JÖNKÖPING UNIVERSITY
School of Engineering

PROGRAMME SYLLABUS
Preliminary, not confirmed

AI Engineering (master), 120 credits

AI Engineering (master), 120 högskolepoäng

Programme Code:	TAAI1	Programmestart:	Autumn 2026
Confirmed:		Education Cycle:	Second-cycle level

Title of qualification

Degree of Master of Science (120 credits) with a major in Computer Science specialisation in Artificial Intelligence (AI) Engineering

Teknologie Masterexamen med huvudområdet datavetenskap inriktning Utveckling av AI-system

Programme overview

Main field of study
"Computer science (CS) is the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society." (Tucker, Allen, ACM, 2006.)

The Computing Sciences Accreditation Board—which is made up of representatives of the Association for Computing Machinery (ACM), and the IEEE Computer Society (IEEE CS)—identifies four areas that it considers crucial to the discipline of computer science: theory of computation, algorithms and data structures, programming methodology and languages, and computer elements and architecture.

In addition to these four areas, CSAB also identifies a large number of fields as being important areas of computer science, e.g., software engineering, artificial intelligence, database systems, parallel and distributed computation, computer networking and communication, operating systems, human–computer interaction, and computer graphics.

The scientific basis for computer science is logic and discrete mathematics. Consequently, mathematical deduction is an important tool. Scientific studies in computer science are usually conducted using quantitative methods from science or engineering. The most typical research approach is controlled experiments, with subsequent statistical analysis and inference; but traditional social science methods like case studies and interviews can be used where appropriate. Another approach is design science, where an IT-artifact is developed to demonstrate how concepts, theories, models and methods work in practice.

Computer science is related to computer engineering, which in turn has a strong connection to electrical engineering. Internationally, computer science is broadly defined, specifically, hardware and computer architectures are usually included, as can also be seen from CSAB's description above. In Sweden, the distinction is often made that computer engineering mainly studies the design and construction of computers and other hardware, while computer science focuses on software systems. Areas such as hardware programming, internet-of-things, embedded systems and robotics are thus shared between the two subjects.

Computer science is also related to information systems, and the border between the two subjects is not sharp. In computer science, the information technology is usually studied from a scientific or an engineering perspective, typically with a focus on the computer system itself. Information systems, on the other hand, mainly uses methods from social science while emphasizing the business context and processes around the IT systems.

Studies in computer science grants knowledge about, e.g., the theoretical underpinnings of computer science, their implementations in computer systems, methods for software development, and methods for evaluating systems and other deliverables. The student develops skills in analyzing problems, systems, and data, in designing and programming tools and systems, in evaluating technology and its uses, and in doing all of this both independently and in collaboration with others.

At JU, computer science is organized under the discipline Industrial Product Realization. Product realization is defined as including all tasks and activities needed to develop solutions to customer needs, and to realize these solutions through physical products and associated services. Research and education in this discipline can focus on specific parts of the product realization process or apply a holistic perspective. Industrial product realization is characterized by customer adaptation, standardization, flexible production, and automation. The process often includes market- and customer analyses, structured requirements elicitation and management, analyses of production processes and materials, optimization of components, systems, and logistics flows, and development of product lifecycle support services (including usage analyses supporting maintenance, product development, and product recycling). Research and education in computer science support these tasks by way of methods and techniques for scalable data analysis, systems development, and intelligent embedded digital solutions.

Background

As a general term, Artificial Intelligence (AI), is the use of intelligence by machines. In computer science, an ideal intelligent machine is one that perceives its environment and takes actions that maximize its chances of achieving some objective. Machine intelligence at human levels is still in the future, but deep learning and edge computing are currently transforming industry and society. Medical diagnosis, personal assistants, surveillance systems, robotic manufacturing, remote sensing, machine translation, speech understanding, financial services, electronic trading, cybersecurity, combat and training simulators, mission management aids, web search, video games, code analysis, tactical decision support systems, product recommendations, and autonomous cars are some examples of applications. These and other applications use AI techniques to interpret data that originates from multiple sources and apply the extracted information in a targeted and intelligent way.

Contemporary AI often involves self-learning systems trained on large amounts of data or interacting intelligent agents that perform distributed computing and reasoning. AI connects sensors with algorithms and human-computer interfaces and extends to large networks of intelligent devices. AI is a rapidly developing research field and one of the driving forces of today's economy. By combining traditional lectures with seminars and lab sessions, the AI master programme aims to teach students the basics of theory and provides hands-on experience in each subject. The acquired knowledge is applied to practical work on real applications through the development, implementation and testing of running software code.

