Curriculum

PhD Program

Computational X

Validity:

The Founding Convention approved the following curriculum on 27.09.2024.

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§ 1   Basis and Applicability:

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

The Founding Convention enacted the following curriculum on 27.09.2024.

§ 2   Program Description and Objectives

The PhD program Computational X promotes interdisciplinary research facilitating the convergence of natural sciences like biology, social sciences and humanities with computational sciences. The program supports junior researchers in developing their abilities to perform independent scientific research.

PhD students will acquire a comprehensive range of computational skills and methods, ranging from data science to artificial intelligence to robotics, as well as a solid core of 21st century skills. This will empower students to transform their respective disciplines with computational methods and explore frontiers in the digitalization of natural sciences, social sciences and humanities. Through the interdisciplinary approach, researchers are enabled to develop, implement, and execute innovative solutions to current societal challenges. This contributes to the digital transformation of science, economy, and society.

§ 3   Qualification profile

The IT:U Doctoral School enables young researchers to conduct independent research at a high international level, thereby contributing to technological and societal progress. The students learn to identify and analyze research gaps and societal issues and to find solutions through interdisciplinary approaches. They work on developing and implementing new technologies that drive digital transformation. In addition to subject-specific knowledge, interdisciplinary key competencies are also promoted to prepare students for leadership positions in academia, industry, or the public sector.

§ 4   Duration and Scope

The planned duration of the PhD program "Computational X" is 4 years. An academic year comprises 60 ECTS credits, with one ECTS credit corresponding to 25 working hours. With 8 semesters, this sums up to 240 ECTS credits in total. The program can be extended as necessary.

§ 5   Admission to the Program

To be admitted to a PhD program at IT:U, candidates must have completed a master'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 PhD 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. Figure 1 provides an overview.
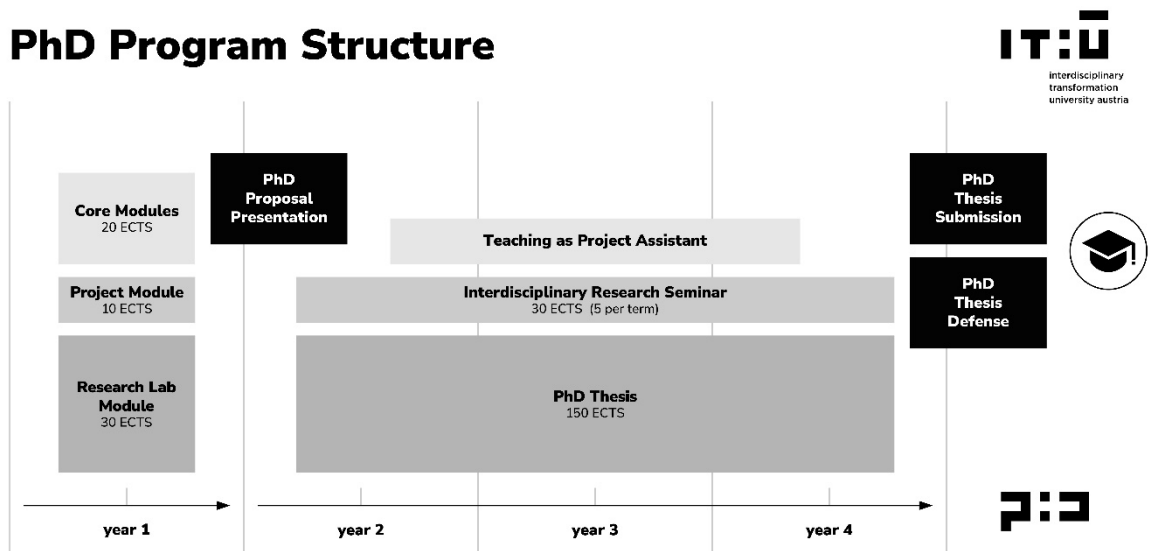

Figure 1: PhD program structure

§ 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 four years . As part of the "feasibility of study", the workload of the program is defined, the organization of exams regarding dates and deadlines is made transparent, and appropriate advising and support services for students are provided. However, support is limited by the necessity of showing independence and personal responsibility as part of the PhD.

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 starting in the second year of study, provided they do not hinder the timely completion of the PhD. The IT:U supports students in organizing these mobility experiences.

§ 8 Thesis

1) A doctoral thesis (dissertation) must be completed as part of the PhD program. It serves to demonstrate the ability to independently address scientific questions. The thesis is a written work and can be composed as a monograph or as a collection of thematically related publications (cumulative dissertation).

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 dissertation.

3) In addition to the primary supervisor, additional secondary supervisors may be appointed due to interdisciplinarity. They must also hold a habilitation (or equivalent) in a field relevant to the thesis and can be from another domestic or recognized foreign university.

4) A change of supervisor can be requested from the Founding President. In the event of the primary supervisor's absence, a substitute supervisor will be assigned.

5) The thesis topic and the supervisors must be announced by the end of the first year of program, and the PhD proposal must be presented before the program committee. The program committee decides by majority whether the proposal is accepted, and the student can continue their studies.

6) It is recommended that completed parts of the thesis project are published in international journals or conferences.

7) The thesis project must comply with the ethical guidelines of the Interdisciplinary Transformation University and, if necessary, obtain approval from the relevant ethics committee.

