interdisciplinary
transformation
university austria

Curriculum

Master's Program

Interdisciplinary Computing

Validity:

The Founding Convention approved the following curriculum on 14th July 2025
Editorial changes were accepted on 1st June 2026

§ 1 Basis and Applicability

The legal basis for the master's program "Interdisciplinary Computing" is the Federal Act on the Institute of Digital Sciences Austria (Interdisciplinary Transformation University) BGBl. I No. 43/2024.

The Founding Convention approved the following curriculum on 14.07.2025. Editorial changes were accepted on 1st June 2026.

§ 2 Program Description and Objectives

The master's program in Interdisciplinary Computing is designed to equip students with advanced skills in computing, data science, and cross-domain innovation. Rooted in the recognition that contemporary challenges demand integrated perspectives, this program merges computer science foundations with specialized knowledge from fields such as engineering, environmental studies, the humanities, and life sciences.

Students explore how to apply computational methods in interdisciplinary contexts, develop systems and data-driven solutions for complex real-world problems, and critically engage with the ethical, legal, and societal dimensions of digital transformation. They learn effective communication and collaboration across disciplines, as well as navigating both academic and industrial research environments.

The curriculum combines foundational modules, domain-oriented specialization tracks, project-based learning, and thesis work, ensuring both academic depth and practical relevance. A strong emphasis is placed on project-based learning, and on integrating international perspectives and mobility opportunities.

§ 3 Qualification Profile

Graduates of the master's program in Interdisciplinary Computing acquire a comprehensive set of qualifications in core areas of computing, including data science, machine learning, algorithms, software engineering, and digital infrastructures. In addition, they possess in-depth knowledge in one of the four interdisciplinary specializations, such as Designing Interactions; Digital Earth, Society, and Networks; Digital Humanities, Health, and Life Sciences; Future Industries. Thus, graduates are adept at connecting computational approaches with domain-specific challenges. They are also equipped with the ability to critically reflect on the societal and ethical implications of technological developments.

Strong communication skills enable them to effectively share their work across academic, professional, and public contexts. Furthermore, they develop robust project management and teamwork abilities, particularly in diverse and intercultural environments. The program prepares graduates for further doctoral studies or roles in industry, non-governmental organizations, or policy institutions.

Graduates are well-suited for careers as data scientists, digital transformation consultants, computational researchers, software architects, and innovation managers. They are particularly equipped to lead and support transformation processes in sectors undergoing digital or sustainable transitions.

§ 4 Duration and Scope

The workload for the master's program in Interdisciplinary Computing is 120 ECTS credits. An academic year comprises 60 ECTS credits, with one ECTS credit corresponding to 25 hours of student workload. This corresponds to a planned duration of four semesters as a full-time program.

§ 5 Admission to the Program

To be admitted to a master's program at Interdisciplinary Transformation University (IT:U), candidates must have completed a bachelor's degree in a relevant field of study or another relevant program of at least the same academic level at a recognized domestic or foreign post-secondary educational institution. To compensate for significant differences in subject matter, supplementary examinations may be required, which must be completed by the end of the second semester of the master's program.

General admission regulations are specified in the respective part of the bylaws.

§ 6 Program Structure

The program conveys content and necessary qualifications through a series of modules. A module is defined by specific entry and exit qualifications, the subject matter, teaching methods, the required workload, and the criteria for performance evaluation. Modules are completed in the form of one or more thematically related courses. There are no additional course types beyond those specified in the bylaws. Within the program there are four specializations that are realized with elective modules.

§ 7 Feasibility of Study and Mobility

The IT:U gives all qualified students, regardless of their personal circumstances, the opportunity to complete their degree within the intended two years. As part of the "feasibility of study," the workload of the program is defined, the organization of assessments regarding dates and deadlines is made transparent, and appropriate advising and support services for students are provided.
The social dimension of feasibility focuses on enabling students to complete their studies within the standard period, irrespective of gender, age, social and ethnic background, physical and mental disabilities, religion, beliefs, sexual orientation, or other diversity characteristics. The compatibility of studies with personal caregiving responsibilities and/or personal circumstances is ensured through individually tailored support measures.

Mobility opportunities for students are available, provided they do not hinder the timely completion of the master's program. The IT:U supports students in organizing these mobility experiences.

§ 8 Examination Regulations

The successful completion of the master's program requires:

1. the successful completion of the modules prescribed in the curriculum
2. the positive evaluation of a master's thesis
3. the successful completion of the final oral examination by a committee consisting of the supervisor and two other qualified persons nominated by the president. This examination takes place before this examination committee and serves to present and defend the thesis, as well as to demonstrate knowledge and understanding of the general academic context.

§ 9 Thesis

1) A master's thesis must be completed as part of the master's program. It serves to demonstrate the ability to independently work on scientific questions.
2) The thesis must be written under the guidance of a primary supervisor. The primary supervisor must be a faculty member of the Interdisciplinary Transformation University with teaching authorization in the respective area of the thesis.
3) In addition to the primary supervisor, additional secondary supervisors may be appointed due to interdisciplinarity. They must also hold a full postdoctoral academic accreditation (habilitation or equivalent) in a field relevant to the thesis and can be from another domestic or recognized foreign university.
4) The student may request a change of supervisor from the president. In the event of the primary supervisor's absence, a substitute supervisor will be assigned.
5) The thesis project must comply with the ethical and scientific guidelines of the Interdisciplinary Transformation University.
6) The thesis topic must be appropriate to the study program and feasible to complete within six months.

§ 10 Academic Degree and Graduation

Graduates of the master's program in Interdisciplinary Computing will be awarded the academic degree "Master of Science" – abbreviated "MSc".

§ 11 Effective Date

This curriculum comes into effect on 01.10.2025.

§ 12 Transitional Provisions

No transitional provisions are provided.

§ 13 Appendix 1 – Module Descriptions

Semester 1	Learn Lab Module 1	Project Based Learning; Foundations and Methods 1; Digital Technologies 1; Learn Lab Project 1; Foundations and Methods 2; Digital Technologies 2; Learn Lab Project 2
Semester 2	Learn Lab Module 2	Digital Technologies 3; Learn Lab Project 3
Semester 2	Pre-specialization Module	Pre-Specialization Elective A; Pre-Specialization Elective B; Pre-specialization Project; Elective A; Elective B
Semester 3	Research Proficiency Module	Research Proficiency
Semester 3	Specialization Module	Specialization Elective A; Specialization Elective B; Interdisciplinary Seminar; Specialization Project
Semester 4	Master's Thesis Module	Master's Thesis

Module	Course	Course type	ECTS
Learn Lab 1 Module			
	Project Based Learning	PIC	2
	Foundations and Methods 1	PIC	3
	Foundations and Methods 2	PIC	5
	Digital Technologies 1	PIC	4
	Digital Technologies 2	PIC	4
	Learn Lab Project 1	PRJ	6
	Learn Lab Project 2	PRJ	6
			30
Learn Lab 2 Module			
	Digital Technologies 3	PIC	4
	Learn Lab Project 3	PRJ	6
			10
Pre-Specialization Module			
	Pre-Specialization Elective A	PIC	3
	Pre-Specialization Elective B	PIC	3
	Pre-Specialization Project	PRJ	8
	Elective A	ILS	3
	Elective B	ILS	3
			20
Research Proficiency Module			
	Research Proficiency	SEM	10
			10
Specialization Module			
	Specialization Elective A	PIC	3
	Specialization Elective B	PIC	3
	Interdisciplinary Seminar	SEM	4
	Specialization Project	PRJ	10
			20
Master Thesis Module			
	30 ECTS/Term	SEM	**30**
			120

