# Vorlesungsverzeichnis

English-taught courses of the Faculty

WiSe 2025/26

Stand 23.02.2026

## English-taught courses of the Faculty

### 424220000 Methods of Social Data Analysis

**M. Jakesch, N. Navajas Fernández** Veranst. SWS: 4
Vorlesung
Mi, wöch., 11:00 - 12:30, Bauhausstraße 11 - R 015, Lecture, ab 22.10.2025
Di, wöch., 15:15 - 16:45, Bauhausstraße 11 - R 015, Lab class, ab 28.10.2025

**Beschreibung**

How can we use data to answer questions about people and society? This course introduces foundational concepts and methods in the quantitative analysis of social data. Through a blend of theoretical insights and hands-on practice, students will get to know the quantitative data analysis pipeline—from data collection and cleaning to statistical modeling and inference.

Topics include the design and execution of surveys and experiments, the concepts of sampling, bias and variance, statistical modeling and inferences, and the ethics of working with people's data. Students will develop an understanding of correlation, regression, statistical power, confidence intervals, and hypothesis tests—skills essential for conducting robust analyses in a data-rich but complex social world.

By the end of the course, students will be able to design basic studies, evaluate the reliability of quantitative evidence, and use statistical methods to test hypotheses on data. They will also have gained some familiarity with R, a statistics-focused programming language widely used data scientists and researchers.

**Voraussetzungen**

Familiarity with basic concepts of programming and probability is required.

**Leistungsnachweis**

In-class presentations, course mini-project, final exam.

## Bachelor

### 422250040 Introduction to Machine Learning (B.Sc.)

**B. Stein, J. Bevendorff, M. Kanadan** Veranst. SWS: 4
Vorlesung
Do, wöch., 09:15 - 10:45, Bauhausstraße 11 - N 004, Vorlesung, ab 23.10.2025
Do, wöch., 09:15 - 10:45, Bauhausstraße 11 - R 014, Vorlesung, ab 23.10.2025
Do, gerade Wo, 11:00 - 13:00, Bauhausstraße 11 - N 004, Übung, ab 30.10.2025
Do, gerade Wo, 11:00 - 13:00, Bauhausstraße 11 - R 014, Übung, ab 30.10.2025

**Beschreibung**

Students will learn to understand machine learning as an informed search in a space of possible hypotheses. The mathematical means to formulate a particular hypothesis class determines the learning paradigm, the discriminative power of a hypothesis, and the complexity of the learning process. Aside from foundations of supervised learning also an introduction to unsupervised learning is given. The lecture covers linear models, neural networks, decision trees and Bayesian learning. It introduces concepts, algorithms, and theoretical backgrounds. The accompanying lab treats both theoretical and applied tasks to deepen the understanding of the field. Team work (2-3 students) is appreciated.

**Leistungsnachweis**

Klausur

## 425210000 Building Language Models

**B. Stein, M. Gohsen, M. Wiegmann** Veranst. SWS: 10
Projekt

**Beschreibung**

Implement several language models from different generations from scratch using the same training texts. Build a website to provide a prefix, select the model and its parameters, and see the differences in the generation.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210001 Experimentelle Videospiel-Entwicklung

**A. Jakoby, G. Pandolfo** Veranst. SWS: 10
Projekt

**Beschreibung**

Das Projektmodul widmet sich der experimentellen Entwicklung von Videospielen und interaktiven Prototypen, die auf kritischen, gestalterischen und forschenden Ansätzen basieren. Die Inhalte des Moduls orientieren sich an den Prinzipien der Research Creation – einer Verbindung von künstlerisch-praktischer und wissenschaftlich-theoretischer Arbeit – und fördern die Auseinandersetzung mit innovativen Spielkonzepten jen-seits konventioneller Formen und Mechaniken.

Im Laufe des Semesters werden eigene Spielideen entworfen, iterativ entwickelt und kritisch reflektiert. Dabei stehen sowohl schnelle Prototyping-Prozesse als auch die konzeptionelle Schärfung individueller Projekte im Fokus. Die Ergebnisse sollen im Rahmen Winterwerkschau 25/26 und der Summaery 2026 sowie über die Online-Plattform des Critical Game Labs veröffentlicht werden. Das Projektmodul wird jedes Semester ange-boten und kann sowohl einmalig als auch mehrfach belegt werden, da sich die inhaltlichen Schwerpunkte und Arbeitsformen kontinuierlich weiter-entwickeln.

Das Modul ist Teil der Bauhaus Gamesfabrik und wird durch das Drittmittelprojekt Freiraum gefördert. Eine inhaltliche Anbindung besteht an das Projektmodul Experimentelle Videospielkritik sowie das Seminarmodul Game Studies, Design and Development von Milan Pingel – eine Kombination dieser Veranstaltungen wird empfohlen.

Teilnahmebedingungen:

Die Teilnehmer*innenzahl ist begrenzt. Für die Teilnahme wird ein kurzes Motivationsschreiben sowie ein Portfolio mit relevanten Arbeiten (z.#B. Game-Design, digitale Medien, interaktive Projekte, künstlerische Arbei-ten etc.) erbeten. Bitte sende beides bis zum Semesterstart per E-Mail an: gianluca.pandolfo@uni-weimar.de

**Bemerkung**

erste Veranstaltung: 16.10.2025

Mittwoch 13:30 Uhr - 15:30 Uhr

**Voraussetzungen**

Studierende der Medieninformatik sollten Programmierkenntnisse mitbringen

## 425210002 Designing Haptics for Tangible Interaction

**E. Hornecker, H. Waldschütz** Veranst. SWS: 10
Projekt

**Beschreibung**

Tangible Interaction (TI) refers to the use of physical artifacts that can be touched and manipulated to interact with a (digital) system. In this research project, we want to investigate the role of haptics in tangible interaction. How can these otherwise passive artifacts be enriched with tactile or haptic output, making the interaction more dynamic and engaging? To approach this question, we have to direct our research in different directions. We begin with the physiological foundations of the human body and move on to literature about topics like the semiotics of touch before exploring technological approaches for prototyping haptic experiences. Throughout the course, we will analyze use cases, identify opportunities, and reflect on the limitations of haptic tangibles.

The course follows a Research through Design (RtD) approach and emphasizes collaborative, interdisciplinary work. Students from technical and design backgrounds will work together to develop concepts and designs to implement haptics for tangible interfaces, for example using motor-based actuation. Alongside engaging with relevant literature, participants will explore different methods for developing and prototyping their ideas and eventually implement some of them in practice.

This course is well-suited for students who enjoy open-ended challenges, are motivated to find and define their own problems, and value both individual exploration and group collaboration. It offers the chance to combine research, ideation, prototyping, and evaluation in a multidisciplinary setting, drawing on diverse skills such as literature and web research, hardware prototyping with Arduino, material experimentation with wood, fabric, or plastics, and even traditional fabrication techniques like origami. With its broad scope and emphasis on hands-on work, the project is particularly suited for students looking for an 18 ECTS course.

Students from HCI Master and Bachelor Informatik apply via the usual project fair mechanism.

**Students from non-Computing programs (Master Media Architecture, Product-Design (BA/MA), Media Arts/ Design (BA/MA)**: There are up to 2 places for non-computing students. Beside creativity, it would be great if you bring practical experience with physical construction e.g. 3D-printing, laser-cutting, woodwork etc. and ideally some prior experience with electronics and Arduino. Interested students from these non-Computing programs **need to apply** and contact Hannes and Eva via email. Please apply until 14.10.2025 by E-Mail to Hannes.waldschuetz@uni-weimar.de and eva.hornecker@uni-weimar.de (please include a description of your prior experience in relevant areas, with examples of prior work / portfolio if applicable)!

**Bemerkung**

Time and place will be announced at the project fair.

## 425210003 Digital Twin Framework for Buildings and Structures

**M. Artus, C. Koch, J. Ringert, B. Burse** Veranst. SWS: 10
Projekt

**Beschreibung**

Buildings and civil engineering structures are unique. Creating a digital twin for them takes much time because of the requirements specific to each building. Reducing the time for creating Digital Twins for these assets, it would be helpful to have a framework that takes care about generating software for embedded systems, data storage, communication and visualization. This project can make use of several software developed in prior projects.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Basic Knowledge in Programming, Software Engineering

## 425210004 From Text to Image

**B. Stein, T. Gollub, S. Ruth** Veranst. SWS: 10
Projekt

**Beschreibung**

The project deals with the problem of automatically assessing the characteristics of images that refer to a particular text. For example, we want to assess which of the main objects mentioned in the text are present in the images. Or how aspects, that are left open in the text, are visualized in the images.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210005 Gaussian Splatting for Mobile Mixed Reality Devices

**B. Fröhlich, A. Kreskowski, G. Rendle** Veranst. SWS: 10
Projekt

**Beschreibung**

Novel-view synthesis techniques based on Neural Radiance Fields [Mildenhall et al. 2020], Plenoxels [Fridovich-Keil et al. 2022], or, most recently and best known, 3D Gaussian Splatting [Kerbl et al. 2023, Liu et al. 2024] enable the visually high-fidelity representation of surfaces that are hard or even almost impossible to reconstruct using classic photogrammetric approaches. Examples of such surfaces include fur, vegetation, transparent or translucent objects and thin structures in general. The novel-view synthesis approaches perform faithful interpolation of existing color information contained in a set of high-quality input images. Novel views can be rendered in real-time, provided one has access to reasonable powerful graphics hardware.

In a previous project, we explored the Gaussian Splatting literature and optimized an existing Unity-based rendering plugin for efficient rendering of Gaussian-based scenes on desktop graphics hardware. We also identified several challenges in rendering these models on mobile devices.

In this project, we aim to build on these insights and optimize Gaussian Splatting algorithms for mobile mixed reality (MR) devices such as the Meta Quest 3 or other mobile devices such as tablets. We will research, implement, and evaluate promising techniques in areas like visibility culling, output-sensitive rendering, data compression, and hybrid representations. Our goal is to fully leverage mobile hardware for real-time rendering at appropriate quality levels.

In addition to the challenge of efficiently rendering on low-power MR hardware, we want to address related research questions with part of the project team, such as how to interact with scene elements consisting of hundreds of thousands of unstructured Gaussian-based primitives or how to convincingly blend Gaussian-Splatting-based scenes with camera streams obtained by mixed-reality devices.

If you are experienced or interested in real-time computer graphics and/or topics in the field of mixed reality, we would be excited to welcome you to our project!

We will provide you with a Quest 3 for the duration of the project and will address the challenges of rendering photorealistic real-world datasets on low-power MR hardware.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Solid software programming skills in C++ and a successfully completed computer graphics course or equivalent qualifications. Experience with GPGPU programming or algorithm design is helpful, but not required.

**Leistungsnachweis**

Active participation during the project meetings; design, implementation and evaluation of algorithms designed throughout the project; intermediate and final project presentations; final project report.

## 425210006 Hot Topics in Computer Vision WiSe25/26

**V. Rodehorst, J. Eick, A. Frolov, M. Kaisheva** Veranst. SWS: 10
Projekt

**Beschreibung**

Die Teilnehmer werden an ein aktuelles forschungs- oder industrierelevantes Thema herangeführt. Es ist nicht beabsichtigt einen festgelegten Bereich in voller Breite zu explorieren. Stattdessen werden die Teilnehmer mit der vollen Komplexität eines begrenzten Themas konfrontiert und die Eigeninitiative gefördert. Es ermöglicht einen Einblick in die Forschungs- und Entwicklungsprojekte des Fachgebiets.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Vorlesungen „Photogrammetric Computer Vision” oder „Image Analysis and Object Recongnition” wünschenswert. Gute Programmierkenntnisse (z.B. C/C++, MATLAB/Octave, Python, OpenCL/CUDA)

**Leistungsnachweis**

Aktive Mitarbeit, Einführungsvortrag, Abschlusspräsentation, Dokumentation

## 425210007 Immersive Decision Theater

**B. Fröhlich, T. Zöppig, E. Schott** Veranst. SWS: 10
Projekt

**Beschreibung**

In today’s fast-paced and interconnected world, making effective decisions in domains such as politics, sustainable development, large-scale infrastructure planning, or crisis response requires a deep understandingof complex systems and their dynamic interdependencies. To make the right decisions, stakeholders must

quickly grasp intricate relationships, integrate expert knowledge from remote locations, visualize cascading effects, and simulate potential outcomes. Immersive environments offer a powerful medium for supporting such high-stakes decision-making processes, enabling distributed decision-makers to collaboratively experience, explore, and evaluate complex scenarios through interactive simulations and immersive visual analytics. In our project ”Immersive Decision Theater,” we aim to develop a mixed-reality application where multiple users can explore

complex scenarios and gain deeper insights into decision parameters and their potential consequences. We envision this as a space where decision-makers, domain experts, and affected communities can collaboratively plan, communicate, and discuss future strategies and scenarios. The platform will feature interactive representations of underlying system models, immersive visual analytics of available data sources and effective visualizations of simulated outcomes to support informed, data-driven decision-making. A central challenge lies in enabling natural communication and collaboration between collocated and distributed VR users, ensuring mutual understanding and supporting decision processes through immersive simulation.

