MOHAMED BIN ZAYED
UNIVERSITY OF
ARTIFICIAL INTELLIGENCE

MBZUAI
University Catalogue

2024-2025

mbzuai.ac.ae

Contents

His Highness Sheikh Mohamed bin Zayed Al Nahyan

President of the UAE

Among his many interests, His Highness Sheikh Mohamed bin Zayed Al Nahyan is known for his unwavering commitment to enhancing educational standards in the Emirate of Abu Dhabi and raising them to be on par with the best international standards. The University is named in his honor.

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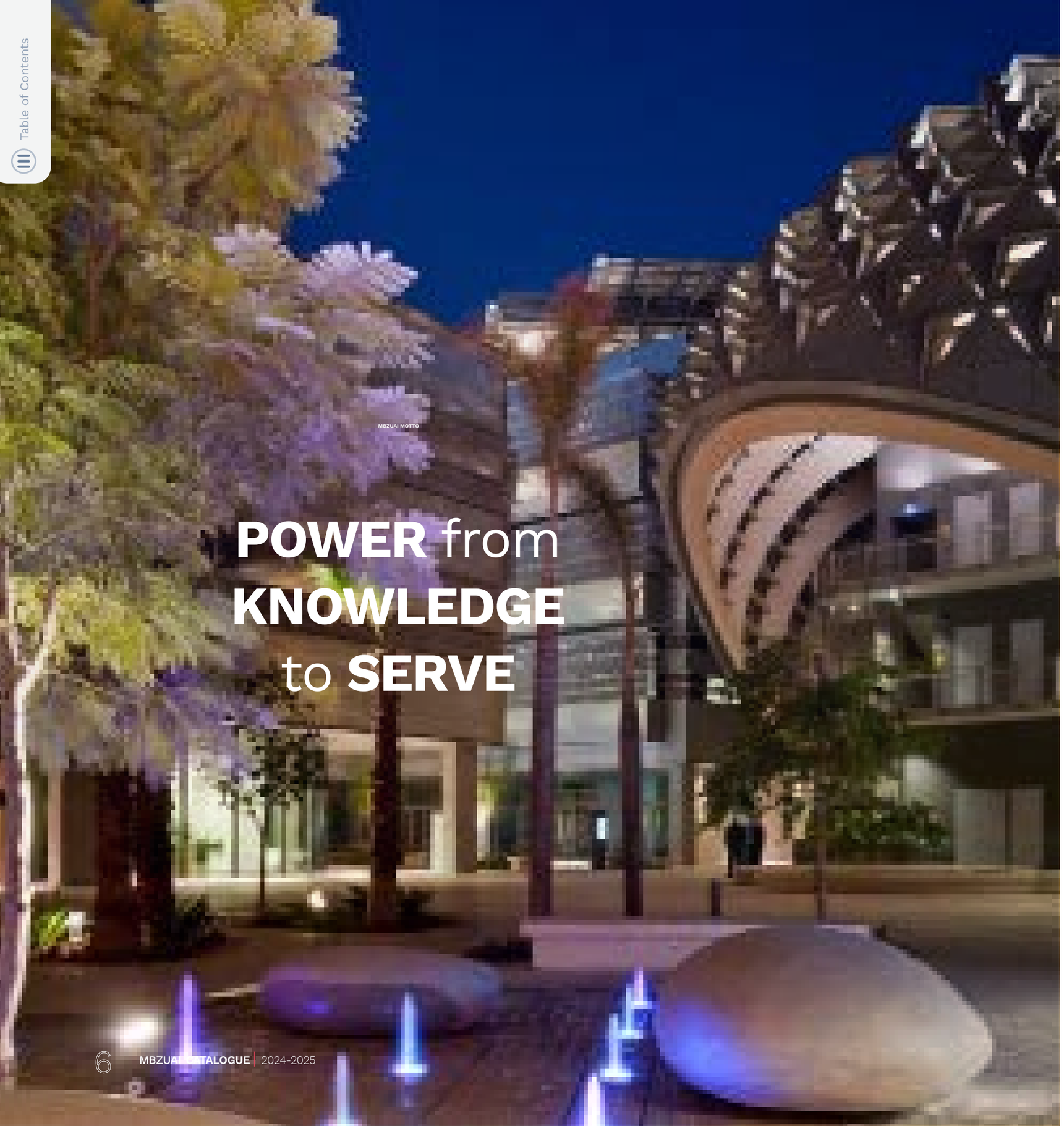

The University

The Mohamed bin Zayed University of Artificial Intelligence (MBZUAI) is established by Law No. 25 of 2019 in the Emirate of Abu Dhabi, with a clear mission to drive Artificial Intelligence (AI) knowledge creation and development, foster economic and social growth, and position the UAE as a hub for the international AI community. MBZUAI is part of the UAE's Vision and National Strategy to become one of the leading nations in AI by 2031.

The University will have an impact on AI advancement in the UAE in multiple ways including, but not limited to:

- Attracting international talents (students and faculty staff) and ensuring the transition to enter the UAE market
- Creating an active AI community and collaborating in AI research and publications
- Hosting conferences that attract AI experts to the UAE
- Supporting technology and AI related startups in the UAE
- Providing AI consulting services, solutions and applications to governments and businesses
- AI training and workshops for public and private sector

MBZUAI currently offers Ph.D. and M.Sc. programs in five AI specializations: Machine Learning (ML), Computer Vision (CV), Natural Language Processing (NLP), Robotics (ROB) and Computer Science (CS).

MBZUAI is located in the Emirate of Abu Dhabi and is officially licensed from March 10, 2020, to February 4, 2025, by the Ministry of Education of the United Arab Emirates (UAE) to award degrees/ qualifications in higher education.

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MBZUAI was established under **Law No. 25 of 2019** as a **semi-government local higher education institution** with administrative authorities which permits **self-governance and regulation**. **MBZUAI** is under and shall be affiliated to the **Abu Dhabi Executive Council**. The University has a **Board of Trustees** comprised of seven members including the **Chairman of the Board**.

Board of Trustees

The Board of Trustees (BoT) comprises several members, including a Chairman of the Board. The BoT candidates were identifies based on their knowledge and expertise in academia and AI applications across various industries. The University's first BoT was formed through a resolution issued by the Chairman of the Executive Council, and concluded its term in January, 2025.

Outgoing Board of Trustees

His Excellency Dr. Sultan Ahmed Al Jaber

Minister of Industry and Advanced Technology, Member of the Federal Cabinet, Special Envoy for Climate Change, UAE

COP28 President

Professor Sir Michael Brady

Emeritus Professor of Oncological Imaging in the Department of Oncology of the University of Oxford

Professor Anil K. Jain

Distinguished Professor in the Department of Computer Science and Engineering at Michigan State University

Dr. Kai-Fu Lee

Chairman and CEO of Sinovation Ventures and President of Sinovation Venture's Artificial Intelligence Institute

Professor Daniela Rus

Professor of Electrical Engineering and Computer Science and Director of the Computer Science and Artificial Intelligence Laboratory (CSAIL) at Massachusetts Institute of Technology

Peng Xiao

CEO of Abu Dhabi-based Group42 Ltd

His Excellency Mansour Ibrahim Al Mansoori

Member of Abu Dhabi Executive Council and the Chairman of the Department of Health in Abu Dhabi

New Board of Trustees

A new BoT was established in January, 2025, through a resolution by the Artificial Intelligence and Advanced Technology Council. The Board shall exercise all the powers needed to conduct the work of the University, supervise the management of its affairs, and achieve its objectives. The Board meets quarterly, with a mission to position MBZUAI as a global leader in innovation, education, and research.

Incoming Board of Trustees

His Excellency Khaldoon Khalifa Al Mubarak
Chairman of MBZUAI and Managing Director and Group CEO, Mubadala

His Excellency Jassem Al Zaabi
Chairman of the Abu Dhabi Department of Finance

His Excellency Saif Saeed Ghobash
Chairman of Crown Prince's Office and Secretary General of the Abu Dhabi Executive Office

Daniela Rus
Professor of Electrical Engineering and Computer Science and Director of the Computer Science and Artificial Intelligence Laboratory (CSAIL) at Massachusetts Institute of Technology

Rima Al Mokarrab
Executive Director, Strategic Affairs Unit, Executive Affairs Authority

Dr. Lisa Su
AMD Chair and Chief Executive Officer

Peng Xiao
Council Member of the Artificial Intelligence and Advanced Technology Council (AIATC) of Abu Dhabi & Group CEO of G42

Martin Edelman
Advisor to Mubadala, Group 42, Royal Group, and Related Companies

Eric Xing
MBZUAI President and University Professor

President’s welcome note

Welcome to Mohamed bin Zayed University of Artificial Intelligence (MBZUAI), a distinguished graduate research institution committed to the advancement of AI and its profound implications for our world. As you embark on your journey with us, prepare for an unparalleled experience characterized by rigorous inquiry, the relentless pursuit of knowledge, and a profound dedication to innovation. Here, you will engage in curiosity-driven research, cultivate a problem-solving ethos, and collaborate with some of the foremost intellects in the field of AI. Your contributions have the potential to shape the future of society and humanity, leaving an indelible mark on generations to come.

Located in Abu Dhabi, MBZUAI was founded in 2019 and is the product of the visionary leadership of the UAE; a country committed to solving the world’s most pressing challenges with the power of AI. We have a responsibility to seed a culture of research and innovation in the region, and lead the world in unleashing the full potential of AI though transformative research, diversity in thought, and scientific discovery.

We are home to an outstanding faculty across a variety of key AI fields, and our curriculum has been designed to align your learning experience with real-life issues; preparing you to use your knowledge and skills to make a difference, whether you choose to stay in research or apply your learning in industry.

What we expect from you

AI is reshaping our lives and the world at a rapid pace. Be curious about how you can promote understanding of AI as a force for good and make a difference in the world. This should be your goal.

I encourage you to challenge existing norms, think creatively, and embrace feedback.

What you can expect from us

At MBZUAI, an unparalleled access to tools, resources and mentorships will allow you to remain curious and hone your research skills.

Like the great scientific revolutions before us – the steam engine, electricity, and the internet – we are helping write the story of what comes next. And you are now part of that story.

Sincerely,

Professor Eric Xing
MBZUAI President

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MBZUAI Vision and Mission

Vision

Drive excellence in knowledge creation, transfer and use of AI to foster economic growth and position Abu Dhabi as a hub for the international AI community.

Mission

Establish and continually evolve interdisciplinary, collaborative research and development capability in the field of AI, while educating students to be innovators and leaders with the breadth and depth to grow technology and enterprise in the UAE and globally.

Strategic objectives

As a unique institution, purpose built to lead the world in AI research, MBZUAI seeks to be a paradise for transformative research; a cradle for the best minds in computer science; and a hub for startups and high-tech innovation.

Its strategic objectives are:

- Attract the best talent focused on AI
- Develop, train, and retain talent for the UAE economy
- Lead Abu Dhabi's efforts to build and sustain an AI-based knowledge economy
- Develop real business applications in collaboration with industry and the public sector to enhance innovation, productivity, and growth
- Be the birthplace of high-tech innovation and AI startups in the UAE, and the Middle East and North Africa (MENA) region.

University leadership

Senior Management Team

Eric Xing
President

Timothy Baldwin
Provost

Sami Haddadin
VP, Research

Sultan Al Hajji
VP of Public Affairs and Alumni Relations

Lily Burns
VP of Global Engagement

Jon Carvill
VP of Marketing and Communications

Dekyi Liang
Chief of Staff & Acting VP of Corporate Services

Joni Cholwich
Senior Advisor & Deputy Chief of Staff

Richard Morton
Senior Advisor

Ephraim Wittman
General Counsel

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Academic calendar 2024-2025

MBZUAI follows an academic year that starts in August and runs through to May, with a two-semester setup per year, of 17 weeks study per semester.