A master's degree in AI opens up career opportunities within companies that build the next generation of AI enhanced products; for example, smart personal assistants, opinion mining systems, customer service systems, biomedical applications, games, computers, intelligent adaptive devices, robots, intelligent planning systems and so on. The programme provides the skills needed for many positions in today’s industry or research centres.

Objectives

The Master Program in AI Engineering aims to develop the knowledge, skills and experiences required to work in companies and organizations that develop products and services with substantial software content. Students develop and/or evaluate software that implements AI solutions. The program also covers additional special topics such as safety and security issues related to AI software solutions. The program involves practical work and technical research.

Post-graduation employment areas

This Master's programme focuses on the development of intelligent software products and services. Specifically, AI, machine learning, and data science are covered in detail. Applications include, but are not limited to, internet-of-things, data analytics and smart cities. The programme enables graduates to aim for the more senior roles in the development of software products aimed at solving AI related problems as well as software products based on AI techniques. The education is also meant to prepare students for research in computer science, possibly within doctoral studies.

Graduates will have developed the capabilities needed to work in both large corporations and smaller specialized software shops. They will be comfortable with delivering major enterprise systems or specialized software components providing AI services across the spectrum of software development, from back-end data processing to Internet-related front-ends.

Objectives

Common learning outcomes

After the completion of the programme, students must meet the intended learning outcomes, as described in The Higher Education Ordinance by Degree of Master (1-9), and also the intended learning outcome, as described by JTH:

Knowledge and Understanding

1. demonstrate knowledge and understanding in the main field of study, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work
2. demonstrate specialised methodological knowledge in the main field of study

Competence and Skills

3. demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information
4. demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work
5. demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences
6. demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity

Judgement and Approach

7. demonstrate the ability to make assessments in the main field of study informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work
8. demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used
9. demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning

JTH. prove ability to embrace interdisciplinary approaches

Programme-specific learning outcomes

Upon completion of the program, the intended learning outcomes provided for programme must also be met.

Knowledge and Understanding

10. display knowledge of the fundamental tasks, methods and algorithms for data analysis
11. display knowledge of the current state-of-the-art in AI, machine learning and data science
12. demonstrate an understanding of the basic algorithms and methods in machine learning
13. demonstrate an understanding of the development of software utilizing AI or machine learning

Competence and Skills

14. demonstrate the ability to implement and test basic learning algorithms based on pseudocode or formal specifications
15. display an ability to use established tools for ontology development, for the processing, storage, and querying of linked data, and for the validation and visualization of linked data and ontologies
16. demonstrate the ability to explain the ways some of the ethical concerns of AI are addressed, both practically and theoretically
17. demonstrate the ability to implement various machine learning and deep learning architectures, including feed-forward, convolutional, recurrent and generative neural networks

Judgement and Approach

18. demonstrate a skill to compare and evaluate different representations and algorithms for intelligent agents
19. demonstrate a skill to suggest suitable AI and machine learning approaches to real-world problems

Contents

Programme principles

A key principle for the program is the treatment of AI as both an integrated part in systems and products and a tool to be used for Data Science and decision support. The program builds upon theoretical knowledge on AI to help acquire practical skills in applying machine learning for data analysis and skills on programming machine learning as well as knowledge on how to utilize the strengths of different hardware platforms. The AI perspective is complemented by the program’s emphasis on growing the competence of the students as professional engineers. The CDIO Initiative™ underpins a new vision for engineering education. By mapping the Curriculum Guidelines for Graduate Degree Programs in AI Engineering and to the AI Engineering Body of Knowledge, the degree builds upon the work of professional software bodies. A commitment to “evidence-based AI engineering” helps students to understand the importance of sound research over hype and myth in the AI field.

Collaboration with businesses and institutions ensures that the program reflects "real-world" Computer Science needs while lectures from external AI software engineers provide a counterpoint to the academic view of software development. The program embraces the Agile Manifesto philosophy which favors a flexible approach to the frequent delivery of working code over a rigid adherence to processes and plans.

Instruction is in the form of lectures, seminars, exercises, laboratory sessions and project work. All courses are held in English. All final course examinations are in English.

Research basis

Computer science, including AI, machine learning and big data analytics, is a major area of research within the School of Engineering. It is underpinned by the Knowledge-Intensive Product Realization research environment (SPARK). Within the Department of Computing there is a strong focus on research related to data analytics, machine learning, and the creation and enhancement of algorithms that improve application effectiveness and efficiency.

