UTN

Technische Universität Nürnberg

M.Sc. / M.A.
“Human and Artificial Intelligence”

Module Handbook

Version 2.0

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Learning Outcomes

Goal 1:

- To provide students with approaches to human cognition and artificial intelligence from the fields of Computer Science, Psychology, and Philosophy.
- To provide students with integrated methods from Philosophy, Psychology, and Computer Science in order to resolve multifaceted problems in the field of responsible AI.

Objective 1.1: Students are able to identify, describe, and classify different approaches to human intelligence and artificial intelligence, understand their synergies and differences, and apply these insights to contemporary challenges in opinion-forming and knowledge-gaining processes.

Objective 1.2: Students are able to indicate and discuss applications and opportunities for Artificial Intelligence and outline specific human abilities in recognition and reasoning.

Objective 1.3: Students are able to predict and describe results of AI-applications based on knowledge and understanding of AI core concepts.

Objective 1.4: Students are able to understand or apply AI technologies and develop criteria and methods for anticipating the ethical, psychological, and societal implications of these applications.

Goal 2:

- To provide students with practice-oriented projects in collaboration with local employers.
- To equip students with the skills to raise public awareness regarding the application areas of AI processes and to strengthen the understanding of the possibilities and limitations of AI applications in organizations, communities, society, and industry.

Objective 2.1: Students are able to use their broad understanding of human cognition in order to and improve human-computer-interactions and to identify novel areas of applying AI.

Objective 2.2: Students are able to facilitate decision making-processes through the implementation of AI methods.

Objective 2.3: Students are able to engage in dialogue concerning AI methods across diverse domains and to develop responsible AI tailored to human problem-solving.

Objective 2.4: Students are able to engineer and analyze AI applications for fairness and collaborate with Data Engineers to avoid biases and safeguard privacy.

Objective 2.5: Students are able to generate ideas for advancing AI technologies and implement them in their professional environments (e.g., organizations, communities, industry, etc.).

Goal 3:

- To provide students with techniques to work effectively in diverse teams and continuously develop their own expertise and learning.
- To provide students with methods to tackle unexplored challenges and develop an innovative problem-solving attitude.

Objective 3.1: Students are able to use adaptive expertise, apply creative thinking and lifelong learning.

Objective 3.2: Students are able to reflect on technology, leadership and knowledge of ethics and relate them to current and future socio-technical contexts.

Objective 3.3.: Students are able to follow the standards of scientific work and effectively integrate AI applications into their own research, information retrieval, and knowledge construction.

Objective 3.4: Students are able to cultivate an innovative mindset, effective problem solving, and critical thinking, particularly in entrepreneurial contexts.

Objective 3.5: Students are able to collaborate effectively in international teams, fostering an appreciation for diversity within their personal environment.

Goal 4:

- To provide students with practice, ideas of sustainability and democratic citizenship.
- To provide students to reflect on and relate their own actions to social and ethical contexts.

Objective 4.1: Students are able to enhance the transparency of AI protocols and ensure democratic participation in determining AI applications.