	Day	Date	Event
Fall semester (2024)	**Monday – Friday**	**August 12 to 16**	Student's Onboarding and Orientation Program
	Monday	**August 19**	First day of classes
	Friday	**August 23**	Last day to add/drop courses
	Friday	**August 30**	Last day to apply for Course Withdrawal/Leave of Absence without penalty
	Tuesday	**October 1 at 8 AM (UAE time)**	Fall 2025 MSc PhD admission cycle opens (MSc students 2023 cohort can also apply at this time)
	Thursday	**October 24**	Spring 2021 cohort–Ph.D. students/final deadline for thesis submission
	Thursday	**November 7**	Spring 2023 cohort–Ph.D. students/deadline to sit for the Candidacy (Oral) Exam
	Monday	**November 11**	Publish the Spring 2025 Class Schedule
	Monday – Friday	**November 18 to 22**	Early Registration for Spring 2025 Semester
	Friday	**November 29**	Last day of classes
	Wednesday – Friday	**December 4 to 6**	Final exams preparation period
	Sunday – Wednesday	**December 8 to 11**	Final exams period
	Monday	**December 16**	Student 360 – Central Committee meeting
	Wednesday	**December 18**	Faculty to submit grades
	Tuesday	**December 24**	Grades announcement
	Friday	**December 27**	Students' deadline to submit grade appeals

Winter break	Day	Date	Event
	Thursday – Friday	**December 12 2024 to January 3 2025**	Winter break for students

The official holidays observed by the University during the Fall 2024 Semester:

Occasion	Date	Holiday duration
Prophet Mohammed's Birthday	**September 15**	**One day**
Commemoration Day	**December 1**	**One day**
UAE National Day	**December 2 and December 3**	**Two days**

Spring semester (2025)	Day	Date	Event
	Monday	**January 6**	First day of classes
	Friday	**January 10**	Last day to add/drop courses
	Wednesday	**January 15 at 5 PM (UAE Time)**	Regular deadline for Fall 2025 MSc and PhD applications
	Friday	**January 17**	Last day to apply for Course Withdrawal/Leave of Absence without penalty
	Tuesday	**February 11**	Graduate Opportunities and Internships Fair
	Wednesday	**April 2**	Fall 2021 Cohort-Ph.D. students/final deadline for thesis submission
	Wednesday	**April 2**	Fall 2023 cohort-M.Sc. students/final deadline for thesis submission

Spring break	Day	Date	Event
	Monday - Friday	**March 24 to 28**	Spring break for students

Spring semester continues (2025)	Day	Date	Event
	Tuesday	**April 8**	Fall 2023 Cohort-Ph.D. students/deadline to sit for the Candidacy (Oral) Exam
	Monday	**April 14**	Publish the Fall 2025 Class Schedule
	Monday – Friday	**April 21 to 25**	Early Registration for Fall 2025 Semester
	Wednesday	**April 30**	Last day of classes
	Thursday – Friday	**May 1 to 2**	Final exams preparation period
	Monday – Thursday	**May 5 to 8**	Final exams period
	Friday	**May 9**	Student 360 – Central Committee meeting
	Tuesday	**May 13**	Faculty to submit grades
	Friday	**May 16**	Grades announcement
	Wednesday	**May 21**	Students' deadline to submit grade appeals
	Thursday	**May 22**	Qualifying Exam for Ph.D. students – 1st attempt
	Saturday	**May 31 at 5 PM (UAE Time)**	Late deadline for Fall 2025 MSc and PhD applications. Late applications submitted after the 'regular deadline' may not be given full consideration.
	Thursday	**June 5**	Qualifying Exam for Ph.D. students – 2nd attempt

Summer break	Day	Date	Event
	Friday	**May 9**	Start of Summer vacation for students

The official holidays observed by the University during the Spring 2025 semester:

Occasion	Date	Holiday duration
New Year's Holiday	January 1	One day
Eid Al Fitr Holiday	March 29 to April 1	Four days

Quick facts about MBZUAI

A graduate research University of AI

CSRankings

10th

Global rank in **AI, computer vision, machine learning, and natural language processing** in CSRankings

84
faculty
(53 from the top 100 AI institutions)

200
researchers and postdocs

365
enrolled students from

49
countries

18%
Emirati students

30%
female students

4.5:1
student-faculty ratio

563
MBZUAI affiliated **peer-reviewed academic publications** in 2023-24

2,086+
publications in journals and conferences

32
Patents: applications or granted

Educational Experience
84.9%
- **89.0%** Access to teaching faculty
- **86.7%** Academic prestige of MBZUAI
- **86.0%** Fellow students' academic ability

Student life
83.3%
- **91.9%** Campus and students' safety
- **86.7%** Student diversity
- **81.5%** Clubs and student's organizations

Services & Facilities
73.6%
- **80.0%** Library
- **78.6%** Class & lab facilities
- **78.5%** Campus location & facilities

Student surveys

Overall student satisfaction

85%

Alumni Advisory Board

The Board's establishment emphasizes MBZUAI's priority to nurture lifelong relationships with our alumni.

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MBZUAI partners

Since its inception, MBZUAI has joined forces with:

Academia partners

- Weizmann Institute of Science
- MIT
- Sorbonne University
- Oxford
- Ecole Polytechnique

Government partners

- ADAFSA
- Crown Prince Court
- DDA
- DED
- DOH
- ECSSR
- MOEI
- NCM
- SEHA
- AD Customs
- Abu Dhabi Police
- ADDGS
- Abu Dhabi Global Market
- ADPHC
- Dubai Municipality
- Dubai Police
- DMT
- GCAA
- SCAD
- TII

Industry partners

- ADNOC
- ADQ
- Core42
- e&
- ESA
- Google
- IBM
- Masdar
- Microsoft
- Silal
- SSMC
- Meta
- ADIA Lab
- CCAD
- Etihad Airways
- Emirates Health Services
- PureHealth
- ENEC
- FAB
- FCC
- GE Healthcare
- OurCrowd
- QURIS
- WAM
- SpeechCare Center

NGO partners

- Al SAQR Foundation
- Khalifa Fund
- Malaria No More Fund

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University campus

MBZUAI is located in Masdar City in the Emirate of Abu Dhabi, one of the world's most sustainable urban communities. This low-carbon development features a rapidly growing clean-tech cluster, a business free zone, and a residential neighborhood with restaurants, shops, and public green spaces. The area offers a student-friendly environment with all necessary amenities. The campus is designed to fully support an optimal educational experience, adhering to both local regulations and international educational standards.

Experience MBZUAI

Click or scan here to view the MBZUAI Digital Campus Tour

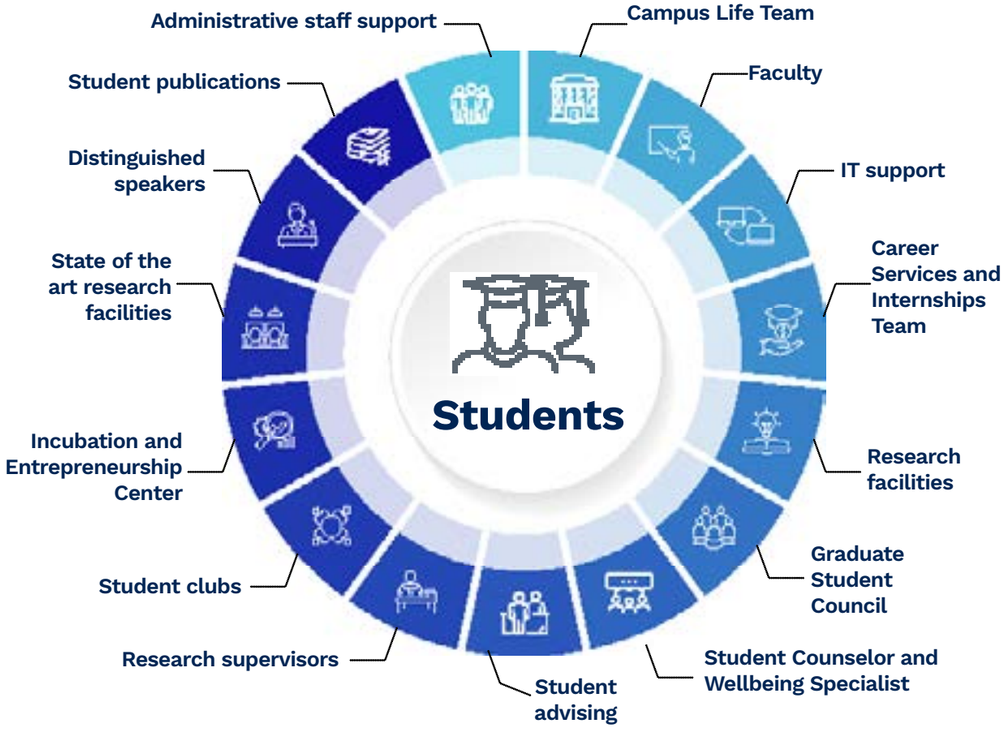
Available services for students on campus

At MBZUAI, students will have access to a wide range of support services, facilities, and programs on campus. These encompass advising, IT support, health services and insurance, prayer rooms, dining facilities, and student lounges, among others.

Educational Affairs

The Educational Affairs department provides students with the needed assistance to settle into the University. The Campus Life team will assist students in getting started at the University through a welcoming orientation and introduction to their accommodation, obtaining health insurance and Emirates Identification cards. Students are further supported by Student Counselor and Wellbeing Specialist who is available on campus. Counseling services offer individual or group therapy sessions, workshops, and training programs that promote mental health awareness and wellbeing.

Student centered learning is a vital part and MBZUAI supports its students to experience a memorable educational journey through the University:



Student support for future endeavors

Students have access to a database of internship and job opportunities via the MBZUAI Student Careers Portal. A Career Services and Internships team is provided to empower students and graduates to access AI-related internship and employment opportunities by offering a high-quality personalized service. Students receive support with developing professional materials (resumes, cover letters, internship/ job applications, LinkedIn, and e-portfolios).

Internship and opportunities fairs, networking events, industry partner sessions, workshops, interview days with industry partners and relevant research organizations occur throughout the academic year.

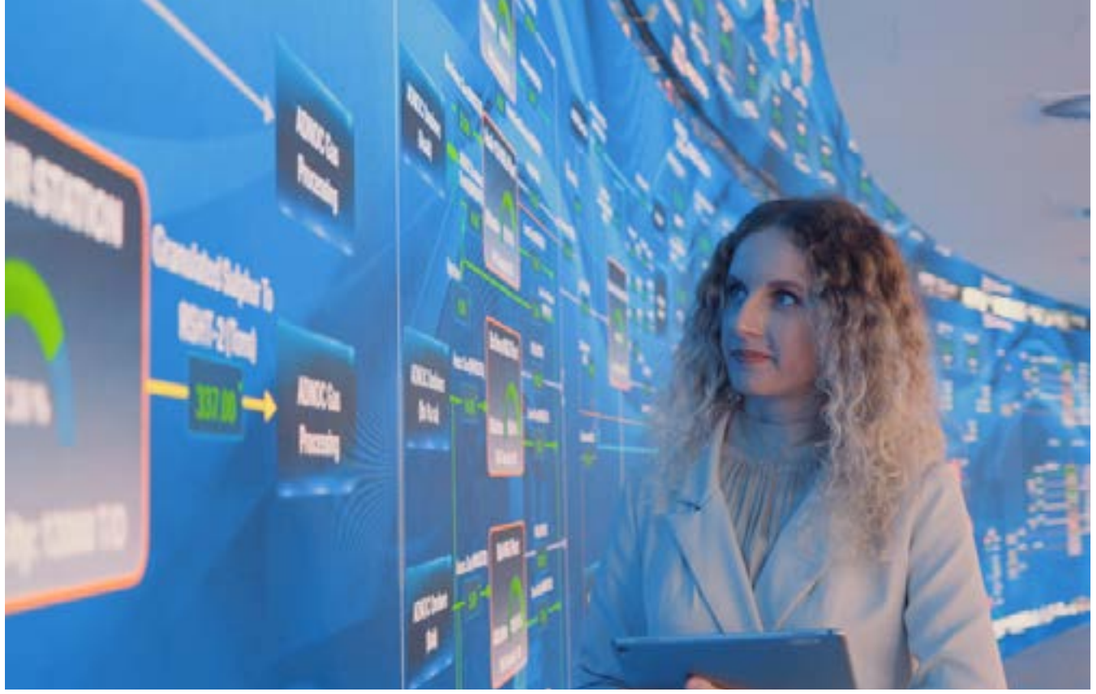
Student voice and clubs

MBZUAI encourages students to become future leaders in the AI ecosystem. This starts at University where the student body elects a MBZUAI Graduate Student Council (GSC) to represent student views and interests. MBZUAI encourages the GSC student voice to develop the ‘for us by us’ ethos and expand leadership skills during University.

The Campus Life team support a number of Student Clubs, which provide outlets for students to pursue extracurricular interests and activities. Students can also work towards gaining the Graduate Plus Award. This is a co-curricular award which recognises students’ non-academic achievements and skills development.

Graduates and alumni are considered ambassadors of MBZUAI and have the opportunity to join the Alumni Advisory Board as a recognized committee of the University. The Alumni Advisory Board serves as a vital link between the University and its alumni community, providing strategic guidance and support to advance the University’s objectives and goals.

The Alumni Advisory Board consists of alumni representatives selected based on their expertise, experience, and commitment to the University’s mission. Board members serve voluntary terms and may include alumni from diverse backgrounds, graduation years, and fields of expertise. The current Alumni Advisory Board are distinguished members of their disciplines and a vital driver for student mentorship and ambitions of future graduates and alumni.



MBZUAI website, intranet & e-services

The University website supports students and all members of the MBZUAI community. The MBZUAI website contains a wealth of useful information, including news channels, links to the available library resources, research activities, the academic calendar and more. Students can find the MBZUAI Catalogue on the website. Detailed information about programs, MBZUAI's policies, procedures, and requirements are available through the intranet.

The MBZUAI website has a link to the restricted access MBZUAI intranet. Students can access with their username and password the full e-services portfolio through the intranet. This can be done using a computer on the campus or anywhere with an internet connection.