8) The completed thesis must be formally submitted and is evaluated by two reviewers, at least one of whom must belong to an external university or research institution. Supervisors cannot act as reviewers for dissertations they have supervised. If the dissertation is positively evaluated by both reviewers, registration for the final oral examination (Rigorosum) can proceed.

§ 9 PhD Thesis Defense (Rigorosum)

1) PhD Thesis Defense is the final comprehensive examination of the PhD program and serves to confirm the candidate's ability to conduct independent research and defend their thesis.
2) A public defense of the thesis is followed by an oral examination conducted by a thesis committee. The defense includes a presentation of the thesis and a question-and-answer session, where the candidate explains and defends their research to the thesis committee.
3) The Defense can take place once all the requirements specified in the curriculum, including the completed thesis, have been fulfilled.
4) The thesis committee consists of at least three members. One of the members is the primary supervisor, and the other members are usually the reviewers of the dissertation.
5) The Defense is chaired by the chairperson of the thesis committee. The chair is appointed by the Founding President. Virtual participation in the Defense is possible with prior approval from the thesis committee, ensuring all technical requirements for a smooth process are met.
6) The Defense has a maximum duration of 120 minutes and includes a presentation by the candidate followed by a discussion of the presentation content.
7) The evaluation of the Defense is conducted by the thesis committee based on the quality of the presentation and the discussion. The final comprehensive examination is assessed according to the following grading scale:
   1. Passed with distinction: for an outstanding performance.
   2. Passed with merit: for a significantly above-average performance.
   3. Passed: for a satisfactorily passed examination.
   4. Failed: for an inadequate performance.
   The result is to be communicated to the candidate immediately after the examination.

§ 10 Academic Degree and Graduation

Graduates of the PhD program "Computational X" will be awarded the academic degree "Doctor of Philosophy" – abbreviated "PhD."
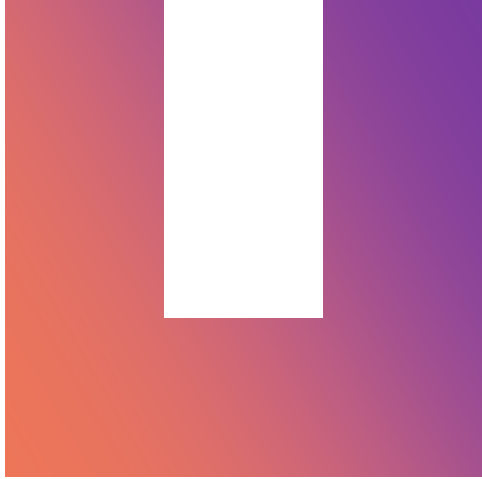
§ 11 Effective Date

This curriculum comes into effect on 30.09.20324.

§ 12 Transitional Provisions

No transitional provisions are provided.

§ 13 Appendix 1 – Module Descriptions

Appendix 1 – Module Descriptions

PhD Program

Computational X

Module plan

Studies are divided into modules. A module is a self-contained learning unit with content and methods that are thematically and temporally cohesive, delivered through one or more compulsory or elective courses.

Compulsory courses are courses that are a prerequisite for completing a degree. Elective courses are courses from which students can select according to the conditions set out in the curriculum. For an elective course, there is an elective course catalog from which students can make their selection.

PhD program "Computational X"

term/ECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

1st term

M11		Core module: Computational X																		M12		Project module: Research Methodology Project							
Prj. Mgmt. & Prj.-based Learning		Elective A					Elective B				Elective C			Computational X Project						Research Methodology		Scient. Writing & Res. Integrity		Elective D		Research Methodology Project			
2 ECTS	PIC	5 ECTS								PIC	5 ECTS			PIC	2 ECTS	PIC	6 ECTS				PIC	2 ECTS	PIC	2 ECTS	PIC	2 ECTS	PIC	4 ECTS		PRJ

2nd term

M21	Research Lab Immersion 1			M22	Research Lab Immersion 2			M23	Research Lab Immersion 3		
	Research Lab Immersion 1				Research Lab Immersion 2				Research Lab Immersion 3		
10 ECTS			PRJ	10 ECTS			PRJ	10 ECTS			PRJ

3rd–8th term

MTh	PhD Thesis	MIRS	Interdisciplinary Research Sem.
	PhD Thesis		Interdisciplinary Research Seminar
	25 ECTS/term 150 ECTS total		5 ECTS/term 30ECTS	SE

Within the module **"Computational X"** there are **three elective courses**, Elective course **A**, Elective course **B** and Elective course **C**. Within the module **"Research Methodology Project"** there is **one elective course D**. Students can select the courses they want to choose out of the elective course catalogue. Depending on the students' prior knowledge and competences they can choose different student pathways or freely combine the elective courses in agreement with the study program coordinator and their supervisor.