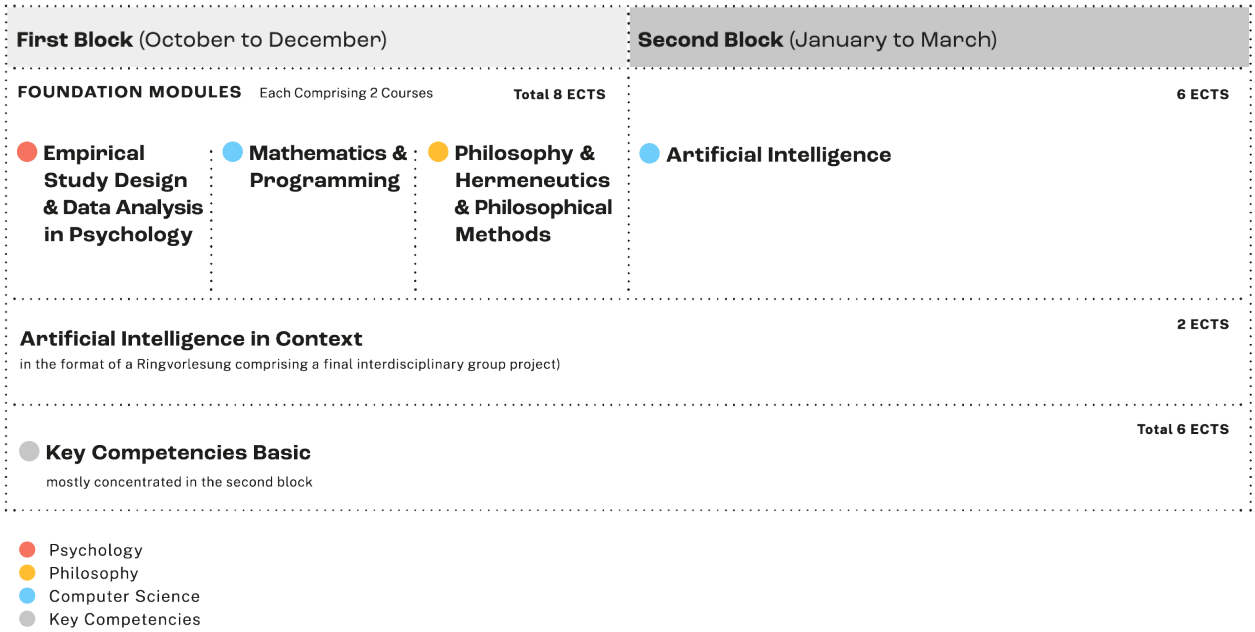
Objective 4.2: Students are able to discuss responsible AI technologies with a wider public and implement in organizations for mastering challenges especially related to the transformation towards a sustainable and fair society.

Objective 4.3: Students are able to understand the functioning of human opinion-forming and decision-making processes in different communities and societies, embrace democratic values, and act accordingly.

Modules Overview

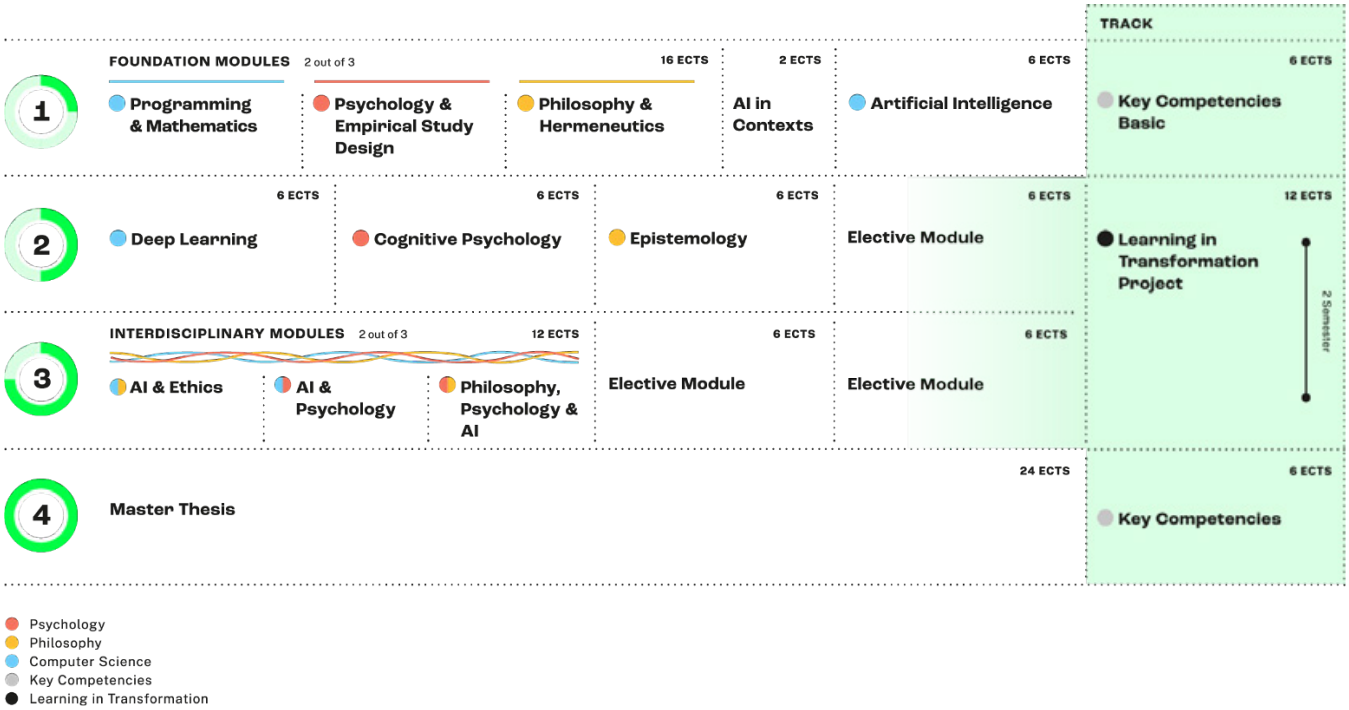
Sem.	Module	ECTS-Punkte	Associated courses
1	Artificial Intelligence in Contexts Module	2	Artificial Intelligence in Contexts
1	Artificial Intelligence Module	6	Artificial Intelligence
Foundation Modules: 16 ECTS points according to notice of admission			
1	Foundations in Programming & Mathematics Module	8	1. Foundations in Mathematics (4 ECTS) 2. Foundations in Programming (4 ECTS)
1	Foundations in Empirical Study Design and Data Analysis in Psychology Module	8	1. Foundations in Empirical Study Design (6 ECTS) 2. Basics of statistical data analysis (2 ECTS)
1	Foundations in Philosophy & Hermeneutics Module	8	1. Foundations in Philosophy (6 ECTS) 2. Philosophical Methods (2 ECTS)
1	Foundation Module 4	8	1. Elective course (6 ECTS) 2. Methods course (2 ECTS)
1	Key Competencies Basic Module	6	1. Good Scientific Practice 2. Democratic Citizenship 3. Resilience
2	Deep Learning Module	6	Deep Learning
2	Cognitive Psychology Module	6	Cognitive Psychology
2	Epistemology Module	6	Epistemology
2+3	Learning in Transformation Module	12	Learning in Transformation Project
Interdisciplinary Modules: 12 ECTS points			
3	AI & Ethics Module	6	AI & Ethics
3	AI & Psychology Module	6	AI & Psychology
3	Philosophy, Psychology & AI Module	6	Philosophy, Psychology & AI
2–3	Elective Module 1	6	All elective courses
2–3	Elective Module 2	6	All elective courses
2–3	Elective Module 3	6	All elective courses
4	Key Competencies Module 1	6	Choose from KC Pool
4	Master Thesis	24	Master Thesis and Colloquium