In addition to the services mentioned above the following is a list of other systems, services and documents that are available:

- Sharepoint
- Student Information System (SIS) - Student Portal
- Learning management system (Moodle)
- Student Handbook
- Online Curriculum Catalogue
- Student Careers Portal
- Housing Manual
- Student Code of Conduct
- Microsoft Office 365
  (email, MS Teams, Word, Excel, PowerPoint, and OneDrive)
- Printing services
- MATLAB

MBZUAI contact information

For inquiries, please find below the list of contacts:

Office of the President	president@mbzuai.ac.ae
Provost Office	provostoffice@mbzuai.ac.ae
Admissions	admission@mbzuai.ac.ae
Registration Office	registrar@mbzuai.ac.ae
Campus Life	campus.life@mbzuai.ac.ae
Career Services and Internships	careerservices@mbzuai.ac.ae
IT Helpdesk	helpdesk@mbzuai.ac.ae
Library	libraryservices@mbzuai.ac.ae
Research	research@mbzuai.ac.ae
Facilities Management	facilities@mbzuai.ac.ae
Finance	finance@mbzuai.ac.ae
Human Resources	hr@mbzuai.ac.ae
Institutional Effectiveness and Quality Assurance	IEQA.Office@mbzuai.ac.ae
Surveys	surveys@mbzuai.ac.ae
Security	security@mbzuai.ac.ae

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IT services

The MBZUAI IT department provides support for the entire University community and campus. This includes the University's network systems, email systems, service support, research and student computing facilities. Wireless fast secure internet is available throughout the campus, and connections from outside campus are available using the MBZUAI virtual private network (VPN).

Support is available via the IT department's Helpdesk, which can be contacted via telephone, email or walk-in during normal business hours:

Service	Hours	Contact details
Telephone support	02-8113000 (external). Extension 3000	**Mon–Thurs, 8:00 am–5:00 pm Fridays: 7:30 am–12:00pm**
Email support	helpdesk@mbzuai.ac.ae	
Walk-in support	Level 2, Building 1A	

Labs and computing

Student computing labs operated by Research-IT feature robust infrastructure, including powerful workstations equipped with NVIDIA Quadro RTX GPUs, ample data storage, and a suite of software tailored for AI and data-intensive tasks.

MBZUAI has four computing labs on level 2 of the 1B Building with a total of 64 workstations, each with Intel CPUs and NVIDIA Quadro 6000 GPUs, ideal for graphics-intensive tasks.

Additionally, MBZUAI provides 32 workstations with Intel CPUs and Nvidia RTX 4090 GPUs, available on a first-come first-served basis, to support students' coursework, experiments, simulations, and data analytics needs.

Access to high performance computing (HPC) resources

Students work on research projects under the guidance of their supervisors, who are domain experts in their fields among MBZUAI faculty members.

MBZUAI students shall be bound by confidentiality regulations and intellectual property rights, as defined by the applicable laws and regulations in UAE in matters related to internal research projects.

Research Office

The Research Office plays a crucial role in the administration and expansion of research initiatives at MBZUAI. Its aim is to foster innovation and to bridge the gap between academic research and industrial application, striving to engage interested stakeholders in research partnerships, to develop advanced technology, and to generate solutions for current global challenges using AI. Leveraging a diverse array of funding sources, the Research Office is committed to supporting the faculty, researchers and students at MBZUAI to advance their expertise and address critical issues in various sectors; fostering a long-lasting societal impact.

As part of this support, the Research Office offers a range of resources to faculty, researchers and students. These include, but are not limited to: grant management, core facilities, research centers, administrative support, entrepreneurship mentoring programs, intellectual property and stakeholder management aimed at commercialization of research initiatives.

The Research Office is also committed to the continuous building and enhancement of research foundations such as the Research Committee, the Research Integrity Committee, and Institutional Review Board, and ensures implementation of research ethics and compliance to critical research-related policies.

Research laboratories

MBZUAI research labs boast a robust infrastructure of 96 powerful workstations, each equipped with powerful NVIDIA Quadro RTX GPUs, ample data storage capabilities, and a comprehensive suite of commercial and academic software specifically designed for AI, data-intensive processing.

These resources are tailored to meet the diverse academic and research needs of MBZUAI students, providing them with cutting-edge technology to support their coursework, experiments, simulations, and data analytics tasks.

Data Acquisition Lab

Deployed with special equipment with the latest technology such as camera systems, thermal imagers, dynamic vision sensors, acquisition systems, and drones.

Data Observatory Center

Data Observatory is the first core facility equipped with high-resolution video walls, incorporating latest visualization technologies to support the delivery of research and educational products. Augmented AI research showcases faculty progress and the social influence of MBZUAI.

Library and learning resources

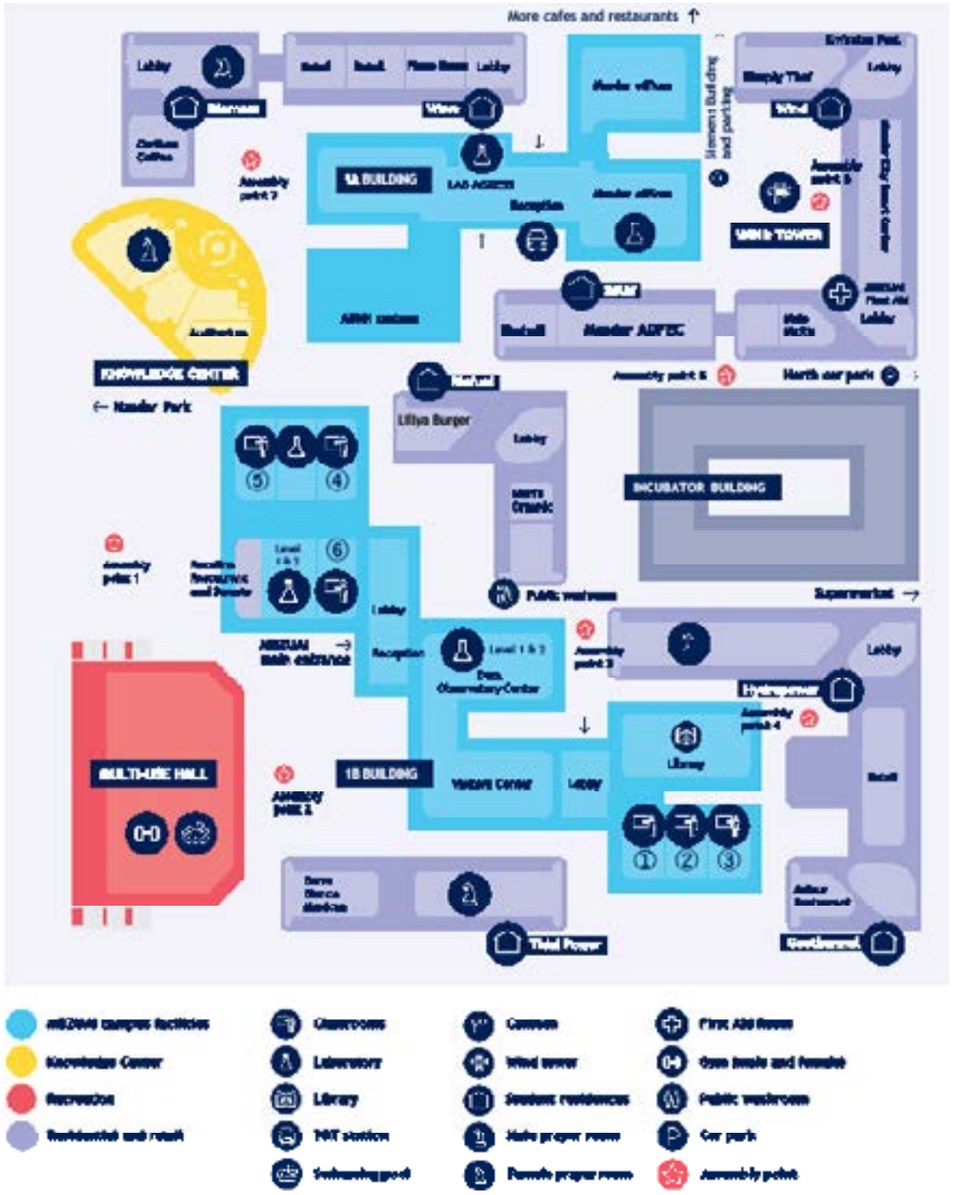
MBZUAI has an equipped library and technological resource on campus to assist users in the effective completion of their academic work and research assignments. The library provides a stable and quiet study space, printing and scanning facilities, access to course reserve and other collections, and an opportunity to consult in person with library staff on resource and research needs.

The MBZUAI library provides print and electronic resources, facilities, and services to support the academic, research and professional information needs of the students, faculty, researchers, and staff.

The library has a single-search interface and print books are available for borrowing. The total library collection of 374,510 is comprised of printed books, streaming videos, online books, journals, and proceedings. Access to faculty affiliated publications, student theses and dissertations is available through the institutional repository, eCommons.

University map

The MBZUAI campus offers state-of-the-art learning spaces, laboratories, and common areas for collaboration. On-campus accommodation ensures convenient living, while diverse restaurants and a nearby shopping mall provide essential services and recreational activities, enhancing the overall student experience.



Sports facilities

The MBZUAI campus features sports facilities, spacious gyms for both men and women, and a swimming pool.

MBZUAI apartments

The residences at MBZUAI are located in buidlings 1A and 1B. The apartment blocks are segregated by gender. Each apartment includes a bedroom, kitchen, bathroom with shower, living/dining area, and study space. Some apartments feature multiple bedrooms. All apartments are fully furnished, have air conditioning, include full amenities, and private balconies. Students must abide by the Housing Manual and related policies.

A common laundry room is available in each residential building. The use of washing/drying machines is free of charge in all facilities.

Catering arrangements

All apartments are fully equipped with full kitchen amenities exclusive of cookware, crockery, and cutlery.

Additionally, a number of retail outlets including restaurants and cafés are located on campus.

Majlis/common areas

Common areas are provided on the podium level of the campus. Male and female majlis areas are in buildings 1A and 1B. Common space is also available in the restaurants, cafés, and the canteen. The common areas are cleaned frequently.

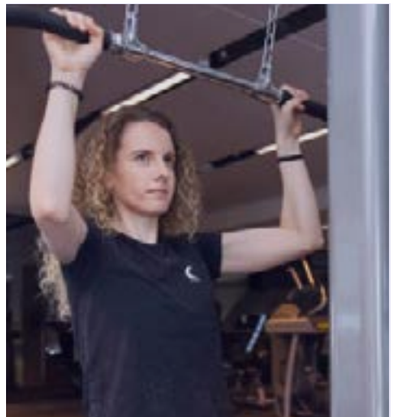
Prayer rooms

There are both male and female prayer rooms located within the campus. A male prayer room is located in the Hydro residential building and a female prayer room is located in the Tidal residential building. In buildings 1A and 1B, there also two prayer rooms for males and females.

The male prayer room is located in the Knowledge Center building and the female prayer room is located in the Biomass residential building.



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Health services and Safety

MBZUAI is committed to providing a safe and healthy environment for our students, staff, and visitors. However, students are expected to take responsibility for their own actions and not put themselves or others at risk.

On-campus assistance is available in the form of first aid kits placed around the campus for minor injuries with certified first aiders. For minor injuries or medical complaints, a medical clinic is available on campus, located in the Solar building podium and open 24/7 with a registered nurse. The clinic is fully equipped and ready to accommodate all first aid needs.

Students may use their health insurance cards provided by MBZUAI to visit a hospital or medical center for more serious injuries. A list will be provided stating the coverages included and allocated limits.

In medical emergencies of a serious injury or illness, the Security Control Room (02 811 3100), Main reception Building 1A (02 811 3469), or Building 1B (02 811 3369) should be contacted, who in turn will contact the relevant authorities.

Any occupational health and safety issues identified will be taken seriously and addressed promptly. If a student identifies any health and safety risks or has any health and safety concerns, they must contact Campus Life promptly to report any injuries or incidents that occur. Smoking is not allowed on the MBZUAI campus, and emergency equipment should not be covered or interrupted.

Fire drills are conducted periodically, and students should familiarize themselves with where emergency exits, fire alarms and fire extinguishers are located. In the event of a fire drill or emergency, students must follow the directions of their faculty, staff, and/or security personnel.

Security

MBZUAI is accessible only to authorized individuals. All MBZUAI premises have security gates with security personnel stationed at each entrance. These security officers will only allow those who are properly authorized to enter the campus. Overnight stays by visitors are prohibited in student accommodation. The visiting time is from 9 a.m.–10 p.m.

Parking

At the Masdar City campus, parking is permitted at the North Car Park. Parking spaces are available for faculty, staff, and students and cannot be reserved. Long time parking is prohibited.

Transportation

Bus services, routes, and fared taxis are available.

All taxi services in the UAE use meters around the city so you will not need to negotiate fares. Drivers in Abu Dhabi speak English and there is a central national transport phone number that can be used to locate the nearest available taxi: 600 535353.

Banking facilities

Most banks have several branches in each city. Contact the bank or visit their website for details of the most convenient branch for you.