Pre-Specialization Elective A			
Designing Interactions path	Ethnographic Methods for Understanding Humans	PIC	3
Digital Earth, Society, and Networks path	Spatial Data Science	PIC	3
Digital Humanities, Health, and Life Sciences path	Digital Humanities, Health, and Life Sciences Pre Spec Elective A	PIC	3
Future Industries Path	Software Engineering for Industry Applications	PIC	3
Pre-Specialization Elective B			
Designing Interactions path	Modeling Human Behavior	PIC	3
Digital Earth, Society, and Networks path	Introduction to Network Science	PIC	3
Digital Humanities, Health, and Life Sciences path	Digital Humanities, Health, and Life Sciences Pre Spec Elective B	PIC	3
Future Industries Path	Hardware Prototyping	PIC	3
Specialization Elective A			
Designing Interactions path	Design Theory & Methods	PIC	3
Digital Earth, Society, and Networks path	Semantic Analysis and NLP	PIC	3
Digital Humanities, Health, and Life Sciences path	NLP (Advanced ML)	PIC	3
Future Industries Path	Advanced Engineering	PIC	3
Specialization Elective B			
Designing Interactions path	Evaluating Interactive Technology	PIC	3
Digital Earth, Society, and Networks path	Multimodal Information Extraction	PIC	3
Digital Humanities, Health, and Life Sciences path	XAI and Ethics	PIC	3
Future Industries Path	Advanced robotics	PIC	3
Elective A and B			
Critical Thinking & Philosophy of Technology		ILS	3
Human-in-the-Loop Simulation		ILS	3
Computational Rationality		ILS	3
Game Theory		ILS	3
Mathematical Modeling I: Dynamical systems and chaos		ILS	3
Mathematical Modeling II: Stochastic processes		ILS	3
From Emissions to Solutions: Environmental Engineering in Practice		ILS	3
Computational methods for understanding musical events		ILS	3

Appendix 1 – Module Descriptions

Master's Program

Interdisciplinary Computing

Learn Lab Module 1	
Abbreviation	M11
Compulsory/Elective	Compulsory Module
ECTS points	30
Semester	1
Frequency	Every year
Module Exam	No
Prerequisite	None

Course **"Project Based Learning"**	
Abbreviation	PBL
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course introduces the core principles of project participation and project management. With a strong emphasis on practical experience, it prepares students to engage confidently and effectively in project-driven interdisciplinary work. By the end of the course, students will be equipped with the knowledge and practical tools needed to succeed in project-based environments; both within academic and professional settings.
Learning Outcomes	After successfully completing the course, students will be able to • Identify the core principles and benefits of project-based learning (PBL) and evaluate its effectiveness in comparison to traditional instructional approaches • Design and implement effective strategies for interdisciplinary teamwork, including collaboration, role interplay, and communication skills in diverse project contexts

	• Apply project management tools and techniques to plan, execute, monitor, and adapt projects in response to evolving goals and constraints • Evaluate potential project risks and formulate appropriate mitigation and contingency strategies to ensure successful project outcomes
Content	• Introduction to project-based learning • Interdisciplinary teamwork and collaboration • Design thinking approach • Project planning and scope management • Time management and scheduling • Project management tools and software
Previous Knowledge	None
Assessment	Continuous assessment

Course **“Foundations and Methods 1”**	
Abbreviation	FouMet1
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	1
Frequency	Every year
Description	This course offers an accessible and engaging introduction to programming methods and paradigms. A general introduction to modern programming methods and paradigms is followed by a practical discussion of structured, object-oriented, and functional programming methods applied in languages like C and Python. An intensive refresher course for students with limited previous coding experience.
Learning Outcomes	After successfully completing the course, students will be able to • Write structured programs in Python, using loops and conditionals to control execution • Manage memory in variables of various types and convert between types • Communicate with users through basic input and output techniques

	• Apply basic debugging approaches to identify and remove faults in code • Create simple object-oriented structures to organize information and functionality • Describe and configure basic build and deploy tool-chains • Organize projects in code
Content	• Fundamentals of structured programming in C • Fundamentals of object-oriented programming in Python • Fundamentals of debugging • Basic build, deploy, and versioning systems
Previous Knowledge	None
Assessment	Continuous assessment

Course “**Digital Technologies 1**”	
Abbreviation	DigTech1
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	4
Semester	1
Frequency	Every year
Description	This course offers an accessible and engaging introduction to digital technologies with a focus on designing and building digital technological artifacts. Students will learn a variety of generic digital design and production methods, which can be applied to address interdisciplinary challenges.
Learning Outcomes	After successfully completing the course, students will be able to • Design digital artifacts combining mechanical and electronic functions • Produce prototypes of digital artifacts using digital production methods • Connect digital artifacts with other machines and transfer data

Content	• Foundations of digital artifact design • Design thinking methodology for artifact design • Selected mechanical prototyping technologies • Selected electronics prototyping technologies • Selected assembling strategies for small scale prototypes • Selected topics in real-time programming
Previous Knowledge	High school level mathematics and physics
Assessment	Continuous assessment

Course **"Learn Lab Project 1"**	
Abbreviation	LeaLabPro1
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	6
Semester	1
Frequency	Every year
Description	The course emphasizes the practical application of theoretical knowledge by encouraging students to find solutions and execute the project from conception to completion. By collaborating on an interdisciplinary project, students will gain experience in project management, research, and communication.
Learning Outcomes	After successfully completing the course, students will be able to • Apply theoretical knowledge gained in their course work to develop practical solutions to real-world problems • Complete a project from the IT:U Learning Projects Catalogue that involves identifying and formulating a real-world problem, designing a solution, and implementing a prototype • Demonstrate the ability to work effectively as part of a team, including distributing tasks, communicating ideas, and managing conflicts

	• Plan, organize, and manage a project
Content	• Formulating the problem and designing solutions • Design thinking principles: empathy, definition, ideation, prototyping, and testing • Project planning and management • Prototyping and implementation • Team dynamics and communication • Project presentation and evaluation • Project reflection
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Foundations and Methods 2"**	
Abbreviation	FouMet2
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course offers two major components: an introduction to the mathematical and statistical methods required to apply data science and, in particular, neuronal network based machine learning approaches to problems and an introduction to human computer interaction, including cognitive, psychological and philosophical aspects, and interaction design.
Learning Outcomes	After successfully completing the course, students will be able to Part 1: Data Analytics • Identify the key elements of the data analytics and machine learning lifecycle • Apply basic statistical tools and methods for analyzing data • Propose analytical methods for specific data domains • Explain the mathematical foundations of deep neu-ronal networks

	• Implement the standard training and evaluation pipelines used for modern machine learning models • Apply different evaluation and comparison metrics Part 2: Human-Computer Interaction (HCI) • Design HCI experiments • Explain ethical and legal considerations • Evaluate experimental results • Describe at least two different methodological approaches beyond the scientific experimental one
Content	• HCI fundamentals • Experiment design • Ethical considerations • Legal considerations • Selected methods
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Digital Technologies 2"**	
Abbreviation	DigTech2
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	4
Semester	1
Frequency	Every year
Description	This course offers an accessible and engaging introduction to digital technologies with a focus on designing, building, and interacting with virtual digital worlds. Students learn a variety of generic design and production methods for mixed realities including vision, sound, motion, and other modalities, which can be applied to address interdisciplinary challenges.
Learning Outcomes	After successfully completing the course, students will be able to • Design mixed reality worlds and user interactions with

	them • Produce prototypes of mixed reality world scenarios • Connect mixed reality prototypes with each other and with real world data
Content	• Foundations of mixed reality design • Design thinking methodology for mixed reality design • Selected design tools for audio, visual, motion, and other modalities • Selected digitalization tools for audio, visual, motion, and other modalities • Selected topics in programming for mixed reality scenarios • Selected technologies for immersing users in mixed reality scenarios
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Learn Lab Project 2"**	
Abbreviation	LeaLabPro2
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	6
Semester	1
Frequency	Every year
Description	The course emphasizes the practical application of theoretical knowledge by encouraging students to find solutions and execute the project from conception to completion. By collaborating on an interdisciplinary project, students will gain experience in project management, research, and communication.
Learning Outcomes	After successfully completing the course, students will be able to • Apply theoretical knowledge gained in their course work to develop practical solutions to real-world

	problems • Complete a project from the IT:U Learning Projects Catalogue that involves identifying and formulating a real-world problem, designing a solution and implementing a prototype • Demonstrate the ability to work effectively as part of a team, including distributing tasks, communicating ideas, and managing conflicts • Plan, organize, and manage a project
Content	• Formulating the problem and designing solutions • Design thinking principles: empathy, definition, ideation, prototyping, and testing • Project planning and management • Prototyping and implementation • Team dynamics and communication • Project presentation and evaluation • Project reflection
Previous Knowledge	None
Assessment	Continuous assessment