Revisions of the first semester of the HAI Master



- Psychology
- Philosophy
- Computer Science
- Key Competencies

Semester Overview



- Psychology
- Philosophy
- Computer Science
- Key Competencies
- Learning in Transformation

Details of Modules

Artificial Intelligence in Contexts Module			**2 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**60 hours**
Module No.	2M-HAI-AIC		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Artificial Intelligence in Contexts		
Instructor	Dr. Rodolfo Garau (seminar leader), Professors from CSAI and LAS.		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Identify and describe various interdisciplinary approaches to AI, integrating perspectives from Computer Science, Psychology, Philosophy, and Human-Computer Interaction (1.1) • Describe and evaluate different historical and contemporary concepts of human and artificial intelligence (1.1;1.2) • Analyze the context and implications of AI applications in various domains (1,2; 1.4) • Critically reflect on the ethical and societal impacts and challenges of AI technologies (2.4) • Complete a collaborative, interdisciplinary research project integrating the various perspectives explored in the class (3.1; 3.2; 3.5)		
Additional specific module related learning outcomes	Students are able to • Develop a nuanced understanding of, and critically evaluate, the interconnected and interdisciplinary nature of the challenges and opportunities posed by AI		
Contents	• Interdisciplinary approaches to AI • Contextual analysis of AI applications • Ethical and societal impacts of AI		
Teaching and learning formats	Attendance to a lecture series; completion of a group project		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Artificial Intelligence Module			**6 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**180 hours**
Module No.	1M-HAI-AIM		
Duration	one semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Artificial Intelligence		
Instructor	N.N. (CSAI)		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand basic concepts in AI, including reasoning, searching, planning, and optimal control (1.1) • Dissect and analyze the weaknesses and strengths of the non-parametric AI techniques compared to data-driven learning paradigms (1.3) • Implement the AI methods and apply them to real-world problems (2.2)		
Contents	• Introduction to Artificial Intelligence • Basic AI concepts such as reasoning, searching, and planning • Non-parametric AI techniques • Data-driven learning paradigms		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Foundations in Programming & Mathematics Module			**8 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**240 hours**
Module No.	1M-HAI-FPM		
Duration	One semester		
Course frequency	Winter semester / First Block		
Module language	English		
Admission requirements	None		
Associated courses	Course 1. Foundations in Mathematics Course 2. Foundations in Programming		
Instructor	Prof. Dr. Christoph Hertrich, Prof. Dr. Johannes Thürauf		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Course 1: Foundations in Mathematics			**4 ECTS (120hrs)**
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand, explain and apply basic concepts of mathematics relevant to AI (1.1)		
Contents	• Basics of Linear Algebra (systems of linear equations, matrices, vectors, norms, inner products, determinants) • Basics of Multivariate Analysis (partial differentiation, gradients, integration) • Basics of Optimization (global vs. local optima, gradient descent) • Basic notions of Probability Theory		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		
Course 2: Foundations in Programming			**4 ECTS (120hrs)**
Program related Learning outcomes	Students are able to: • Solve basic programming problems and implement the solution in programming languages commonly used in AI (1.1)		
Contents	• Basic usage of the command line interface • Basics of Python programming (variables, data types, conditionals, loops, functions) • Basic data structures (arrays, lists, dictionaries, etc.) • Outlook to more advanced programming concepts, e.g., recursion, exceptions, libraries, file I/O, object-oriented programming		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Foundations in Empirical Study Design and Data Analysis in Psychology Module			**8 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**240 hours**
Module No.	2M-HAI-FED		
Duration	One semester		
Course frequency	Winter semester / First Block		
Module language	English		
Admission requirements	None		
Associated courses	1. Foundations in Empirical Study Design 2. Methods Course: Basics of Statistical Data Analysis		
Instructor	Prof. Dr. Charlotte Grosse Wiesmann PD Dr. Bernhard Pastötter		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Course 1: Foundations in Empirical Study Design			**6 ECTS (180 hours)**
Program related Learning outcomes (see pp. 3-4)	Students are able to • Phrase empirically testable research questions and hypotheses (1.1; 3.1) • Design and conduct empirical studies to investigate human cognition and behavior including in relation to AI (1.1; 3.3) • Report and interpret empirical data appropriately (1.1; 3.3) • Apply principles of good scientific practice in psychology (3.3)		
Additional specific module related learning outcomes	Students are able to • Formulate psychological research questions and hypotheses • Design and conduct empirical studies to investigate human cognition and behavior • Summarize and report empirical data in a concise manner		
Contents	• Psychological research questions • Phrasing and testing Hypotheses • Empirical study design • Data collection and analysis • Interpretation of data and analyses		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		
Course 2: Methods Course: Basics of Statistical Data Analysis			**2 ECTS (60 hours)**
Program related Learning outcomes	Students are able to • Analyze empirical data using basic statistical methods (3.1 & 3.3)		

Additional specific module related learning outcomes	Students are able to: • Analyze empirical data using appropriate statistical methods
Contents	Data analysis
Teaching and learning formats	Hands-on; learn-by-doing;
Related programs	M. Sc. / M. A. Human and Artificial Intelligence

Foundations in Philosophy & Hermeneutics Module			**8 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**240 hours**
Module No.	2M-HAI-FPH		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Course 1. Foundations in Philosophy Course 2. Philosophical Methods		
Instructor	Prof. Dr. Gyburg Uhlmann / Prof. Dr. Dana Jalobeanu		
Examination	Written examination without supervision / Written examination under supervision / Oral examination		
Grading	Graded		