Finding solutions to complex problems in distributed immersive environments raises several research questions. These include how to spatially organize diverse information sources and corresponding data visualizations within the virtual decision theater, how to ensure coherent and meaningful experiences for both collocated and remote participants and how to enable fluid transitions between different content layers, presentation forms, and user perspectives, e.g. by transitioning between the real and virtual worlds.

To address these challenges, you will learn to design and implement social mixed reality applications using Unity3D and C#. Furthermore, you will explore advanced multi-user interaction concepts by experimenting with world-in-miniatures, mixed-reality transitions, visualizing data in a spatial context and many others. Programming and interaction design will be central components of the project; therefore, we recommend a strong background in VR development with Unity and C#, and/or solid experience in designing user

interactions for social immersive environments.

Objectives

• Design and conceptualize a decision theater that supports multiple perspectives on complex scenarios.

• Implement strategies and techniques to interact with and explore the scenario and its underlying data.

• Address potential conflicts between collocated and spatially or temporally distributed users.

• (Optional) Integrate simulation frameworks that react on changes in the virtual model.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Solid software programming / scripting experience (e.g. C#, C++, Python). Experience in Unity is very helpful. Successful completion of the Virtual Reality course is recommended.

## 425210008 Next-Generation Development of the Args.me Argument Search Engine

**B. Stein, K. Heinrich, M. Kanadan** Veranst. SWS: 10
Projekt

**Beschreibung**

In this project, we enhance args.me, an argument search engine, by expanding its features and improving performance. We develop a unified user interface that incorporates advanced retrieval algorithms, considers user preferences, leverages argumentative snippets, and integrates dialogical argumentation capabilities.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210009 Optimierung von Stundenplänen

**A. Jakoby** Veranst. SWS: 10
Projekt

**Bemerkung**

Time and place will be announced at the project fair.

## 425210010 Robustheit von Digitalen Wasserzeichen

**A. Jakoby** Veranst. SWS: 10
Projekt

**Bemerkung**

Time and place will be announced at the project fair.

## 425210011 Software Engineering for Autonomous Vehicles 3

**J. Ringert, .. Soaibuzzaman** Veranst. SWS: 10
Projekt

**Beschreibung**

We will develop software to control autonomous vehicles. The physical vehicle will be equipped with a range of sensors, e.g., LiDAR, cameras, gyroscopes, and distance sensors. We will use industry strength software platforms like the Robot Operating System (ROS2).

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Digital Engineering students must have completed their foundations.

**Leistungsnachweis**

Projektbericht und Ergebnisse in Form von Software.

## 425210012 SPHINCS and Friends: Modern Hash-Based Signatures

**S. Lucks, J. Leuther** Veranst. SWS: 10
Projekt

**Beschreibung**

Hash-based signature algorithms are promising candidates for securing communication in the age of quantum computers. SPHINCS+ is an example of such a stateless signature algorithm that gained popularity from the recent „Post-Quantum Cryptography Standardisation Competition”. A major downside of hash-based signature algorithms like SPHINCS+ is the size of the signature itself, which is magnitudes larger than what other algorithms provide.

However, there are recent alternatives to SPHINCS+ that are being developed to reduce the downsides while still maintaining the benefits of the hash-based approach. For example, two such variants are Giza and Manticore. In this project, you will work with experts on this subject to get familiar with these alternatives. Your task is to analyse them cryptographically and to implement prototypes of these algorithms.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

- Course: Introduction to Modern Cryptography (or equivalent)
- Interest in Scientific Work
- Ability to self-organize

**Leistungsnachweis**

Zwischenpräsentationen, Abschlusspräsentation, Abschlussbericht

## 425210013 UX4HA: Making Home Assistant Easy to Use for Energy Management

**E. Hornecker, M. Osipova** Veranst. SWS: 10
Projekt

**Beschreibung**

Home Assistant (https://www.home-assistant.io) is the world’s largest open-source project on GitHub, developed and maintained by a global community of contributors. With over 2 million installations, the smart home platform represents a significant open-source success story, built around the values of choice, sustainability, and privacy. Home Assistant runs locally unlike many commercial alternatives, allowing users full data ownership.

The platform is increasingly adopted by individuals motivated by goals such as sustainability, cost-efficiency, and energy independence. Many people are driven to smart home technologies that track their consumption and allow them to engage in active energy management, such as reducing peak load, responding to time-varying electricity prices, and integrating personal power production. Importantly, energy in this context comes from different sources: gas, water, electricity from the grid, self-generated solar power, electricity storage in home batteries, etc. This energy can be used for lighting, cooling, heating, ventilating, and many other purposes. Monitoring and managing these diverse energy flows is essential for achieving broader sustainability and efficient resource consumption. In addition to energy, the Home Assistant energy dashboard provides features to monitor water usage within the smart home.

This research project is run in collaboration with ”Open Home Foundation”, the parent organization behind the Home Assistant platform. The project will investigate how effectively Home Assistant products support people who use the platform with these energy-related motivations. It explores the user journey from initial awareness, to setup, to meaningful usage of the Energy Dashboard and energy-related features. The focus lies on analyzing how the platform's current features equip people to consume, monitor, interpret, and act on their energy data in ways that align with their sustainability and energy management goals.

The project tasks include evaluating Home Assistant’s energy features and the associated setup and onboarding processes, assessing usability, clarity, and alignment with the expectations of both novel and experienced users that newly started with energy management. The aim is to identify how the platform, particularly its energy features, can better support users' energy-related needs and wishes regarding smart home practices.

The project’s active phase runs till the end of March. Presence in Weimar is mandatory with a possibility of remote work during the last three weeks of March. Vacations can be organized with a prior notice (thus the workload can be managed by the team). Christmas break is already scheduled according to official break duration.

Through User-Centered Design process we will go from research to prototypes. The deliverables of the project include: platform evaluation, UX research and actionable research report, and new features/feature improvement prototypes. The research results could be used as a case for your portfolios.

Project is offered as 12 ECTs or 18 ECTs project with respective amount of workload. The workload is scheduled in two-week sprints and distributed through the whole semester with accommodation for a Christmas break. Presence at the project meeting and ability to allocate required time for working on the project is mandatory requirement (therefore, we do **not** recommend doing more than 30 ECTS altogether and to carefully consider which other intensive courses to take alongside).

All students need to email Margarita with CV to check whether you qualify for the project. Feel free to reach out for more details or with questions or clarifications to be sure that this project is a good fit for you. margarita.osipova@uni-weimar.de

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

**Students from HCI Masters and CS4DM:** have successfully completed at least one of the following courses from the HCI chair: ”HCI Theory & Research Methods”, ”Ubiquitous Computing”, or ”HCI Introduction”.

We further expect general interest in smart home technology and UX research and design, willingness to work in a team and solve complex design problems. Prototyping skills (lo-fi and hi-fi) as well as Figma knowledge would be beneficial.

We additionally require for the applicants to have a respective amount of time to work on the project from October till the end of March.

To avoid issues after the project selection algorithm, we **require** interested students to write an email to Margarita to confirm eligibility for participation in the project. If you have not emailed us and do not qualify after the algorithm distribution, you would be automatically unenrolled from this project.

Please apply by E-Mail to margarita.osipova@uni-weimar.de (please include a motivation statement, mention which courses you took, and provide a description of your prior experience in relevant areas, with examples of prior work if applicable)!

## 425210014 Visuelle Analyse von Fragebögen

**B. Fröhlich, D. Kiesel, I. López García** Veranst. SWS: 10
Projekt

**Beschreibung**

Fragebögen sind eines der am häufigsten genutzten Mittel um Daten zu erheben, sei es für eine Wahrnehmungsstudie, eine Meinungsumfrage oder die sozialwissenschaftliche Feldforschung. Die Auswertung dieser Fragebögen nutzt meist statistische Standardverfahren, die jede Frage gesondert betrachten. Zusammenhänge zwischen Antworten oder Verbindungen zu orthogonalen Informationen wie beispielsweise der Demographie der Teilnehmenden werden dabei oft vernachlässigt.

Im Rahmen dieses studentischen Projektes werden wir verschiedene Visualisierungen und Interaktionen entwickeln, die verschiedene Fragetypen – etwa Einfachauswahl, Mehrfachauswahl, Bewertungsskala oder Freitext – darstellen, Zusammenhänge zwischen Antworten und Demographie aufdecken und damit die Analyse von Fragebogendaten deutlich erleichtern können.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Programming skills in Javascript and D3.js. A completed Visualization course.

**Leistungsnachweis**

active participation during the project meetings; presentation of literature; design, implementation and evaluation of different visualization and interaction designs; intermediate and final project presentation; final report.

## 425210025 Numerische Modellierung von Luftverteilungs- und Lüftungsstrategien

**H. Alsaad** Veranst. SWS: 10
Projekt

**Beschreibung**

A lot of research was done in the past about the importance of good indoor climate for health and well-being. Indoor air quality as well as thermal comfort are impacted by mechanical ventilation. Several different mechanisms for mechanical ventilation are known, such as forced convection, natural convection, or Coanda effect. The goal is to obtain a validated numerical model of several different mechanical ventilation systems within the CFD software ANSYS Fluent. The model must be validated using experimental data gathered inside the climate chamber of the department of Building Physics. For this, the chamber shall be equipped representing an office setup with a workstation and a thermal manikin. The experimental data is used to find the most appropriate calculation model for the simulations.

Tasks:

- Literature research
- Measurements in the climate chamber of the department of building physics
- Setup of the numerical model in ANSYS Fluent incl. geometry & mesh generation
- Validation of the numerical model
- Simulation of different ventilation systems
- Analysis of the indoor air quality and thermal comfort

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Knowledge of the fundamentals of computational fluid dynamics and indoor environmental modeling is recommended.

**Leistungsnachweis**

Written scientific group report and oral presentation

## 425210026 Umfangreicher Digitaler Zwilling des Fassadenbegrünungssystems VertiKKA

**H. Alsaad, T. Paskert** Veranst. SWS: 10
Projekt

**Beschreibung**

Recently, digitalization technologies have become more important for enhancing tasks such as monitoring and product process planning. Large amounts of data are analyzed and made available for simulation and optimization. Creating a digital twin, these processes can be united. The novel living wall system VertiKKA, located at the campus in Coudraystraße, combines vertical greening, grey-water filtering, and energy production via photovoltaic-modules. It impacts the surrounding environment in complex ways, and underlies seasonal and meteorological impacts. Data is generated with a manifold of ready-installed sensors. These preconditions result in the necessity of a representation for visualization, simulation, and optimization.

The aim is to create a concept of a digital twin, which represents the VertiKKA geometrically, as well as by means of physical data. Using the game engine Unity, the model shall be created and first attempts for data transfer shall be probed. This requires a capable software environment. Additionally, the available data shall be processed to be used for simulations and to predict potential issues, or optimize settings.

Tasks:

- Literature research
- Creation of a software concept capable for data transfer and updating the digital twin
- Generation of the digital twin (e.g. using Unity)
- Implementation of defining properties of VertiKKA, such as plant properties, exposure to sun or wind, or heat transfer coefficient of the wall
- Integration of actors, such as the watering system, or PV-module control system

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Background in 3D modeling and coding recommended.