Learn Lab Module 2	
Abbreviation	M21
Compulsory/Elective	Compulsory Module
ECTS points	10
Semester	2
Frequency	Every year
Module Exam	No
Prerequisite	None

Course **"Digital Technologies 3"**	
Abbreviation	DigTech3
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	4
Semester	1
Frequency	Every year
Description	This course offers an accessible and engaging introduction to digital technologies with a focus on collecting and analyzing existing data and/or designing and conducting experiments to generate new data under controlled conditions. Students learn methodologies for planning and conducting experiments, for preparing and analyzing data, and for visualizing and communicating findings.
Learning Outcomes	After successfully completing the course, students will be able to • Design and implement a data lifecycle to collect, analyze and utilize existing data • Design and conduct a scientific experiment to collect data about phenomena under controlled conditions • Identify ethical challenges in the context of collecting

	data and conducting experiments with humans
Content	• Practical data analytics and experiment design • Design thinking methodology for data driven approaches to problem solving • Selected technologies and tools for experiment design • Application specific data collection technologies • Selected technologies and tools for data analytics
Previous Knowledge	High school level mathematics and physics
Assessment	Continuous assessment

Course **"Learn Lab Project 3"**	
Abbreviation	LeaLabPro3
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	6
Semester	1
Frequency	Every year
Description	The course emphasizes the practical application of theoretical knowledge by encouraging students to find solutions and execute the project from conception to completion. By collaborating on an interdisciplinary project, students will gain experience in project management, research, and communication.
Learning Outcomes	After successfully completing the course, students will be able to • Apply theoretical knowledge gained in their course work to develop practical solutions to real-world problems • Complete a project from the IT:U Learning Projects Catalogue that involves identifying and formulating a real-world problem, designing a solution and implementing a prototype • Demonstrate the ability to work effectively as part of a team, including distributing tasks, communicating

	ideas, and managing conflicts • Plan, organize, and manage a project
Content	• Formulating the problem and designing solutions • Design thinking principles: empathy, definition, ideation, prototyping, and testing • Project planning and management • Prototyping and implementation • Team dynamics and communication • Project presentation and evaluation • Project reflection
Previous Knowledge	None
Assessment	Continuous assessment

Pre-Specialization Module	
Abbreviation	M22
Compulsory/Elective	Compulsory Module
ECTS points	20
Semester	2
Frequency	Every year
Module Exam	No
Prerequisite	Completion of: • Project Based Learning course • Foundations and Methods (FM1), FM2 course • 2 completed LearnLab projects (within LearnLab Module 1 or 2 with associated Digital Technologies Courses)

Pre-Specialization "Designing Interactions – Understanding Humans"

Course **"Ethnographic Methods for Understanding Humans"**	
Abbreviation	EMUH
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This course offers an introduction to ethnographic methods for the purpose of designing digital technology. This includes classical methods such as interviews, observations, and focus groups, but also covers more specific techniques such as online user research, experience sampling, and other qualitative and quantitative methods for researching humans in social contexts. The course introduces analytical approaches (e.g. Grounded Theory, Thematic Analysis) and techniques to translate ethnographic insights for design.

Learning Outcomes	After successfully completing the course, students will be able to • Plan and conduct ethnographic interviews and observations • Explain the strengths and limitations of a wide range of ethnographic methods for designing interactive technology • Analyze ethnographic data and translate it for design processes
Content	• Ethnographic methods for user research • Analysis of qualitative and quantitative data • Techniques for translation into design processes
Previous Knowledge	None
Assessment	Continuous assessment

Course "**Modeling Human Behavior**"	
Abbreviation	MHB
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This course offers an introduction to modeling human behavior using mathematical and computational methods. This includes approaches like computational rationality, game theory, individual-based simulations, task analysis, and other data-driven methods.
Learning Outcomes	After successfully completing the course, students will be able to • Explain different approaches to how human behavior can be formally modeled • Explain the benefits and limitations of these approaches • Create models for simple scenarios • Apply this knowledge to design studies to verify models and their assumptions and validate specific designs against the model

Content	• Introduction to human behavior modeling • Introduction to Game Theory • Task analysis and rule-based behavior models (GOMS, KLM, ACT-R) • Data-driven modelling • Introduction to computational rationality
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Humans in Context Project"**	
Abbreviation	HumConPrj
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	8
Semester	2
Frequency	Every year
Description	In this project, students apply a range of different methods to better understand human behavior in specific social contexts. Interdisciplinary teams of students will work in the field, i.e. in real-world social contexts or experimental setups, and apply a wide range of methods to answer a given research question from this context. They will analyze the data collected through these methods and develop insights either for designing interactive technology (e.g. through task models or ethnographic reports) or for creating computational models of human behavior.
Learning Outcomes	After successfully completing the course, students will be able to • Apply the theoretical knowledge of ethnographic methods into practice • Apply a range of these methods in a specific social context, addressing a specific research question • Plan, coordinate, and execute field work as a team • Gain unique insights for a particular social context • Present these insights for a particular target audience

Content	• Organizational aspects of field work • Conducting field research in real world settings • Analysis of quantitative and qualitative data • Translation of insights for design and human behavior modeling
Previous Knowledge	None
Assessment	Continuous assessment

Pre-Specialization "Digital Earth, Society, and Networks – Digital Earth Systems"

Course **"Spatial Data Science"**	
Abbreviation	SDS
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	Students learn how to handle geospatial data, including spatial data formats, analysis methods, and map visualization. These topics are elaborated in the course of real-world examples in order to illustrate their practical relevance.
Learning Outcomes	After successfully completing the course, students will be able to • Explain spatial data structures, standards, spatial association and autocorrelation • Apply exploratory spatial data analysis (ESDA) and spatial statistical analysis • Explain map design: How to build appropriate and beautiful maps • Critically evaluate the interdisciplinary nature of geospatial analysis and visualization

Content	• How spatial is special: spatial association and autocorrelation • Basic spatial analysis methods and spatial statistics • Spatial data integration, service-based data access, spatial data types • Map design: How to build correct and beautiful maps (map design principles, visual perception) • Real-world research examples: spatial analysis of human-generated data (geo-social media posts, physiological sensor data, etc.) • Discussion: the interdisciplinary, cross-cutting nature to geospatial analysis and visualization
Previous Knowledge	None
Assessment	Continuous assessment

Course “**Introduction to Network Science**”	
Abbreviation	INS
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This course provides a self-contained introduction to the interdisciplinary field of network science, which explores the structure, dynamics, and function of complex networks found in nature, society, technology, and information systems. Students learn the foundational principles of graph theory, network modeling, and the analysis of real-world networks such as social networks, biological networks, and communication systems.
Learning Outcomes	After successfully completing the course, students will be able to • Demonstrate a quantitative intuition about networks and ability to reason about network phenomena • Explain network representations • Summarize the principles and methods for describing

	network data • Conduct and interpret numerical network experiments • Analyze and model real-world network data
Content	• Mathematical models of network structure • Network formation mechanisms • Descriptive network analysis • Mixing patterns and community structure • Dynamical processes on networks • Spreading dynamics and percolation • Diffusion models • Opinion formation and cascades • Networks in the real world • Classes of empirical networks • Network data sources, acquisition, and error assessment • Network inference
Previous Knowledge	Basic knowledge of probability, statistics, linear algebra, and programming in Python
Assessment	Continuous assessment

Course **"Geo-social Network Analysis Project"**	
Abbreviation	GeoNetAnaPrj
Compulsory/Elective	Compulsory Course
Course type	Project
ECTS points	8
Semester	2
Frequency	Every year
Description	Students gain an overview of the value of social network data for analyzing societal processes. This involves dealing with various modalities in the data including geospatial positions, temporal patterns, semantic content, or network structures. Students are provided with a real-world dataset and are able to work on a societal topic of their choice.