First Abu Dhabi Bank
Tel: 02 681 1511
www.bankfab.com

Abu Dhabi Commercial Bank
Tel: 600 50 2030
www.adcb.com

Abu Dhabi Islamic Bank
Tel: 600543216
www.adib.ae

Citibank
Tel: 04 311 4000
www.citibank.com/uae

HSBC
Tel: 600 55 4722
www.hsbc.ae

Masdar Park

Masdar Park is a 2,500 square meter green space adjacent to campus, open daily from 9 a.m.-10 p.m. The park features a children's playground, a music wall and art installations themed on sustainability. Visitors can charge their phones and digital devices using the park's solar-powered benches and interact with the Tree of Light, which is made from recycled building materials and changes color when touched. For more information visit https://www.masdarcity.ae/about-masdar

Travel and tourism

The Abu Dhabi Department of Culture and Tourism and Visit Abu Dhabi provide information regarding travel and tourism:
https://visitabudhabi.ae/en

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Degrees offered

Academic programs

The University seeks to empower a new generation of AI leaders through exceptional education and a unique model of academia. MBZUAI is a modern and innovative University offering a choice of graduate programs in AI that are relevant to market needs, with an aim to help students succeed in their chosen career and leverage their acquired knowledge to tackle some of the greatest challenges of our time.

MBZUAI offers M.Sc. and Ph.D. programs in the following areas of AI specialization:

Computer Science (CS)

The study of the theory, design, development and most effective use of computers and computer systems. Computer scientists analyze complex problems relating to fields like artificial intelligence, programming, algorithms, data structures, machine learning, cybersecurity, database systems, and human-computer interaction. Challenges range from the abstract, such as computing limits or algorithm complexity, to the more practical, like security measures. Through the undertaking of scientific, innovative, ethical, and socially responsible research, computer scientists aim to discover solutions to complex problems, impacting business, technology, science and many other aspects of life.

Institute Programs
DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE
MASTER OF SCIENCE IN COMPUTER SCIENCE

Computer Vision (CV)

This scientific field studies how computers can be used to automatically understand and interpret visual imagery. It aims to mimic the astounding capabilities of the human visual cortex using machine vision algorithms. It studies how an image is created, the geometry of the 3D world and high-level tasks such as object recognition, object detection, and tracking, image segmentation and action recognition. Computer vision has important applications in augmented / virtual reality, autonomous cars, service robots, biometrics and forensics, remote sensing and security and surveillance.

Institute Programs
DOCTOR OF PHILOSOPHY IN COMPUTER VISION
MASTER OF SCIENCE IN COMPUTER VISION

Machine Learning (ML)

Machine Learning is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on patterns and inference instead. These algorithms are based on mathematical models learned automatically from data, thus allowing machines to intelligently interpret and analyze input data to derive useful knowledge and arrive at important conclusions. Machine learning is heavily used for enterprise applications (e.g. business intelligence and analytics), effective web search, robotics, smart cities and understanding of the human genome.

Institute Programs
DOCTOR OF PHILOSOPHY IN MACHINE LEARNING
MASTER OF SCIENCE IN MACHINE LEARNING

Natural Language Processing (NLP)

NLP enables computers to communicate with people using everyday language. Large language models (LLMs), in particular are key drivers of language based interaction, potentially including extra data modalities such as structured data or images. Such systems also enable sophisticated tasks such as language translation, semantic understanding, text summarization, and natural language dialogue. Applications of NLP include interactive speech-based applications, automated translators, digital personal assistance and chat bots.

Institute Programs
DOCTOR OF PHILOSOPHY IN NATURAL LANGUAGE PROCESSING
MASTER OF SCIENCE IN NATURAL LANGUAGE PROCESSING

Robotics (ROB)

Robotics focuses on rigorous, high-impact, original research, emphasizing robot learning and robot algorithms. Topics of interest include perception and applied machine learning, human-robot interaction, cognitive and soft robotics, and swarm intelligence. Research and development of this transformative technology continues to be a priority set by both government and industry, and will revolutionize sectors like manufacturing, healthcare, agriculture, and transportation. A degree in this field, in part earned by designing, prototyping, and validating intelligent robotic systems, prepares students for careers at the cutting edge of academia, industry, and government.

Institute Programs
DOCTOR OF PHILOSOPHY IN ROBOTICS
MASTER OF SCIENCE IN ROBOTICS

Admission requirements

Admission deadlines

The admissions deadlines are strictly adhered to, and applications should be complete with supporting documentation. All applicants shall be given fair opportunity and consideration under the Admission Policy Manual.

Fall 2025 admission cycle for M.Sc. and Ph.D. programs (all nationalities):

Application portal opens	Regular deadline	Decision notification date	Late deadline
October 1, 2024 (8:00 AM UAE time)	**January 15, 2025** (5:00 PM UAE time)	**March 31, 2025** (5:00 PM UAE time)	**May 31, 2025** (5:00 PM UAE time)
	High-calibre applicants who apply by the **'Regular Deadline'** and have complete applications (including the required recommendations) will be given full consideration.		The online application portal will remain open until the **'Late Deadline'.** We do not guarantee that these late applications will be given full consideration.

Application rules and regulations:

1. All applications for admission to the M.Sc. and Ph.D. programs must be submitted online (https://mbzuai.ac.ae/register), providing all required documentation. Failure to upload the required documentation information or incorrect data will result in an incomplete application, which will not be considered.
2. Applicants may only apply to one program per admission cycle; multiple submissions will not be considered for evaluation.
3. All application documents must either be in English originally or include official English translations. Additionally, official academic documents should be stamped and signed by the University authorities.
4. Senior-level students can apply initially with a copy of their transcript and must submit an official complete degree certificate/transcript upon admission.
5. Applicants are strongly encouraged to regularly follow up with their nominated referees to ensure the prompt submission of the required recommendations.
6. Complete applications submitted by the regular deadline (https://mbzuai.ac.ae/study/admission-process) will be given full consideration. Late applications, on the other hand, will be processed only as needed.
7. Applicants with complete files, including the required number of recommendations, will be invited to participate in an online screening exam to assess their knowledge and skills. Guidelines are available in the admission criteria section of the offered programs' webpages: Master's programs | Ph.D. programs. Completion of the exam is not mandatory but highly encouraged as it would provide additional information to the evaluation committee. Waiving the exam is only recommended for applicants who can provide strong evidence of their research capability, subject matter expertise, and technical skills.
8. Exam waiver requests should be sent to admission@mbzuai.ac.ae prior to an applicant's scheduled exam. Once the exam is completed, the results will automatically be recorded in the applicant's application file and may no longer be discarded.
9. A select number of applicants may be invited to an interview with faculty as part of the screening process. The time and instructions for this will be communicated to applicants on timely bases.

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To be considered for admission into the Master of Science (M.Sc.) and Doctor of Philosophy (Ph.D.) programs at MBZUAI, an applicant must provide evidence of the following:

For M.Sc. programs: a completed Bachelor's degree in a STEM field such as Computer Science, Electrical Engineering, Computer Engineering, Mathematics, Physics or other relevant Science or Engineering major with a minimum CGPA of 3.2 (on a 4.0 scale) or equivalent

For Ph.D. programs in Computer Vision, Machine Learning, Natural Language Processing, and Robotics: a completed degree in a STEM field such as Computer Science, Electrical Engineering, Computer Engineering, Mathematics, Physics, or other relevant Science or Engineering major that demonstrates academic distinction in a discipline appropriate for the doctoral degree - either:

- Bachelor's degree with a minimum CGPA of 3.5 (on a 4.0 scale) or equivalent, or
- Master's degree with a minimum CGPA of 3.2 (on a 4.0 scale) or equivalent

For Ph.D. in Computer Science program: a completed degree in Computer Science which demonstrates academic distinction and a strong background in both applied and theoretical aspects of Computer Science – either:

- Bachelor's degree with at least 50% Computer Science content and minimum CGPA of 3.5 (on a 4.0 scale) or equivalent, or
- Master's degree with a minimum CGPA of 3.2 (on a 4.0 scale) or equivalent

For Academically Distinguished Student Portfolio, each applicant must submit evidence including, but not limited to:

- Completed Degree (as per the mentioned degree requirements for M.Sc. and Ph.D. programs)
- Minimum CGPA 3.0 (on a 4.0 scale) or equivalent
- Research Capability & Output
- Technical Skills
- Graduation from a highly-ranked University

Additional Requirements

Knowledge, skills, and competencies in the following areas:

- Programming skills in programming languages such as Python, C, C++, or MatLab
- Math skills such as linear algebra, probability, Statistics, and calculus
- Computer Science skills in algorithms and data sciences

Valid English Language Proficiency Certificate with the below minimum requirements must be submitted upon admission:

- TOEFL iBT with a minimum total score of 90, or
- IELTS Academic with a minimum overall score of 6.5, or
- EmSAT English with a minimum total score of 1550

Waiver requests from applicants who undertook all their schooling (K-12) plus a bachelor's degree in English in a reference English-speaking country (e.g., UK, USA, Australia, New Zealand) may be processed in accordance with the Admissions Procedure. Applicants must submit notarized copies of their documents during the application stage and attested documents upon admission. Waiver decisions will be given within seven days after receiving all requirements.

Letters of recommendation (minimum 2 for M.Sc. and 3 for Ph.D.) from mentors, supervisors, or others with good knowledge of the applicant's qualifications and at least one should be from a previous course instructor or faculty/research advisor.

Statement of Purpose: In an essay ranging from 500 to 1,000 words, the applicant should present his/her motivation for applying to the University. It may include information regarding the applicant's personal and academic background as well as his/her chosen career path, goals as a prospective student, graduation plans, and other details that will support the application.

Research Statement (for Ph.D. applications only): In a 1–3-page document, the applicant should provide a high-level overview of the applicant's past research experience and the research they are interested in working on, including their motivation for wanting to investigate this area. Note that applicants are expected to write a research statement completely independently. The admission committee will review an applicant's research statement and use it as one of the measures to determine if an applicant's interests and experience make them a good fit for MBZUAI's research programs.

MBZUAI faculty will NOT help applicants write a research statement for the purpose of the application. It is recommended that the statement contains a few sections, including an introduction, literature review, problem definition, methods (optional), timeline, and a list of references.

Submission of GRE scores is optional for all applicants but will be considered a plus during the evaluation.

Conditional and Provisional Admission

Conditional Admission:
M.Sc. applicants with a recognized Bachelor's degree and iBT TOEFL score of 71, or an overall academic IELTS score of 5.5, or an EmSAT English score of 1250 may be considered for conditional admission in special circumstances. Such a student must meet the following requirements by the end of their first registered semester or be subject to dismissal:

- Obtain valid scores from standard exams of any of the following by the end of their first registered semester: TOEFL iBT with a minimum total score of 90, or IELTS Academic with a minimum overall score of 6.5, or EmSAT English with a minimum total score of 1550.
- Students may register for a maximum of six credit hours in the first semester of study and must achieve good academic standing in the registered courses.

Provisional Admission:
M.Sc. applicants with a recognized Bachelor's degree and a lower CGPA score (minimum 2.5 out of 4.0 or equivalent) may be granted provisional admission in special circumstances. Such a student must take a maximum of nine credit hours of courses studied for the graduate program during the period of conditional admission and must achieve good academic standing by the end of their first registered semester or be subject to dismissal.

Transfer Admission and Credit Transfer

MBZUAI does not accept transfer students.
Admitted students who wish to transfer credits should comply with the following:

- Only credits from a University accredited or recognized by the United Arab Emirates (UAE) Ministry of Education (MoE) will be considered.
- The limit for the number of transfer credits that may be accepted for a specific degree program is 25% of the total Credit Hours for M.Sc. and Ph.D. programs.
- Transfers will only be permitted for students in good academic standing and eligible to return to their current or former institution.
- MBZUAI will accept the transfer of credits only for courses relevant to the degree that provide equivalent learning outcomes and in which the student earned a grade of B (3.0 on a 4.0 scale) or better.
- The grade of the transfer credit course will be recorded as a "TC" on the transcript record. The approved transfer credits will be calculated towards the credit hours but not included in the GPA calculation.
- The course transfer credits may not have been used previously in any graduate program to fulfil the requirement of any other graduate degree.

- The course credits must have been completed no more than a maximum of (2) years prior to the student's acceptance into the MBZUAI program.

The MBZUAI Academic Department will have the ultimate right to accept or reject transfer requests for any student.

All applications for transfer credit to M.Sc. or Ph.D. programs must be submitted online, providing all required documentation.

Recognition of Prior Learning

MBZUAI provides postgraduate continuing education and acknowledges the prior degree(s) of prospective students during admission to the University. Prospective students must have attained at least a level 7 Bachelor degree recognized by the UAE's Ministry of Education and aligned with the Emirates Qualification Framework (EQF) to be eligible for academic programs at MBZUAI.

Prior learning in the form of professional certification, training programs, credit-bearing courses of non-accredited degrees, and other similar programs will not receive any credit toward academic degree programs.

After admission, students may apply for course exemptions on the basis of recognized prior learning. The criteria and processes for course exemptions are specified in the Registration Office Policy Manual.

Progression and Applications for Second Degree

Progression: MBZUAI M.Sc. students in their final University year may apply for Ph.D. studies by submitting their application through the online application portal within the application deadline specified in the Official Academic Calendar and meeting the program-specific requirements.

Applicants for a Second Degree:
MBZUAI alumni applying for a second degree (M.Sc. / Ph.D.) must submit their application through the online application portal and meet the program-specific requirements to be considered for admission.

