes at different organizational levels,
- transfer concepts and methods of digital transformation to other types of societal or organizational transformations.

Prerequisites

There are no prerequisites for attending this course.

Assessment

- Final exam – 60%
- Case study or paper presentation – 20%
- Discussion / participation – 20%
  (more details will be announced in the first session)

Chair: https://tm.ris.uni-due.de

Pervasive Computing

Master / Graduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Pedro José Marrón

Course Description

This course introduces the fundamental concepts of pervasive and ubiquitous computing, where computing systems are seamlessly integrated into everyday environments. Students explore how heterogeneous, networked devices interact to provide context-aware and distributed services beyond traditional computer systems. The course focuses on architectures and middleware solutions that enable communication and service abstraction in pervasive computing environments. Topics include context and activity recognition, location-based services, distributed data storage, and issues of security and privacy. Theoretical foundations are complemented by practical exercises that apply these concepts to real-world scenarios such as smart environments and home automation systems.

Learning Outcomes

After completing the course, students will be able to:

- explain core concepts and architectures of pervasive and ubiquitous computing,
- analyze the requirements of applications in pervasive computing environments,
- design and implement service- and communication-oriented middleware solutions,
- apply pervasive computing concepts to practical use cases,
- discuss current research topics and challenges in the field.

Prerequisites

- Basic knowledge of computer networks
- Programming experience (Java recommended)

Assessment

Written or oral examination. The specific examination format will be announced during the course.

Chair: https://www.nes.uni-due.de

Scientific Visualization

Master / Graduate level – 6 ECTS
Summer Semester – Campus Duisburg
Format: Lecture
Lecturer: Prof. Dr. Jens Krüger

Course Description

This introductory course focuses on techniques for visualizing large-scale scientific data from simulation and measurement. It introduces the visualization pipeline and covers core concepts such as data representation, interpolation, filtering, and rendering methods. A particular emphasis is placed on interactive and GPU-accelerated visualization techniques. Typical applications include volume and flow visualization as well as visualization methods for virtual reality environments.

Learning Outcomes

After completing the course, students will be able to:

- explain core concepts and algorithms of scientific visualization,
- describe the characteristics of scientific data from simulation and measurement,
- select suitable visualization techniques for different data types,
- apply fundamental methods such as interpolation and filtering within the visualization pipeline,
- analyze large scientific data sets using interactive and GPU-based visualization approaches.

Prerequisites

Knowledge of machine learning or human–computer interaction can be helpful but is not required.

Assessment

- Written exam **or** oral examination
  (The examination format will be announced at the beginning of the course.)

Chair: https://www.cgvis.de

Further Information: module handbook (p. - xxx -)
https://www.uni-due.de/imperia/md/content/cps/m-cps_ing_-21_-_modulhandbuch_deutsch.pdf

Strategic Planning of IS (SPIS)

Master / Graduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture with tutorial
Lecturer: Prof. Dr. Frederik Ahlemann

Course Description

Information systems play a critical role in enabling business strategy and organizational performance. This course focuses on the strategic planning and management of information systems at the interface between business and IT. Students learn how organizations leverage IT/IS to create value, support digital business models, and achieve strategic alignment. The course covers key decision domains of IT strategy, including IT governance, demand management, enterprise architecture, project portfolio management, and sourcing. Through lectures, case studies, and discussions, students develop the ability to analyze strategic IT challenges and design appropriate organizational and managerial solutions.

Learning Outcomes

After completing the course, students will be able to:

- describe and critically reflect on the leverage of IT/IS systems,
- explain management challenges at the interface between business and IT,
- describe different decision domains that IT strategy needs to incorporate and align,
- describe the interfaces between different strategic IT planning topics,
- describe fundamental processes, methods, and tools for the strategic planning of IS, and
- discuss the challenges and limitations of those processes, methods, and tools

Prerequisites

Basic knowledge of information systems, strategic management, and project management is recommended.

Assessment

- Written exam – 50%
- Case study presentation – 50%
- Admission to the final exam requires passing intermediate tests (details announced at the beginning of the course)

Chair: https://sitm.ris.uni-due.de

Towards Sustainable Futures with AI

Master / Graduate level – 6 ECTS
Summer Semester – Campus Essen
Format: Lecture and Tutorial
Lecturer: Prof. Dr. Hannes Rothe

Course Description

This course examines how artificial intelligence can contribute to sustainable economic, social, and ecological development. Students learn how AI systems are designed and applied in organizations, with a focus on data-centric thinking, machine learning, and sustainability. The course combines conceptual foundations with practical work, enabling students to critically assess the societal impact of AI and develop AI-based solutions for sustainability-related challenges.