Learning Outcomes	After successfully completing the course, students will be able to • Understand the value of social media content for analyzing societal processes. • Deal with analysis methods for several modalities (geospatial, temporal, semantic, network) • Critically evaluate the pros and cons of social media data analytics. • Interpret the insights gained in the project in the context of real-world use cases.
Content	• Semantic analysis of social media text • Basic analysis of networks structures in social media • Spatial and spatio-temporal pattern detection in social media data
Previous Knowledge	None
Assessment	Continuous assessment

Pre-Specialization “Digital Humanities, Health, and Life Sciences”

Course **“Digital Health and Life Sciences “Digital Humanities, Health, and Life Sciences Pre-Specialization Elective A”**	
Abbreviation	DHHLPSEA
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This elective is one of two electives with regards to topics of the three domains: humanities, health , and life sciences (biology, chemistry etc.). The exact content depends on the professor holding the course. For example, if the domain

	would be neuroscience which includes both health and life sciences and some psychology, the topic would be Digital Humanities, Health, and Life-Neuroscience and would hold learning outcomes for this topic.
Learning Outcomes	After successfully completing the course, students will be able to • Demonstrate first knowledge about a certain domain like health (medicine etc.), life sciences (biology, chemistry etc.), and humanities (psychology, history, archaeology etc.)
Content	• Overview of particular domain knowledge and how it connects with technical digitalization
Previous Knowledge	Basic programming skills
Assessment	Continuous assessment

Course **"Digital Humanities, Health , and Life Sciences Pre-Specialization Elective B"**	
Abbreviation	DHHLPSEB
Compulsory/Elective	Compulsory Course – Pre-specialization
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This elective is one of two electives with regards to topics of the three domains: humanities, health, and life sciences. The exact content depends on the professor holding the course. For example, if the domain would be neuroscience which includes both health and life sciences and some psychology, the topic would be Digital Humanities, Health, and Life-Neuroscience and would hold learning outcomes for this topic.

Learning Outcomes	After successfully completing the course, students will be able to • Demonstrate first knowledge about a certain domain like health (medicine etc.), life (biology, chemistry etc.), and humanities (psychology, history, archaeology etc.)
Content	• Overview of particular domain knowledge and how it connects with technical digitalization
Previous Knowledge	Basic programming skills
Assessment	Continuous assessment

Course **"Digital Humanities, Health, and Life Sciences Pre-Specialization Project"**	
Abbreviation	DigHumHeaLifSciPrePrj
Compulsory/Elective	Compulsory Course – Pre-specialization
Course type	PRJ
ECTS points	8
Semester	2
Frequency	Every year
Description	This introductory pre-project offers a foundational orientation to the interdisciplinary landscape of the specialization *Digital Humanities, Health and Life Sciences*. It is designed for students from diverse academic backgrounds who are entering a program that bridges humanities, life sciences, digital technologies, and ethical reflection. The project focuses on fostering a shared vocabulary, outlining the core themes of the curriculum, and guiding students toward self-directed research pathways within the scope of the program. Students are introduced to key domains in digital humanities and their relevance to societal challenges, including health, mental well-being, technology ethics, and cultural knowledge systems. They engage with selected readings, interdisciplinary dialogues, and reflective writing tasks, culminating in a short concept paper. The goal is to stimulate intellectual curiosity, build interdisciplinary sensitivity, and support students in aligning their personal interests with the

	wider aims of the master's program.
Learning Outcomes	After successfully completing the course, students will be able to • Describe the key research areas and methodological orientations in digital humanities with a focus on health and life sciences • Reflect critically on the societal and ethical dimensions of digital technologies in interdisciplinary contexts • Identify and articulate a preliminary research interest or thematic focus aligned with the master's program • Discuss in constructive dialogue with peers from other disciplines and communicate their ideas clearly and concisely
Content	• Introduction to digital humanities and key program themes • Interdisciplinary project case studies • Core ethical principles in technology and society • Reflective writing and critical dialogue • Concept paper on personal research focus • Peer feedback and discussion
Previous Knowledge	None
Assessment	Continuous assessment

Pre-Specialization “Future Industries – Foundations of Future Industry”

Course “**Software Engineering for Industrial Applications**”	
Abbreviation	SEIA
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This course offers an introduction to software-based concepts used in industrial applications. It covers a range of topics, such as basics of robot programming using ROS, Internet-of-Things (Sensors, Actuators, and Communication via MQTT), and/or mixed reality applications in 3D simulation engines. In addition, the course provides a short theoretical background of software development processes and requirements engineering, i.e., agile development, V-model or waterfall model, software testing, verification frameworks, and quality assurance.

Learning Outcomes	After successfully completing the course, students will be able to
	• Apply theoretical knowledge of ethnographic methods into practice
	• Select an appropriate development life-cycle model for a given industrial scenario
	• Select functional and non-functional requirements in a structured format
	• Develop and demonstrate prototypical solutions in either a
	  ○ ROS-based robot node
	  ○ MQTT IoT device using sensors/actuators
	  ○ A 3D-Mixed Reality Scene
	• Plan and execute basic verification tests to validate whether the solutions meet the before-defined requirements

Content	• Overview of software processes
	• Requirements engineering basics
	• Quality assurance, testing, and verification
	• Basic principles of either
	  ○ Robot operating system
	  ○ IoT, sensors, actuators, communication
	• Mixed Reality Programming

Previous Knowledge	Basic programming (python, C++, or C#) Linear algebra
Assessment	Continuous assessment

Course **"Hardware Prototyping"**	
Abbreviation	HarPro
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	2
Frequency	Every year
Description	This course introduces basic knowledge for prototyping industrial hardware applications using microcontrollers, sensors, and actuators in a Makerspace learning lab. Students design elementary circuits, develop embedded firmware using the microcontroller environment, integrate sensors and actuators, and communicate to other systems via MQTT.
Learning Outcomes	After successfully completing the course, students will be able to • Select a suitable microcontroller board, sensors, and actuators for a given industrial challenge • Design and apply these designs on the microcontroller • Develop and deploy firmware that broadcasts obtained sensor data via MQTT and receives requests for actuation • Plan and execute simple tests to demonstrate that the prototype meets specified requirements

Content	• Basics of embedded systems • Microcontroller toolchain, libraries, and environment • Digital in- and output • Timers and interrupts • Basics of sensing and actuating • MQTT data exchange • Maker space fabrication practices
Previous Knowledge	Basic programming (python, C++, or C#) Basics of electronics
Assessment	Continuous assessment

Course **"Industry in Context Project"**	
Abbreviation	IndConPrj
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	8
Semester	2
Frequency	Every year
Description	In this project, students are introduced to a specific industry context and are guided in understanding, shaping, and solving the problem to achieve a prototypical solution (for example, integrating sensors into an assembly line, human-robot interaction, robot programming, etc.). This includes stakeholder management, learning about innovation landscapes in the industry, business constraints, and responsible innovation. The project itself comprises technical innovation in an industry-related field, such as robotics, internet-of-things, supply chain management, or human-in-the-loop simulation for operator training and research.
Learning Outcomes	After successfully completing the course, students will be able to • Apply the theoretical knowledge of ethnographic methods into practice • Apply a range of these methods in a specific social context, addressing a specific research question • Plan, coordinate, and execute field work as a team • Create unique insights for a particular social context

	• Present these insights to a particular target audience
Content	• Prototyping project for industry • Stakeholder management • Process and team management
Previous Knowledge	None
Assessment	Continuous assessment

Pre-Specialization "Elective A and B" Catalogue

Course **"Critical Thinking & Philosophy of Technology"**	
Abbreviation	CTPT
Compulsory/Elective	Elective
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	This seminar offers an overview of central positions in the critical philosophy of technology with a special focus on digital technologies. The seminar asks how technologies shape our politics, societies, and specific ideas of the human and how different understandings of technology can open up alternative and more inclusive perspectives. In addition to the critical analysis of existing technologies, speculative approaches are discussed in order to explore alternatives and the possibilities of change in technologies. Finally, the theories and approaches discussed are applied to the technologies with which the students themselves work.