Holders of a degree awarded by MBZUAI are considered to have already satisfied the MBZUAI English language proficiency requirements.

Attestation and Certificate of Recognition

Applicants from universities accredited or recognized by the UAE Ministry of Education (MoE) may be eligible for admission.

Admitted students must submit the following within their first semester at the University:

- Degree certificate and transcript attested by the MoE for those who completed their previous degree/s in the UAE
- Authenticated degree certificate and transcript and a certificate of recognition from MoE for those with degree/s acquired outside the UAE. The authenticity of the academic documents may be obtained from the UAE Embassy in the country of study or through MoE's trusted partners as mentioned on their website

  https://www.moe. gov.ae/En/EServices/ServiceCard/pages/UniversiyCertificateEquilization.aspx

Students of Determination

Prospective students with determination shall not be denied admission due to their disability and will complete the online application form and go through the standard admission process, which is based on their academic qualifications. Those students should comply with the academic program requirements and any other academic regulations.

During the application process, applicants shall declare that they identify as a student of determination. Upon arrival in the UAE and when they receive their Emirates ID they shall submit their People of Determination number (obtained from the relevant UAE authorities, e.g. TAMM application) to the Registrar's Office and Campus Life unit.

The University shall be responsible for providing reasonable and suitable academic accommodations for accepted students with disabilities in accordance with current legislation while maintaining the academic integrity and basic requirements of the programs and courses.

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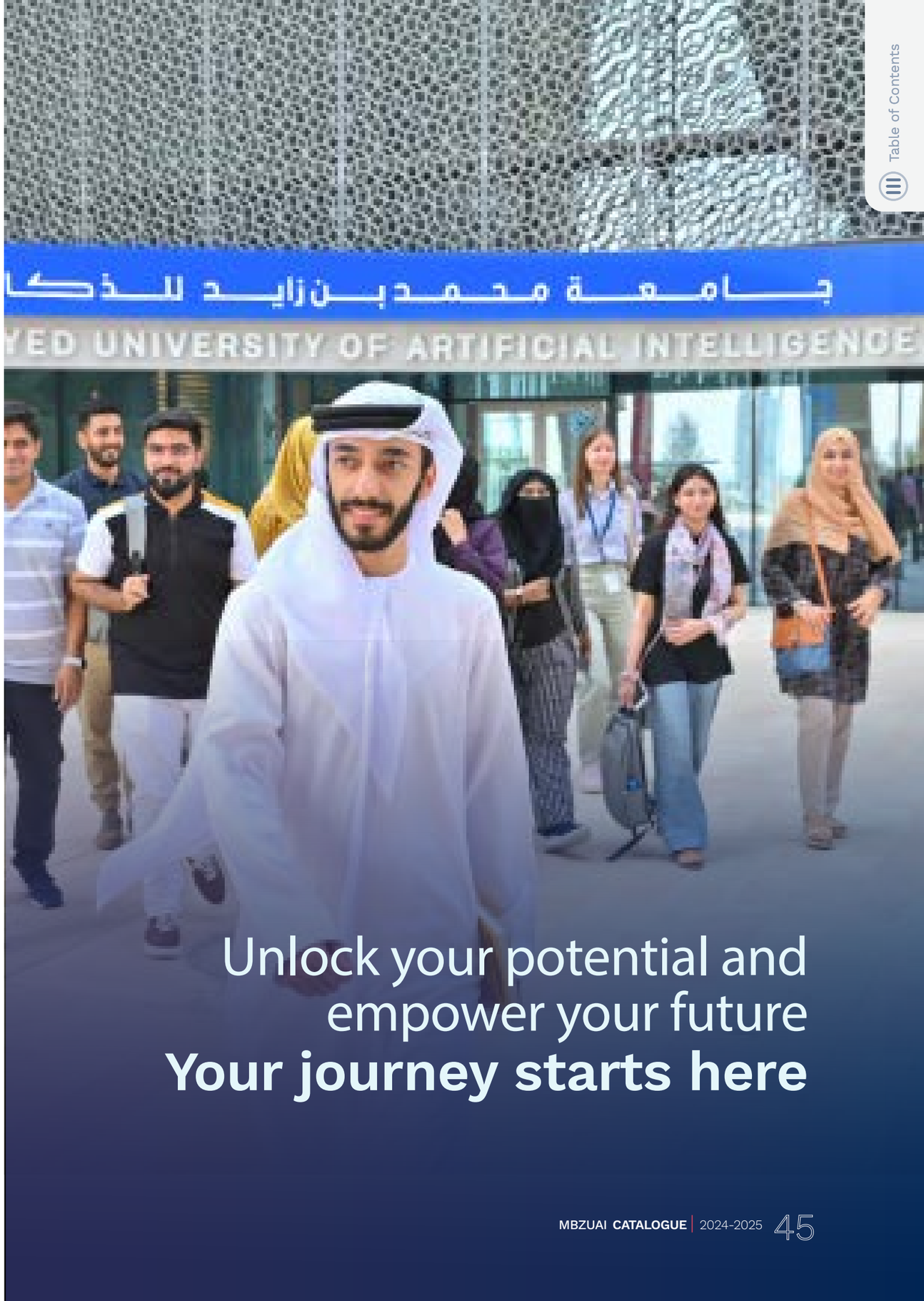

Unlock your potential and empower your future

Your journey starts here

Scholarships and tuition fees

All eligible students are granted a full scholarship upon acceptance. The scholarship may include 100% tuition fees, accommodation, health insurance and a competitive monthly stipend and annual ticket to the student's home country based on their categories: Ph.D. single UAE, Ph.D. married UAE, Ph.D. international student, M.Sc. single UAE, M.Sc. married UAE or M.Sc. international student.

To retain a scholarship, students must meet the following criteria:

- Maintain the minimum required CGPA as per their intake year.
- Complete their degree requirements within the allowed duration as per the study plan.
- Maintain a clean deed record and a good Academic Standing.
- Compliant with the Registrar's Office, Educational Affairs and Code of Conduct policies.

Fee per credit hour:

Program	Fee per one credit
M.Sc.	AED 5,000
Ph.D.	AED 6,600

Complete withdrawal from the University

A student may voluntarily withdraw from the University after the approval of the Appeal Committee and subject to the terms and conditions of the University policy in this regard.

Students should be aware that they will need to pay to the University all expenses including tuition fees, monthly allowances, medical expenses, and any other expenses incurred by the University during the period of study.

If the student submits legitimate justification for withdrawal the University may exempt the student from all or some of the financial obligations.

Scholarship financial penalties

Students are entitled to scholarships during their study at the University and entitlements are individualized for each student. Scholarships have a range of benefits which are defined based on the student's enrolment status, and relevant policies.

- Students who violate University policies or fail to meet specified criteria may face fines, sanctions, or loss of eligibility for benefits, potentially impacting one or more of the following benefits, either partially or entirely.
- 100% paid tuition fees.
- Monthly stipend.
- Accommodation in University dorms / housing allowance (if applicable).
- Health insurance for international students.
- Annual ticket allowance for international students.

Below is the students' payment plan of the tuition fees against complete withdrawal, leave of absence, and dismissal after the deadline.

No obligations	Within the deadline
Payment of 25% of the tuition fees	After 1 week from the deadline
Payment of 50% of the tuition fees	After 2 weeks from the deadline
Payment of 75% of the tuition fees	After 3 weeks from the deadline
Payment of 100% of the tuition fees	After 4 weeks from the deadline

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Academic regulations and policies

The Registrar's Office (RO) Policy Manual describes the regulations and principles guiding students' academic advancement from initial course enrollment to graduation. As the primary administrative center for student enrollment, course registration, and academic documentation, the RO at MBZUAI is dedicated to delivering efficient assistance to students, faculty, and staff, guaranteeing precision, adherence to policies, and prompt resolution of inquiries. Academic regulations including the grading system, policies regarding academic progress, opportunities for appeal by students are detailed in the RO policy manual. Moreover, academic standing, scholarship, tuition fees, final examinations defense, financial penalties, payment schedules, awarding of degrees are stipulated in the Registrar's Office and Educational Affairs policy manuals. Warnings and sanctions are clearly stated in the Code of Conduct. All students are expected to abide by the University's policies and procedures.

Research supervisor selection process

Research is fundamental to University education, fostering innovation and expanding knowledge into AI technological advancements. At MBZUAI, Ph.D. and M.Sc. students are assigned supervisors early in their academic journey to guide their research and academic development. Ph.D. candidates can list preferred supervisors during admission, while M.Sc. students are matched with available faculty within their department. Assignments are finalized by the Registrar's Office in collaboration with the Academic Department Chairs, ensuring at least one tenured supervisor per student. Students may request changes to their supervisor during their first semester. Detailed guidelines and timelines will be communicated by the Registrar's Office in the first semester.

Duration of study

Students are required to make steady progress towards meeting degree requirements and must successfully pass all program components as per their intake year study plan within the normal allowed time to completion.

The normal time to complete for a M.Sc program is two years, and the maximum time to complete is four years, inclusive of any approved leave of absence.

The normal time to complete a Ph.D. program is four years, and the maximum time to complete is six years, inclusive of any approved leave of absence.

Program transfer

To change the current program, The student must meet all the admission requirements of the target program they seek to transfer into. A transfer into the target program is contingent upon there being available space within that program, and a Primary Supervisor in the target program willing to take on the student.

Upon approval of a program transfer, the student is required to meet all the coursework requirements of the new program. It is important to note that there is no guarantee that courses completed in the original program can be transferred as credit towards the new program. Each case will be assessed individually to ensure the integrity of the academic qualifications awarded.

Managing courses

Course withdrawal

A student who encounters unanticipated difficulty in a course may withdraw from a course as per the University calendar. Withdrawing from a course after the deadline will result in academic/financial penalty.

Attendance

Students are strongly encouraged to physically attend all lectures and lab sessions to foster a deeper understanding, promote interactive learning, and facilitate effective communication.

Leave of absence

A student may request a leave of absence for a maximum of two (2) semesters during the period of study at MBZUAI for extenuating circumstances.

If the student exceeds the approved leave of absence duration without a formal notification, they will be considered withdrawn from the University and financial implications will apply.

Annual leave

Full-time graduate students holding a MBZUAI scholarship may be eligible to take annual leave as per the entitlement stated in the financial obligations policy.

Students must meet, discuss and obtain the approval of their advisor(s) prior to applying for leave. The advisor is responsible for guiding the student and approving annual leave requests.

Teaching requirement

MBZUAI strives to cultivate an environment that fosters academic excellence and integrity, upholds the principles of free inquiry, and aligns with its overarching educational mission. The University operates on the assumption that all students have a serious commitment to their educational pursuits, expecting them to embody responsibility and adhere to the highest standards of ethical behavior, honesty, and academic integrity. Any form of academic dishonesty is deemed incompatible with the fundamental principles of higher education and is prohibited as it undermines the core values and integrity of the University.

Students are required to conduct themselves in a manner that enhances the positive atmosphere within the University, emphasizing values such as respect, civility, diversity, opportunity, tolerance, and inclusiveness. Every student at MBZUAI is obligated to show respect towards fellow students, faculty members, staff, and the public. It is expected that students act with honesty and integrity, adhering to the University's regulations, policies, and guidelines to ensure the success of both the individual and the community. Any document that contains non-public information about students or applicants is considered confidential as per the University policies and procedures.

All students are expected to abide by the Code of Conduct.

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Student rights and responsibilities

Part of the learning experience of our graduate students includes the ability to help others acquire new technical knowledge. Typically, we do this by having graduate students support our regular teaching activities, for example, by leading lab sessions, preparing and grading student labs/assignments, serving as class assistants, leading discussion sessions, or providing supervised teaching. This training experience helps graduate students improve their technical communication and presentation skills and allows them to explore a possible career path in academia.

PhD students are required to complete at least two (2) teaching assistantships (TA-ships) before graduation. In rare cases, one of these TA-ships can be replaced by a pre-approved “alternative service” to the department. TA-ships might involve an effort of up to 10hr/week for the semester.

Students must apply for a TA position within their departments. To become eligible to apply for a TA position, students must have completed their mandatory coursework and have completed the TA training module. Successful fulfillment of this requirement includes a positive evaluation from the faculty member for whom the student serves as a TA.

Student Handbook

The Educational Affairs Policy Manual establishes a framework for delivering exceptional student support, fostering campus community development, and supporting students in securing suitable internships and achieving successful graduate outcomes. All students are expected to follow the Educational Affairs, Registrar’s Office, and Code of Conduct Policy Manuals.