Course 1: Foundations in Philosophy	**6 ECTS (180hrs)**
Program related Learning outcomes (see pp. 3-4)	Students are able to • Read, understand and evaluate philosophical texts coming from different contexts (1.1) • Integrate philosophical insights into their broader academic and professional pursuits (3.2) • Apply principles of good scientific practice in philosophy (1.2; 3.3)
Additional specific module related learning outcomes	Students are able to • Identify central claims, reconstruct arguments, and analyse key concepts in philosophical texts • Critically assess objections and responses within philosophical arguments • Apply basic hermeneutic methods, including close attention to textual detail, conceptual structure, and historical context • Distinguish between different interpretative approaches (thematic, problem-oriented, and author-centred) • Establish connections between classical philosophical discussions and contemporary debates on human understanding, communication, and forms of intelligence
Contents	• Selected philosophical problems, texts, and authors, thematically and problematically organized. • Foundational questions concerning understanding, knowledge, and cognition across major periods of Western philosophy • Hermeneutic approaches to philosophical texts: methods of close reading, conceptual analysis, and historical contextualisation • The interpersonal and societal dimensions of knowledge: dialogical thinking, communication, and forms of under-standing

	• Connections between selected philosophical discussions and contemporary debates concerning human understanding, communication, and forms of intelligence
Teaching and learning formats	Course materials, and thematic focus, and learning format vary according to the expertise of the instructors responsible for the course. See syllabus
Related programs	M. Sc. / M. A. Human and Artificial Intelligence
Course 2: Philosophical Methods	**2 ECTS (60 hrs)**
Program related Learning outcomes	Students are able to: • Read closely primary texts, recognize arguments, identify (and question) assumptions and interpretative stances (1.1) • Compare different interpretations of the same philosophical text, learning how to evaluate and question them (1.1) • Engage constructively with feedback and systematically revise their opinions and written work (1.1) • Apply conventions of academic citation and source integration correctly (3.3)
Additional specific module related learning outcomes	Students are able to: • Identify argumentative structures and meaningful units within philosophical texts • Draft and revise short analytical texts in philosophy, observing the requirements of philosophical writing • Evaluate texts and arguments from the perspective of clarity and argumentative rigour • Work productively with primary philosophical texts and, where appropriate, selected secondary literature
Contents	• Close reading of philosophical texts: collaborative annotation and textual structuring • Argument reconstruction: identifying argumentative structures and meaningful units within texts • Interpretative discussion: methods for moving from initial reading to guided interpretation • Drafting and revising short analytical philosophical texts • Requirements of philosophical writing: conceptual precision and argumentative rigour • Engaging constructively with feedback and systematically refining written work
Teaching and learning formats	Hands-on; learn-by-doing
Related programs	M. Sc. / M. A. Human and Artificial Intelligence

Foundations Module 4			**8 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**240 hours**
Module No.	2M-HAI-FO4		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Course 1: Elective course (6 ECTS) One course must be selected from all elective courses and must be approved by the academic mentor. Course 2: Method course (2 ECTS) Methods course from Foundation Modules to be decided in accordance with the academic mentor.		
Instructor	Depending on needed academic mentorship		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Course 1: Elective Course			**6 ECTS** **(180hrs)**
Program related Learning outcomes (see pp. 3-4)	Students are able to • Focus on a specialized disciplinary or interdisciplinary research area (1.1) • Demonstrate comprehensive knowledge of their chosen area (1.1) • Critically evaluate literature and propose new research questions (2.1) • Reflect on their learning and recognize connections (3.1) • Raise new research questions in preparation for their Master's thesis (2.5)		
Contents	To be decided in accordance with an Academic Mentor		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		
Course 2: Methods Course			**2 ECTS** **(60 hrs)**
Program related Learning outcomes	Students are able to: • Apply selected methods of the three fields of the program (3.3)		
Contents	• To be decided in accordance with an Academic Mentor		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Deep Learning Module			**6 ECTS**
Recommended Semester	**2nd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-DLM		
Duration	One semester		
Course frequency	Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	Deep Learning		
Instructor	Prof. Dr. Josif Grabocka		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Explain core concepts and techniques in deep learning. (1.1) • Train neural networks following both predictive and generative objectives (2.4) • Apply deep learning methods to solve real-world problems. (1.2) • Understand the ethical implications of deep learning. (1.4; 2.3)		
Additional specific module related learning outcomes	Students are able to • Evaluate the performance of deep networks using statistical methods.		
Contents	• Introduction to artificial intelligence and machine learning • Supervised and unsupervised learning • Neural networks and deep learning • Model evaluation and validation		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence M.Sc. Artificial Intelligence and Robotics		

Cognitive Psychology Module			**6 ECTS**
Recommended Semester	**2nd semester**	**Total Workload**	**180 hours**