Learning Outcomes	After successfully completing the course, students will be able to • Identify and explain central positions of critical philosophy of technology • Assess the political, ethical, ecological and societal aspects of specific technologies • Discuss gender, race, class, disability, and other aspects of discrimination in respect to technologies • Differentiate philosophical methods and their application • Apply practical approaches to technologies with a theoretical discussion and understanding
Content	• Introduction to central approaches in the philosophy of technology • Challenge dominant narratives on digital technologies and explore alternative and critical-speculative narratives • Focus on exclusions and discriminations in digital technologies • Combining theoretical and practical forms of analysis • Application of theory to the own technical practice
Previous Knowledge	None
Assessment	Continuous assessment

Course "**Human-in-the-Loop Simulation**"	
Abbreviation	HLS
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	This course teaches the basics of human-in-the-loop (HiL) and simulation development, including 3D simulation, fidelity dimensions, motion sickness, and immersion/presence, as well as the evaluation of such systems in various context like industry, flight operation, or driving.

Learning Outcomes	After successfully completing the course, students will be able to • Define requirements for a HiL system • Design a simulation according to HiL-fidelity dimensions • Implement a simulation in a 3D simulation engine • Evaluate the simulator according to relevant psychological constructs such as simulator sickness or presence/immersion
Content	• Simulator and HiL history for human factors engineering • Simulation fidelity dimensions • 3D game and simulation engines • HiL evaluation methods
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Computational Rationality"**	
Abbreviation	ComRat
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	This course teaches the basics of computational rationality (CR). Students learn about cognitive and physical constraint modelling in reinforcement learning environments, external/internal environments, hierarchical reinforcement learning models, and evaluation based on human data.
Learning Outcomes	After successfully completing the course, students will be able to • Explain the principles of computational rationality • Explain theory and practice of human constraint modelling in both cognitive and physical (motor) dimensions

	• Define and implement a partially observable Markov decision process over a traditional Markov decision process via an internal environment and probabilistic updates • Train and evaluate the system in comparison with data gathered by human subjects
Content	• Basics of human modelling • Partially observable Markov decision processes • Bayes rule and Bayesian updates • CR architectures for cognitive and biomechanical models • Training and evaluation of CR models
Previous Knowledge	None
Assessment	Continuous assessment

Course **“Game Theory”**	
Abbreviation	GamThe
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	Game theory is a scientific field that aims to make sense of strategic decision-making. The field has broad applications in a variety of social contexts, such as in bargaining, negotiations, collaborations, and competitive relationships. In this course, students learn how to translate real-world social interactions into formal game theory models. In a follow-up step, students are then exposed to different techniques of how to analyze these games: by identifying the game’s equilibria, by running individual-based simulations, or by employing controlled lab experiments with human participants.

Learning Outcomes	After successfully completing the course, students will be able to • Describe how to understand social interactions through the lens of game theory. This requires identifying the relevant players, their possible actions, the information they have, and their incentives to choose different actions • Predict behavior in these different games by either computing their equilibria, or by simulating how individuals might learn how to play strategically • Assess these theoretical predictions with empirical data on human behavior in strategic/social interactions
Content	• Overview on different classes of games (simultaneous versus sequential decision-making, complete versus incomplete information) • Appropriate solution concepts (Nash equilibrium, backward induction, Bayesian Nash equilibrium) • Learning in games and evolutionary dynamics • Comparison to empirical/experimental data
Previous Knowledge	None
Assessment	Continuous assessment

Course “**Mathematical Modeling I: Dynamical Systems and Chaos**”	
Abbreviation	MM1DSC
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	Many natural processes can be mathematically described as a dynamical system (e.g., the spread of a disease in a vulnerable population, the dynamics of ecosystems, etc). The respective mathematical representation then either takes the form of differential equations (if time is taken to be continuous), or of a map (if time is discrete, e.g., measured in

	annual intervals). While exact solutions to these dynamical systems are often infeasible, their qualitative long-run dynamics can often be characterized. For example, in the long run, the process may either converge towards a stable equilibrium, it may result in oscillations, or it may give rise to chaotic dynamics altogether (where even minor changes in the system can have major implications). In this course, students learn some of the necessary concepts to study such dynamical systems analytically and numerically.
Learning Outcomes	After successfully completing the course, students will be able to • Implement simple real-world processes into a dynamical system • Describe the various qualitative behaviors that dynamical systems can give rise to • Describe the properties of chaotic systems
Content	• A formal account of dynamical systems • Classification of 2-dimensional systems of linear differential equations • Local stability of fixed points of arbitrary systems • Global stability and Lyapunov functions • Chaos • Bifurcation diagrams
Previous Knowledge	Some knowledge of elementary math courses (calculus and linear algebra) is required
Assessment	Continuous assessment

Course “**Mathematical Modeling II: Stochastic Processes**”	
Abbreviation	MM2SP
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	A proper mathematical description of many processes in nature and society needs to consider the impact of chance events (e.g. the arrival of mutations, an online post becoming

	viral, etc.). The dynamics of such systems are best described as a stochastic process. This course presents some basic concepts to analyze such processes. In particular, the course provides an elementary introduction into the theory of Markov chains, random walks, branching processes, and diffusion processes.
Learning Outcomes	After successfully completing the course, students will be able to • Mathematically describe real phenomena as a sto-chastic process • Assess some key quantities for the relevant system (e.g. absorption probabilities, expected waiting times, invariant distributions, etc.) • Implement simulations of the respective system and compare outcomes to analytical predictions
Content	• Key concepts in probability theory • Markov chains and their long-run behavior • Random walks • Branching processes • Diffusion processes • Master equation
Previous Knowledge	Some knowledge of elementary math courses (calculus and linear algebra) is required
Assessment	Continuous assessment

Course **“From Emissions to Solutions: Environmental Engineering in Practice”**	
Abbreviation	FESEEP
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	This elective course explores how industrial processes and technological activities interact with the environment through the lens of pollution control, process design, and sustainable innovation. Emphasizing both environmental and chemical engineering approaches, the course examines the sources, effects, and

	reduction of pollutants. Students explore the design and optimization of process systems aimed at minimizing environmental impact, while also considering regulatory frameworks and real-world implementation. In addition to established methods, the course incorporates emerging technologies to demonstrate how innovation can support more responsive and sustainable solutions. Through the application of theoretical concepts to case study, students gain a deeper understanding of industrial challenges and approaches. Students gain tools to critically engage with real-world challenges and shape impactful Ideas that support healthier environments and communities by bridging technical knowledge with social responsibility.
Learning Outcomes	After successfully completing the course, students will be able to • Explain key principles of pollution control and process optimization in industrial and urban contexts • Identify major sources and effects of air and water pollutants, and interpret related regulations • Apply approaches to evaluate and improve pollution mitigation systems • Apply system thinking and life cycle approaches to assess environmental performance. • Reflect on the social and ethical dimensions of pollution control in relation to public health and sustainability
Content	• Pollution sources, effects, and regulations • Emerging tools for sustainable impact • Process design and optimization • Approaches to environmental performance
Previous Knowledge	None
Assessment	Continuous assessment