Students are given detailed descriptions of the University’s services, academic procedures, and all aspects of student life are detailed in the Student Handbook

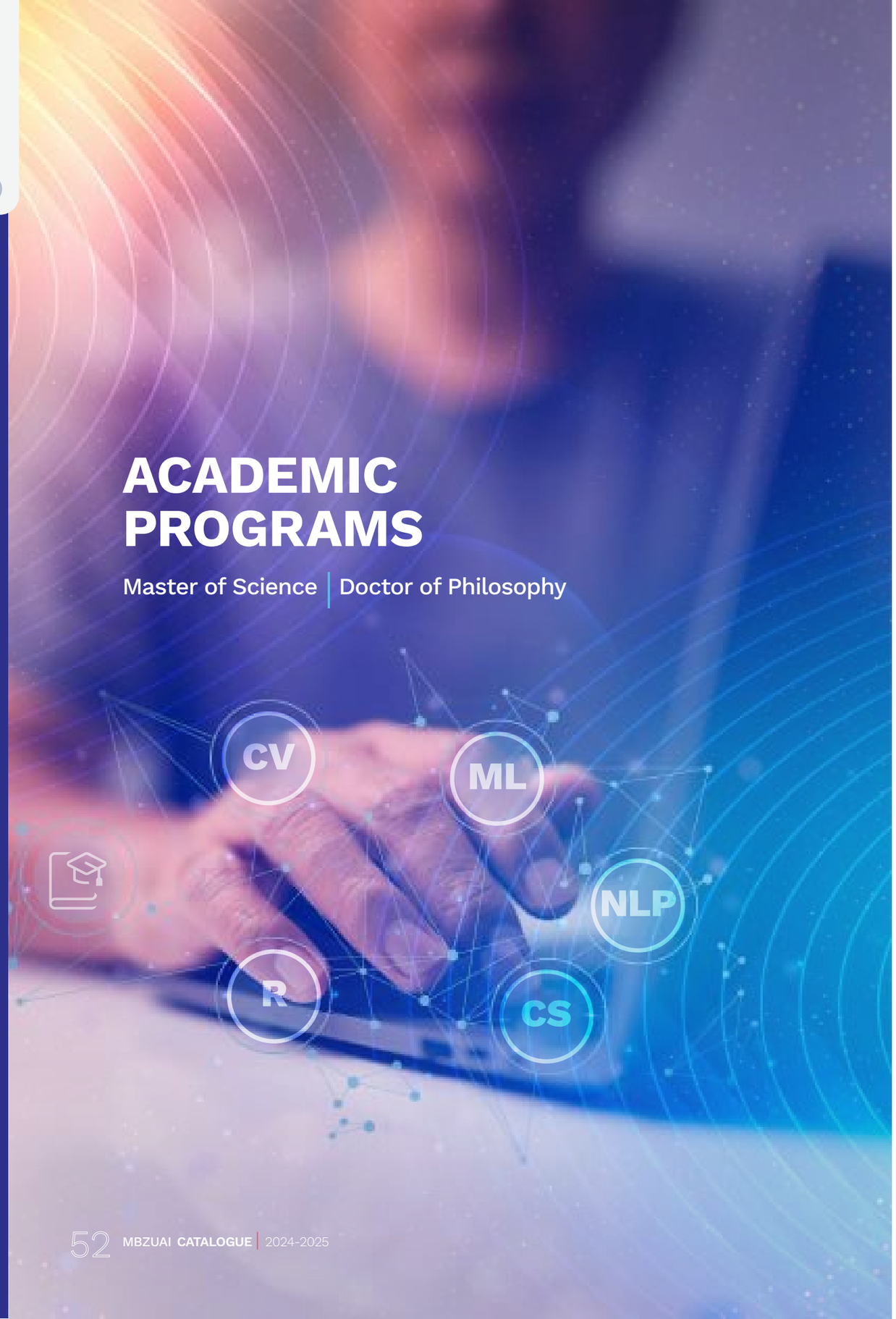
Student grievances and resolutions

MBZUAI recognizes the fundamental importance of fostering an environment that empowers students and upholds their rights. Student rights, a cornerstone of academic governance, encompass a spectrum of privileges and protections aimed at ensuring a conducive and equitable learning experience. These rights extend beyond the pursuit of knowledge to include a commitment to fair treatment, freedom of expression, and access to resources that facilitate personal and academic growth. Acknowledging the rights of students reinforces the principles of academic integrity but also cultivates a vibrant and inclusive educational community.

MBZUAI’s Code of Conduct, Educational Affairs and Registrar’s Office policy manuals ensure that student rights and grievances are dealt with in a fair and transparent manner.

ACADEMIC PROGRAMS

Master of Science | Doctor of Philosophy



Master of Science in **Computer Science**

CS

Mode Full-time

Credits 36

Location On-campus

Program aims

The goals of the Master of Science in Computer Science are to train specialists to (1) analyze complex computer science and AI problems, (2) take a scientific, innovative, ethical, and socially responsible approach to conducting and contributing to computer science research, and (3) solve complex problems in the field. As technological progress accelerates, so does the demand for skilled computer science professionals. The Master of Science in Computer Science is intended for students desiring to substantially advance their knowledge and skill in a field or fields of computer science. Students will be supervised and mentored by faculty members with world-class expertise in a variety of areas in computer science, including algorithms, systems, and computational intelligence. This master's program is ideally suited to students wishing to become senior professionals in the technology industry or to those seeking to prepare for a career in scientific research.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with the Emirates Qualifications Framework and, as such, are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Role in context (RC) and Self-development (SD).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Analyze real-world problems and apply principles of computer science and other relevant disciplines to meet desired needs.
2. Analyze and prove the properties of data structures, algorithms and/ or computing systems using the theoretical underpinnings of computer science.
3. Identify and apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems.
4. Function effectively as a member and leader of a team engaged in computer science projects and research of varying complexity.
5. Communicate the practical and entrepreneurial feasibility and sustainability of research findings and innovations, orally and in written form, to both specialist and general audiences.

The PLOs are mapped to a level nine (9) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program learning outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1, 2, 3L9	S-1, 3L9	AR-1, 3L9	RC-1L9	SD-3L9
PLO2	K-4L9	S-1L9	AR-3L9	-	SD-1L9
PLO3	K-1, 2L9	S-2L9	-	-	SD-1, 2L9
PLO4	-	S-1L9	AR-1, 2L9	RC-2L9	SD-3L9
PLO5	-	S-4L9	-	-	-

Aligning PLOs for Master of Science in Computer Science to QF Emirates Level 9 Framework.

Program study plan

Students are expected to complete coursework in the first year of degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and, similarly, can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
CS701	Advanced Algorithms and Data Structures
MTH703	Mathematics for Theoretical Computer Science
CS702	Theory of Computer Science
SEMESTER 2	
CS703	Operating Systems + two electives
SUMMER	
INT799	Internship (up to six weeks)
SEMESTER 3	
RES799	Introduction to Research Methods
CS799	Master's Research Thesis
SEMESTER 4	
CS799	Master's Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Master of Science is 36 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
At least one internship of up to six weeks duration must be satisfactorily completed as a graduation requirement		
Research Methods	1	2
Research Thesis	1	8

Program courses

Core courses

The Master of Science in Computer Science is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so that they can successfully accomplish their research project (thesis). Students are required to take MTH703, CS701, CS702, CS703, RES799 and INT799 as mandatory courses. They can select two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection.

The decision on the courses to be taken will be made in consultation with students' supervisory panel, which will comprise two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
CS701	Advanced Algorithms and Data Structures	4
MTH703	Mathematics for Theoretical Computer Science	4
CS702	Theory of Computer Science	4
CS703	Operating Systems	4
INT799	Master of Science Internship	2
RES799	Introduction to Research Methods	2
CS799	Computer Science M.Sc. Research Thesis	8

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Elective courses

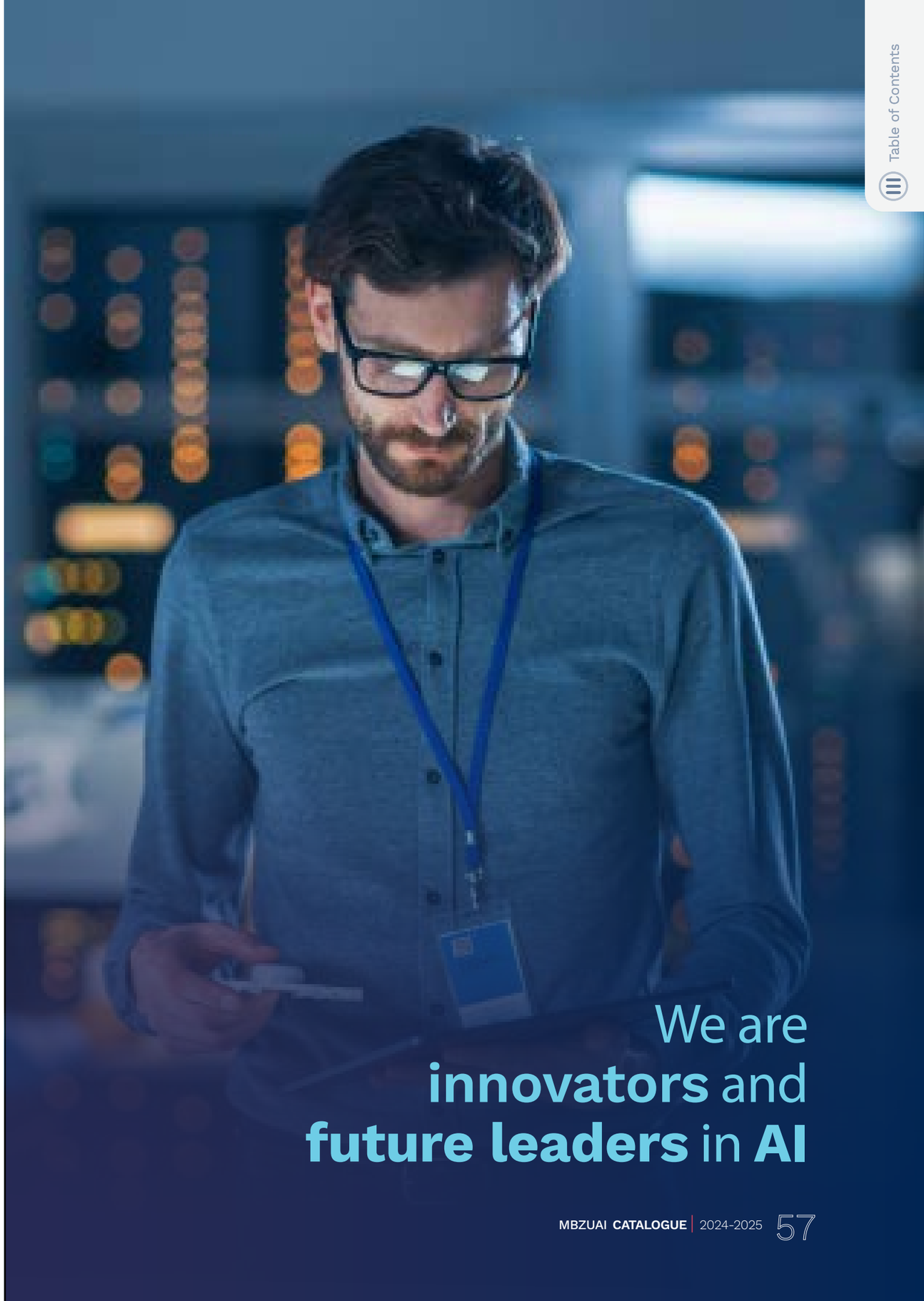
Students will select a minimum of two elective courses, with a total of eight (or more) credit hours based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Master of Science in Computer Science are listed in the tables below. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
CS704	Programming Languages and Implementation	4
CS705	Distributed and Parallel Computing	4
DS701	Data Mining	4
DS702	Big Data Processing	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP703	Speech Processing	4
ROB701	Introduction to Robotics	4

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. For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course name	Credit hours
CS799	Master's Research Thesis	8



Master of Science in **Computer Vision**

CV

Mode Full-time

Credits 36

Location On-campus

Program aims

The goals of the Master of Science in Computer Vision are to train specialists to (1) analyze complex problems within the field of computer vision (2) take a scientific, innovative, ethical, and socially responsible approach to conducting and contributing to research, and (3) solve complex problems in the field. This scientific field studies how computers can be used to automatically understand and interpret visual imagery. It aims to mimic the astounding capabilities of the human visual cortex using machine vision algorithms. It studies how an image is created, the geometry of the 3D world and high-level tasks such as object recognition, object detection, and tracking, image segmentation and action recognition. Computer vision has important applications in augmented/virtual reality, autonomous cars, service robots, biometrics and forensics, remote sensing and security and surveillance.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Demonstrate highly specialized knowledge of computer vision in line with the underlying mathematical and computational principles.
2. Perform critical literature surveys and develop new ideas by integrating multidisciplinary knowledge.
3. Apply advanced problem-solving skills to analyze, design and execute solutions for the existing and new problems in computer vision faced by both industry and academia.
4. Initiate, manage and complete multifaceted computer vision projects and clearly communicate concepts, complex ideas, and conclusions both orally and in the form of technical reports.
5. Function independently and in a team to address computer vision problems under complex and unpredictable real-world settings.
6. Contribute to cutting-edge computer vision research to produce new knowledge or take responsibility to lead innovative and impactful computer vision projects in industry.
7. Manifest the right learning attitude during coursework and research that clearly shows ownership, personal and technical growth, and responsibility.
8. Articulate legal, ethical, environmental, and socio-cultural ramifications of computer vision technologies, and be able to make informed and fair decisions on complex issues.