Learning Outcomes

After completing the course, students will be able to:

- explain key concepts of AI, machine learning, and data-centric thinking,
- analyze organizational and sustainability-related implications of AI applications,
- apply selected machine learning techniques using low-code tools,
- evaluate the impact of AI systems on selected Sustainable Development Goals,
- design a basic business case and prototype for an AI application.

Prerequisites

Basic knowledge of information systems, strategic management, and databases is recommended.

Assessment

- Written exam – 50%
- Written paper – 50%
- **Passing two intermediate oral tests is required for admission to the final examination**

Chair: https://sust.ris.uni-due.de

Further Information

Detailed module information can be found in the official module handbook (p. 37): https://www.ris.uni-due.de/studium/studienorganisation/ordnungen-und-dokumente-master/

Advanced Topics in Embedded Systems

Master / Graduate level – 6 ECTS
Irregular – Campus Essen
Format: Lecture with exercise
Lecturer: Prof. Dr. Pedro José Marrón

Course Description

This course covers advanced and current topics in the field of embedded systems. It provides students with both in-depth theoretical knowledge and practical insights into recent developments in research and industry. The specific topics vary from semester to semester and are announced at the beginning of the course or on the department's website. Students learn to assess the applicability of advanced embedded systems concepts and develop suitable solution approaches for complex computer science problems.

Learning Outcomes

After completing the course, students will be able to:

- explain advanced concepts and recent developments in embedded systems,
- evaluate the applicability of embedded systems technologies to specific problem settings,
- develop solution approaches for complex problems in embedded and networked systems,
- apply theoretical knowledge to practice-oriented scenarios.

Prerequisites

Basic knowledge of computer science and programming is recommended.

Assessment

- Written exam **or** Oral examination
  (The examination format is announced at the beginning of the course.)

Chair: http://www.nes.uni-due.de/

Further Information

Detailed module information can be found in the official module handbook (p.5):
https://www.uni-due.de/imperia/md/images/informatik/bmse/sne-ma-2016-mhb.pdf

Empirical Methods for Software Engineers
Bachelor / Undergraduate level – 6 ECTS
Every Semester – Campus Essen
Format: Lecture with exercise
Lecturer: Dr. Stefan Hanenberg

Course Description
This course introduces empirical research methods used in software engineering to systematically observe, analyze, and evaluate software-related phenomena. Students learn how empirical studies support evidence-based decisions in software development, for example when assessing programming techniques, software performance, or user satisfaction. The course covers both quantitative and qualitative methods, with a strong focus on controlled experiments, measurement techniques, and data analysis. Through lectures and practical exercises, students gain hands-on experience in designing, conducting, and critically evaluating empirical studies in software engineering.

Learning Outcomes
After completing the course, students will be able to:

- design and conduct quantitative and qualitative empirical studies in software engineering,
- plan, execute, and analyze controlled experiments,
- apply performance measurements, software metrics, and repository mining techniques,
- evaluate the validity and reliability of empirical study designs and results,
- identify methodological weaknesses and limitations in empirical software engineering research.

Prerequisites
No formal prerequisites.

Assessment
Oral examination
Admission to the examination may require successful participation in the exercise sessions, as announced at the beginning of the course.

Chair
https://www.se.wiwi.uni-due.de/

Intelligent User Interfaces (IUI)
Bachelor / Undergraduate level – 6 ECTS
Irregular – Campus Essen
Format: Lecture with integrated exercise (project-based)
Lecturer: Prof. Dr. Stefan Schneegaß

Course Description
This course explores intelligent user interfaces at the intersection of human–computer interaction and artificial intelligence. Students learn how modern user interfaces incorporate intelligent methods such as machine learning to adapt to users, context, and behavior. The course covers different types of intelligent interfaces, including gesture-based interaction, natural language interfaces, adaptive systems, and intelligent agents. In addition to understanding technical foundations, students examine the implications of intelligent interfaces for usability, user experience, and system design. The integrated exercises focus on hands-on prototyping, allowing students to design and implement intelligent user interface concepts in small teams.

Learning Outcomes
After completing the course, students will be able to:
- explain concepts and research topics related to intelligent user interfaces,
- evaluate existing intelligent interfaces with respect to technical requirements and usage scenarios,
- design and implement intelligent user interfaces in different application contexts,
- analyze implications of intelligent interfaces for users and interactive systems,
- assess future developments and trends in the field of intelligent user interfaces.

Prerequisites
Basic programming skills are required.
Knowledge of human–computer interaction and machine learning is helpful but not mandatory.

Assessment
- Portfolio assessment consisting of project work completed during the semester
- Presentation of project results

Chair: https://www.hci.wiwi.uni-due.de/