**Leistungsnachweis**

Written scientific group report and oral presentation

## 425210027 Generative Modelierung mit CAD

**S. Kollmannsberger, L. Herrmann** Veranst. SWS: 10
Projekt

**Beschreibung**

This project will explore the possibilities of generative CAD modeling. The following steps are envisioned but may be changed upon mutual agreement with the supervisors

1. Comprehensive literature study highlighting approaches of Generative CAD modeling
2. Evaluation of existing approaches with freely available code (such as e.g. https://github.com/ChrisWu1997/DeepCAD )
3. Suggestions for integration of side conditions such as mechanical stiffnesses
4. Implementation

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Successful completion of the second semester of the Masters' Program Digital Engineering.

**Leistungsnachweis**

Final presentation, code, and technical report.

## 425210028 Hybrid Numerical Modelling: Finite Element and Material Point Coupling within numgeo

**P. Staubach, C. Rodríguez Lugo** Veranst. SWS: 10
Projekt

**Beschreibung**

While the Finite Element Method (FEM) has proven efficient for simulating various civil engineering problems, its results are usually limited to small deformation problems. Alternatives for modelling large deformations exist in different forms, with the most common being remeshing techniques and coupling between particle methods and finite element methods. Particle methods allow for both small and large deformations; in particular, the Material Point Method (MPM) shares similarities with FEM.

In soil mechanics, large deformations often found after material failure, leading to a complex material response that is difficult to capture with conventional FEM alone. Typical examples include the deformations of soil during landslides and other mass movements, as well as those encountered with soil penetration during testing or sampling, pile driving, and deep compaction; among others. Accurate numerical models for such scenarios demand methods capable of tracking both small and large deformations during and after failure.

Both a finite element program (*numgeo*) and an MPM program have been developed at the Chair of Geotechnics at Bauhaus-Universität Weimar. The aim of this project is to combine both methods into a standalone implementation based on the *numgeo* framework. The conceptual part of the theoretical coupling between methods has been developed by the supervisors using isogeometric formulations. This concept has been validated in Python and it needs to be effectively implemented into the *numgeo* framework using modern Fortran.

The objectives of the project are:

1) The efficient implementation of isogeometric shape functions of the B-spline type within *numgeo*.

2) Implementing numerical integration at arbitrary material point locations within *numgeo.*

3) The generation of the necessary datasets to effectively and efficiently enable MPM integration for simple 1D and 2D models within *numgeo.*

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Project Report

## 425210029 Optimierung geotechnischer Finite-Elemente-Simulationen: Parallelisierung und KI-gestützte Erweiterung von numgeo

**P. Staubach** Veranst. SWS: 10
Projekt

**Beschreibung**

The Finite Element Method (FEM) is a widely adopted numerical technique in civil and geotechnical engineering for modelling the geometry and mechanical behaviour of structures and subsurface materials subjected to various

types of loads. The FEM program *numgeo* (www.numgeo.de), developed by the Chair of Geotechnics at Bauhaus-Universität Weimar, is an open-access tool used by thousands of engineers and researchers worldwide.

One prominent application of numgeo is the modelling of offshore wind turbine foundations. Current FEM-based predictions typically involve the simulation of millions of load cycles, such as those generated by sea waves or the rotation of wind turbine rotors, which are transmitted from the superstructure to the supporting soil. The interaction between soil and structure is therefore accounted for through these simulations, with the largest models requiring several hours of computational time to complete.

*numgeo* is written in modern Fortran, a language still widely used for performance-oriented scientific computing, though no longer commonly taught in standard curricula. The program currently supports shared-memory parallelisation via OpenMP, enabling efficient use of multi-core CPUs for specific computational routines. However, other components of the code still execute serially, presenting opportunities for further optimisation.

This project has two main objectives (to be worked on by 2 students). The first is to explore and implement advanced parallelisation strategies to improve computational performance. This includes enhancing existing OpenMP capabilities, integrating GPU acceleration via OpenACC and potentially rewriting performance-critical components using CUDA for direct execution on NVIDIA GPUs.

The second objective is to improve the user interface and workflow through the integration of open-source AI tools. The goal is to link *numgeo* with existing mesh generation tools and develop a dedicated pre-processor that allows intuitive model setup. The AI component should be trained and optimised to enable users to define key features of the intended numerical model (such as geometry, boundary conditions, material properties, and loading scenarios) through natural language input or a guided interface. It should then automatically generate a consistent and solvable finite element model that can be directly processed and computed by numgeo. This not only reduces manual pre-processing effort but also broadens accessibility for less-experienced users. Such integration has the potential to significantly accelerate the modelling workflow, improve reproducibility, and foster the use of advanced simulation techniques in geotechnical practice.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Project Report

## 425210030 Spannungsberechnung auf Basis von CT-Scans

**S. Kollmannsberger, M. Christmann** Veranst. SWS: 10
Projekt

**Beschreibung**

The special project addresses the following four aspects:

**FFT method** [single]:

The first student will be given an existing implementation of the FTT method and corresponding literature. The student will then

- Carry out a literature review
- analyze the computational complexity of the method analytically and for practical examples.
- analyze pros and cons of the method
- propose, rewrite and implement remedies

**Finite Cell Method (FCM) with Moment Fitting** [single]**:**

The second student will be given an existing implementation of the moment fitting method for a 2D finite element case and corresponding literature. The student will then

- Carry out a short literature review
- Analyze the computational complexity of the method analytically
- Understand and implement the moment fitting method in FCM and analyze the computational complexity

**Pre-Integration** [single]**:**

The third student will work on implementing a pre-integration technique. Additionally, the student will prepare a given FEM framework for a meaningful comparison of the homogenization methods of student one and two. The tasks include:

- Carry out a short literature review
- Analyze the computational complexity of the method analytically
- Implement the pre-integration method and analyze its computational complexity
- Prepare an interface to include the methods of student one and two.

[team]:

The three students will then jointly compare their results on benchmark examples in a written report and present their findings in a final presentation. The modified codes must be handed in along with the technical report.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Background Computational Mechanics

Programming knowledge (either C++ or Python)

**Leistungsnachweis**

Final presentation, code, and technical report.

## 425210032 Parallel Acceleration and Performance Optimization of Python Modules in Particle-Based Numerical Modelling

**C. Rodríguez Lugo** Veranst. SWS: 10
Projekt

**Beschreibung**

Numerical modelling is a tool widely used in different fields of engineering and physics to predict the response of matter subjected to different conditions. Particle-based methods are a branch of numerical modelling techniques that allow the simulation of the response of granular materials, such as soils, subjected to wide ranges of deformation. Such simulations serve as predictions of the soil behaviour under specific conditions for civil engineering analyses.

This project investigates different techniques aimed at the acceleration and optimization of computational routines developed as part of the implementation of a particle-based method. In particular, the Material Point Method (MPM) has been implemented into a Python program developed for geotechnical and soil simulation. MPM simplifies a solid as a collection of material points or particles and uses a background mesh for the solution of the system, similar to the finite element approach.

Students will work with standalone Python scripts extracted from the full MPM program. The focus of the project lies on the optimization and benchmarking of low-level numerical operations, with the aim of improving computational efficiency. Possible developments of the standalone Python scripts include:

- Computation of Shape Functions at Material Points

Optimize how shape functions and their gradients are computed, as well as the connectivity between material points and the background mesh.

- Cell-Level Matrix/Vector Computation

Improve the performance of routines responsible for calculating cell-level quantities, including stiffness matrices and load vectors.

- Global (System) Assembly

Enhance the global assembly of matrices and vectors using contributions from the individual cells.

The project includes a literature review focused on available techniques for parallelisation in Python, particularly those that are free and easily available to employ. Students are expected to assess and compare different approaches such as Numba and multiprocessing, among others; based on quantitative performance parameters. These parameters may include real time, speedup ratios, and scalability metrics, evaluated using standard Python tools and basic profiling utilities.

**Bemerkung**

Time and place will be announced at the project fair.

## 425210038 Responsible AI

**M. Jakesch** Veranst. SWS: 10
Projekt

**Beschreibung**

Responsible AI refers to principles, practices, and frameworks that can guide the ethical and accountable development of artificial intelligence systems and ensure that deployed systems are safe, fair, and beneficial to society. In this project, students will engage with perspectives from across the field through weekly readings, reflections, and discussions of central texts.

In parallel, each student will design and carry out a Responsible AI research project. Possible approaches include system audits, experiments, user studies, conceptual work, or dataset collection. The course emphasizes both conceptual engagement and hands-on practice, with the goal of preparing students to participate in the evolving debates around responsible AI.

The main project outcome will be an individual project report, giving students the opportunity to practice scientific writing and potentially develop a publishable contribution. Assessment will be based on the final project, as well as active participation, presentations, and demonstrated progress throughout the semester.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Successful prior completion of ”Methods of Social Data Analysis” or "Machine Learning" or "Natural Language Processing". If you do not fulfill the requirement but believe you would be a good fit for the project, please reach out to the instructor.

**Leistungsnachweis**

Scientific project report

## 425210042 Good Dog! – Teaching new Tricks to Spot the Robot

**C. Koch, R. Helbing** Veranst. SWS: 10
Projekt

**Beschreibung**

Explore the potential and limitations of the Boston Dynamics Spot robot in this project. While impressive, Spot's standard configuration presents opportunities for enhancement. Currently, its autonomy depends critically on QR codes, its features are spread across different applications, and collected data isn't readily processed for analysis. This can lead to inefficient, manual workflows and usability issues due to missing features or integration gaps, particularly noticeable in industries like construction.

The goal of this project is to expand Spot's usability and practical capabilities. You'll dive into testing its standard functions with various payloads, identifying challenges and improvement opportunities using basic workflow scenarios. You will examine existing Python examples and then engage in hands-on development, adapting these examples and using trial and error to create a more streamlined, minimal workflow. This project offers a chance to directly address current limitations and make Spot a more integrated and efficient tool.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

1) Project Report

2) Intermediate Presentation

3) Final Presentation

## 425220000 Methods of Social Data Analysis (B.Sc)

**M. Jakesch, N. Navajas Fernández** Veranst. SWS: 4
Vorlesung
Mi, wöch., 11:00 - 12:30, Bauhausstraße 11 - R 015, Vorlesung, ab 22.10.2025
Di, wöch., 15:15 - 16:45, Bauhausstraße 11 - R 015, Übung, ab 28.10.2025

**Beschreibung**

How can we use data to answer questions about people and society? This course introduces foundational concepts and methods in the quantitative analysis of social data. Through a blend of theoretical insights and hands-on practice, students will get to know the quantitative data analysis pipeline—from data collection and cleaning to statistical modeling and inference.

Topics include the design and execution of surveys and experiments, the concepts of sampling, bias and variance, statistical modeling and inferences, and the ethics of working with people’s data. Students will develop an understanding of correlation, regression, statistical power, confidence intervals, and hypothesis tests—skills essential for conducting robust analyses in a data-rich but complex social world.

By the end of the course, students will be able to design basic studies, evaluate the reliability of quantitative evidence, and use statistical methods to test hypotheses on data. They will also have gained some familiarity with R, a statistics-focused programming language widely used data scientists and researchers

**Voraussetzungen**

Familiarity with basic concepts of programming and probability is required.

**Leistungsnachweis**

In-class presentations, course mini-project, final exam.

## 425220001 AISprintLab

**M. Wehrmann** Veranst. SWS: 4

Werk-/Fachmodul

Di, wöch., 17:15 - 20:30, Bauhausstraße 11 - Pool G, ab 21.10.2025

**Beschreibung**

Das Werkmodul „AI-SprintLab" ist als Labor konzipiert, in dem die rasante Entwicklung Künstlicher Intelligenz praktisch erprobt und künstlerisch untersucht wird. Im Zentrum steht das schnelle, kollaborative Arbeiten: Jede Woche steht ein neues Tool oder Medium im Fokus – von Bild- und Video-Generatoren über Sound- und Voice-Cloning bis zu Text- und Chatmodellen.