Course **“Computational Methods for Understanding Musical Events”**	
Abbreviation	CMUME
Compulsory/Elective	Elective Course
Course type	ILS
ECTS points	3
Semester	3
Frequency	Every year
Description	Humans routinely participate in musical events across a wide range of social and cultural contexts. Such complexity of musical events can only be fully understood when studied from an interdisciplinarity approach and computational methods offer exceptional opportunities for this study. In this course, students explore the multidimensional nature of musical events and gain hands-on experience with state-of-the-art technologies for their interdisciplinary analysis.
Learning Outcomes	After successfully completing the course, students will be able to • Describe and use basic music theory terminology • Describe the multidimensional nature of musical events and break them down into their different components • Identify different types of digital traces from musical events and existing tools for their analysis • Apply existing algorithms and libraries for processing and analyzing data related to musical events • Work in interdisciplinary teams on the design and implementation of research tasks aimed at understanding specific dimensions of musical events • Generate digital data and small datasets from musical events in IT:U’s LearnLabs • Evaluate and present results from computational analyses of musical events from a musicological perspective
Content	• The multidimensional nature of musical events • Introduction to musicology and ethnomusicology: basic music theory • Existing datasets and computational tools for the analysis of musical events

	• Ethical principles when working with music related data • Design, implement, evaluate, and present a research project
Previous Knowledge	Basic programming skills, preferably in Python
Assessment	Continuous assessment

Research Proficiency Module	
Abbreviation	M31
Compulsory/Elective	Compulsory Module
ECTS points	10
Semester	3
Frequency	Every year
Module Exam	No
Prerequisite	Completion of Pre-Specialization module

Course **"Research Proficiency"**	
Abbreviation	ResPro
Compulsory/Elective	Compulsory Course
Course type	SEM
ECTS points	10
Semester	3
Frequency	Every year
Description	This course prepares students for independent academic research by building foundational competencies in scientific reasoning, research ethics, and scholarly communication. Students engage with core concepts from the philosophy and history of science, develop AI literacy, and explore technology assessment frameworks. Through reading, discussing, and writing about scientific literature, they sharpen their critical thinking, media literacy, and academic writing skills. The course also emphasizes responsible innovation, research integrity, and effective science communication. By the end of

	the course, students are able to design a coherent, methodologically sound master's thesis proposal and reflect on their research competencies.
Learning Outcomes	After successfully completing the course, students will be able to • Apply principles of critical thinking to assess scientific arguments, identify assumptions, and evaluate evidence • Demonstrate foundational AI literacy, including understanding the limitations, ethical challenges, and implications of AI tools and models • Describe the principles of research integrity and ethics and apply them to subject-specific problems • Conduct critical assessments of technologies, considering their societal, environmental, and ethical implications through the lens of technology assessment methodologies and responsible innovation • Critically read, interpret, and synthesize scientific literature, engaging in structured academic discussions and peer feedback • Produce clear, well-structured academic writing, conforming to disciplinary standards of scientific communication and academic integrity • Effectively communicate complex ideas, both orally and in writing, to academic and non-specialist audiences, demonstrating proficiency in presentation skills and science communication • Design and write a coherent, feasible, and methodologically sound master's thesis proposal • Reflect on personal research competencies and scholarly development in preparation for the master's thesis
Content	• Philosophy of science and critical thinking • Media literacy and science literacy • AI literacy • Research ethics and research integrity • History of science and technology • Technology assessment • Presentation skills and science communication • Reading scientific papers and texts (mini journal club) • Scientific writing
Previous Knowledge	None
Assessment	Continuous assessment

Specialization Module	
Abbreviation	M32
Compulsory/Elective	Compulsory Module
ECTS points	20
Semester	3
Frequency	Every year
Module Exam	No
Prerequisite	Completion of Learn Lab Module 1 and 2; Pre-specialization electives (PICs) A+B and the Pre-specialization project.

Specialization “Designing Interactions – Interaction Design Studio”

Course **“Design Theory & Methods”**	
Abbreviation	DTM
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course offers an introduction to design processes for creating interactive computational artifacts in complex social contexts. It covers theoretical foundations of design and an overview of different design approaches (e.g. transformational, participatory, critical, speculative). Classical elements of design processes (e.g. design brief, iterative prototyping, design critique) are covered as well as specific techniques such as brainstorming, material explorations, or design fiction. Students also learn different approaches to evaluate designed artifacts in context.

Learning Outcomes	After successfully completing the course, students will be able to • Explain the unique qualities of design in comparison to engineering approaches • Explain the different flavors of design and their intent • Describe various elements of design processes • Apply a rich toolbox of methods for design that enable them to effectively implement design processes • Evaluate their designs in studies
Content	• Design theory • Design methods • Evaluation in complex social contexts
Previous Knowledge	None
Assessment	Continuous assessment

Course “**Human Factors & Psychology of Interaction**”	
Abbreviation	HFPI
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course focuses on the psychological and ergonomical aspects of humans interacting with digital technology. The Human-Centered Design (HCD) process is covered alongside theories and methods that inform the creation and evaluation of interactive artefacts using standardized measures such as user experience, technology acceptance, or trust in AI.
Learning Outcomes	After successfully completing the course, students will be able to • Create interactive artifacts in accordance with the HCD process • Apply evaluation methods for studying interactive arti-facts

	• Select evaluation objectives from a range of psychological constructs and standardized measures • Plan and implement evaluation studies along these measures • Evaluate and interpret the results in relation to the initial hypotheses
Content	• Human-Centered Design • Psychological constructs, dimensions, and measurements of interaction with technology • Study design and evaluation • Evaluation of interpretation of statistical results • Logistics and ethics for evaluation studies
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Designing Interactions Project"**	
Abbreviation	DesIntPrj
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	10
Semester	3
Frequency	Every year
Description	In this project, interdisciplinary teams implement a full cycle of designing interactive technology. Given a specific context and design brief as a starting point, the teams conduct field research to understand needs and opportunities before entering an iterative design process. The teams develop a series of low-fi and high(er)-fi prototypes and at the end conduct a preliminary evaluation study in the context. The results are compiled as a detailed report.
Learning Outcomes	After successfully completing the course, students will be able to • Explain the unique qualities of design in comparison to engineering approaches • Apply their theoretical knowledge of ethnographic research, human modelling, human factors and the

	psychology of interaction in a real-world design project • Design interactions with technology for particular social contexts and human needs • Evaluate their design
Content	• Real-world design project
Previous Knowledge	Pre-specialization module “Humans in Context”
Assessment	Continuous assessment, weekly design critiques

Specialization “Digital Earth, Society, and Networks”

Course **“Multimodal Machine Learning”**	
Abbreviation	MML
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course introduces the principles and techniques behind machine learning systems that process and integrate multiple data modalities. The course covers both techniques for feature engineering and approaches to multimodal machine learning models.
Learning Outcomes	After successfully completing the course, students will be able to • Describe the challenges of multimodal machine learning • Create a meaningful feature engineering process • Design and implement multimodal machine learning models/algorithms

Content	• Discuss examples and representations of modalities: text, images, time series, network, geospatial, audio, etc. • Feature engineering for multimodal analysis • Multitask learning and inductive knowledge transfers • Multimodal learning: key concepts and challenges • Self-supervised learning basics and application to multimodality, e.g., CLIP • Model stitching and cross-modal alignment, e.g. alignment techniques, latent space mapping • Theory: alignment conjectures
Previous Knowledge	Machine learning basics
Assessment	Continuous assessment

Course "**Semantic Analysis and NLP**"	
Abbreviation	SANLP
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course introduces students to the basic concepts of natural language processing (NLP), providing essential knowledge for analyzing and working with text data. It also includes a discussion of modern NLP techniques, particularly those based on transformers.
Learning Outcomes	After successfully completing the course, students will be able to • Identify and analyze tasks related to natural language understanding and generation • Select suitable evaluation metrics for evaluating solutions to a given NLP problem • Design and implement basic NLP pipelines using contemporary tools and libraries