Elective courses				
Possible student pathways	**Elective A**	**Elective B**	**Elective C**	**Elective D**
e.g. Computational pathway Students with no prerequisites in Computation could select	Introduction to Computing 5 ECTS — PIC	Introduction to Data Science and Statistics 5 ECTS — PIC	XR Technologies Fundamentals and Applications 2 ECTS — PIC	XR Technologies Fundamentals and Applications 2 ECTS — PIC
e.g. AI, Machine Learning pathway Students with foundational prerequisites in Computation	Introduction to Machine Learning 5 ECTS — PIC	Advanced Machine Learning and Deep Learning 5 ECTS — PIC	Machine and Deep Learning Applications 2 ECTS — PIC	Innovate and Transform 2 ECTS — PIC
e.g. Data Science pathway Students with foundational prerequisites in Computation	Introduction to Data Science and Statistics 5 ECTS — SE	Advanced Data Science 5 ECTS — SE	Introduction to Machine Learning 2 ECTS — PIC	Research Ethics 2 ECTS — PIC
			Making and Prototyping 2 ECTS — PIC	

Core Module "**Computational X**"

Abbreviation	CompX
Type	Compulsory module
ECTS points	20
Semester	1
Frequency	Every year
Module exam	No
Prerequisite	None

Compulsory Courses

Course "**Project Management and Project-based Learning**"

Abbreviation	PM&PBL
Type	Compulsory Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course provides higher education students with an introduction to the fundamental concepts of participating in and managing projects using a project-based learning (PBL) approach. Emphasizing practical experience, the course is designed to prepare students to engage effectively in project-based assignments. Through hands-on activities, case studies, and collaborative projects, students will learn to apply PBL principles to real-world challenges, enhancing their problem-solving, teamwork, and critical thinking skills. The course aims to equip students with the knowledge and skills needed to thrive in project-based environments, both in academic settings and future professional settings.
Learning Outcomes	After successfully completing the course, students will be able to ... ● explain the principles and benefits of project-based learning and how it differs from traditional learning methods

	- create project proposals that outline objectives, scope, deliverables, and timelines - work effectively in teams, improving collaboration and communication skills - use basic project management tools and techniques to plan, execute, and monitor projects. - apply project management methodologies (e.g., Agile, Waterfall) in a practical context - identify potential risks and develop mitigation strategies
Content	- Introduction to Project-Based Learning - Team dynamics and collaboration - Project planning and scope management - Project management frameworks (Agile, Waterfall, Hybrid) - Time management and scheduling - Risk management - Project management tools and software
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Computational X Project**"

Abbreviation	CompXPrj
Type	Compulsory course
Course type	PRJ
ECTS points	6
Semester	1
Frequency	Every year
Description	The course emphasizes practical application of theoretical knowledge, 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 implement 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	Courses with continuous assessment

Elective Courses A

Course "Introduction to Computing"

Abbreviation	IntroComp
Type	Elective Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course introduces students to the fundamental concepts of computing, including computational thinking and basic programming (data types, control structures, functions, testing, and debugging). Additionally, students will learn about basic algorithms and data structures, as well as the fundamentals of operating systems, computer organization, and web technologies. Through practical programming

	exercises, students will gain foundational skills and knowledge to understand how computers and networks function, preparing them for further study.
Learning Outcomes	After successfully completing the course, students will be able to ... ● apply computational thinking to solve simple problems. ● write and debug basic programs using a programming language. ● understand and implement basic algorithms (e.g., sorting, searching) and data structures (e.g., arrays, lists). ● understand the functionalities of an operating system and basic architecture of a computer. ● apply the basics of web development.
Content	● Problem decomposition, pattern recognition, abstraction, and algorithms. ● Introduction to programming languages (Python), basic syntax, variables, conditionals, loops, and functions. ● Introduction to common algorithms (e.g., sorting and searching) and data structures (arrays, lists). ● Overview of computer hardware components (CPU, memory, I/O devices), and the role of the operating system in managing resources. Practical working with Linux and the Shell. ● Basic understanding of the web, HTML, CSS, client-server architecture, and the role of protocols.
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Introduction to Machine Learning**"	
Abbreviation	IntroML
Type	Elective Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course provides a foundational introduction to machine

	learning, focusing on the key principles, algorithms, and applications. Students will explore essential concepts such as supervised and unsupervised learning, data preprocessing, and model evaluation. The course covers fundamental algorithms, e.g. linear regression, decision trees, and clustering methods, with an introduction to neural networks and deep learning. Ethical considerations will also be discussed, including bias and fairness in machine learning. Emphasis will be placed on the practical implementation of these techniques with commonly-used machine-learning libraries. By the end of the course, students will be equipped with the knowledge and skills to apply machine learning models to real-world data.
Learning Outcomes	After successfully completing the course, students will be able to… • understand the fundamental concepts and types of machine learning, e.g. supervised, unsupervised, and reinforcement learning. • preprocess and clean data effectively, e.g. handling missing values, normalization, and feature engineering. • implement and apply key machine learning algorithms, e.g. regression. • evaluate and validate models using, e.g. train-test split, cross-validation, and performance metrics. • gain a basic understanding of artificial neural networks and their role in deep learning. • use popular machine learning libraries to develop and deploy machine learning models. • identify and address ethical considerations in machine learning, e.g.bias, fairness, and transparency.
Content	• Introduction to machine learning (e.g. definitions, types, and applications) • Data preprocessing (e.g. handling missing data, normalization, and feature engineering) • Supervised learning algorithms (e.g. regression) • Unsupervised learning algorithms (e.g. clustering). • Introduction to neural networks and deep learning basics. • Model evaluation and validation technique: (e.g. train-test split, cross-validation, confusion matrix, ROC curves) • Implementation using popular libraries (e.g. scikit-learn, PyTorch). • Ethical considerations in machine learning (e.g. bias, fairness, and interpretability)
Previous Knowledge	Programming basics (or alternatively course „Introduction to Computing")
Assessment	Courses with continuous assessment

