MOHAMED BIN ZAYED
UNIVERSITY OF
ARTIFICIAL INTELLIGENCE

MBZUAI Course Catalogue

AI701 - Artificial Intelligence

This course provides the students a comprehensive introduction to modern artificial intelligence (AI), and some of its representative applications. The students will be familiarized with both the historical and recent AI techniques that have proven successful in building practical systems.

AI702 – Deep Learning

This course provides a comprehensive overview of different concepts and methods related to deep learning. Students will first learn the foundations of deep learning, after which they will be introduced to a series of deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

COM701 - Research Communication and Dissemination

In this course, students will learn how to effectively communicate and disseminate their research findings, both orally and in written form, to the larger community. In addition to acquiring hard communication skills, students will also be familiarized with how these skills fit into a broader context, learning, for instance, the importance of peer review, how to select a journal or conference for publication, how to measure impact factor, how to gauge and adjust to different audiences, the various ethical issues that can arise, etc.

CV699 - Computer Vision Master's Research Thesis

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of one year. Master's thesis research helps train graduates to pursue more advanced research in their Ph.D. degree. Further, it enables graduates to independently pursue an industrial project involving a research component.

CV701 - Human and Computer Vision

This course provides a comprehensive introduction to the basics of human visual system and color perception, image acquisition and processing, linear and nonlinear image filtering, image features description and extraction, classification, and segmentation strategies. Moreover, students will be introduced to quality assessment methodologies for computer vision and image processing algorithms.

CV702 – Geometry for Computer Vision

The course provides a comprehensive introduction to the concepts, principles and methods of geometry-aware computer vision which helps in describing the shape and structure of the world. In particular, the objective of the course is to introduce the formal tools and techniques that are necessary for estimating depth, motion, disparity, volume, pose and shapes in 3D scenes.

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CV703 - Visual Object Recognition and Detection

This course provides a comprehensive overview of different concepts and methods related to visual object recognition and detection. In particular, the students will learn a large family of successful and recent state-of-the-art architectures of deep neural networks to solve the tasks of visual recognition, detection, and tracking.

CV704 - Advanced Techniques in Low-Level Vision

This course provides focused coverage of the following special topics: 1) image restoration and enhancement, 2) hand-crafted features, and 3) visual object tracking. The students will develop skills to critique the state-of-the-art works on the aforementioned problems. Moreover, students will be required to implement papers with the aims of, (1) reproducing results reported in the papers and (2) improving performance of the published works. This course builds upon concepts from Human and Computer Vision (course code: CV701) and assumes familiarity with fundamental concepts in image processing.

CV705 - Advanced 3D Computer Vision

The course exercises an in-depth coverage of special topics in 3D computer vision. The students will be able to critique the state-of-the-art methods on 3D reconstruction, 3D visual scene understanding and multi-view stereo. In addition, students will have to implement papers to accomplish the following goals: (1) reproduce results reported in the papers, and (2) improve the performance of published peer-reviewed works. This course builds upon concepts from Human and Computer Vision (CV701), Geometry for Computer Vision (CV702) and assumes that the students are familiar with the basic concepts of machine learning and optimization.

CV706 - Advanced Techniques in Visual Object Recognition and Detection

This course provides focused coverage of special topics on object recognition and detection. The students will develop skills to critique the state-of-the-art works on visual object recognition and detection. Moreover, students will be required to implement papers with the following aims: (1) reproduce results reported in the seminal research papers, and (2) improve the performance of the published works. This course builds upon concepts from Human and Computer Vision (CV701), Visual Object Recognition and Detection (CV702) and assumes familiarity with fundamental concepts in machine learning and optimization.

CV707 – Digital Twins

This course provides a comprehensive introduction to Digital Twins. Students will learn about digital twin technology, its common applications, and benefits, how to create a digital twin for predictive analytics using sensory data fusion, primary predictive modeling methods and how to implement and interacts with a digital twin using different platforms.

CV799 - Computer Vision Ph.D. Research Thesis

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of three to four years. Ph.D. thesis research helps train graduates to become leaders in their chosen area of research through partly supervised study, eventually transforming them into researchers who can work independently or interdependently to carry out cutting edge research.

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DS701 – Data Mining

This course is an introductory course on data mining, which is the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems.

DS702 – Big Data Processing

This course is an introductory course on big data processing, which is the process of analyzing and utilizing big data. The course involves methods at the intersection of parallel computing, machine learning, statistics, database systems, etc.

HC701 - Medical Imaging: Physics and Analysis

This course provides a graduate-level introduction to the principles and methods of Medical Imaging, with thorough grounding in the physics of the imaging problems. This course covers the fundamentals of X-ray, CT, MRI, Ultrasound, and PET, imaging. In addition, the course provides an overview of 3D geometry of medical images and a few classical problems in medical images analysis including classification, segmentation, registration, quantification, reconstruction and radiomics.

ML699 - Machine Learning Master's Research Thesis

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of one year. Master's thesis research helps train graduates to pursue more advanced research in their Ph.D. degree. Further, it enables graduates to independently pursue an industrial project involving research component.

ML701 – Machine Learning

This course provides a comprehensive introduction to Machine Learning. It builds upon fundamental concepts in Mathematics, specifically probability and statistics, linear algebra, and calculus. Students will learn about supervised and unsupervised learning, various learning algorithms, and basics of learning theory, graphical models, and reinforcement learning.

ML702 – Advancing Machine Learning

This course focuses on recent advances in machine learning and on developing skills for performing research to advance the state of the art in machine learning. Students will learn concepts in kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. This course builds upon concepts from Machine Learning (ML701) and assumes familiarity with fundamental concepts in machine learning, optimization, and statistics.