Im Laufe des Semesters werden nicht nur technische Grundlagen vermittelt, sondern in kurzen kreativen Sprints Experimente und Projekte entwickelt. Fehler, Überraschungen und unerwartete Ergebnisse sind ausdrücklich Teil des Prozesses. Neben den wöchentlichen Sprints entstehen eigenständige Arbeiten, die am Ende des Semesters in einer öffentlichen Präsentation vorgestellt werden.

Das „AI-SprintLab" versteht sich als kollektiver Lernraum: Wissen wird gemeinsam erarbeitet, geteilt und erweitert. Zunächst steht die kritische Auseinandersetzung mit der Geschwindigkeit und den Implikationen der aktuellen KI-Entwicklung im Vordergrund. Daran anschließend wird untersucht, welche Rolle diese Technologien für Kunst und Lehre spielen können: Wie lassen sie sich künstlerisch erproben, reflektieren und produktiv einsetzen? Zwischen Faszination, Kritik und kreativem Überschuss eröffnen sich neue Perspektiven auf KI in künstlerischen und pädagogischen Kontexten.

Bitte beachten Sie: Der Kurs soll (bei Bedarf) auf Englisch stattfinden. Wenn ihr Englisch nicht das Beste ist sind sie trotzdem herzlich willkommen hier ein wenig zu üben. Wir werden einen Weg finden miteinander zu kommunizieren. Bitte tragen Sie sich ins Moodle des Kurses ein, um über mögliche Änderungen und Updates informiert zu bleiben.

**Voraussetzungen**

Studierende des BA Medienkultur und studierende anderer Fächer

**Leistungsnachweis**

Anwesenheit und aktive Mitarbeit  am Unterricht, Hausaufgaben, Referat

## 425220002 Off

**M. Wehrmann** Veranst. SWS: 4

Werk-/Fachmodul

Do, wöch., 13:30 - 16:45, Diese Veranstaltung findet in der Bauhausstraße 11, 3. OG im Raum 308 statt!, ab 23.10.2025

**Beschreibung**

Das Werkmodul „Off" widmet sich dem Zustand des Abgeschaltet-Seins bzw. der Praxis des Offline-Gehens – technisch, sozial und künstlerisch. In einer Zeit des Standby, in der Bildschirme, Benachrichtigungen und Algorithmen die Rhythmen des Alltags bestimmen, richtet dieser Kurs den Fokus auf Unterbrechungen, Entzug und Distanz. Es geht um den Moment, in dem Verfügbarkeit endet und ein anderes Tempo erfahrbar wird. „Off" bedeutet hier nicht nur das Deaktivieren von Geräten, sondern auch das Eröffnen neuer Wahrnehmungs- und Erfahrungsräume.

Wir werden künstlerische Strategien des Rückzugs, der Entschleunigung und der bewussten Verweigerung von Beschleunigung erproben. Neben sinnlichen Erfahrungsräumen stehen vor allem medienpraktische Übungen im

Vordergrund, die analoge Bild- und Klangverfahren in den Mittelpunkt rücken. Ein besonderes Augenmerk liegt auf der Frage, wie sich historische Verfahren und kulturtechnische Perspektiven mit aktuellen Medien verbinden lassen.

Ausgehend von diesen Fragestellungen sollen eigene künstlerische Experimente durchgeführt, dokumentiert und zu einem individuellen Projekt ausgearbeitet werden. Am Ende des Kurses steht eine öffentliche Präsentation, bei der die im Semesterverlauf entwickelten Projekte gezeigt werden.

Bitte beachten Sie: Der Kurs kann in Teilen auf Englisch stattfinden. Bitte tragen Sie sich ins Moodle des Kurses ein, um über mögliche Änderungen und Updates informiert zu bleiben.

**Voraussetzungen**

Studierende des BA Medienkultur und studierende anderer Fächer

**Leistungsnachweis**

Anwesenheit und aktive Mitarbeit  am Unterricht, Hausaufgaben, Referat

## 425220003 PsychoGPT

**M. Wehrmann** Veranst. SWS: 4

Werk-/Fachmodul

Mi, wöch., 09:15 - 12:30, Bauhausstraße 11 - Pool G, ab 22.10.2025

**Beschreibung**

Die Rolle von KI als Lebenscoach oder sogar als Psychotherapeut:in wird immer populärer. In diesem Werkmodul begegnen wir dieser Entwicklung künstlerisch, indem wir die Rollen umkehren – bei uns liegt die KI auf der Couch. Unsere „Patient:innen” sind Sprachmodelle und Bildgeneratoren, deren Antworten und Bilder wir wie Symptome lesen und deuten.

Wir fragen: Was bedeutet es, wenn eine Maschine Symptome zeigt? Welche „Psyche” entdecken wir in ihren Halluzinationen, Störungen oder Projektionen? Gemeinsam befragen wir generative KI-Modelle nach ihren verborgenen Wünschen, Ängsten und Neurosen. Doch kann ein Modell überhaupt eine Psyche haben? Dieser Frage wollen wir uns künstlerisch-forschend annähern.

Ziel des Kurses ist es, eigene Arbeiten zu entwickeln – von experimentellen Gesprächstherapien mit Chatbots über performative Inszenierungen bis hin zu visuellen Interpretationen maschinischer Traumwelten. Am Semesterende werden die Projekte in einer öffentlichen Präsentation gezeigt.

Bitte beachten Sie: Der Kurs kann in Teilen auf Englisch stattfinden. Bitte tragen Sie sich ins Moodle des Kurses ein, um über mögliche Änderungen und Updates informiert zu bleiben.

**Voraussetzungen**

Studierende des BA Medienkultur und studierende anderer Fächer

**Leistungsnachweis**

Anwesenheit und aktive Mitarbeit  am Unterricht, Hausaufgaben, Referat

## 4445201 Photogrammetric Computer Vision (B.Sc.)

**V. Rodehorst, M. Kaisheva** Veranst. SWS: 4

Vorlesung

Mo, wöch., 09:15 - 10:45, Bauhausstraße 11 - N 004, Vorlesung , ab 20.10.2025
Mo, unger. Wo, 11:00 - 12:30, Bauhausstraße 11 - N 004, Übung, ab 20.10.2025

**Beschreibung**

Die Vorlesung gibt eine Einführung in die Grundlagen der Sensor-Orientierung und 3D-Rekonstruktion. Das Ziel ist ein Verständnis der Prinzipien, Methoden und Anwendungen der bildbasierten Vermessung. Behandelt werden unter anderem die algebraische projektive Geometrie, Abbildungsgeometrie, Kalibrierung, Orientierungsverfahren, Stereo-Bildzuordnung und weitere Verfahren zur Oberflächenrekonstruktion.

**Bemerkung**

**Voraussetzungen**

Einführung in die Informatik, Grundlagen Programmiersprachen

**Leistungsnachweis**

Erfolgreiche Bearbeitung der Übungen und des Projektes mit abschließender Klausur

## Master

### 205007 Modelling of steel structures and numerical simulation (L + E)

**M. Kraus, S. Ibañez Sánchez, S. Chowdhury** Veranst. SWS: 4

Vorlesung

Mi, Einzel, 17:45 - 19:15, Marienstraße 13 C - Hörsaal B, Exercise, 22.10.2025 - 22.10.2025
Mi, Einzel, 17:45 - 19:15, Marienstraße 13 C - Hörsaal B, Exercise, 12.11.2025 - 12.11.2025
Mi, Einzel, 17:45 - 19:15, Marienstraße 13 C - Hörsaal B, Exercise, 26.11.2025 - 26.11.2025
Mi, Einzel, 17:45 - 19:15, Marienstraße 13 C - Hörsaal B, Exercise, 10.12.2025 - 10.12.2025
Di, wöch., 17:00 - 18:30, Marienstraße 7 B - Seminarraum 105, Lecture, ab 06.01.2026
Mi, wöch., 17:00 - 18:30, Marienstraße 7 B - Seminarraum 105, Exercise, ab 07.01.2026

**Beschreibung**

The students will be familiar with skills and expertise in the field of nonlinear structural analyses. Extensive knowledge of theoretical basics and modern modelling methods, including numerical representations are the aim of the course. The students will acquire skills in handling advanced tools for the analysis and the design of structures.

Design of steel structures using finite element methods; basics of the design; modelling of structures and loads; nonlinear material behaviour, numerical analyses of steel-members and structures regarding geometric and physical nonlinearities; stability behaviour of members including flexural and lateral torsional buckling

**Voraussetzungen**

B.Sc.

Mechanics

**Leistungsnachweis**

**1 Project report**

”Modelling of steel structures and numerical simulation” (0%) / **WiSe**

**1 written exam**

”Modelling of steel structures and numerical simulation”/ 120 min (100%) / **WiSe** + SuSe

## 303005 Object-oriented Modeling and Programming in Engineering

**C. Koch, M. Artus** Veranst. SWS: 4

Vorlesung

1-Gruppe Di, wöch., 15:15 - 16:45, Marienstraße 7 B - Projektraum 301, ExerciseNHRE
3-Gruppe Fr, wöch., 11:00 - 12:30, Marienstraße 7 B - Projektraum 301, ExerciseDEM
4-Gruppe Fr, wöch., 11:00 - 12:30, Marienstraße 7 B - Projektraum 302, ExerciseDEM
Fr, Einzel, 11:00 - 12:30, Coudraystraße 13 B - Hörsaal 3, 17.10.2025 - 17.10.2025
Do, wöch., 11:00 - 12:30, Marienstraße 13 C - Hörsaal B, lecture

**Beschreibung**

Objektorientierte Modellierung und Programmierung für Ingenieure

In diesem Modul wird fundamentales Wissen vermittelt, um objektorientierte Softwarelösungen für Ingenieuraufgaben zu konzipieren und zu implementieren. Dies beinhaltet Fähigkeiten zur Analyse von Ingenieurproblemen, um entsprechende objektorientierte Modelle zu erzeugen und geeignete Algorithmen auszuwählen. Die verwendete Programmiersprache ist Java. Da die Basiskonzepte allgemeingültig beschrieben werden, werden die Studierenden in die Lage versetzt, auch andere modernen Programmiersprachen zu einzusetzen.

Inhalte:

- Kontrollstrukturen (alternatives, loops, sequences)
- Grundlegende Datenstrukturen und Algorithmen
- Prinzipien der objektorientierten Softwareentwicklung (Datenkapselung, Vererbung, Polymorphie)
- Unified Modeling Language als Werkzeug für Softwareentwurf und –dokumentation
- Entwicklung grafischer Nutzerschnittstellen mithilfe des Model-View-Controller-Entwurfsmusters

**engl. Beschreibung/ Kurzkommentar**

Object-oriented Modeling and Programming in Engineering

This module covers the basic knowledge needed to develop and implement object-oriented software solutions for engineering problems. This includes the ability to analyse an engineering problem, so that corresponding object-oriented models can be created and suitable algorithms can be selected. The programming language used in this module is Java. However, the since fundamental concepts are described in general, students will be able to program in other modern programming languages.

Content:

- Essential programming constructs (alternatives, loops, sequences)
- Fundamental data structures and algorithms
- Principles of object oriented software development (encapsulation, inheritance and polymorphism)
- The Unified Modeling Language as a tool for software design and documentation

Development of graphical user interfaces using the Model-View-Controller pattern

**Leistungsnachweis**

schriftliche Klausur

**1 written exam**

”Object-oriented Modeling and Programming in Engineering”

120min (100%) / **WiSe** + SuSe

## 418260002 Security Engineering

**S. Lucks, J. Leuther** Veranst. SWS: 3

Vorlesung

Mo, wöch., 15:15 - 16:45, Karl-Haußknecht-Straße 7 - Hörsaal (IT-AP), Lecture, ab 13.10.2025
Do, gerade Wo, 15:15 - 16:45, Karl-Haußknecht-Straße 7 - Hörsaal (IT-AP), Lab class, ab 16.10.2025

**Beschreibung**

Die Entwicklung sicherer und vertraulicher Systeme ist eine Herausforderung für System-Architekten als auch für Software-Entwickler. Die IT-Sicherheit wird durch das immer größer werdende Bewusstsein in der Politik und den Massenmedien zu einem stetig wachsenden und wichtigen Aspekt in der IT-Industrie.