The exponential growth of the digital society, particularly in the form of storage and computing power in recent decades, enables companies to accumulate vast amounts of data at a moderate cost. This technological shift has been accompanied by a widespread recognition that the collected data may contain valuable information. Exploiting this stored data, to extract useful and actionable information, is the overall goal of the generic activity termed data analytics. The AI research at Jönköping University focuses on developing machine learning algorithms for data analytics, when necessary, utilizing high performance computing. Most research is applied, and often co-produced with industry.

The focus of this Master's degree program is on the development of intelligent software products and services. In particular, AI, machine learning, deep learning, and data science are covered in detail. Applications include Internet-of-things, data analytics, and smart cities, among others. The programme enables graduates to aim for more senior roles in the development of software products aimed at solving AI related problems as well as software products based on AI techniques. The education is also meant to prepare students for computer science research, possibly through doctoral studies.

Graduates will have developed the capabilities needed to work in both large corporations and smaller specialized software shops. They will be comfortable delivering major enterprise systems or specialized software components and providing AI services across the spectrum of software development, from back-end data processing to Internet-related front ends.

Equal terms, gender equality and diversity

The School of Engineering (JTH) strives in all its activities to ensure that all individuals are given equal opportunities and treated equally. At both the JU and JTH levels, this is reflected in governing documents concerning organizational and personnel matters, the establishment and delivery of programmes and courses, as well as the monitoring of educational quality. At JTH, student influence is also ensured through student representation in various educational and industry councils.

Questions related to equality, gender equality, and diversity are addressed in the courses *Ethics of Artificial Intelligence*, *Machine Learning*, and *Research Methods for Intelligent Systems* through content and learning objectives centered around inclusion, diversity, and AI's societal impact.

Study abroad

JTH has internationalization as a focus area where the educational programmes include opportunities for both international experiences at home as well as various opportunities to do internships and study abroad, giving students valuable experiences and skills to prepare them for a global labour market.

Semester 3 of the programme is intended as an exchange semester. The student chooses substitute courses for the compulsory courses of the programme and the choice of courses is made in consultation with the programme manager via Jönköping University's internal system for study abroad.

Programme progression

Year 1

First semester

The course *Artificial Intelligence* (AI) is a fundamental course in artificial intelligence with a focus on traditional AI, i.e., GOFAI (Good Old-Fashioned Artificial Intelligence). The course covers many different basic and intermediate topics in the field, alternating theory with practice, it introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence. Upon completion of the course, the students should be able to develop basic intelligent systems and understand the role of knowledge representation, inference, search and learning in intelligent- system engineering. Those students who have already taken the course *Artificial Intelligence* (TAIK19) must select an alternative course on advanced level within the fields of computer engineering, informatics, or mathematics. In parallel the course *Mathematics for Intelligent Systems* contains elements from various fields of mathematics and mathematical statistics used when intelligent systems and machine learning are developed, used and analyzed.

The course *Knowledge Representation and Reasoning (KRR)* introduces students to how machines model, represent, and reason about knowledge, enabling AI systems to handle both complex structured and unstructured data, make logical inferences, and solve real-world problems. It covers both foundational and advanced topics in KRR and teaches students how to apply these concepts to enhance the capabilities of AI systems across various domains. The course *Data Science* introduces students to fundamental topics in data analysis and develops their skills in performing data analysis using software tools. The course covers the standard data analysis techniques and their application to different business domains.

Second semester
The *Machine Learning* course introduces the basics of machine learning, focusing on basic building blocks, families of machine learning algorithms and how to evaluate performance. In parallel the course *Intelligent Optimization and Problem Solving* equips students with advanced knowledge and practical skills in combinatorial optimization and declarative problem solving, preparing them to tackle complex challenges across various industries. Students will gain a comprehensive understanding of declarative methods and meta-heuristic approaches, learning to model, optimize, and solve real-world problems using state-of-the-art tools and techniques. The course emphasizes hands-on experience and innovative thinking to foster adaptability in problem solving.

The course *Deep Learning* covers basic and state-of-the-art algorithms for training various deep neural network architectures, alternating theory with practice. The course includes assignments where the students both implement various deep learning algorithms from scratch and use modern deep learning software. The course *Research Methods for Intelligent Systems* covers the theoretical foundations of typical research approaches in artificial intelligence and related areas as well as common research methods and ways of reporting research findings.