Content	• A brief history of natural language processing • NLP fundamental concepts • Text classification, sentiment, and emotion analysis • Neural networks for NLP • N-gram language models • Transformers and large language models (LLMs) • Natural language generation (NLG) • Recent advancements and challenges of LLMs
Previous Knowledge	None
Assessment	Continuous assessment

Course "**Understanding Digital Earth Systems Project**"	
Abbreviation	UndDigEarSysPrj
Compulsory/Elective	Compulsory Course
Course type	Project
ECTS points	10
Semester	3
Frequency	Every year
Description	Students conduct an entire end-to-end project, which involves hypothesis building, data collection (crawling or sensing), data pre-processing, feature engineering, data analysis (spatial, network, semantic, emotions), and visualization (maps, graphs, etc.). Students work on a real-world challenge in areas like climate change, societal sustainability, humanitarian action, urban analysis, or fake news detection.
Learning Outcomes	After successfully completing the course, students will be able to • Formulate meaningful hypotheses for analyzing multi-modal Digital Earth data • Describe projects that involve the analysis of multiple data sources and modalities • Describe and apply methods from different fields for generating interdisciplinary insights • Critically review and evaluate the produced results against the context of real-world challenges • Effectively communicate the challenges, results and value of the project

Content	• Design, conceive, and implement a project involving multiple data sources and modalities • Explain and use multimodal machine learning methods and semantic analysis • Visualize and communicate multimodal information • Explain the value of social media content for analyzing societal processes • Synthesize analysis methods for several modalities (geospatial, temporal, semantic, network) • Critically evaluate the pros and cons of social media data analytics • Interpret the insights gained in the project in the context of real-world use cases
Previous Knowledge	Geo-social network analysis Basics of spatial data science Basics of network science
Assessment	Continuous assessment

Specialization “Digital Humanities, Health, and Life Sciences”

Course **“Advanced Machine Learning”**	
Abbreviation	AML
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course introduces students to advanced machine learning methods with an emphasis on their application to health and life sciences, and digital humanities contexts.

Learning Outcomes	After successfully completing the course, students will be able to • Explain the architecture and functioning of advanced machine learning models, including transformers • Critically assess the appropriateness of machine learning methods in humanities research contexts • Apply domain adaptation and transfer learning to interdisciplinary datasets • Design and evaluate machine learning experiments with an emphasis on interpretability and ethical practice
Content	• Introduction to deep learning with applications in humanities research • Transformer architectures and the use of large language models (LLMs) • Supervised and unsupervised learning techniques for historical and cultural datasets • Transfer learning and domain adaptation for text and image-based data • Evaluation metrics tailored to small, imbalanced, or noisy datasets • Methods and limitations of interpretable machine learning • Ethical considerations and principles of human-centered AI design • Development of project proposals and exploration of relevant datasets • Implementation and presentation of a final project applying deep learning in a humanities context
Previous Knowledge	None
Assessment	Continuous assessment

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Course **"XAI and Ethics"**	
Abbreviation	XAIE
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course explores how explainability and ethics intersect in the deployment of AI systems in sensitive areas. Through philosophical inquiry, technical training, and case-based learning, students interrogate the assumptions and consequences of opaque algorithmic systems.
Learning Outcomes	After successfully completing the course, students will be able to • Identify and apply key methods in explainable AI • Evaluate fairness, accountability, and transparency in algorithmic systems • Analyze ethical dilemmas in real-world AI deploy-ments • Recommend ethically sound, explainable alternatives to existing systems
Content	• Foundations of AI ethics and explainable artificial intelligence (XAI) • Methods of explainability, including SHAP, LIME, and counterfactual explanations • Fairness metrics and techniques for bias detection and auditing in AI systems • Application of ethical principles to real-world case studies in health, education, and justice • Overview of responsible AI frameworks, guidelines, and policy initiatives • Philosophical concepts related to AI ethics such as autonomy, justice, and harm • Participatory and human-centered approaches to ethical AI design

	• Practical group work on ethical challenges and design solutions in AI • Presentation of group projects and structured peer feedback • Final reflection on learning outcomes and submission of an individual portfolio
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Digital Humanities, Health, and Life Sciences Project"**	
Abbreviation	DigHumHeaLifPrj
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	10
Semester	3
Frequency	Every year
Description	This follow-up project builds upon the foundational work completed in the pre-specialization project and enables students to advance their ideas into a more concrete and applied research direction. It emphasizes synthesis, research planning, and early-stage implementation of individual or small-group investigations that align with the interdisciplinary focus of the program. Students deepen their engagement with their chosen thematic areas, further develop their methodological approach, and begin articulating the scope, impact, and feasibility of a research contribution within digital humanities, health, life sciences, or society. This project acts as a bridge between coursework and more formal research activities (e.g., thesis), allowing students to consolidate knowledge, practice independent inquiry, and receive targeted feedback.
Learning Outcomes	After successfully completing the course, students will be able to • Develop a focused and methodologically sound re-search plan

	• Synthesize prior coursework and disciplinary knowledge into an interdisciplinary research framework • Analyze, prototype, or test key elements of a digital humanities or health-related inquiry • Reflect critically on research design decisions and ethical implications • Integrate technologies like AI, XR and sensor readings
Content	• Research question refinement and problem framing • Identification of methods and relevant data or material • Conceptual and ethical reflection on design choices • Drafting a mini research proposal or prototype • Presentation and peer discussion of project ideas • Process and team management • Evaluation and results pitch
Previous Knowledge	None
Assessment	Continuous assessment

Specialization "Future Industries"

Course **"Advanced Industrial Engineering"**	
Abbreviation	AIE
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year
Description	This course integrates business-oriented and technical perspectives to equip students with the skills needed to plan, model, and optimize industrial systems. Topics include technology-driven project management, supply-chain and customer service strategy, manufacturing architectures,

	system modelling and simulation, production-data analytics, computer-aided engineering, and the internet-of-goods paradigm.
Learning Outcomes	After successfully completing the course, students will be able to • Plan and manage multidisciplinary, technology-centered projects, addressing scope, schedule, risk, and stakeholders • Analyze, configure, and improve supply-chain and customer service strategies • Model and simulate manufacturing systems and interpret results for decision support • Apply data-driven methods to production and logistics data • Employ computer-aided engineering tools • Assess the impact of the internet-of-goods, digital twins, and connected supply chains on industrial operations
Content	• Business project management and tools • Supply-chain management • Customer service dimensions in industrial contexts • Flexible manufacturing systems • Systems modelling and simulation • Advanced data analytics for manufacturing • Computer-aided engineering workflows
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Advanced Robotics"**	
Abbreviation	AdvRob
Compulsory/Elective	Compulsory Course
Course type	PIC
ECTS points	3
Semester	3
Frequency	Every year

Description	This course focuses on perception-driven and learning-based autonomous robotic systems. Students integrate camera, LiDAR, and IMU data using computer vision pipelines and apply machine learning techniques to task such as grasping, movement, or motion planning.
Learning Outcomes	After successfully completing the course, students will be able to • Design and configure ROS perception stacks that fuse data from different sensors • Train, optimize, and deploy machine learning models (such as reinforcement learning or deep learning) • Implement manipulation or navigation tasks • Translate results from simulated into real environ-ments • Apply system performance using robotic benchmarks and document safety and real-time capabilities
Content	• Sensor calibration, synchronization, and clocks • Computer vision for robotics • Machine learning for robotic systems • Basics of ROS 2 nodes and reinforcement learning • Simulations and digital twins • Verification, benchmarking, and safety considerations of robotics systems
Previous Knowledge	None
Assessment	Continuous assessment