ML703 - Probabilistic and Statistical Inference

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover different modes of performing inference including statistical modelling, data-oriented strategies, and explicit use of design and randomization in analyses. Furthermore, it will provide an in-depth treatment of the broad theories (frequentists, Bayesian, likelihood) and numerous practical complexities (missing data, observed and unobserved confounding, biases) for performing inference. This course presents the fundamentals of statistical and probabilistic inference and shows how these fundamental concepts are applied in practice.

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ML704 - Machine Learning Paradigms

This course focuses on machine learning and on developing skills for performing research to the state of the art in machine learning. This course builds upon concepts from ML 701 and assumes familiarity with fundamental concepts in optimization, and statistics. Students will learn about methods in supervised, unsupervised learning, semi-supervised learning, transfer learning, multi-task learning, online learning, active learning, meta learning, and variational inference. The course will discuss variants of learning algorithms in various learning paradigms mentioned above.

ML705 - Topics in Advanced Machine Learning

This course focuses on recent advances in machine learning and on developing skills for performing research to advance the state of the art in machine learning. This course builds upon concepts from ML701 and ML702 and additionally assumes familiarity with fundamental concepts in optimization, and math. The course covers advanced topics in statistical machine learning, unsupervised learning, high-dimensional statistics, and reinforcement learning. Students will be engaged through coursework, assignments, and projects.

ML706 - Advanced Probabilistic and Statistical Inference

The study of probabilistic and statistical inference deals with the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover some highly specialized topics related to statistical inference and their application to real-world problems. The main topics covered in this course are latent variable learning, kernel methods and approximate probabilistic inference strategies. This course will provide an in-depth treatment to various learning techniques (likelihood, Bayesian and max-margin) and numerous practical complexities (missing data, observed and unobserved confounding, biases) for performing inference.

ML707 - Smart City Services and Applications

This course provides a comprehensive introduction to using AI/ML in smart city services and applications. The course will start by reviewing basic concepts. Students will learn how to apply AI/ML to develop, design and improve smart city services. They will be able to demonstrate an understanding of the smart city concept, applications, requirements, and system design. They will develop capabilities of integrating emerging technologies in smart city components and be able to implement them. In addition, they will gain knowledge in applying security, data analytics, Internet of Things (IoT), communications and networking and work on case studies solutions for smart city infrastructures.

ML708 - Trustworthy Artificial Intelligence

This course provides students with a comprehensive introduction to various trust-related issues in applications of artificial intelligence and machine learning. Students will learn about attacks against computer systems that use machine learning, as well as defense mechanisms to mitigate such attacks.

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ML799 - Machine Learning Ph.D. Research Thesis

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of three to four years. Ph.D. thesis research helps train graduates to become leaders in their chosen area of research through partly supervised study, eventually transforming them into researchers who can work independently or interdependently to carry out cutting-edge research.

MTH701 - Mathematical Foundations for AI

This course provides a comprehensive mathematical foundation for artificial intelligence. It builds upon fundamental concepts in linear algebra, probability theory, and basic statistics and overviews basics and advanced topics that are frequently encountered in AI applications. The students will learn the basic mathematical concepts for main AI systems, as well as realistic applications in AI of mathematical tools.

MTH702 – Optimization

This course provides a graduate-level introduction to the principles and methods of optimization, with a thorough grounding in the mathematical formulation of optimization problems. The course covers fundamentals of convex functions and sets, 1st order and 2nd order optimization methods, problems with equality and/or inequality constraints, and other advanced problems.

NLP699 – Natural Language Processing Master's Research Thesis

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of one year. Master's thesis research helps train graduates to pursue more advanced research in their Ph.D. degree. Further, it enables graduates to independently pursue an industrial project involving a research component.

NLP701 - Natural Language Processing

This course provides a comprehensive introduction to Natural Language Processing. It builds upon fundamental concepts in Mathematics, specifically probability and statistics, linear algebra, and calculus, and assumes familiarity with programming.

NLP702 – Advanced Natural Language Processing

This course provides a comprehensive introduction to Natural Language Processing. It builds upon fundamental concepts in Natural Language Processing and assumes familiarization with Mathematical concepts and programming.

NLP703 – Speech Processing

This course provides a comprehensive introduction to Speech Processing. It builds upon fundamental concepts in Speech Processing and assumes familiarization with Mathematical and Signal Processing concepts.

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NLP704 - Deep Learning for Language Processing

This course focuses on recent advances in Natural Language Processing and on developing skills for performing research to advance the state of the art in Natural Language Processing. This course builds upon concepts from Natural Language Processing (NLP701) and assumes familiarity with fundamental concepts in Word Embedding, Information Extraction and Machine Translation.

NLP705 - Topics in Advanced Natural Language Processing

This course focuses on recent advances in Natural Language Processing and on developing skills for performing research to advance the state of the art in Natural Language Processing. This course builds upon concepts from Natural Language Processing (course code: NLP 701) and assumes familiarity with fundamental concepts in question answering, text summarization and opinion mining.

NLP706 - Advanced Speech Processing

This course focuses on developing skills for performing research to advance the state of the art in Speech Processing. This course builds upon concepts from Basic Speech Processing (NLP 703) and assumes familiarity with fundamental concepts in Speech Recognition, Speech Synthesis and Speaker Identification.

NLP799 - Natural Language Processing Ph.D. Research Thesis

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of three to four years. Ph.D. thesis research helps train graduates to become leaders in their chosen area of research through partly supervised study, eventually transforming them into researchers who can work independently or interdependently to carry out cutting edge research.