Year 2

First Semester
The course *Ethics of Artificial Intelligence* gives an introduction to the ethics of AI, discussing ethical concerns that arise from the use and development of AI. As a parallel course, *Reinforcement Learning* offers a solid introduction to reinforcement learning's main approaches and challenges. The course includes elements such as Markov Decision Processes (MDPs), model-based and model-free prediction and control, on-policy and off-policy methods, Monte Carlo, Temporal Difference, Policy-Gradient, and Actor-Critic methods, exploration versus exploitation trade-off, including regret, bias versus variance trade-off, stability, function approximation, Deep Reinforcement Learning, Imitation Learning, and Reinforcement Learning with Human Feedback (RLHF).

The course *State-of-the-Art in AI Research* discusses selected topics and methods within AI, machine learning and their applications. Examples may include areas, such as computational intelligence algorithms in search, optimization and classification, natural language processing and FAT (fairness, accountability, transparency) aspects. Examples of relevant applications could include robotics, music, health and medicine. In parallel, in the *Industrial Placement Course* (NFK), students will gain real workplace experience with a collaborating organization.

Second semester
The fourth and final semester focuses on further developing the students' analytical skills and ability to perform independent and critical research in the area of Computer Science, specialization in AI. Students spend the semester writing a 30 credit *Master Thesis in Computer Science* on a topic related to AI.

Courses

Course changes can occur, as long as they do not substantially affect the programme's content and learning goals.

Mandatory courses

Semester	Course Name	Credits	Main field of study	Specialised in	Course Code
1	Artificial Intelligence	7.5	Computer Science	A1N	TARI29
1	Data Science	7.5	Computer Science	A1N	TDSR22

1	Knowledge Representation and Reasoning	7.5	Computer Science	A1N	TKRR25
1	Mathematics for Intelligent Systems	7.5		A1N	TMAR21
2	Deep Learning	7.5	Computer Science	A1F	TDIS22
2	Intelligent Optimization and Problem Solving	7.5	Computer Science	A1F	TIOS26
2	Machine Learning	7.5	Computer Science	A1F	TMLS22
2	Research Methods for Intelligent Systems	7.5	Computer Science	A1F	TRIS22
3	Possibility to study abroad	30			
3	Ethics of Artificial Intelligence	7.5	Computer Science	A1N	TAIR22
3	Reinforcement Learning	7.5	Computer Science	A1F	TFSS25
3	Industrial Placement Course in Computer Science	7.5	Computer Science	A1F	TNDS22
3	State-of-the-Art in AI Research	7.5	Computer Science	A1F	TSFS22
4	Final Project Work in Computer Science	30	Computer Science	A2E	TEXV23

Teaching and examination

The academic year is divided into two semesters, and the semesters into two study periods. In each study period two courses are generally taken in parallel. Assessment is part of each course or module. Modes of assessment and grades are shown in each course syllabus.

Entry requirements

The applicant must hold the minimum of a bachelor’s degree (i.e the equivalent of 180 ECTS credits at an accredited university) with at least 90 credits in computer engineering, computer science or electrical engineering (with relevant courses in computer engineering), or equivalent. The bachelor’s degree should comprise a minimum of 15 credits in mathematics. Proof of English proficiency is required.

Continuation Requirements

In order to begin the second year, at least 37,5 credits from the programme's first year must be completed.

Qualification Requirements

To obtain a Degree of Master of Science (120 credits) with a major in Computer Science, specialisation in AI Engineering, students must complete a minimum of 120 higher education credits in accordance with the current programme syllabus, at least 60 of which must be in the main field of study Computer Science and 21 credits in Mathematics.
In addition a Degree of Bachelor of Science in Engineering/Degree of Bachelor of Science or an equivalent Swedish or foreign qualification is required.

Quality Development

At JTH, systematic quality assurance is carried out within JU's established quality system. This system, based on the requirements of the Higher Education Act, the Higher Education Ordinance, and the Standards and Guidelines for Quality Assurance in the European Higher Education Area, has been reviewed and approved by the Swedish Higher Education Authority.

Active and continuous course evaluation, including student feedback through course surveys, forms one of the cornerstones of this system. Annual programme evaluations and student representation in JTH's various educational and industry councils are two additional examples.

Other Information

Admission is under ‘Admission regulations for first- and second cycle courses and study programmes at Jönköping University (Admission regulations)’.

This syllabus is based on ‘Regulations and guidelines for first-, second- and third-cycle education at Jönköping University’.