Module No.	2M-HAI-COP
Duration	One semester
Course frequency	Summer semester
Module language	English
Admission requirements	None
Associated courses	Cognitive Psychology
Instructor	Prof. Dr. Magdalena Abel
Examination	Project / Written examination under supervision / Oral examination
Grading	Graded
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand major theories and models of human cognition (1.1) • Describe the cognitive processes involved in different areas such as perception, attention, learning and memory, decision-making, reasoning, and/or problem solving (2.2)
Additional specific module related learning outcomes	Students are able to • Read and critically evaluate empirical studies on human cognition.
Contents	• Theories and models of human cognition • Cognitive processes, e.g. in: perception, attention, memory, decision-making, reasoning, and/or problem solving • Experimental methods in cognitive psychology
Teaching and learning formats	See syllabus
Related programs	M. Sc. / M. A. Human and Artificial Intelligence

Epistemology Module			**6 ECTS**
Recommended Semester	**2nd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-EPI		
Duration	One semester		
Course frequency	Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	Epistemology		
Instructor	Prof. Dr. Miklos Redei		
Examination	Written examination without supervision / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • critically assess different philosophical positions about knowledge (1.1) • distinguish different ways of assessing knowledge claims including qualitative and quantitative confirmation (1.2) • understand and apply norms regulating belief formation, in particular in the Bayesian framework that uses probability theory to describe belief change (4.3) • understand and apply central epistemological concepts such as different forms of explanation (2.1)		
Additional specific module related learning outcomes	Students are able to • be aware of arguments distinguishing science and pseudo-science • see some limitations of human knowledge		
Contents	• The verificationist and falsificationist positions about knowledge, their shortcomings • Methodology of scientific research programmes • Paradigmatic knowledge production and scientific revolutions • Hypothetico-deductive confirmation; confirmation criteria and incremental qualitative confirmation • Interpretations of probability • Bayesian confirmation theory • Deductive nomological and inductive-statistical explanations		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

AI & Ethics Module			**6 ECTS**
Recommended Semester	**3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-AIE		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	AI & Ethics		
Instructor	Prof. Dr. Michael Klenk Prof. Dr. Steffen Eger		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand the principles of trustworthy and explainable AI. (1.1; 1.4) • Analyze ethical issues related to the development and deployment of AI systems. (2.3) • Develop explainable AI models that prioritize transparency and accountability. (2.4; 4.1) • Apply philosophical frameworks to evaluate the ethical implications of AI technologies. (4.2)		
Contents	• Principles of trustworthy and explainable AI • Methods for enhancing transparency in AI systems • Ethical frameworks for evaluating AI technologies • Case studies on the ethical implications of AI • Techniques for building explainable AI models • Interdisciplinary approaches to AI ethics		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