Course "**Introduction to Data Science and Statistics**"	
Abbreviation	IntroDS
Type	Elective Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course introduces students to the fundamental steps of the data science process, from data collection and cleaning to analysis, visualization, and interpretation. It provides an overview of core concepts, tools, and techniques used in these steps, including statistical methods, machine learning algorithms, and visualization methods that are essential for research. Emphasis is placed on the application toreal-world data to provide students with the practical skills required by the project work.
Learning Outcomes	After successfully completing the course, students will be able to, ... • understand Data Science Fundamentals, such as the data science process, including data collection, cleaning, analysis, visualization, and interpretation. • understand essential techniques and tools used in these steps (e.g. Python libraries, Jupyter Notebook, R, SPSS) • understand statistical techniques (e.g. descriptive statistics, group comparisons) • understand machine learning methods (e.g. basic supervised and unsupervised methods) • understand how to create meaningful visualizations and communicate findings effectively • apply methods to real-world data • recognize ethical considerations and privacy issues associated with data science and the responsible use of data
Content	• Introduction to data science and state-of-the-art tools and environments • Data collection and data wrangling • Introduction to data analysis – statistical methods • Introduction to data analysis – machine learning

	● Data visualisation ● Data ethics and privacy
Previous Knowledge	Programming basics (or alternatively course „Introduction to Computing")
Assessment	Courses with continuous assessment

Elective Courses B

Course "**Introduction to Data Science and Statistics**"

See Elective A

Course "**Advanced Machine Learning and Deep Learning**"

Abbreviation	AdvML
Type	Elective Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course delves into advanced machine learning and deep learning topics, building on foundational knowledge to explore more complex algorithms and techniques. Students will gain a deep understanding of advanced supervised and unsupervised learning methods and neural network architectures such as convolutional neural networks and large language models. The course also covers deep learning frameworks, e.g. TensorFlow or PyTorch, for practical model implementation and deployment. Special emphasis will be placed on optimization techniques, model tuning, and real-world applications. Ethical issues and challenges related to deep learning, such as data privacy and the interpretability of complex models, will also be discussed. By the end of the course, students will be equipped to develop, train, and evaluate models for complex data-driven tasks.

Learning Outcomes	After successfully completing the course, students will be able to…
	- understand and apply advanced machine learning techniques. - understand deep learning models using various neural network architectures e.g. convolutional neural networks (CNNs), recurrent neural networks (RNNs), Generative Adversarial Networks (GANs), Large Language Models (LLMs). - utilize deep learning frameworks, e.g. TensorFlow and PyTorch for building, training, and deploying complex models. - optimize deep learning models. - evaluate model performance using advanced metrics and addresschallenges during training. - analyze real-world applications of deep learning in various fields, e.g. computer vision, natural language processing, time series analysis. - address ethical considerations and challenges in deep learning, including model interpretability, bias, and data privacy.
Content	- Review of advanced machine learning techniques, e.g. ensemble methods (bagging, boosting), support vector machines, and dimensionality reduction techniques. - Introduction to deep learning architectures, e.g. feedforward networks, CNNs, RNNs, LLMs - Deep learning frameworks, e.g. TensorFlow or PyTorch. - Model optimization, e.g. hyperparameter tuning, regularization, dropout, and batch normalization. - Advanced topics in deep learning: GANs, autoencoders, and transfer learning. - Evaluation and performance metrics, e.g. precision, recall, F1 score, AUC-ROC, and confusion matrix. - Applications of deep learning in fields such as computer vision (image classification, object detection), natural language processing (text classification, sentiment analysis), or time series forecasting. - Ethical considerations: fairness, bias, and data privacy in complex models.
Previous Knowledge	Introduction to Machine Learning
Assessment	Courses with continuous assessment

Course "**Advanced Data Science**"	
Abbreviation	AdvDS
Type	Elective Course
Course type	PIC
ECTS points	5
Semester	1
Frequency	Every year
Description	This course offers an in-depth exploration of advanced data science techniques, focusing on applying statistical, machine learning, and data visualization methods to complex datasets. Students will learn to handle large-scale data, apply sophisticated analytical methods, and develop predictive models. The course covers advanced topics such as time series analysis, network analysis, and natural language processing. Practical skills in using data science tools such as R, Python, and cloud-based data platforms will be emphasized. Ethical considerations, data privacy, and the challenges of working with big data will also be discussed. By the end of the course, students will be able to design, execute, and communicate complex data science projects that address real-world problems.
Learning Outcomes	After successfully completing the course, students will be able to… ● apply advanced statistical and machine learning techniques to analyze complex datasets, (e.g. GLMs, PCA, SVM, ensemble methods) ● utilize data science tools and platforms (e.g., R, Python,, cloud services) for data wrangling, analysis, and visualization. ● handle and analyze large-scale data using big data technologies. ● implement advanced data visualization techniques. ● critically assess and address ethical considerations, privacy concerns, and data security issues in data science projects. ● design and execute end-to-end data science projects, from data collection and cleaning to analysis, modeling, and presentation.
Content	● Advanced statistical methods and machine learning techniques, e.g. generalized linear models, support vector machines, ensemble methods. ● Network analysis: graph theory, social network analysis, community detection.