In dieser Vorlesung wird die Programmiersprache Ada'05 (bzw. Ada'12) eingeführt, welche heutzutage als geeignete Sprache für die Implementierung sicherer und vertraulicher Systeme betrachtet wird. Desweiteren werden Methoden aus dem Feld des Software-Engineering präsentiert, welche es ermöglichen, Software-Systeme sicher, vertraulich und benutzbar zu gestalten.

**engl. Beschreibung/ Kurzkommentar**

Security Engineering

The development of safe and reliable systems is a challenging task for both system architects and software developer.
Due to the raising awareness of the politics and mass media, IT-security is becoming an increasingly important aspect of the IT industry.

The course introduces the programming language Ada'05,which is considered particularly suitable for implementing secure and reliable systems. In addition, methods from the field of software engineering are presented, which serve the safety, reliability and maintainability of software systems.

**Leistungsnachweis**

Mündliche Prüfung
Beleg als Voraussetzung zur Prüfungszulassung.

## 422250037 Formal Methods for Software Engineering

**J. Ringert, .. Soaibuzzaman** Veranst. SWS: 4

Vorlesung

Di, wöch., 09:15 - 10:45, Bauhausstraße 11 - R 015, Lecture, ab 14.10.2025
Fr, wöch., 11:00 - 12:30, Bauhausstraße 11 - R 015, Lecture/ Lab class, ab 17.10.2025

**Beschreibung**

Formal methods are rigorous techniques for the mathematical analysis of software and hardware systems. This course introduces aspects of formal methods with applications to software engineering problems.

The topics covered in the course include:

- Introduction to Formal Methods

- Formal methods tools, e.g.,
  - SMT solvers on the example of Z3
  - Relational models and the Alloy Analyzer
  - Model Checking using SMV
- Applications of formal methods in practice

After completion students will be able to

- Model problems in different formalisms
- Analyze software models using formal method tools
- Evaluate formal methods for software engineering problems

**Leistungsnachweis**

Participation in exercises

Marked homework project including a presentation

## 423150021 Deep Learning for Computer Vision

**V. Rodehorst, J. Eick, A. Frolov, D. Tschirschwitz** Veranst. SWS: 4
Integrierte Vorlesung
Fr, wöch., 15:15 - 16:45, Bauhausstraße 11 - N 004, Lecture/ Lab class, ab 17.10.2025
Mo, wöch., 17:00 - 18:30, Bauhausstraße 11 - N 004, Lecture/ Lab class, 20.10.2025 - 24.11.2025
Mo, wöch., 17:00 - 18:30, Bauhausstraße 9a - Linux-Pool, DBL, 1.OG, LINUX-Pool, DBL, Bh9a, 1. OG, ab 01.12.2025

**Beschreibung**

In diesem Kurs werden die Prinzipien, Techniken und Anwendungen des tiefgehenden Lernens in Computer Vision behandelt. Die Teilnehmer lernen, wie man neuronale Netze für die Bildklassifizierung, Objekterkennung, semantische Segmentierung und andere Computer-Vision-Aufgaben entwickelt, trainiert und validiert. Es werden auch Techniken zur Verbesserung der Leistung von Deep-Learning-Modellen und Veranschaulichungen behandelt, um Anhaltspunkte für die weitere Modellentwicklung zu erhalten. Am Ende des Kurses werden die Studierenden in der Lage sein, Deep-Learning-Techniken anzuwenden, um reale Probleme in verschiedenen Bereichen zu lösen.

**Voraussetzungen**

Image Analysis and Object Recognition

**Leistungsnachweis**

Erfolgreiche Teilnahme an den Laborübungen.

Gewichtung der Note: 100% schriftliche Klausur

## 425210000 Building Language Models

**B. Stein, M. Gohsen, M. Wiegmann** Veranst. SWS: 10
Projekt

**Beschreibung**

Implement several language models from different generations from scratch using the same training texts. Build a website to provide a prefix, select the model and its parameters, and see the differences in the generation.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210001 Experimentelle Videospiel-Entwicklung

**A. Jakoby, G. Pandolfo** Veranst. SWS: 10
Projekt

**Beschreibung**

Das Projektmodul widmet sich der experimentellen Entwicklung von Videospielen und interaktiven Prototypen, die auf kritischen, gestalterischen und forschenden Ansätzen basieren. Die Inhalte des Moduls orientieren sich an den Prinzipien der Research Creation – einer Verbindung von künstlerisch-praktischer und wissenschaftlich-theoretischer Arbeit – und fördern die Auseinandersetzung mit innovativen Spielkonzepten jen-seits konventioneller Formen und Mechaniken.

Im Laufe des Semesters werden eigene Spielideen entworfen, iterativ entwickelt und kritisch reflektiert. Dabei stehen sowohl schnelle Prototyping-Prozesse als auch die konzeptionelle Schärfung individueller Projekte im Fokus. Die Ergebnisse sollen im Rahmen Winterwerkschau 25/26 und der Summaery 2026 sowie über die Online-Plattform des Critical Game Labs veröffentlicht werden. Das Projektmodul wird jedes Semester ange-boten und kann sowohl einmalig als auch mehrfach belegt werden, da sich die inhaltlichen Schwerpunkte und Arbeitsformen kontinuierlich weiter-entwickeln.

Das Modul ist Teil der Bauhaus Gamesfabrik und wird durch das Drittmittelprojekt Freiraum gefördert. Eine inhaltliche Anbindung besteht an das Projektmodul Experimentelle Videospielkritik sowie das Seminarmodul Game Studies, Design and Development von Milan Pingel – eine Kombination dieser Veranstaltungen wird empfohlen.

Teilnahmebedingungen:

Die Teilnehmer*innenzahl ist begrenzt. Für die Teilnahme wird ein kurzes Motivationsschreiben sowie ein Portfolio mit relevanten Arbeiten (z.#B. Game-Design, digitale Medien, interaktive Projekte, künstlerische Arbei-ten etc.) erbeten. Bitte sende beides bis zum Semesterstart per E-Mail an: gianluca.pandolfo@uni-weimar.de

**Bemerkung**

erste Veranstaltung: 16.10.2025

Mittwoch 13:30 Uhr - 15:30 Uhr

**Voraussetzungen**

Studierende der Medieninformatik sollten Programmierkenntnisse mitbringen

## 425210002 Designing Haptics for Tangible Interaction

**E. Hornecker, H. Waldschütz** Veranst. SWS: 10
Projekt

**Beschreibung**

Tangible Interaction (TI) refers to the use of physical artifacts that can be touched and manipulated to interact with a (digital) system. In this research project, we want to investigate the role of haptics in tangible interaction. How can these otherwise passive artifacts be enriched with tactile or haptic output, making the interaction more dynamic and engaging? To approach this question, we have to direct our research in different directions. We begin with the

physiological foundations of the human body and move on to literature about topics like the semiotics of touch before exploring technological approaches for prototyping haptic experiences. Throughout the course, we will analyze use cases, identify opportunities, and reflect on the limitations of haptic tangibles.

The course follows a Research through Design (RtD) approach and emphasizes collaborative, interdisciplinary work. Students from technical and design backgrounds will work together to develop concepts and designs to implement haptics for tangible interfaces, for example using motor-based actuation. Alongside engaging with relevant literature, participants will explore different methods for developing and prototyping their ideas and eventually implement some of them in practice.

This course is well-suited for students who enjoy open-ended challenges, are motivated to find and define their own problems, and value both individual exploration and group collaboration. It offers the chance to combine research, ideation, prototyping, and evaluation in a multidisciplinary setting, drawing on diverse skills such as literature and web research, hardware prototyping with Arduino, material experimentation with wood, fabric, or plastics, and even traditional fabrication techniques like origami. With its broad scope and emphasis on hands-on work, the project is particularly suited for students looking for an 18 ECTS course.

Students from HCI Master and Bachelor Informatik apply via the usual project fair mechanism.

**Students from non-Computing programs (Master Media Architecture, Product-Design (BA/MA), Media Arts/ Design (BA/MA)**: There are up to 2 places for non-computing students. Beside creativity, it would be great if you bring practical experience with physical construction e.g. 3D-printing, laser-cutting, woodwork etc. and ideally some prior experience with electronics and Arduino. Interested students from these non-Computing programs **need to apply** and contact Hannes and Eva via email. Please apply until 14.10.2025 by E-Mail to Hannes.waldschuetz@uni-weimar.de and eva.hornecker@uni-weimar.de (please include a description of your prior experience in relevant areas, with examples of prior work / portfolio if applicable)!

**Bemerkung**

Time and place will be announced at the project fair.

## 425210003 Digital Twin Framework for Buildings and Structures

**M. Artus, C. Koch, J. Ringert, B. Burse** Veranst. SWS: 10
Projekt

**Beschreibung**

Buildings and civil engineering structures are unique. Creating a digital twin for them takes much time because of the requirements specific to each building. Reducing the time for creating Digital Twins for these assets, it would be helpful to have a framework that takes care about generating software for embedded systems, data storage, communication and visualization. This project can make use of several software developed in prior projects.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Basic Knowledge in Programming, Software Engineering

## 425210004 From Text to Image

**B. Stein, T. Gollub, S. Ruth** Veranst. SWS: 10
Projekt

**Beschreibung**

The project deals with the problem of automatically assessing the characteristics of images that refer to a particular text. For example, we want to assess which of the main objects mentioned in the text are present in the images. Or how aspects, that are left open in the text, are visualized in the images.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210005 Gaussian Splatting for Mobile Mixed Reality Devices

**B. Fröhlich, A. Kreskowski, G. Rendle** Veranst. SWS: 10
Projekt

**Beschreibung**

Novel-view synthesis techniques based on Neural Radiance Fields [Mildenhall et al. 2020], Plenoxels [Fridovich-Keil et al. 2022], or, most recently and best known, 3D Gaussian Splatting [Kerbl et al. 2023, Liu et al. 2024] enable the visually high-fidelity representation of surfaces that are hard or even almost impossible to reconstruct using classic photogrammetric approaches. Examples of such surfaces include fur, vegetation, transparent or translucent objects and thin structures in general. The novel-view synthesis approaches perform faithful interpolation of existing color information contained in a set of high-quality input images. Novel views can be rendered in real-time, provided one has access to reasonable powerful graphics hardware.

In a previous project, we explored the Gaussian Splatting literature and optimized an existing Unity-based rendering plugin for efficient rendering of Gaussian-based scenes on desktop graphics hardware. We also identified several challenges in rendering these models on mobile devices.

In this project, we aim to build on these insights and optimize Gaussian Splatting algorithms for mobile mixed reality (MR) devices such as the Meta Quest 3 or other mobile devices such as tablets. We will research, implement, and evaluate promising techniques in areas like visibility culling, output-sensitive rendering, data compression, and hybrid representations. Our goal is to fully leverage mobile hardware for real-time rendering at appropriate quality levels.

In addition to the challenge of efficiently rendering on low-power MR hardware, we want to address related research questions with part of the project team, such as how to interact with scene elements consisting of hundreds of thousands of unstructured Gaussian-based primitives or how to convincingly blend Gaussian-Splatting-based scenes with camera streams obtained by mixed-reality devices.

If you are experienced or interested in real-time computer graphics and/or topics in the field of mixed reality, we would be excited to welcome you to our project!

We will provide you with a Quest 3 for the duration of the project and will address the challenges of rendering photorealistic real-world datasets on low-power MR hardware.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Solid software programming skills in C++ and a successfully completed computer graphics course or equivalent qualifications. Experience with GPGPU programming or algorithm design is helpful, but not required.

**Leistungsnachweis**

Active participation during the project meetings; design, implementation and evaluation of algorithms designed throughout the project; intermediate and final project presentations; final project report.