The PLOs are mapped to a level nine (9) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program learning outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L9	-	AR-1L9	-	-
PLO2	K-2,4L9	S-1,2L9	-	-	-
PLO3	K-2L9	S-1,2,3L9	AR-2L9	-	-
PLO4	-	S-1,2,3,4L9	AR-3L9	RC-1L9	-
PLO5	-	S-2,4L9	AR-1,3L9	RC-1,2L9	SD-1L9
PLO6	K-3L9	S-1,3L9	-	-	-
PLO7	-	-	AR-2,3L9	RC-2L9	SD-1,2L9
PLO8	-	-	AR-1,3L9	RC-1L9	SD-3L9

Aligning PLOs for Master of Science in Computer Vision to QF Emirates Level 9 Framework.

Program study plan

Students are expected to complete coursework in the first year of the degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and similarly can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
AI701	Foundations of Artificial Intelligence
MTH701	Mathematical Foundations of Artificial Intelligence
CV701	Human and Computer Vision
SEMESTER 2	
CV702	Geometry for Computer Vision **OR**
CV703	Visual Object Recognition and Detection
	+ 2 electives
SUMMER	
INT799	Master of Science Internship
SEMESTER 3	
RES799	Introduction to Research Methods
CV799	Computer Vision Master's Research Thesis
SEMESTER 4	
CV799	Computer Vision Master's Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Master of Science in Computer Vision is 36 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Research Methods	1	2
Research Thesis	1	8

Program courses

Core courses

The Master of Science in Computer Vision is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take AI701, MTH701, CV701, RES799 and INT799 as mandatory courses. They can select either CV702 or CV703 along with two electives.

To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions. The following core courses must be taken by all students:

Code	Course title	Credit hours
AI701	Foundations of Artificial Intelligence	4
MTH701	Mathematical Foundations of Artificial Intelligence	4
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision **OR**	4
CV703	Visual Object Recognition and Detection	4
INT799	Master of Science Internship	2
RES799	Introduction to Research Methods	2
CV799	Computer Vision M.Sc. Research Thesis	8

Elective courses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Master of Science in Computer Vision are listed in the tables below. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
AI702	Deep Learning	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
CV707	Digital Twins	4
DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics and Analysis	4
ML701	Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML707	Smart City Services and Applications	4
ML708	Trustworthy Artificial Intelligence	4
ML709	IoT, Smart Systems, Services and Applications	4
ML710	Parallel and Distributed Machine Learning Systems	4
ML711	Intermediate Music AI	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP703	Speech Processing	4
ROB701	Introduction to Robotics	4

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. For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
CV799	Computer Vision Master's Research Thesis	8

ML

Mode
Full-time

Credits
36

Location
On-campus

Program aims

The goals of the Master of Science in Machine Learning (ML) are to train specialists to (1) analyze complex problems within the field of ML, (2) take a scientific, innovative, ethical, and socially responsible approach to conducting and contributing to research, and (3) solve complex problems in the field. ML is the scientific study scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on patterns and inference instead. These algorithms are based on mathematical models learned automatically from data, thus allowing machines to intelligently interpret and analyze input data to derive useful knowledge and arrive at important conclusions. Machine learning is heavily used for enterprise applications (e.g., business intelligence and analytics), effective web search, robotics, smart cities and understanding of the human genome.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Explain the modern machine learning pipeline: data, models, algorithmic principles, and empirics.
2. Employ data-preprocessing and various exploration and visualization tools.
3. Identify and differentiate the capabilities and limitations of the different forms of learning algorithms.
4. Critically analyze, evaluate, and continuously improve the performance of the learning algorithms.
5. Analyze computational and statistical properties of advanced learning algorithms and their performance.
6. Apply and deploy ML-relevant programming tools for a variety of complex ML problems.
7. Problem-solve through independently applying machine learning methods to multiple. often ambiguous, complex problems.
8. Apply sophisticated skills in initiating, managing, completing, and communicating multiple project reports, highly complex ideas, and critiques on a variety of machine learning methods using innovative and sustainable approaches.

The PLOs are mapped to a level nine (9) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L9	-	-	-	-
PLO2	-	-	-	-	-
PLO3	K-1,3L9	S-1,2L9	-	-	-
PLO4	K-3L9	S-1,2L9	AR-1,3L9	-	SD-2L9
PLO5	K-3L9	S-1,2L9	-	-	-
PLO6	-	S-3L9	AR-1L9	-	SD-3L9
PLO7	K-2,4L9	S-2,3L9	AR-1,2L9	RC-2L9	SD-1,3L9
PLO8	K-2L9	S-3,4L9	-	RC-1L9	-

Aligning PLOs for Master of Science in Machine Learning to QF Emirates Level 9 Framework.

Program study plan

Students are expected to complete coursework in the first year of degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and similarly can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
AI701	Foundations of Artificial Intelligence
MTH701	Mathematical Foundations of Artificial Intelligence
ML701	Machine Learning
SEMESTER 2	
ML702	Advanced Machine Learning **OR**
ML703	Probabilistic and Statistical Inference
	+ 2 electives
SUMMER	
INT799	Master of Science Internship
SEMESTER 3	
RES799	Introduction to Research Methods
ML799	Machine Learning Master's Research Thesis
SEMESTER 4	
ML799	Machine Learning Master's Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Master of Science in Machine Learning is 36 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Introduction to Research	1	2
Research Thesis	1	8

Program courses

Core courses

The Master of Science in Machine Learning is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take AI701, MTH701, ML701, ML702 or ML703, INT799 and RES799 as mandatory courses, along with two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project.

For full descriptions of courses, please refer to Appendix 1: Course descriptions. The following core courses must be taken by all students:

Code	Course title	Credit hours
AI701	Foundations of Artificial Intelligence	4
MTH701	Mathematical Foundations of Artificial Intelligence	4
ML701	Machine Learning	4
ML702	Advanced Machine Learning **OR**	4
ML703	Probabilistic and Statistical Inference	4
INT799	Master of Science Internship	2
RES799	Introduction to Research Methods	2
ML799	Machine Learning M.Sc. Research Thesis	8

Elective courses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Master of Science in Machine Learning are listed in the tables below. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
AI702	Deep Learning	4
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
CV707	Digital Twins	4
DS701	Data Mining	4
DS702	Big Data Processing	4
DS703	Information Retrieval	4
DS704	Statistical Aspect of Machine Learning / Statistical Theory	4
HC701	Medical Imaging: Physics and Analysis	4
ML702	Advanced Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML707	Smart City Services and Applications	4
ML708	Trustworthy Artificial Intelligence	4
ML709	IoT, Smart Systems, Services and Applications	4
ML710	Parallel and Distributed Machine Learning Systems	4
ML711	Intermediate Music AI	4
MTH702	Optimization	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP703	Speech Processing	4
ROB701	Introduction to Robotics	4

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. For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
ML799	Master's Research Thesis	8

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Master of Science in **Natural Language Processing**

NLP

Mode
Full-time

Credits
36

Location
On-campus

Program aims

NLP enables computers to communicate with people using everyday language. Large language models (LLMs), in particular are key drivers of language based interaction, potentially including extra data modalities such as structured data or images. Such systems also enable sophisticated tasks such as language translation, semantic understanding, text summarization, and natural language dialogue. Applications of NLP include interactive speech-based applications, automated translators, digital personal assistance and chat bots.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Analyze and model textual and speech data with applications to real world scenarios.
2. Identify and explain the syntactic and semantic structures in speech and textual data (e.g., the predicate-argument structure).
3. Implement cutting-edge NLP algorithms and benchmark the achieved results.
4. Formulate own research questions, analyze the existing body of knowledge, propose, and develop solutions to new problems.
5. Use and deploy NLP related programming tools for a variety of NLP problems.
6. Work independently as well as part of a team, in a collegial manner, on NLP related projects.
7. Effectively communicate the feasibility and sustainability of experimental results, innovations and research findings orally and in writing, and critique existing body of work.

The PLOs are mapped to a level nine (9) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L9	S-1,3L9	AR-1,3L9	-	-
PLO2	K-2L9	S-4L9	-	-	-
PLO3	K-2L9	S-2L9	-	RC-1L9	SD-2L9
PLO4	K-2,4L9	S-1,2,3,4L9	AR-1,3L9	-	-
PLO5	K-4L9	-	-	-	SD-3L9
PLO6	-	S-2L9	AR-1,2L9	RC-1,2L9	SD-1L9
PLO7	K-3L9	S-1,4L9	-	-	-

Aligning PLOs for Master of Science in Natural Language Processing to QF Emirates Level 9 Framework.

Program study plan

The students are expected to complete coursework in the first year of their degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and similarly can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
AI701	Foundations of Artificial Intelligence
MTH701	Mathematical Foundations of Artificial Intelligence

SEMESTER 1	
NLP701	Natural Language Processing
SEMESTER 2	
NLP702	Advanced Natural Language Processing
	+ 2 electives
SUMMER	
INT799	Master of Science Internship
SEMESTER 3	
RES799	Introduction to Research Methods
NLP799	Natural Language Processing Master's Research Thesis
SEMESTER 4	
NLP799	Natural Language Processing Master's Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Master of Science in Natural Language Processing is 36 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Introduction to Research	1	2
Research Thesis	1	8

Program courses

Core courses

The Master of Science in Natural Language Processing is primarily a research based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take AI701, MTH701, NLP701, NLP702, INT799 and RES799 as mandatory courses. They can select two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
AI701	Foundations of Artificial Intelligence	4
MTH701	Mathematical Foundations of Artificial Intelligence	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4

Code	Course title	Credit hours
INT799	Master of Science Internship	4
RES799	Introduction to Research Methods	4
NLP799	Natural Language Processing M.Sc. Research Thesis	8

Elective courses

Students will select a minimum of two elective courses, with a total of 8 credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Master of Science in Natural Language Processing are listed in the table below. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
AI702	Deep Learning	4
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
CV707	Digital Twins	4
DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics and Analysis	4
ML701	Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML707	Smart City Services and Applications	4
ML708	Trustworthy Artificial Intelligence	4
ML709	IoT, Smart Systems, Services and Applications	4
ML710	Parallel and Distribution Machine Learning Systems	4
ML711	Intermediate Music AI	4
NLP703	Speech Processing	4
ROB701	Introduction to Robotics	4

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.

For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
NLP799	Master's Research Thesis	8

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Master of Science in **Robotics**

Mode Full-time | **Credits** 36 | **Location** On-campus

Program aims

The aims of the Master of Science in Robotics are (1) to develop students' interest in, knowledge and understanding of robotics and autonomous systems and (2) to prepare them for Ph.D. research in that area and/ or the industry workforce. The program teaches students to apply the research techniques and knowledge they have gained to solve complex problems in the field of Robotics. Robotics research and the development of intelligent systems continue to be one of the key priorities set by both government and industry. Interdisciplinary in scope, our Master's in Robotics provides an ideal foundation for what today's experts in robotics and intelligent systems need to know. Along with the chance to learn from world leaders in their fields from across the globe, our program offers hands-on activities where you will learn by designing, prototyping, and validating intelligent robotic systems. As a graduate of the Master of Science in Robotics program you will take a leading role in the development of integrated robotics technologies and systems, both locally and internationally.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with the Emirates Qualifications Framework and, as such, are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Role in context (RC), and Self-development (SD).

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Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Discuss and explain concepts and key components of robotics technologies
2. Compare and contrast various robot sensors and their perception principles that enable a robot to analyze their environment, reason and take appropriate actions toward the given goal.
3. Analyze and solve problems in spatial transformation robot locomotion, kinematics, motion control, localization and mapping, navigation, and path planning.
4. Critically appraise current research literature and situationally appropriate experiments with state-of-the-art robotic algorithms on a robotic platform.
5. Effectively communicate the practical and entrepreneurial feasibility and sustainability of robotics concepts, innovations and design decisions using a range of media/visual mediums.
6. Function effectively in and lead a team that creates a collaborative and inclusive environment, establishes research goals, plans tasks, and meets desired objectives.

The PLOs are mapped to a level nine (9) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L9	S-1L9	-	-	-
PLO2	K-1,3L9	S-2,3L9	AR-1,3L9	RC-1L9	SD-1L9
PLO3	K-1L9	S-1, 2,3L9	-	-	-
PLO4	K-2,4L9	-	-	-	SD-1L9
PLO5	-	S-4L9	-	-	-
PLO6	-	-	AR-1,2L9	RC-1, 2L9	SD-1,2,3L9

Aligning PLOs for Master of Science in Robotics to QF Emirates Level 9 Framework.