	- Natural language processing (NLP): text preprocessing, sentiment analysis, topic modeling. - Big data technologies for data science. - Data visualization: interactive and dynamic visualizations using tools, e.g. Tableau, D3.js, and Plotly.
Previous Knowledge	Introduction to Data Science and Statistics
Assessment	Courses with continuous assessment

Elective Courses C

Course "**Introduction to Machine Learning**"	
Abbreviation	IntroML2
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course introduces the fundamental principles and techniques of machine learning. Students will explore key concepts such as supervised and unsupervised learning, data preprocessing, and model evaluation. The course covers essential algorithms, including linear regression and decision trees. By the end of the course, students will have a solid foundation to apply machine learning techniques to real-world problems across various domains.
Learning Outcomes	After successfully completing the course, students will be able to ... - understand the basic machine learning concepts and types, including supervised, unsupervised, and reinforcement learning. - preprocess data effectively, including handling missing data, normalization, and feature engineering. - implement and evaluate core machine learning algorithms, e.g.regression and decision trees. - use popular machine learning libraries to develop and

	deploy models. ● recognize and address ethical issues in machine learning, such as algorithmic bias and fairness.
Content	● Fundamentals of machine learning, such as key concepts, definitions, and types ● Overview of data preprocessing: handling missing data, normalization, and feature engineering. ● Core machine learning algorithms, e.g. regression, decision trees. ● Use of popular machine learning libraries and tools. ● Ethical considerations in machine learning: bias, fairness, and interpretability.
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Making and Prototyping**"

Abbreviation	MakePro
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course is a hands-on, project-based learning experience designed to engage students in making and fabrication. This course empowers students to explore, design, and create using a variety of tools and technologies while working on a project that progressively builds their expertise in different aspects of making.
Learning Outcomes	After successfully completing the course, students will be able to ... ● use safely and effectively a variety of tools and equipment commonly found in a Maker's lab, such as a 3D printer, laser cutter, CNC machines, soldering irons, and tools to quickly prototype ideas ● understand the different materials and their properties, selecting appropriated materials for their prototypes ● understand the fundamentals of electronics and circuitry ● use digital tools to design and virtually prototype simple mechanical and electrical systems ● build and test simple electronics prototypes

Content	- Overview of making and fabrication - Safety protocols for working in a maker's lab - Introduction to tools and equipment - Material properties and selection - Fundamentals of electronics and circuitry - Digital design and virtual prototyping e.g. CAD - Prototyping
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Machine and Deep Learning Applications**"

Abbreviation	LearnPsyAI
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course introduces the practical applications of machine learning and deep learning techniques. Students will learn to implement basic models such as convolutional neural networks (CNNs) for specific tasks like image classification or RNNs for text classification. The focus will be on understanding the workflow of applying machine learning models from data preparation to model deployment. Ethical considerations and practical challenges in deploying machine learning applications will be discussed.
Learning Outcomes	After successfully completing the course, students will be able to… - understand the basic workflow of applying machine and deep learning models to real-world problems. - implement simple machine learning models such as CNNs for image classification and RNNs for text analysis. - utilize basic tools and frameworks like TensorFlow or Keras for model implementation. - evaluate model performance using basic metrics such as accuracy and loss. - discuss practical and ethical considerations in deploying machine learning applications, including model

	interpretability and bias.
Content	- Introduction to machine and deep learning applications: key concepts and workflow. - Basic implementation of CNNs and RNNs using frameworks like TensorFlow/Keras. - Data preparation and preprocessing for machine learning applications. - Model evaluation: understanding basic metrics (accuracy, loss) and overfitting. - Ethical considerations: bias, fairness, and model interpretability.
Previous Knowledge	Introduction to Machine Learning
Assessment	Courses with continuous assessment

Course "**XR Technologies Fundamentals and Applications**"

Abbreviation	XRFundApp
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course provides an in-depth exploration of Extended Reality (XR) technologies, including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), with a focus on their practical applications across various domains such as education, healthcare, and industry. Students will learn about the fundamentals of XR, biosensors, and their integration into immersive and collaborative environments. The course will equip students with the skills to design and implement XR projects, with an emphasis on enhancing communication, collaboration and on accommodating diverse user needs. Through hands-on projects and research, students will develop the expertise to create inclusive and effective XR experiences.
Learning Outcomes	After successfully completing the course, students will be able to ... - understand XR Technologies: Gain a comprehensive understanding of VR, AR, and MR technologies, including their hardware and software components, as well as its benefits and limitations.

	- learn about biosensors and their role in enhancing XR experiences, particularly in analysing and adapting to users' sensory needs. - evaluate XR applications: Research and evaluate the benefits of XR technologies and biosensor data across various domains, such as education, healthcare, and industry. - enhance communication: Analyse how XR technologies can enhance communication and collaboration through immersive experiences, supporting diverse user needs, e.g., accessibility. - design and implement XR projects: Develop skills to design and implement XR projects focused on virtual meetings, collaborative environments, and communication on specific topics. - gain basic skills to conduct research on the application of XR in various fields and develop innovative solutions to real-world problems.
Content	- Introduction to XR Technologies: - Overview of VR, AR, and MR - Hardware and software components - Current trends, limitations and future directions - Biosensors in XR: - Types of biosensors (e.g., eye-tracking, ECG) - Integration of biosensors with XR technologies - Monitoring and adapting to sensory needs - Evaluating XR Applications: - Benefits of XR in education, healthcare, industry - Case studies and practical applications - Addressing specific needs and challenges in each domain - Enhancing Communication with XR: - Immersive experiences and their impact on communication and collaboration - Supporting diverse user styles - Accessibility and Ethics in XR - Designing and Implementing XR Projects: - Principles and Guidelines of XR project design and storytelling - User-centred design methodologies - Prototyping and testing XR environments - Research Methods and Project Development: - Research methodologies in XR - Developing and conducting experiments - Analysing and presenting research findings - Hands-On Project: - Designing an XR experience for a collaborative environment - Implementing biosensors in XR environments - Focusing on real-world application to improve communication and teamwork