## 425210006 Hot Topics in Computer Vision WiSe25/26

**V. Rodehorst, J. Eick, A. Frolov, M. Kaisheva** Veranst. SWS: 10
Projekt

**Beschreibung**

Die Teilnehmer werden an ein aktuelles forschungs- oder industrierelevantes Thema herangeführt. Es ist nicht beabsichtigt einen festgelegten Bereich in voller Breite zu explorieren. Stattdessen werden die Teilnehmer mit der vollen Komplexität eines begrenzten Themas konfrontiert und die Eigeninitiative gefördert. Es ermöglicht einen Einblick in die Forschungs- und Entwicklungsprojekte des Fachgebiets.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Vorlesungen „Photogrammetric Computer Vision” oder „Image Analysis and Object Recongnition” wünschenswert. Gute Programmierkenntnisse (z.B. C/C++, MATLAB/Octave, Python, OpenCL/CUDA)

**Leistungsnachweis**

Aktive Mitarbeit, Einführungsvortrag, Abschlusspräsentation, Dokumentation

## 425210007 Immersive Decision Theater

**B. Fröhlich, T. Zöppig, E. Schott** Veranst. SWS: 10
Projekt

**Beschreibung**

In today’s fast-paced and interconnected world, making effective decisions in domains such as politics, sustainable development, large-scale infrastructure planning, or crisis response requires a deep understandingof complex systems and their dynamic interdependencies. To make the right decisions, stakeholders must

quickly grasp intricate relationships, integrate expert knowledge from remote locations, visualize cascading effects, and simulate potential outcomes. Immersive environments offer a powerful medium for supporting such high-stakes decision-making processes, enabling distributed decision-makers to collaboratively experience, explore, and evaluate complex scenarios through interactive simulations and immersive visual analytics. In our project ”Immersive Decision Theater,” we aim to develop a mixed-reality application where multiple users can explore complex scenarios and gain deeper insights into decision parameters and their potential consequences. We envision this as a space where decision-makers, domain experts, and affected communities can collaboratively plan, communicate, and discuss future strategies and scenarios. The platform will feature interactive representations of underlying system models, immersive visual analytics of available data sources and effective visualizations of simulated outcomes to support informed, data-driven decision-making. A central challenge lies in enabling natural communication and collaboration between collocated and distributed VR users, ensuring mutual understanding and supporting decision processes through immersive simulation.

Finding solutions to complex problems in distributed immersive environments raises several research questions. These include how to spatially organize diverse information sources and corresponding data visualizations within the virtual decision theater, how to ensure coherent and meaningful experiences for both collocated and remote participants and how to enable fluid transitions between different content layers, presentation forms, and user perspectives, e.g. by transitioning between the real and virtual worlds.

To address these challenges, you will learn to design and implement social mixed reality applications using Unity3D and C#. Furthermore, you will explore advanced multi-user interaction concepts by experimenting with world-in-miniatures, mixed-reality transitions, visualizing data in a spatial context and many others. Programming and interaction design will be central components of the project; therefore, we recommend a strong background in VR development with Unity and C#, and/or solid experience in designing user

interactions for social immersive environments.

Objectives

• Design and conceptualize a decision theater that supports multiple perspectives on complex scenarios.

• Implement strategies and techniques to interact with and explore the scenario and its underlying data.

• Address potential conflicts between collocated and spatially or temporally distributed users.

• (Optional) Integrate simulation frameworks that react on changes in the virtual model.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Solid software programming / scripting experience (e.g. C#, C++, Python). Experience in Unity is very helpful. Successful completion of the Virtual Reality course is recommended.

## 425210008 Next-Generation Development of the Args.me Argument Search Engine

**B. Stein, K. Heinrich, M. Kanadan** Veranst. SWS: 10
Projekt

**Beschreibung**

In this project, we enhance args.me, an argument search engine, by expanding its features and improving performance. We develop a unified user interface that incorporates advanced retrieval algorithms, considers user preferences, leverages argumentative snippets, and integrates dialogical argumentation capabilities.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Abschlusspräsentation und Ausarbeitung

## 425210009 Optimierung von Stundenplänen

**A. Jakoby** Veranst. SWS: 10
Projekt

**Bemerkung**

Time and place will be announced at the project fair.

## 425210010 Robustheit von Digitalen Wasserzeichen

**A. Jakoby** Veranst. SWS: 10
Projekt

**Bemerkung**

Time and place will be announced at the project fair.

## 425210011 Software Engineering for Autonomous Vehicles 3

**J. Ringert, .. Soaibuzzaman** Veranst. SWS: 10
Projekt

**Beschreibung**

We will develop software to control autonomous vehicles. The physical vehicle will be equipped with a range of sensors, e.g., LiDAR, cameras, gyroscopes, and distance sensors. We will use industry strength software platforms like the Robot Operating System (ROS2).

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Digital Engineering students must have completed their foundations.

**Leistungsnachweis**

Projektbericht und Ergebnisse in Form von Software.

## 425210012 SPHINCS and Friends: Modern Hash-Based Signatures

**S. Lucks, J. Leuther** Veranst. SWS: 10
Projekt

**Beschreibung**

Hash-based signature algorithms are promising candidates for securing communication in the age of quantum computers. SPHINCS+ is an example of such a stateless signature algorithm that gained popularity from the recent „Post-Quantum Cryptography Standardisation Competition”. A major downside of hash-based signature algorithms like SPHINCS+ is the size of the signature itself, which is magnitudes larger than what other algorithms provide. However, there are recent alternatives to SPHINCS+ that are being developed to reduce the downsides while still maintaining the benefits of the hash-based approach. For example, two such variants are Giza and Manticore. In this project, you will work with experts on this subject to get familiar with these alternatives. Your task is to analyse them cryptographically and to implement prototypes of these algorithms.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

- Course: Introduction to Modern Cryptography (or equivalent)
- Interest in Scientific Work
- Ability to self-organize

**Leistungsnachweis**

Zwischenpräsentationen, Abschlusspräsentation, Abschlussbericht

## 425210013 UX4HA: Making Home Assistant Easy to Use for Energy Management

**E. Hornecker, M. Osipova** Veranst. SWS: 10
Projekt

**Beschreibung**

Home Assistant (https://www.home-assistant.io) is the world's largest open-source project on GitHub, developed and maintained by a global community of contributors. With over 2 million installations, the smart home platform represents a significant open-source success story, built around the values of choice, sustainability, and privacy. Home Assistant runs locally unlike many commercial alternatives, allowing users full data ownership.

The platform is increasingly adopted by individuals motivated by goals such as sustainability, cost-efficiency, and energy independence. Many people are driven to smart home technologies that track their consumption and allow them to engage in active energy management, such as reducing peak load, responding to time-varying electricity prices, and integrating personal power production. Importantly, energy in this context comes from different sources: gas, water, electricity from the grid, self-generated solar power, electricity storage in home batteries, etc. This energy can be used for lighting, cooling, heating, ventilating, and many other purposes. Monitoring and managing these diverse energy flows is essential for achieving broader sustainability and efficient resource consumption. In addition to energy, the Home Assistant energy dashboard provides features to monitor water usage within the smart home.

This research project is run in collaboration with "Open Home Foundation", the parent organization behind the Home Assistant platform. The project will investigate how effectively Home Assistant products support people who use the platform with these energy-related motivations. It explores the user journey from initial awareness, to setup, to meaningful usage of the Energy Dashboard and energy-related features. The focus lies on analyzing how the platform's current features equip people to consume, monitor, interpret, and act on their energy data in ways that align with their sustainability and energy management goals.

The project tasks include evaluating Home Assistant's energy features and the associated setup and onboarding processes, assessing usability, clarity, and alignment with the expectations of both novel and experienced users that newly started with energy management. The aim is to identify how the platform, particularly its energy features, can better support users' energy-related needs and wishes regarding smart home practices.

The project's active phase runs till the end of March. Presence in Weimar is mandatory with a possibility of remote work during the last three weeks of March. Vacations can be organized with a prior notice (thus the workload can be managed by the team). Christmas break is already scheduled according to official break duration.

Through User-Centered Design process we will go from research to prototypes. The deliverables of the project include: platform evaluation, UX research and actionable research report, and new features/feature improvement prototypes. The research results could be used as a case for your portfolios.

Project is offered as 12 ECTs or 18 ECTs project with respective amount of workload. The workload is scheduled in two-week sprints and distributed through the whole semester with accommodation for a Christmas break. Presence at the project meeting and ability to allocate required time for working on the project is mandatory requirement (therefore, we do **not** recommend doing more than 30 ECTS altogether and to carefully consider which other intensive courses to take alongside).

All students need to email Margarita with CV to check whether you qualify for the project. Feel free to reach out for more details or with questions or clarifications to be sure that this project is a good fit for you. margarita.osipova@uni-weimar.de

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

**Students from HCI Masters and CS4DM:** have successfully completed at least one of the following courses from the HCI chair: ”HCI Theory & Research Methods”, ”Ubiquitous Computing”, or ”HCI Introduction”.

We further expect general interest in smart home technology and UX research and design, willingness to work in a team and solve complex design problems. Prototyping skills (lo-fi and hi-fi) as well as Figma knowledge would be beneficial.

We additionally require for the applicants to have a respective amount of time to work on the project from October till the end of March.

To avoid issues after the project selection algorithm, we **require** interested students to write an email to Margarita to confirm eligibility for participation in the project. If you have not emailed us and do not qualify after the algorithm distribution, you would be automatically unenrolled from this project.

Please apply by E-Mail to margarita.osipova@uni-weimar.de (please include a motivation statement, mention which courses you took, and provide a description of your prior experience in relevant areas, with examples of prior work if applicable)!

## 425210014 Visuelle Analyse von Fragebögen

**B. Fröhlich, D. Kiesel, I. López García** Veranst. SWS: 10
Projekt

**Beschreibung**

Fragebögen sind eines der am häufigsten genutzten Mittel um Daten zu erheben, sei es für eine Wahrnehmungsstudie, eine Meinungsumfrage oder die sozialwissenschaftliche Feldforschung. Die Auswertung dieser Fragebögen nutzt meist statistische Standardverfahren, die jede Frage gesondert betrachten. Zusammenhänge zwischen Antworten oder Verbindungen zu orthogonalen Informationen wie beispielsweise der Demographie der Teilnehmenden werden dabei oft vernachlässigt.

Im Rahmen dieses studentischen Projektes werden wir verschiedene Visualisierungen und Interaktionen entwickeln, die verschiedene Fragetypen – etwa Einfachauswahl, Mehrfachauswahl, Bewertungsskala oder Freitext – darstellen, Zusammenhänge zwischen Antworten und Demographie aufdecken und damit die Analyse von Fragebogendaten deutlich erleichtern können.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Programming skills in Javascript and D3.js. A completed Visualization course.

**Leistungsnachweis**

active participation during the project meetings; presentation of literature; design, implementation and evaluation of different visualization and interaction designs; intermediate and final project presentation; final report.

## 425210016 Designing Futures: Between Speculation, Technological Tinkering and political Possibilities

**I. Kaldrack** Veranst. SWS: 4
Plenum

Mo, wöch., 13:30 - 16:45, Berkaer Straße 1 - Seminarraum 003, ab 20.10.2025

**Beschreibung**

Im Plenum setzen wir uns mit historischen und aktuellen Zukunftsentwürfen aus verschiedenen Kontexten wie Politikberatung, Science Fiction und Aktivismus auseinander. Auf dieser Grundlage nähern wir uns spekulativen Methoden, die wir anhand von Fallbeispielen, konkreten Projekten, sowie technologischer und gesellschaftlicher Szenarien experimentell erproben, diskutieren und weiter denken.

Es wird gewünscht, dass alle 3 Veranstaltungen des Projektmoduls "Future Environments 1" besucht werden. Bitte melden Sie sich für die Veranstaltungen im zugehörigen Moodle an.

**Voraussetzungen**

B.A.

**Leistungsnachweis**

Modulabschlussprüfung: Projektarbeit

## 425210022 Predicting Futures: Climate, Economy, Technology

**I. Kaldrack** Veranst. SWS: 2
Seminar
Di, wöch., 17:00 - 18:30, Bauhausstraße 11 - R 014, ab 21.10.2025

**Beschreibung**

Das Seminar beschäftigt sich mit unterschiedlichen Formen oder Verfahren, Zukünfte vorherzusagen. Untersucht wird, wie mithilfe von Daten, Modellen und Narrativen Zukunftsbilder entstehen und welche Konzepte von Weltentwürfen darin zum Tragen kommen.