AI & Psychology Module			**6 ECTS**
Recommended Semester	**3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-AIP		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	AI & Psychology		
Instructor	Prof. Dr. Michael Roth Prof. Dr. Charlotte Grosse Wiesmann		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand the most prominent theories of human learning. (1.1) • Understand different paradigms and types of AI learning. (1.1) • Identify and explain the fundamental similarities and differences between human and AI learning. (1.1) • Identify and explain how human cognition and AI development influence each other. (2.1)		
Additional specific module related learning outcomes	Students are able to • Evaluate the extent to which specific deep learning architectures mirror or differ from human cognitive processes. (1.4)		
Contents	• Principles of human cognition and learning • AI model architectures • Core similarities between human and AI learning • Core differences between human and AI learning • How psychology inspires AI design • How AI models test psychological theories		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Philosophy, Psychology & AI Module			**6 ECTS**
Recommended Semester	**3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-PPA		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Philosophy, Psychology & AI		
Instructor	Prof. Dr. Dana Jalobeanu Prof. Dr. Magdalena Abel		
Examination	Written examination without supervision / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand major philosophical and psychological theories dealing with key concepts such as consciousness, the construction of the self, perception, awareness, and their implications for intelligence in minds and machines. (1.1; 4.3) • Read and critically evaluate empirical studies from psychology and neuroscience that examine conscious experience. (1.1) • Integrate interdisciplinary perspectives to argue about the nature, measurement, and possible realization of consciousness in biological and artificial systems. (1.1) • Critically reflect on the historical, ethical and societal implications of artificial intelligence (3.2) • Analyze ethical and societal implications of attributing (or denying) consciousness to artificial agents. (3.2)		
Additional specific module related learning outcomes	This interdisciplinary module aims to foster a dialogue between psychology, philosophy of mind and history of philosophy. It will focus on key concepts such as consciousness, the construction of the self, perception, awareness, and others. It will critically explore ethical and societal implications thereby connected. Each year, the specific focus will change, reflecting the expertise of the teachers involved.		
Contents	• Key psychological concepts across psychology and philosophy • Empirical research on consciousness • Philosophical perspectives on the role of technology in society • Historical and contextual developments of key-concepts in psychology and philosophy of mind, theoretically organized and problematized		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Elective Module 1			**6 ECTS**
Recommended Semester	**2nd or 3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-EL1		
Duration	One semester		
Course frequency	Winter or Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	One course must be selected from all interdisciplinary or advanced courses and must be approved by the academic mentor.		
Instructor	Depends on selected course		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Focus on a specialized disciplinary or interdisciplinary research area; (1.1) • Demonstrate comprehensive knowledge of their chosen area; (1.1) • Critically evaluate literature and propose new research questions; (2.1) • Reflect on their learning and recognize connections; (3.1) • Raise new research questions in preparation for their Master's thesis. (2.5)		
Contents	• See syllabus (varies by course)		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Elective Module 2			**6 ECTS**
Recommended Semester	**2nd or 3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-EL2		
Duration	One semester		
Course frequency	Winter or Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	One course must be selected from all interdisciplinary or advanced courses and must be approved by the academic mentor.		
Instructor	Depends on selected course		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Focus on a specialized disciplinary or interdisciplinary research area; (1.1) • Demonstrate comprehensive knowledge of their chosen area; (1.1) • Critically evaluate literature and propose new research questions; (2.1) • Reflect on their learning and recognize connections; (3.1) • Raise new research questions in preparation for their Master's thesis. (2.5)		
Contents	• See syllabus		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Elective Module 3			**6 ECTS**
Recommended Semester	**2nd or 3rd semester**	**Total Workload**	**180 hours**
Module No.	2M-HAI-EL3		
Duration	One semester		
Course frequency	Winter or Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	One course must be selected from all interdisciplinary or advanced courses and must be approved by the academic mentor.		
Instructor	Depends on selected course		
Examination	Written examination without supervision / Written examination under supervision / Oral examination		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Focus on a specialized disciplinary or interdisciplinary research area; (1.1) • Demonstrate comprehensive knowledge of their chosen area; (1.1) • Critically evaluate literature and propose new research questions; (2.1) • Reflect on their learning and recognize connections; (3.1) • Raise new research questions in preparation for their Master's thesis. (2.5)		
Contents	• See syllabus (varies by course)		
Teaching and learning formats	See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Key Competencies Basic Module			**6 ECTS**
Recommended Semester	**1st semester**	**Total Workload**	**180 hours**
Module No.	8M-KCO-KCB		
Duration	One semester		
Course frequency	Winter semester		
Module language	English		
Admission requirements	None		
Associated courses	Good Scientific Practice Democratic Citizenship Resilience All three courses have to be completed		
Instructor	Depending on course		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Pass/Fail		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Understand basic principles of good scientific practice. (3.3) • Identify different forms and situations of scientific misconduct and apply strategies to avoid them. (3.3) • Demonstrate values of a democratic society as well as sustainable environment and act accordingly. (4.1) • Reflect on technology leadership and knowledge of ethics and relate them to current and future socio-technical contexts. (3.2; 4.3) • Understand different techniques to cope with stress and adverse working conditions. (3.5) • Act effectively in global and personal challenges and continuously develop their own expertise and learning. (3.5)		
Contents	• Good Scientific Practice Students learn the rules and values of responsible and ethical research. This includes handling data, sources, and ideas of others, citation rules, forms of scientific misconduct and how to avoid them, and research ethics. • Democratic Citizenship Students acquire knowledge about principles of vivid democracies and civic rights and responsibilities and foster the respect for diversity. They know how to engage actively and responsibly in democratic processes and civic life and learn how to responsibly use their specialized knowledge and be aware of unintended consequences of their actions. • Resilience Students acquire techniques to cope with stress and manage diverse challenges with resilience in a productive way. They will use methods for effectively analyzing problems and generating creative solutions to overcome obstacles. Furthermore, students learn strategies for setting realistic goals and maintaining motivation to achieve them, even in face of adversity.		
Teaching and learning formats	Courses are offered in weekly sessions or as block courses during the course-free period. The syllabus specifies the course content.		
Related programs	M.Sc. Human and Artificial Intelligence M.Sc. Artificial Intelligence and Robotics		

