MASTER OF SCIENCE IN ARTIFICIAL INTELLIGENCE SYSTEMS

Artificial Intelligence has gained a central position in society and economic systems worldwide. It radically changes our relationship with the significant issues of the contemporary world, including health, security, production, transportation, and education. The role of Artificial Intelligence is central to society and will continue to grow. At the same time, implementing computer systems that express such innovation requires a methodological and architectural foundation in software development and database design. The pathway of the Master of Science in Artificial Intelligence Systems incorporates the fundamental features of the changes taking place with a vision attentive to the future evolution of Artificial Intelligence and computer systems development.

The major topics addressed include interoperability among information systems, database development (including multimedia), knowledge management, personalized information services, autonomous and multi-agent systems, web-centric services, data warehouses, and machine learning.

The Master of Science in Artificial Intelligence Systems offers two areas of concentration:

Methodologies and Applications with three subareas

Machine Vision

Machine Vision focuses on enabling computers to interpret and make decisions based on visual inputs. This minor explores the fundamental principles of image processing, pattern recognition, and computer vision. Students will explore techniques for object detection, facial recognition, and scene understanding, as well as the underlying algorithms, such as convolutional neural networks (CNNs) and deep learning frameworks that power these technologies. Practical applications include developing systems for autonomous vehicles, medical image analysis, and industrial inspection. By mastering these concepts, students can create solutions that enhance the capability of machines to understand and interact with their environments visually.

In addition to theoretical knowledge, the Machine Vision minor emphasizes hands-on experience with state-of-the-art tools and software. Students will engage in projects that require them to apply their learning to real-world problems, such as developing vision systems for drones or robotic assistants. This practical approach ensures graduates are well-equipped to tackle challenges in various industries, from healthcare to automotive.

By the end of the program, students will have a comprehensive understanding of how to design, implement, and optimize robust and efficient vision systems.

Methodologies

The Methodologies minor program is dedicated to the systematic approaches and best practices in developing and deploying artificial intelligence systems. This area covers essential topics such as algorithm design, data science, and statistical methods, providing students with a strong foundation in the theoretical underpinnings of AI. It also includes an in-depth study of machine learning models, including supervised, unsupervised, and reinforcement learning techniques. Students learn to select the appropriate models for specific tasks, tune them for optimal performance, and assess their effectiveness using various metrics and validation techniques. The program also emphasizes hands-on experience, where students gain proficiency in software development practices tailored to AI projects, including agile methodologies, version control, and collaboration tools.

Students will also gain proficiency in software development practices tailored to AI projects, including agile methodologies, version control, and collaboration tools. The curriculum emphasizes the importance of ethical considerations and responsible AI, focusing on addressing bias, ensuring fairness, and promoting transparency. Through case studies and hands-on projects, students apply these methodologies to real-world scenarios, preparing them to lead AI initiatives in diverse fields such as finance, healthcare, and technology.

By the end of the minor, students will be equipped with the skills to design, implement, and manage reliable, ethical, and scalable AI systems.

Intelligent Robots

The Intelligent Robots minor is a unique program integrating AI with robotics to create autonomous systems capable of performing complex tasks. This minor covers the fundamentals of robotics, including kinematics, dynamics, and control systems, as well as advanced topics such as sensor integration, path planning, and autonomous navigation. Students will learn how to develop algorithms that enable robots to perceive their surroundings, make decisions, and execute actions in dynamic environments. Key areas of study include robotic vision, motion planning, and human-robot interaction.

Practical experience is a cornerstone of this minor, with students participating in lab sessions and projects that involve designing, building, and programming intelligent robots. These projects may range from developing robotic arms for manufacturing to creating service robots for healthcare or hospitality. The curriculum also explores the ethical and societal implications of robotics, preparing students to address the challenges and opportunities that arise as robots become increasingly integrated into everyday life. Graduates will have the expertise to innovate in the rapidly evolving field of robotics, contributing to advancements in automation, artificial intelligence, and human-machine collaboration.