Wir fragen, wie Vorhersagen oder Prognosen einerseits Zukünfte entwerfen und andererseits Plausiblität herstellen. Grundlage unserer Überlegungen bilden (medien-)theoretische Texte zu Zukunftsentwürfen, Programmatiken und medialen Umwelten.

Es wird gewünscht, dass alle 3 Veranstaltungen des Projektmoduls "Future Environments 1" besucht werden. Bitte melden Sie sich für die Veranstaltungen im zugehörigen Moodle an.

**Voraussetzungen**

B.A.

**Leistungsnachweis**

Modulabschlussprüfung: Projektarbeit

## 425210024 Thinking Futures

**I. Kaldrack** Veranst. SWS: 2
Seminar
Di, wöch., 11:00 - 12:30, Bauhausstraße 11 - R 014, ab 21.10.2025

**Beschreibung**

In diesem Seminar setzen wir uns mit medien- und kulturwissenschaftlichen Denkmodellen auseinander, die den Anspruch verfolgen, Vorstellungen einer besseren Zukunft zu entwerfen. Im Mittelpunkt stehen theoretische Ansätze, die historisch aufgeklärt, analytisch präzise und methodisch reflexiv argumentieren.

Es wird gewünscht, dass alle 3 Veranstaltungen des Projektmoduls "Future Environments 1" besucht werden. Bitte melden Sie sich für die Veranstaltungen im zugehörigen Moodle an.

**Voraussetzungen**

B.A.

**Leistungsnachweis**

Modulabschlussprüfung: Projektarbeit

## 425210025 Numerische Modellierung von Luftverteilungs- und Lüftungsstrategien

**H. Alsaad** Veranst. SWS: 10
Projekt

**Beschreibung**

A lot of research was done in the past about the importance of good indoor climate for health and well-being. Indoor air quality as well as thermal comfort are impacted by mechanical ventilation. Several different mechanisms for mechanical ventilation are known, such as forced convection, natural convection, or Coanda effect. The goal is to obtain a validated numerical model of several different mechanical ventilation systems within the CFD software ANSYS Fluent. The model must be validated using experimental data gathered inside the climate chamber of the department of Building Physics. For this, the chamber shall be equipped representing an office setup with a workstation and a thermal manikin. The experimental data is used to find the most appropriate calculation model for the simulations.

Tasks:

- Literature research
- Measurements in the climate chamber of the department of building physics
- Setup of the numerical model in ANSYS Fluent incl. geometry & mesh generation
- Validation of the numerical model
- Simulation of different ventilation systems
- Analysis of the indoor air quality and thermal comfort

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Knowledge of the fundamentals of computational fluid dynamics and indoor environmental modeling is recommended.

**Leistungsnachweis**

Written scientific group report and oral presentation

## 425210026 Umfangreicher Digitaler Zwilling des Fassadenbegrünungssystems VertiKKA

**H. Alsaad, T. Paskert** Veranst. SWS: 10
Projekt

**Beschreibung**

Recently, digitalization technologies have become more important for enhancing tasks such as monitoring and product process planning. Large amounts of data are analyzed and made available for simulation and optimization. Creating a digital twin, these processes can be united. The novel living wall system VertiKKA, located at the campus in Coudraystraße, combines vertical greening, grey-water filtering, and energy production via photovoltaic-modules. It impacts the surrounding environment in complex ways, and underlies seasonal and meteorological impacts. Data is generated with a manifold of ready-installed sensors. These preconditions result in the necessity of a representation for visualization, simulation, and optimization.

The aim is to create a concept of a digital twin, which represents the VertiKKA geometrically, as well as by means of physical data. Using the game engine Unity, the model shall be created and first attempts for data transfer shall be probed. This requires a capable software environment. Additionally, the available data shall be processed to be used for simulations and to predict potential issues, or optimize settings.

Tasks:

- Literature research
- Creation of a software concept capable for data transfer and updating the digital twin
- Generation of the digital twin (e.g. using Unity)
- Implementation of defining properties of VertiKKA, such as plant properties, exposure to sun or wind, or heat transfer coefficient of the wall
- Integration of actors, such as the watering system, or PV-module control system

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Background in 3D modeling and coding recommended.

**Leistungsnachweis**

Written scientific group report and oral presentation

## 425210027 Generative Modelierung mit CAD

**S. Kollmannsberger, L. Herrmann** Veranst. SWS: 10
Projekt

**Beschreibung**

This project will explore the possibilities of generative CAD modeling. The following steps are envisioned but may be changed upon mutual agreement with the supervisors

1. Comprehensive literature study highlighting approaches of Generative CAD modeling
2. Evaluation of existing approaches with freely available code (such as e.g. https://github.com/ChrisWu1997/DeepCAD )
3. Suggestions for integration of side conditions such as mechanical stiffnesses
4. Implementation

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Successful completion of the second semester of the Masters' Program Digital Engineering.

**Leistungsnachweis**

Final presentation, code, and technical report.

## 425210028 Hybrid Numerical Modelling: Finite Element and Material Point Coupling within numgeo

**P. Staubach, C. Rodríguez Lugo** Veranst. SWS: 10
Projekt

**Beschreibung**

While the Finite Element Method (FEM) has proven efficient for simulating various civil engineering problems, its results are usually limited to small deformation problems. Alternatives for modelling large deformations exist in different forms, with the most common being remeshing techniques and coupling between particle methods and finite element methods. Particle methods allow for both small and large deformations; in particular, the Material Point Method (MPM) shares similarities with FEM.

In soil mechanics, large deformations often found after material failure, leading to a complex material response that is difficult to capture with conventional FEM alone. Typical examples include the deformations of soil during landslides and other mass movements, as well as those encountered with soil penetration during testing or sampling, pile driving, and deep compaction; among others. Accurate numerical models for such scenarios demand methods capable of tracking both small and large deformations during and after failure.

Both a finite element program (*numgeo*) and an MPM program have been developed at the Chair of Geotechnics at Bauhaus-Universität Weimar. The aim of this project is to combine both methods into a standalone implementation based on the *numgeo* framework. The conceptual part of the theoretical coupling between methods has been developed by the supervisors using isogeometric formulations. This concept has been validated in Python and it needs to be effectively implemented into the *numgeo* framework using modern Fortran.

The objectives of the project are:

1) The efficient implementation of isogeometric shape functions of the B-spline type within *numgeo*.

2) Implementing numerical integration at arbitrary material point locations within *numgeo.*

3) The generation of the necessary datasets to effectively and efficiently enable MPM integration for simple 1D and 2D models within *numgeo.*

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Project Report

## 425210029 Optimierung geotechnischer Finite-Elemente-Simulationen: Parallelisierung und KI-gestützte Erweiterung von numgeo

**P. Staubach** Veranst. SWS: 10
Projekt

**Beschreibung**

The Finite Element Method (FEM) is a widely adopted numerical technique in civil and geotechnical engineering for modelling the geometry and mechanical behaviour of structures and subsurface materials subjected to various types of loads. The FEM program *numgeo* (www.numgeo.de), developed by the Chair of Geotechnics at Bauhaus-Universität Weimar, is an open-access tool used by thousands of engineers and researchers worldwide.

One prominent application of numgeo is the modelling of offshore wind turbine foundations. Current FEM-based predictions typically involve the simulation of millions of load cycles, such as those generated by sea waves or the rotation of wind turbine rotors, which are transmitted from the superstructure to the supporting soil. The interaction between soil and structure is therefore accounted for through these simulations, with the largest models requiring several hours of computational time to complete.

*numgeo* is written in modern Fortran, a language still widely used for performance-oriented scientific computing, though no longer commonly taught in standard curricula. The program currently supports shared-memory parallelisation via OpenMP, enabling efficient use of multi-core CPUs for specific computational routines. However, other components of the code still execute serially, presenting opportunities for further optimisation.

This project has two main objectives (to be worked on by 2 students). The first is to explore and implement advanced parallelisation strategies to improve computational performance. This includes enhancing existing OpenMP capabilities, integrating GPU acceleration via OpenACC and potentially rewriting performance-critical components using CUDA for direct execution on NVIDIA GPUs.

The second objective is to improve the user interface and workflow through the integration of open-source AI tools. The goal is to link *numgeo* with existing mesh generation tools and develop a dedicated pre-processor that allows intuitive model setup. The AI component should be trained and optimised to enable users to define key features of the intended numerical model (such as geometry, boundary conditions, material properties, and loading scenarios) through natural language input or a guided interface. It should then automatically generate a consistent and solvable finite element model that can be directly processed and computed by numgeo. This not only reduces manual pre-processing effort but also broadens accessibility for less-experienced users. Such integration has the potential to significantly accelerate the modelling workflow, improve reproducibility, and foster the use of advanced simulation techniques in geotechnical practice.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

Project Report

## 425210030 Spannungsberechnung auf Basis von CT-Scans

**S. Kollmannsberger, M. Christmann** Veranst. SWS: 10
Projekt

**Beschreibung**

The special project addresses the following four aspects:

**FFT method** [single]:

The first student will be given an existing implementation of the FTT method and corresponding literature. The student will then

- Carry out a literature review
- analyze the computational complexity of the method analytically and for practical examples.
- analyze pros and cons of the method
- propose, rewrite and implement remedies

**Finite Cell Method (FCM) with Moment Fitting** [single]**:**

The second student will be given an existing implementation of the moment fitting method for a 2D finite element case and corresponding literature. The student will then

- Carry out a short literature review
- Analyze the computational complexity of the method analytically
- Understand and implement the moment fitting method in FCM and analyze the computational complexity

**Pre-Integration** [single]**:**

The third student will work on implementing a pre-integration technique. Additionally, the student will prepare a given FEM framework for a meaningful comparison of the homogenization methods of student one and two. The tasks include:

- Carry out a short literature review
- Analyze the computational complexity of the method analytically
- Implement the pre-integration method and analyze its computational complexity
- Prepare an interface to include the methods of student one and two.

[team]:

The three students will then jointly compare their results on benchmark examples in a written report and present their findings in a final presentation. The modified codes must be handed in along with the technical report.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Background Computational Mechanics

Programming knowledge (either C++ or Python)

**Leistungsnachweis**

Final presentation, code, and technical report.

## 425210032 Parallel Acceleration and Performance Optimization of Python Modules in Particle-Based Numerical Modelling

**C. Rodríguez Lugo** Veranst. SWS: 10
Projekt

**Beschreibung**

Numerical modelling is a tool widely used in different fields of engineering and physics to predict the response of matter subjected to different conditions. Particle-based methods are a branch of numerical modelling techniques that allow the simulation of the response of granular materials, such as soils, subjected to wide ranges of deformation. Such simulations serve as predictions of the soil behaviour under specific conditions for civil engineering analyses.

This project investigates different techniques aimed at the acceleration and optimization of computational routines developed as part of the implementation of a particle-based method. In particular, the Material Point Method (MPM) has been implemented into a Python program developed for geotechnical and soil simulation. MPM simplifies a solid as a collection of material points or particles and uses a background mesh for the solution of the system, similar to the finite element approach.

Students will work with standalone Python scripts extracted from the full MPM program. The focus of the project lies on the optimization and benchmarking of low-level numerical operations, with the aim of improving computational efficiency. Possible developments of the standalone Python scripts include:

- Computation of Shape Functions at Material Points

Optimize how shape functions and their gradients are computed, as well as the connectivity between material points and the background mesh.

- Cell-Level Matrix/Vector Computation

Improve the performance of routines responsible for calculating cell-level quantities, including stiffness matrices and load vectors.

- Global (System) Assembly

Enhance the global assembly of matrices and vectors using contributions from the individual cells.

The project includes a literature review focused on available techniques for parallelisation in Python, particularly those that are free and easily available to employ. Students are expected to assess and compare different approaches such as Numba and multiprocessing, among others; based on quantitative performance parameters. These parameters may include real time, speedup ratios, and scalability metrics, evaluated using standard Python tools and basic profiling utilities.

**Bemerkung**

Time and place will be announced at the project fair.