Previous Knowledge	Basic programming skills preferred but not mandatory
Assessment	Courses with continuous assessment

Project Module "Research Methodology Project"

Abbreviation	ResMethProj
Type	Compulsory module
ECTS points	10
Semester	1
Frequency	Every year
Module exam	No
Prerequisite	None

Compulsory courses

Course "Research Methodology"

Abbreviation	ResMethods
Type	Compulsory Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course provides a practical introduction to the methods and techniques of academic research. Students will learn about research design, data collection, analysis, and interpretation. Through a real-world project, students will apply theoretical knowledge to develop research questions, conduct literature reviews, and implement research methods. The course emphasizes critical thinking, analytical skills, and collaboration, equipping students with the tools and experience necessary to conduct effective and ethical research in an interdisciplinary context.

Learning Outcomes	After successfully completing the course, students will be able to ...
	- understand and critically assess different research designs and apply them in interdisciplinary research projects. - set up a study and formulate research questions and hypotheses. - review, analyze, and compare scientific literature. - create effective research plans, including methodology, sampling techniques, and data collection methods. - choose and employ appropriate tools, data collection and analysis techniques, and interpret results to draw meaningful conclusions. - understand and apply ethical principles in research, including issues related to consent, confidentiality, and data integrity.
Content	- Foundations of scientific research: Definition, objectives, motivation, and the language of research - Problem identification and formulation of research questions and hypotheses - Research design - Literature search and review - Data types and data collection methods - Quantitative and qualitative methods and data analysis - Interpreting and presenting results - Ethical considerations in research - Use of tools for research
Previous Knowledge	Basic programming skills preferred but not mandatory
Assessment	Courses with continuous assessment

Course "**Scientific Writing and Research Integrity**"

Abbreviation	SciWriResInt
Type	Compulsory Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course introduces students to the fundamentals of scientific writing and addresses research integrity issues. Students will

	learn how to effectively communicate scientific ideas, research findings, and data through clear, structured writing. By engaging in a writing project such as research papers, lab reports, and literature reviews, students will apply key principles of scientific writing, including clarity, precision, and proper citation practices. The course emphasizes the development of critical thinking and analytical skills, equipping students with the tools needed to produce high-quality scientific documents.
Learning Outcomes	After successfully completing the course, students will be able to ... • understand and apply the conventions of scientific writing, including structure, style, and tone appropriate for academic and research contexts. • construct well-organized and logically coherent scientific arguments based on evidence and research. • develop skills in revising and editing scientific documents to improve clarity, accuracy, and overall quality.
Content	• Discussion and application of scientific writing in the context of communicating research procedures and results in PhD-theses and papers • Structuring scientific documents • Collaborative writing projects and peer review • Critical thinking and logical argumentation • Scientific integrity and research ethics
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Research Methodology Project**"

Abbreviation	ResMethPrj
Type	Compulsory Course
Course type	PRJ
ECTS points	4
Semester	1
Frequency	Every year
Description	The course emphasizes practical application of theoretical knowledge, 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 implement 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	Basic programming skills preferred but not mandatory
Assessment	Courses with continuous assessment

Elective Courses D

Course "XR Technologies Fundamentals and Applications"

See Elective C

Course "Research Ethics"

Abbreviation	ResEth
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1

Frequency	Every year
Description	This course focuses on the ethical dimensions of research in the context of digital transformation. It introduces students to key ethical theories, principles, and dilemmas that arise in research, particularly in digital environments. Topics include privacy, data integrity, intellectual property, and the ethical challenges of AI, machine learning and XR. Students will explore real-world case studies, engage in debates, and apply ethical frameworks to their own research. The course emphasizes critical ethical reasoning, responsible decision-making, and the integration of ethical considerations throughout the research process.
Learning Outcomes	After successfully completing the course, students will be able to ... • understand the foundational ethical principles that govern research and apply them to digital transformation contexts. • identify and analyze ethical issues related to privacy, consent, and confidentiality in digital research. • critically evaluate ethical dilemmas in the use of digital tools and technologies, including artificial intelligence, machine learning and XR. • apply ethical frameworks to the design and implementation of research studies, ensuring adherence to ethical standards. • navigate intellectual property rights and issues of authorship in the digital age. • implement data integrity and security practices to ensure the ethical management of research data. • understand and apply ethical principles in interdisciplinary and international research collaborations.
Content	• Foundations of research ethics: Key theories, principles, and dilemmas • Privacy, consent, and confidentiality in digital research • Ethical challenges in AI, machine learning, and XR • Data integrity, security, and management • Intellectual property, plagiarism, and authorship • Ethical considerations in interdisciplinary research • International and cultural dimensions of research ethics • Case studies: Ethical failures and successes in digital research • Practical tools and frameworks for ethical decision-making in research
Previous Knowledge	None
Assessment	Courses with continuous assessment