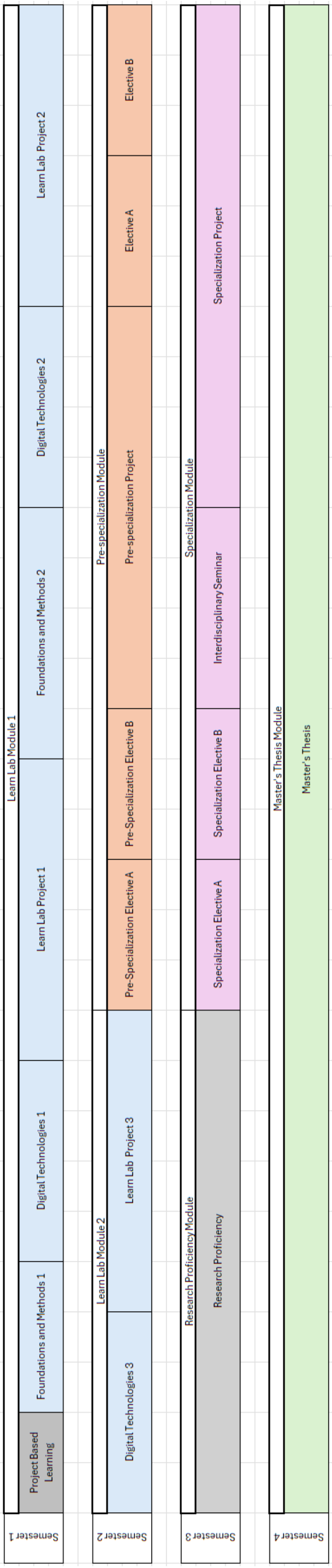
Course **“Applied Industry Project”**	
Abbreviation	ApplndPrj
Compulsory/Elective	Compulsory Course
Course type	PRJ
ECTS points	10
Semester	3
Frequency	Every year
Description	The student group solves a real challenge embedded in a particular industry context. Based on the knowledge from the pre-specialization module, the group develops an innovative solution and evaluates it within the given context. The project goes beyond the technology-centric focus of the pre-specialization module. Students evaluate existing processes and elaborate requirements, define a viable alternative solution, develop a prototype, evaluate the system, and demonstrate its capabilities.
Learning Outcomes	After successfully completing the course, students will be able to • Apply their theoretical knowledge, problem-shaping, and problem-solving skills in an industrial context • Implement business processes, customer service dimensions, and project requirements • Plan, coordinate, and execute work as a team • Create unique insights into the problem scenario • Present these insights for a specified target audience
Content	• Prototyping project for industry • Stakeholder management • Business process management • Process and team management • Evaluation and results pitch
Previous Knowledge	None
Assessment	Continuous assessment

Course **"Interdisciplinary Seminar"**	
Abbreviation	IntSem
Compulsory/Elective	Compulsory Course
Course type	SEM
ECTS points	4
Semester	3
Frequency	Every year
Description	This course aims to foster interdisciplinary collaboration within the cohort of students and enable them to effectively communicate their work to audiences with different expertise and backgrounds. The course emulates a scientific conference in which student teams across all specializations present and discuss their semester projects. Every team writes a short publication on their results which is peer-reviewed and revised. Students are responsible for organizing the conference, including the review process, programming of presentations and panels, and the creation of final proceedings.
Learning Outcomes	After successfully completing the course, students will be able to • Explain their work across disciplines • Conduct engaging presentations to an interdisciplinary audience • Provide constructive feedback to peers • Engage with feedback to refine ideas and approaches • Organize academic conferences
Content	• Academic processes and conferences • Interdisciplinary communication
Previous Knowledge	None
Assessment	Continuous assessment

Master’s Thesis Module	
Abbreviation	M41
Compulsory/Elective	Compulsory Module
ECTS points	30
Semester	4
Frequency	Every year
Module Exam	No
Prerequisite	Completion of Research Proficiency Module, Specialization Module

“Master’s Thesis”	
Abbreviation	Master’s Thesis
Compulsory/Elective	Compulsory
Course type	
ECTS points	30
Semester	4
Frequency	Every semester
Description	Students demonstrate their ability to correctly use scientific methods to solve problems. They apply their knowledge and skills to a thesis project and systematically organize their findings into a coherent report.
Learning Outcomes	After successfully completing the course, students will be able to • Formulate clear and feasible research questions • Identify, evaluate, and synthesize literature relevant to the topic • Apply appropriate research methodologies and techniques to collect and analyze data • Develop a clear and coherent structure for their thesis

	• Employ language appropriate to the scientific community • Articulate their findings in both written and oral formats
Content	• Independent planning, development, and completion of a master's thesis project • Formulation of a clear and researchable question or hypothesis • Comprehensive literature review and synthesis of relevant academic sources • Selection and application of appropriate research methodologies and tools • Data collection, analysis, and interpretation (qualitative, quantitative, or mixed methods) • Critical discussion of findings in the context of existing research • Consideration of ethical standards and principles of academic integrity • Development of a coherent thesis structure and academic writing style • Regular consultation with academic supervisor(s) • Preparation and delivery of an oral defense or presentation of the thesis
Previous Knowledge	None
Assessment	Master's thesis oral examination Evaluation of master's thesis



Module	Course	Course type	ECTS
Learn Lab 1 Module			
	Project Based Learning	PIC	2
	Foundations and Methods 1	PIC	3
	Foundations and Methods 2	PIC	5
	Digital Technologies 1	PIC	4
	Digital Technologies 2	PIC	4
	Learn Lab Project 1	PRJ	6
	Learn Lab Project 2	PRJ	6
			30
Learn Lab 2 Module			
	Digital Technologies 3	PIC	4
	Learn Lab Project 3	PRJ	6
			10
Pre-Specialization Module			
	Pre-Specialization Elective A	PIC	3
	Pre-Specialization Elective B	PIC	3
	Pre-Specialization Project	PRJ	8
	Elective A	ILS	3
	Elective B	ILS	3
			20
Research Proficiency Module			
	Research Proficiency	SEM	10
			10
Specialization Module			
	Specialization Elective A	PIC	3
	Specialization Elective B	PIC	3
	Interdisciplinary Seminar	SEM	4
	Specialization Project	PRJ	10
			20
Master Thesis Module			
	30 ECTS/Term	SEM	**30**
			120

Pre-Specialization Elective A			
Designing Interactions path	Ethnographic Methods for Understanding Humans	PIC	3
Digital Earth, Society, and Networks path	Spatial Data Science	PIC	3
Digital Humanities, Health, and Life Sciences path	Digital Humanities, Health, and Life Sciences Pre Spec Elective A	PIC	3
Future Industries Path	Software Engineering for Industry Applications	PIC	3
Pre-Specialization Elective B			
Designing Interactions path	Modeling Human Behavior	PIC	3
Digital Earth, Society, and Networks path	Introduction to Network Science	PIC	3
Digital Humanities, Health, and Life Sciences path	Digital Humanities, Health, and Life Sciences Pre Spec Elective B	PIC	3
Future Industries Path	Hardware Prototyping	PIC	3
Specialization Elective A			
Designing Interactions path	Design Theory & Methods	PIC	3
Digital Earth, Society, and Networks path	Semantic Analysis and NLP	PIC	3
Digital Humanities, Health, and Life Sciences path	NLP (Advanced ML)	PIC	3
Future Industries Path	Advanced Engineering	PIC	3
Specialization Elective B			
Designing Interactions path	Evaluating Interactive Technology	PIC	3
Digital Earth, Society, and Networks path	Multimodal Information Extraction	PIC	3
Digital Humanities, Health, and Life Sciences path	XAI and Ethics	PIC	3
Future Industries Path	Advanced robotics	PIC	3
Elective A and B			
Critical Thinking & Philosophy of Technology		ILS	3
Human-in-the-Loop Simulation		ILS	3
Computational Rationality		ILS	3
Game Theory		ILS	3
Mathematical Modeling I: Dynamical systems and chaos		ILS	3
Mathematical Modeling II: Stochastic processes		ILS	3
From Emissions to Solutions: Environmental Engineering in Practice		ILS	3
Computational methods for understanding musical events		ILS	3