## 425210038 Responsible AI

**M. Jakesch** Veranst. SWS: 10
Projekt

**Beschreibung**

Responsible AI refers to principles, practices, and frameworks that can guide the ethical and accountable development of artificial intelligence systems and ensure that deployed systems are safe, fair, and beneficial to society. In this project, students will engage with perspectives from across the field through weekly readings, reflections, and discussions of central texts.

In parallel, each student will design and carry out a Responsible AI research project. Possible approaches include system audits, experiments, user studies, conceptual work, or dataset collection. The course emphasizes both conceptual engagement and hands-on practice, with the goal of preparing students to participate in the evolving debates around responsible AI.

The main project outcome will be an individual project report, giving students the opportunity to practice scientific writing and potentially develop a publishable contribution. Assessment will be based on the final project, as well as active participation, presentations, and demonstrated progress throughout the semester.

**Bemerkung**

Time and place will be announced at the project fair.

**Voraussetzungen**

Successful prior completion of ”Methods of Social Data Analysis” or "Machine Learning" or "Natural Language Processing". If you do not fulfill the requirement but believe you would be a good fit for the project, please reach out to the instructor.

**Leistungsnachweis**

Scientific project report

## 425210042 Good Dog! – Teaching new Tricks to Spot the Robot

**C. Koch, R. Helbing** Veranst. SWS: 10
Projekt

**Beschreibung**

Explore the potential and limitations of the Boston Dynamics Spot robot in this project. While impressive, Spot's standard configuration presents opportunities for enhancement. Currently, its autonomy depends critically on QR codes, its features are spread across different applications, and collected data isn't readily processed for analysis. This can lead to inefficient, manual workflows and usability issues due to missing features or integration gaps, particularly noticeable in industries like construction.

The goal of this project is to expand Spot's usability and practical capabilities. You'll dive into testing its standard functions with various payloads, identifying challenges and improvement opportunities using basic workflow scenarios. You will examine existing Python examples and then engage in hands-on development, adapting these examples and using trial and error to create a more streamlined, minimal workflow. This project offers a chance to directly address current limitations and make Spot a more integrated and efficient tool.

**Bemerkung**

Time and place will be announced at the project fair.

**Leistungsnachweis**

1) Project Report

2) Intermediate Presentation

3) Final Presentation

## 425270000 Basic Module: Perspectives on Media Ecologies

**J. Hess** Veranst. SWS: 2
Seminar
Di, wöch., 15:15 - 16:45, ab 21.10.2025

**Beschreibung**

The reading seminar complements the lecture series by deepening its theoretical perspectives in a smaller setting. It is dedicated to the collective exploration of questions in media ecology through selected texts. At its core is the intensive engagement with concepts, positions, and methodological approaches.

**Leistungsnachweis**

Protokoll einer Sitzung der Vortragsgruppe pro Student/in (3-5 Seiten)

## 4256303 Photogrammetric Computer Vision

**V. Rodehorst, M. Kaisheva** Veranst. SWS: 4
Vorlesung
Mo, wöch., 09:15 - 10:45, Bauhausstraße 11 - N 004, Lecture, ab 20.10.2025
Mo, unger. Wo, 11:00 - 12:30, Bauhausstraße 11 - N 004, Lab class, ab 20.10.2025

**Beschreibung**

Die Vorlesung gibt eine Einführung in die Grundlagen der Sensor-Orientierung und 3D-Rekonstruktion. Das Ziel ist ein Verständnis der Prinzipien, Methoden und Anwendungen der bildbasierten Vermessung. Behandelt werden unter anderem die algebraische projektive Geometrie, Abbildungsgeometrie, Kalibrierung, Orientierungsverfahren, Stereo-Bildzuordnung und weitere Verfahren zur Oberflächenrekonstruktion.

**Voraussetzungen**

Einführung in die Informatik, Grundlagen Programmiersprachen

**Leistungsnachweis**

Erfolgreiche Bearbeitung der Übungen und des Projektes mit abschließender Klausur

## 439100 Raumbezogene Informationssysteme/ Spatial information systems (GIS)

**T. Gebhardt, V. Rodehorst** Veranst. SWS: 4

Integrierte Vorlesung

Fr, wöch., 13:30 - 15:00, Marienstraße 13 C - Hörsaal B, Übungen, ab 24.10.2025
Mi, wöch., 09:15 - 10:45, Marienstraße 13 C - Hörsaal B, Vorlesungen

**Beschreibung**

Die Vorlesung vermittelt vertiefte Grundlagen raumbezogener Informationssysteme, wie z.B. die Aufnahme, Organisation, Analyse und Präsentation raumbezogener Daten. Die Themen umfassen geographische Daten und frei verfügbare Ressourcen, Referenzsysteme und Kartennetzentwürfe, Geo-Datenbanken und effiziente Datenstrukturen, geometrische und topologische Datenanalyse, kartographische Generalisierung und Visualisierung sowie GIS im Planungskontext.

**Bemerkung**

Für die Selbsteinschreibung in den zugehörigen MOODLE-Lernraum (Hyperlink siehe oben!) lautet das Passwort: spatial2025

**Leistungsnachweis**

Erfolgreiche Bearbeitung der Übungen und des Projektes mit abschließender Klausur

## 4439110 Introduction to Machine Learning

**B. Stein, J. Bevendorff, M. Kanadan** Veranst. SWS: 4

Vorlesung

Do, wöch., 09:15 - 10:45, Bauhausstraße 11 - N 004, Lecture , ab 23.10.2025
Do, wöch., 09:15 - 10:45, Bauhausstraße 11 - R 014, Lecture , ab 23.10.2025
Do, gerade Wo, 11:00 - 12:30, Bauhausstraße 11 - N 004, Lab class, ab 30.10.2025
Do, gerade Wo, 11:00 - 12:30, Bauhausstraße 11 - R 014, Lab class, ab 30.10.2025

**Beschreibung**

In this course students will learn to understand machine learning as a guided search in a space of possible hypotheses. The mathematical means to formulate a particular hypothesis class determines the learning paradigm, the discriminative power of a hypothesis, and the complexity of the learning process.

The lecture covers hypothesis spaces, model bias, regression for classification, logistic regression, effectiveness computation, loss function derivation, gradient descent, regularization, neural networks, decision trees, impurity functions, Bayesian learning. The lecture introduces concepts, algorithms, and theoretical backgrounds.

The accompanying lab treats both theoretical and applied tasks to deepen the understanding and hands-on experience of the field. Team work (2-3 students) is appreciated.

**Leistungsnachweis**

Klausur

## 4526501 Academic English Part One

**G. Atkinson** Veranst. SWS: 2

Kurs

Mi, wöch., 15:15 - 16:45, Consultations, R.N212, B11 (indiv.appointments)
Mi, wöch., 17:00 - 18:30, Bauhausstraße 11 - R 015, Academic English Part I+II (alternating)

**Beschreibung**

This is the first part of a two-part course which aims to improve your ability to express yourself clearly in written English and to develop a suitably coherent academic writing style. Part One concentrates mainly on structure in writing academic articles, essays and reports. We begin by examining the structure of individual paragraphs and move on to extended texts of various types (e.g. process essays, cause/effect, comparison/contrast, etc.). Particular attention is paid to connectives, i.e. transitional phrases and constructions which help you link ideas and paragraphs in a logical, systematic way.

**Bemerkung**

You are advised to take Part One first, although it is possible to take both parts in reverse order or concurrently (i.e. in the same semester). You may only do the latter on the authority of the course leader (Atkinson).

**Voraussetzungen**

Registration (compulsory)

**All students must register.** First time particpants are required to present a B2 English Level certificate along with their email registration. All students, **including those who have already taken Academic English Part Two and those who need to repeat Academic English Part One,** must register by contacting Howard Atkinson at: howard.atkinson@uni-weimar.de**.**

**You will be informed by email when registration opens and when the deadline is. Please do not attempt to register until you have received this Email. Registration Emails should be given the subject heading: AE I Registration.**

**Leistungsnachweis**

continuous assessment

## 4526502 Academic English Part Two

**G. Atkinson** Veranst. SWS: 2

Kurs

Mi, wöch., 15:15 - 16:45, Consultations, R.N212, B11 (indiv.appointments)
Mi, wöch., 17:00 - 18:30, Bauhausstraße 11 - R 015, Academic English Part I+II alternating

**Beschreibung**

Part Two of the Academic English course concentrates on improving and refining aspects of academic writing style. It includes sections on clause and sentence structure, punctuation rules and how to incorporate quotations, statistics and footnotes into academic texts.

**Bemerkung**

You are advised to take Part One first, although it is possible to take both parts in reverse order or concurrently (i.e. in the same semester). You may only do the latter on the authority of the course leader (Atkinson).

**Voraussetzungen**

Registration (compulsory)

**All students must register.** First time particpants are required to present a B2 English Level certificate along with their email registration. All students, **including those who have already taken Academic English Part One and those who need to repeat Academic English Part Two,** must register by contacting Howard Atkinson at: howard.atkinson@uni-weimar.de**.**

**You will be informed by email when registration opens and when the deadline is. Please do not attempt to register until you have received this Email. Registration Emails should be given the subject heading: AE II Registration.**

**Leistungsnachweis**

continuous assessment

## 4556228 Virtual Reality

**B. Fröhlich, K. Brehm, E. Schott, T. Zöppig** Veranst. SWS: 4

Vorlesung

Do, wöch., 13:30 - 15:00, Bauhausstraße 11 - R 015, Lecture, ab 16.10.2025
Fr, wöch., 09:15 - 10:45, Lab class, Group AVR-Lab, R.N104, B11, ab 17.10.2025
Fr, wöch., 11:00 - 12:30, Lab Class, Group BVR-Lab, R.N204, B11, ab 17.10.2025

**Beschreibung**

Virtual Reality (VR) erfreut sich seit mehreren Jahren großer Beliebtheit in Forschung, Unterhaltung und Bildung. VR-Systeme ermöglichen die Interaktion einer oder mehrerer Benutzer*innen mit einer computersimulierten Umgebung, welche dreidimensional auf einem stereoskopischen Display dargestellt wird. In dieser Veranstaltung lernen Sie die theoretischen, technischen und angewandten Grundlagen moderner Virtual Reality-Systeme genauer kennen.

Die Vorlesung beginnt mit den Grundlagen der Computergrafik und des stereoskopischen Sehens, welche zur Realisierung von VR-Anwendungen erforderlich sind. Danach werden Sie verschiedene 3D-Eingabegeräte und 3D-Interaktionstechniken wie Selektion, Manipulation und Navigation in virtuellen Umgebungen kennenlernen. Der letzte Teil des Kurses baut auf dem bereits erworbenen Wissen auf und konzentriert sich auf kollaborative VR-Systeme für mehrere am gleichen oder an verschiedenen Orten befindliche Benutzer*innen.

Die Vorlesung wird von Laborveranstaltungen begleitet, welche neueste Virtual Reality-Technologien wie Multi-Viewer-3D-Projektionssysteme und hochauflösende Head-Mounted Displays einsetzen. Im Rahmen der Übungsaufgaben werden Sie verschiedene 3D-Interaktionstechniken für diese immersiven Displays sowie unter Nutzung von räumlichen Trackingsystemen und 3D-Eingabegeräten implementieren und auswerten. Je nach Situation können Sie auch von zu Hause aus an den Übungen arbeiten.

Wir planen, ausgewählte Vorlesungen und Übungen direkt in virtueller Realität durchzuführen, um das Konzept „Teaching VR in VR" zu testen. Dazu werden wir nach Möglichkeit alle Teilnehmer*innen mit HMDs ausstatten.

**Voraussetzungen**

Basic knowledge of computer graphics is recommended. Fundamental programming skills are required.

Digital Engineering or MediaArchitecture students may also attend this lecture if they have already acquired the necessary programming skills through successful completion of appropriate courses and are able to demonstrate their programming skills at the beginning of the lab course. If you are interested in attending this course, please contact one of the teaching assistants named above.

**Leistungsnachweis**

Vorlesungsbegleitende, bewertete Übungen, zweiwöchentliche Testate und eine schriftliche Abschlussprüfung.