Course "**Innovate and Transform**"	
Abbreviation	InnovTrans
Type	Elective Course
Course type	PIC
ECTS points	2
Semester	1
Frequency	Every year
Description	This course offers an engaging introduction to digital transformation through a hands-on project. Students will explore how emerging technologies and digital strategies reshape industries and organizations through several use cases. By working on a practical project, they will apply concepts such as data analysis and change management to a real-world scenario. The course emphasizes critical thinking, problem-solving, and teamwork as students develop interdisciplinary solutions to digital transformation challenges.
Learning Outcomes	After successfully completing the course, students will be able to ... ● name and understand key digital technologies and their impact on business and industry ● create and implement strategies for integrating digital tools and technologies into organizational processes ● learn and apply change management principles to facilitate successful digital transformation initiatives ● work effectively in teams to develop and present digital transformation solutions for real-world problems ● assess the effectiveness of digital solutions and reflect on their impact on organizational performance and innovation
Content	● Introduction to digital transformation (concepts and definitions, impact) ● Key digital technologies and their applications ● Digital strategy development ● Change management principles ● Assessing effectiveness and impact
Previous Knowledge	None
Assessment	Courses with continuous assessment

Research Lab Module **"Research Lab Immersion 1"**

Abbreviation	RLab1
Type	Compulsory module
ECTS points	10
Semester	2
Frequency	Every semester
Module exam	No
Prerequisite	None

Course: "**Research Lab Immersion 1**"

Abbreviation	RLab 1
Type	Compulsory course
Course type	PRJ
ECTS points	10
Semester	2
Frequency	Every year
Description	This course provides students with the opportunity to develop and execute a research project that explores interdisciplinary work within a specific research area. By immersing themselves in diverse research environments, students will gain hands-on experience with various research methodologies and approaches from multiple fields. The course is designed to foster a deeper understanding of how interdisciplinary research can address complex problems and to enhance students' ability to integrate knowledge and techniques from different disciplines into their own projects.
Learning outcomes	After successfully completing the course, students will be able to ... • formulate and develop a research project that integrates methodologies and concepts from multiple disciplines • utilize and adapt various research methodologies from different fields to address complex problems • demonstrate the ability to select and apply appropriate research techniques based on the interdisciplinary nature of the project

	• synthesize knowledge and techniques from multiple disciplines to enhance a research project
Content	Defined accordingly with research project
Previous knowledge	None
Assessment	Courses with continuous assessment

Research Lab Module "Research Lab Immersion 2"

Abbreviation	RLab2
Type	Compulsory Module
ECTS points	10
Semester	2
Frequency	Every year
Module exam	No
Prerequisite	None

Course "Research Lab Immersion 2"

Abbreviation	RLab 2
Type	Compulsory course
Course type	PRJ
ECTS points	10
Semester	2
Frequency	Every year
Description	This course provides students with the opportunity to develop and execute a research project that explores interdisciplinary work within a specific research area. By immersing themselves in diverse research environments, students will gain hands-on experience with various research methodologies and approaches from multiple fields. The course is designed to foster a deeper understanding of how interdisciplinary research can address complex problems and to enhance students' ability to integrate knowledge and techniques from different disciplines into their own projects.
Learning outcomes	After successfully completing the course, students will be able to ...

	• formulate and develop a research project that integrates methodologies and concepts from multiple disciplines • utilize and adapt various research methodologies from different fields to address complex problems • demonstrate the ability to select and apply appropriate research techniques based on the interdisciplinary nature of the project • synthesize knowledge and techniques from multiple disciplines to enhance a research project
Content	Content is determined accordingly with the project.
Previous knowledge	None
Assessment	Courses with continuous assessment

Research Lab Module "Research Lab Immersion 3"

Abbreviation	RLab3
Type	Compulsory module
ECTS points	10
Semester	2
Frequency	Every year
Module exam	No
Prerequisite	None

Course "Research Lab Immersion 3"

Abbreviation	PRJ RLab 3
Type	Compulsory course
Course type	PRJ
ECTS points	10
Semester	2
Frequency	Every year
Description	This course provides students with the opportunity to develop and execute a research project that explores interdisciplinary work within a specific research area. By immersing themselves in diverse research environments, students will gain hands-on experience with various research methodologies and approaches from multiple fields. The course is designed to foster a

	deeper understanding of how interdisciplinary research can address complex problems and to enhance students' ability to integrate knowledge and techniques from different disciplines into their own projects.
Learning outcomes	After successfully completing the course, students will be able to ... • formulate and develop a research project that integrates methodologies and concepts from multiple disciplines • utilize and adapt various research methodologies from different fields to address complex problems • demonstrate the ability to select and apply appropriate research techniques based on the interdisciplinary nature of the project • synthesize knowledge and techniques from multiple disciplines to enhance a research project
Content	Content is determined accordingly with the project.
Previous knowledge	None
Assessment	Courses with continuous assessment

Module "Interdisciplinary Research Seminar"

Abbreviation	IntdResSem
Type	Compulsory module
ECTS points	5
Semester	3 - 8
Frequency	Every semester
Module exam	No
Prerequisite	None

Course "Interdisciplinary Research Seminar Series"

Abbreviation	IntdResSem
Type	Compulsory course
Course type	SEM
ECTS points	5
Semester	3 – 8
Frequency	Every semester