Key Competencies Module 1			**6 ECTS**
Recommended Semester	**4th semester**	**Total Workload**	**180 hours**
Module No.	8M-KCO-KC1		
Duration	One semester		
Course frequency	Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	Students select KQ courses that provide a total of 6 ECTS points (usually 2-3 courses) per module. A total of 6 ECTS points must be earned from the available KQ courses.		
Instructor	Depends on selected course		
Examination	Project / Written examination under supervision / Oral examination		
Grading	Pass/Fail		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Apply key techniques and methodologies needed to work in an academic and professional environment; (3.4) • Communicate effectively in foreign languages; (3.5) • Reflect on and extend their knowledge independently. (3.1)		
Contents	Students develop academic and professional key competencies. Students select two or three courses from the key competencies course offerings. The syllabus outlines the specific course content.		
Teaching and learning formats	Courses are offered in weekly sessions or as block courses during the course-free period. The syllabus outlines specific course information.		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence M.Sc. Artificial Intelligence and Robotics		

Learning in Transformation Module			**12 ECTS**
Recommended Semester	**2nd and 3rd semester**	**Total Workload**	**360 hours**
Module No.	2M-HAI-LIT		
Duration	Two semesters		
Course frequency	Summer semester		
Module language	English		
Admission requirements	None		
Associated courses	Transformative Learning Project		
Instructor	1-2 professor(s) from any department who can supervise the projects and coaches/teaching assistants		
Examination	Project		
Grading	Pass/Fail		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Identify steps to solving a real-world research problem and design an action plan to implement these steps; (2.5; 3.3; 3.4) • Develop and test a working prototype; (2.5) • Critically evaluate and provide feedback on solution approaches from other student groups; (4.2) • Explain and present the solution approach to the stakeholder(s) and peers; (4.2) • Assess/evaluate the outcome of the project and defend the development steps. (4.2)		
Contents	The Learning in Transformation Project is an interdisciplinary scientific research project that focuses on practical learning experiences. It aims to provide students with a scientific-based approach to solve real-world problem with industrial, societal, or political problems working with non-university stakeholders. The project encourages students to creatively apply their prior knowledge to solve these problems in groups. For further information see the syllabus.		
Teaching and learning formats	The module combines learning units, discussion and supervision sessions, field trips, and a high proportion of independent work within student groups (guided by an instructor). Over the course of two semesters, milestones help structuring the project planning and assure that the group is on track and on time. Students document the project and learning progress. For further information see the syllabus.		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		

Master Thesis Module			**24 ECTS**
Recommended Semester	**4th semester**	**Total Workload**	**720 hours**
Module No.	2M-HAI-THE		
Duration	One semester		
Course frequency	Winter and summer semester		
Module language	English		
Admission requirements	None		
Associated courses	Master Colloquium		
Instructor	Student select the thesis advisor		
Examination	Thesis and oral exam		
Grading	Graded		
Program related Learning outcomes (see pp. 3-4)	Students are able to • Formulate a research question in AI and robotics, select the appropriate methodology and literature, and design an evaluation strategy; (1.1) • Use scientific methods to propose an innovative solution to a complex problem; (3.3) • Critically analyze and evaluate theories and approaches and reflect on their assumptions and limitations in an interdisciplinary context; (2.1) • Integrate knowledge from different domains to create novel solutions to the research problem; (2.4) • Independently plan a research project within a given time frame; (3.4) • Apply the rules of good scientific practice to all parts of the research project; and (3.3) • Structure and communicate research results in accordance with academic standards. (4.2)		
Contents	The students select their research topics in coordination with their advisor. The students present their work during a research colloquium that takes place during the term/semester.		
Teaching and learning formats	Independent research and colloquium See syllabus		
Related programs	M. Sc. / M. A. Human and Artificial Intelligence		