Artificial Intelligence and Innovation

The Artificial Intelligence and Innovation minor is designed to equip students with the skills and knowledge necessary to drive technological advancements and develop innovative solutions utilizing AI. This minor explores the intersection of AI and entrepreneurship, focusing on how artificial intelligence can be leveraged to create innovative products, services, and business models. Students will explore various AI technologies, including natural language processing, machine learning, and data analytics, and learn how to apply these technologies to solve real-world problems creatively.

Courses will include case studies of successful AI startups and companies, providing insights into the strategies and processes that lead to groundbreaking innovations.

In addition to technical proficiency, the minor emphasizes the importance of creativity, critical thinking, and strategic planning in the innovation process. Students will engage in hands-on projects that require them to conceptualize, design, and implement AI-driven solutions, often working in interdisciplinary teams to simulate real-world scenarios. The curriculum also covers intellectual property rights, funding, and the ethical implications of AI innovations, preparing students to navigate the complex landscape of technology development and commercialization.

By the end of the program, students will be equipped with the tools and mindset to lead and inspire AI-driven innovation across various industries, including healthcare, finance, entertainment, and beyond.

Educational Objectives and Methodology

The primary objective of the Master of Science in Artificial Intelligence Systems is to train professionals who are exceptionally competent in data and knowledge modeling, information flow analysis and decision-making, machine learning, automatic problem-solving, or, in general, in advanced techniques and models for software and database design and development. Graduate students can conceive, design, and develop information systems using modern artificial intelligence and distributed software systems development technologies. Students will have the skills necessary to solve problems posed by the growing need for integration and interaction between complex and potentially heterogeneous information systems. At the end of the master's program, graduates should be able to operate autonomously on projects and facilities, taking into account both the methodological and scientific training of students, as well as the development of practical and design skills.

Career Opportunities

The occupational fields for this study include the design, organization, management, and maintenance of complex information systems for organizations that utilize sophisticated and potentially geographically distributed information systems. Computer systems are particularly relevant for employment and professional advancement in industries, services, health, science, culture, cultural heritage, and public administration.

The innovative applications include artificial intelligence, machine learning, neural networks, soft computing, databases, business process management, automatic natural language processing, human-computer interaction, and multimedia databases. Our graduates can work as software architects, producing innovative computing solutions and services in research and development centers.

Curricular Program (36 CH)

The master's program offers four different curricula:

A. Core Courses (21 CH) These courses provide the foundation for upper-level graduate courses.

- COM 521 - Introduction to Robotics
- COM 525 - Artificial Intelligence
- COM 530 - Signal, Image, and Video
- COM 535 - Natural Language Understanding

- COM 621 - Human-Machine Dialogue
- COM 625 - Artificial and Biological Neural Systems
- COM 630 - Artificial Intelligence and Innovation

B. Concentration Area (9 CH). To complete the Master's degree in AIS, students must choose an area of concentration most relevant to their career goals. All courses build on what students have learned in the core courses of the Master's in Artificial Intelligence Systems program. Students should consult their advisor about scheduling to plan to complete the curriculum.

Methodologies and Applications

- **Computer Vision**
  COM 522 - Computer Vision
  COM 523 - Advanced Computer Vision
  COM 524 - Trends and Applications of Computer Vision

or

- **Methodologies**
  COM 526 - Advanced Computer Vision
  COM 527 - Advanced Topics in Machine Learning and Optimization
  COM 528 - Optimization Techniques

or

- **Intelligent Robots**
  COM 531 - Distributed Robot Perception
  COM 532 - Optimization-Based Robot Control
  COM 533 - Robot Planning and Its Application

Artificial Intelligence and Innovation

COM 536 - Bio-Inspired Artificial Intelligence
COM 537 - Innovation and Entrepreneurship Basic
COM 538 - Sensing and Radar Technologies

C. General Electives (3 CH), one course chosen by the student

COM 540 - Analysis and Visualization of Complex Networks
COM 541 - Performance Evaluation: Simulation and Modeling
COM 542 - Bioinformatics
COM 543 - Natural Language Technologies
COM 544 - Analysis and Processing of Digital Signals

D. Research and Master's Thesis (3 CH)

COM 690 - Master's Thesis