Description	This course is designed to support PhD students through the entire process of developing their dissertations, with a focus on interdisciplinary research. Over the span of six semesters, students will engage in a series of workshops, seminars, and collaborative projects that explore the theories, methodologies, and practical challenges of conducting research across disciplinary boundaries. The course emphasizes the integration of diverse perspectives, fostering innovation, and addressing complex research questions that require interdisciplinary approaches.
Learning outcomes	After successfully completing the course, students will be able to ... • understand and discuss the importance of interdisciplinary research in addressing complex societal and academic challenges • demonstrate the ability to apply interdisciplinary approaches to their PhD thesis, including the identification of appropriate research questions and hypotheses • effectively communicate and collaborate with peers and faculty from various disciplines to enrich their research • identify and overcome common barriers to interdisciplinary research, such as differing terminologies, research methods, and evaluation criteria
Content	• Introduction to interdisciplinary research concepts and planning • Developing and refining interdisciplinary research strategies • Advanced interdisciplinary research techniques and collaboration • Synthesis, presentation, and reflection on interdisciplinary research
Previous knowledge	None
Assessment	Courses with continuous assessment

Module **"PhD Thesis"**

Abbreviation	PhD Thesis
Type	Compulsory module
ECTS points	150
Semester	3-8
Frequency	Every semester
Module exam	No
Prerequisite	Accepted PhD proposal

Course **"PhD Thesis"**

Abbreviation	PhD Thesis
Type	Compulsory course
Course type	
ECTS points	150
Semester	3-8
Frequency	Every semester
Description	Within the context of this course the students will develop their thesis involving processes like identifying a research question or hypothesis, conducting in-depth research, and systematically organizing the findings into a coherent and well-supported argument. It culminates in the creation of a thesis document that presents original contributions to knowledge within a specific field of study.
Learning outcomes	After successfully completing the course, students will be able to ... - formulate clear and feasible research questions or hypotheses for their PhD thesis - design a detailed research plan, including methodology, data collection, and analysis strategies, that aligns with their research objectives - identify, evaluate, and synthesize relevant literature to establish a strong theoretical foundation for their research - critically assess existing research to identify gaps that their thesis will address - apply appropriate research methodologies and techniques to collect and analyse data - adapt and refine their research approach based on ongoing findings and feedback from peers and faculty

	- develop a clear and coherent structure for their dissertation - participate in peer review sessions, offering and receiving constructive feedback to enhance the quality of their research - incorporate feedback from supervisors, peers, and other faculty members to refine their thesis - articulate and defend their research findings in both written and oral formats - develop presentation skills and strategies for effectively communicating complex research to academic and non-academic audiences
Content	
Previous knowledge	None
Assessment	PhD thesis examination and thesis defence

PhD program "Computational X"

interdisciplinary transformation university austria

term/ECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1st term	**M11** Core module: Computational X																				**M12** Project module: Research Methodology Project									
	Prj. Mgmt. & Prj.-based Learning — PIC — 2 ECTS		Elective A — PIC — 5 ECTS					Elective B — PIC — 5 ECTS				Elective C — PIC — 6 ECTS									Research Methodology — PIC — 2 ECTS	Scient. Writing & Res. Integrity — PIC — 2 ECTS	Elective D — PIC — 2 ECTS	Research Methodology Project — PRJ — 4 ECTS					
2nd term	**M21** Research Lab Immersion 1 — 10 ECTS — PRJ										**M22** Research Lab Immersion 2 — 10 ECTS — PRJ										**M23** Research Lab Immersion 3 — 10 ECTS — PRJ									
	Research Lab Immersion 1 — PIC										Computational X Project — PIC																			
3rd-8th term	**MTh** PhD Thesis																								**MIRS** Interdisciplinary Research Sem.					
	PhD Thesis																								Interdisciplinary Research Seminar					
	25 ECTS/term 150 ECTS total																								5 ECTS/term 30 ECTS — SE					

PhD program "Computational X"

Module	Course	Course type	ECTS
Core module: „Computational X"			
	Project Management and Project-based Learning	PIC	2
	Elective A	PIC	5
	Elective B	PIC	5
	Elective C	PIC	2
	Computational X Project	PRJ	6
			20
Project Module "Research Methodology Project"			
	Research Methodology	PIC	2
	Scientific Writing and Research Integrity	PIC	2
	Elective D	PIC	2
	Research Methodology Project	PRJ	4
			10
Research Lab Module "Research Lab Immersion 1"			
	Research Lab Immersion 1	PRJ	**10**
Research Lab Module "Research Lab Immersion 2"			
	Research Lab Immersion 2	PRJ	**10**
Research Lab Module "Research Lab Immersion 3"			
	Research Lab Immersion 1	PRJ	**10**
Module "Interdisciplinar Research Seminar"			
	Interdisciplinar Research Seminar Series (6*5 ECTS)	SEM	**30**
Module "PhD Thesis"			
	PhD Thesis Development	PRJ	**150**
			240

Elective A

Computational pathway	Introduction to Computing	PIC	5
AI, pathway	Introduction to Machine Learning	PIC	5
Data Science pathway	Introduction to Data Science and Statistics	PIC	5

Elective B

Computing pathway	Introduction to Data Science and Statistics	PIC	5
AI pathway	Advanced Machine Learning and Deep Learning	PIC	5
Data Science pathway	Advanced Data Science	PIC	5

Elective C

Computing pathway	XR Technologies Fundamentals and Applications	PIC	2
AI pathway	Machine and Deep Learning Applications	PIC	2
Data Science pathway	Introduction to Machine Learning	PIC	2
	Making and Prototyping	PIC	2

Elective D

free - no pathway	XR Technologies Fundamentals and Applications	PIC	2
free - no pathway	Innovate and Transform	PIC	2
free - no pathway	Research Ethics	PIC	2