Program study plan

Students are expected to complete coursework in the first year of degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and, similarly, can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
AI701	Foundations of Artificial Intelligence
ROB701	Introduction to Robotics
	+ one elective
SEMESTER 2	
ROB702	Robotic Vision and Intelligence
ROB703	Robot Localization and Navigation
	+ one elective
SUMMER	
INT799	Master of Science Internship (up to six weeks)
SEMESTER 3	
RES799	Introduction to Research Methods
ROB799	Master's Research Thesis
SEMESTER 4	
ROB799	Master's Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Master of Science in Robotics is 36 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Introduction to Research	1	2
Research Thesis	1	8

Program courses

Core courses

The Master of Science in Robotics is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so that they can successfully accomplish their research project (thesis). Students are required to take AI701, ROB701, ROB702, ROB703, RES799 and INT799 as mandatory courses. They can select two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with students' supervisory panel, which will comprise two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
AI701	Foundations of Artificial Intelligence	4
ROB701	Introduction to Robotics	4
ROB702	Robotic Vision and Intelligence	4
ROB703	Robot Localization and Navigation	4
INT799	Master of Science Internship	2
RES799	Introduction to Research Methods	2
ROB799	Robotics M.Sc. Research Thesis	8

Elective courses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Master of Science in Robotics are listed in the table below.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
MTH701	Mathematical Foundations for Artificial Intelligence	4
DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics & Analysis	4
ML701	Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML707	Smart City Services and Applications	4
ML709	IoT, Smart Systems, Services and Applications	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP703	Speech Processing	4

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.

For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
ROB799	Master's Research Thesis	8

Doctor of Philosophy in **Computer Science**

CS

Mode
Full-time

Credits
60

Location
On-campus

Program aims

The goal of the Doctor of Philosophy (Ph.D.) in Computer Science is to produce highly trained researchers for industry and academia. The program prepares students to apply the research techniques and knowledge they have gained to solve complex problems in the field of Computer Science and AI.

The Ph.D. in Computer Science offers exciting opportunities to do cutting-edge applied research and produce new intellectual contributions with world leaders in their field. It is designed to prepare students for leadership careers in academia, industry research labs and education in computer science. As a graduate of this program, students will not only have strong technical and research expertise in their field but will also have the ability to work effectively in interdisciplinary teams and be able to tackle problems that require both technical and non-technical solutions.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with the Emirates Qualifications Framework and, as such, are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Role in context (RC), and Self-development (SD).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Analyze complex computing problems and apply principles of computing and other relevant disciplines to devise solutions.
2. Develop research projects in computer science that meet high standards of theoretical and methodological rigor.
3. Recognize social and professional responsibilities and make informed decisions, which consider the impact, sustainability and entrepreneurial feasibility of computer science solutions and innovations in global and local, economic, environmental, and societal contexts.
4. Systematically review, analyze, and interpret the body of scientific literature and innovations in computer science.
5. Communicate new knowledge orally and through original research of publishable quality that satisfied peer review.

The PLOs are mapped to a level ten (10) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program learning outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1,2L10	S-1,2L10	AR-1L10	RC-1L10	SD-1,3L10
PLO2	K-1,2L10	S-2L10	AR-1L10	RC-1, 2,3L10	SD-1L10
PLO3	K-2L10	S-1L10	AR-2L10	RC-3L10	SD-1,3L10
PLO4	K-2L10	S-1L10	AR-2L10	RC-3L10	SD-1,2,3L10
PLO5	-	-	-	-	-

Aligning PLOs for Doctor of Philosophy in Computer Science to QF Emirates Level 10 Framework.

Program study plan

Students are expected to complete coursework in the first year of degree and focus on the research and thesis writing in the subsequent three years. Students must successfully pass a qualifying exam (QE) at the end of the first year to progress to the research component of the Ph.D. At the end of the second year, which is focused on research, students must present evidence of satisfactory research progress at a candidacy exam (CE) to progress to the final two years of research.

A typical study plan is as follows:

SEMESTER 1	
CS801	Advanced Complexity
CS802	Advanced Data Structures
	+ one elective
SEMESTER 2	
CS803	Randomized Algorithms

SEMESTER 2	
CS804	Combinatorial Optimization
	+ one elective
SUMMER	
INT899	Ph.D. Internship (up to four months)
SEMESTER 3	
RES899	Advanced Research Methods
CS899	Ph.D. Research Thesis
SEMESTER 4	
CS899	Ph.D. Research Thesis
SEMESTER 5	
CS899	Ph.D. Research Thesis
SEMESTER 6	
CS899	Ph.D. Research Thesis
SEMESTER 7	
CS899	Ph.D. Research Thesis
SEMESTER 8	
CS899	Ph.D. Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Doctor of Philosophy in Computer Science is 60 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Research Methods	1	2
Research Thesis	1	32

Program courses

Core courses

The Doctor of Philosophy in Computer Science is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so that they can successfully accomplish their research project (thesis). Students are required to take CS801, CS802, CS803, CS804, RES899 and INT899 as mandatory courses. They can select two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection.

The decision on the courses to be taken will be made in consultation with students' supervisory panel, which will comprise two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
CS801	Advanced Complexity	4
CS802	Advanced Data Structures	4
CS803	Randomized Algorithms	4
CS804	Combinatorial Optimization	4
INT899	Ph.D. Internship	2
RES899	Advanced Research Methods	2
CS899	Computer Science Ph.D. Research Thesis	32

Elective Ccourses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Doctor of Philosophy in Computer Science are listed in the table below. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
NLP804	Deep Learning for Natural Language Generation	4
NLP805	Natural Language Processing-Ph.D.	4
NLP806	Advanced Natural Language Processing	4
NLP807	Speech Processing	4
NLP808	Current Topics in Natural Language Processing	4
NLP809	Advanced Speech Processing	4
NLP810	Robust and Trustworthy Natural Language Processing	4
CV804	3D Geometry Processing	4

Research thesis

The Ph.D. research thesis exposes students to cutting-edge and unsolved research problems in the field of computer science, 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. For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course name	Credit hours
CS899	Ph.D. Research Thesis	32

Doctor of Philosophy in **Computer Vision**

CV

Mode
Full-time

Credits
60

Location
On-campus

Program aims

The goal of the Doctor of Philosophy (Ph.D.) in Computer Vision is to produce highly trained researchers for industry and academia. The program prepares students to apply the research techniques and knowledge they have gained to solve complex problems in the field of computer vision and AI.

This scientific field studies how computers can be used to automatically understand and interpret visual imagery. It aims to mimic the astounding capabilities of the human visual cortex using machine vision algorithms. It studies how an image is created, the geometry of the 3D world and high level tasks such as object recognition, object detection, and tracking, image segmentation and action recognition. Computer vision has important applications in augmented/ virtual reality, autonomous cars, service robots, biometrics and forensics, remote sensing and security and surveillance.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Develop expertise in several specialized areas of research in computer vision.
2. Compare and contrast existing literature, apply reasoning, and master necessary skills and techniques to develop novel ideas that are recognized by the experts of the computer vision discipline.
3. Apply advanced problem-solving skills to analyze, design and execute innovative solutions for the existing and/or new problems faced in both industry and academia .
4. Initiate, manage and complete technically challenging computer vision projects and clearly communicate concepts, highly complex ideas, and key findings in the form of technical reports, scientific publications, and oral presentations at relevant technical venues.
5. Select and use programming tools, libraries, and other relevant resources to solve real-world computer vision problems.
6. Develop advanced ability to work independently with substantial authority or in team collaboration with professional integrity to complete highly challenging computer vision projects in a timely manner.
7. Develop new knowledge in computer vision that makes students suitable for a role in academia or industry.
8. Practice research ethics and commit to professional responsibilities while conducting cutting-edge innovative, sustainable and entrepreneurial advancement in computer vision discipline.
9. Articulate legal, ethical, environmental, and socio-cultural ramifications of computer vision technologies, and take a lead in making informed and fair decisions on complex issues.

The PLOs are mapped to a level 10 qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program learning outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L10	-	-	-	-
PLO2	K-1L10	S-1,2L10	AR-1L10	-	SD-1L10
PLO3	K-1L10	S-1,2L10	AR-1L10	RC-1L10	SD-1L10
PLO4	K-2L10	S-1,3L10	-	RC-1L10	-
PLO5	K-1L10	S-1,2L10	-	-	-
PLO6	-	S-1,2L10	AR-1L10	RC-1,2,3L10	-
PLO7	K-2L10	S-2L10	-	-	-
PLO8	-	-	AR-1L10	-	SD-2,3L10
PLO9	-	S-3L10	AR-2L10	-	SD-3L10

Aligning PLOs for Doctor of Philosophy in Computer Vision to QF Emirates Level 10 Framework..

Program study plan

Students are expected to complete course work in the first year of their degree and focus on the research and thesis writing in the subsequent three years. Students must successfully pass a qualifying exam (QE) at the end of the first year to progress to the research component of the Ph.D. At the end of the second year, which is focused on research, students must present evidence of satisfactory research progress at a candidacy exam (CE) to progress to the final two years of research.

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A typical study plan is as follows:

SEMESTER 1	
CV801	Advanced Computer Vision
CV802	Advanced 3D Computer Vision
	+ 1 elective
SEMESTER 2	
CV803	Advanced Techniques in Visual Object Recognition and Detection
CV804	3D Geometry Processing
	+ one elective
SUMMER	
INT899	Ph.D. Internship
SEMESTER 3	
RES899	Advanced Research Methods
CV899	Computer Vision Ph.D. Research Thesis
SEMESTER 4	
CV899	Computer Vision Ph.D. Research Thesis
SEMESTER 5	
CV899	Computer Vision Ph.D. Research Thesis
SEMESTER 6	
CV899	Computer Vision Ph.D. Research Thesis
SEMESTER 7	
CV899	Computer Vision Ph.D. Research Thesis
SEMESTER 8	
CV899	Computer Vision Ph.D. Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Doctor of Philosophy in Computer Vision is 60 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Advanced Research Methods	1	2
Research Thesis	1	32

Program courses

Core courses

The Doctor of Philosophy in Computer Vision is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take CV801, CV802, CV803, CV804, INT899 and RES899 as mandatory courses.

To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
CV801	Advanced Computer Vision	4
CV802	Advanced 3D Computer Vision	4
CV803	Advanced Techniques in Visual Object Recognition and Detection	4
CV804	3D Geometry Processing	4
INT899	Ph.D. Internship	2
RES899	Advanced Research Methods	2
CV899	Computer Vision Ph.D. Research Thesis	32

Elective courses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Doctor of Philosophy in Computer Vision are listed in the tables below.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
CV805	Life-long Learning Agents for Vision	4
CV806	Advanced Topics in Vision and Language	4
CV807	Safe and Robust Computer Vision	4
ML801	Foundations and Advanced Topics in Machine Learning	4
ML803	Advanced Probabilistic and Statistical Inference	4
ML804	Advanced Topics in Continuous Optimization	4
ML805	Advanced Machine Learning	4
ML806	Advanced Topics in Reinforcement Learning	4
ML807	Federated Learning	4
ML808	Advanced Topics in Causality and Machine Learning	4
ML809	Advanced Learning Theory	4
ML812	Advanced Topics in Algorithms for Big Data	4
ML813	Topics in Dimensionality Reduction and Manifold Learning	4
NLP804	Deep Learning for Natural Language Generation	4
NLP805	Natural Language Processing-Ph.D.	4
NLP806	Advanced Natural Language Processing	4
NLP807	Speech Processing	4
NLP808	Current Topics in Natural Language Processing	4
NLP809	Advanced Speech Processing	4
NLP810	Robust and Trustworthy Natural Language Processing	4
ROB804	Vision for Autonomous Robotics	4

Research thesis

The Ph.D. research thesis exposes students to cutting-edge and unsolved research problems in the field of computer vision, 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. For further details on the research thesis, please refer to Appendix 1: Course descriptions

Code	Course title	Credit hours
CV899	Computer Vision Ph.D. Research Thesis	32

ML

Mode
Full-time

Credits
60

Location
On-campus

Program aims

The goal of the Doctor of Philosophy (Ph.D.) in Machine Learning is to produce highly trained researchers for industry and academia. The program prepares students to apply the research techniques and knowledge they have gained to solve complex problems in the field of machine learning and AI. Machine learning is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on patterns and inference instead. These algorithms are based on mathematical models learned automatically from data, thus allowing machines to intelligently interpret and analyze input data to derive useful knowledge and arrive at important conclusions. Machine learning is heavily used for enterprise applications (e.g., business intelligence and analytics), effective web search, robotics, smart cities and understanding of the human genome.

National Qualifications Framework – five strands

The program learning outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Express comprehensive and deep understanding of the pipelines at the frontier of machine learning: data, models, algorithmic principles, and empirics.
2. Apply a range of skills and techniques in data-preprocessing, exploration, and visualization of data-statistics as well as complex algorithmic outcomes.
3. Identify the capabilities and limitations of the different forms of learning algorithms and critically analyze, evaluate, and improve the performance of the learning algorithms.
4. Develop problem-solving skills through independently applying the principles and methods learned in the program to various complex real world problems.
5. Compare and contrast statistical properties and performance guarantees including convergence rates (in theory and practice) for different learning algorithms.
6. Employ and deploy ML-relevant programming tools for a variety of ML problems.
7. Identify the limitations of existing machine learning algorithms and conceptualize, design, and implement an innovative, sustainable, and entrepreneurial solution for a variety of highly complex problems.
8. Initiate, manage, and complete research manuscripts that demonstrate expert self-evaluation and advanced skills in communicating highly complex ideas related to machine learning.
9. Initiate, manage, and complete multiple complex project reports, and critiques.

The PLOs are mapped to a level 10 qualification according to the FIVE strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L10	-	-	-	-
PLO2	K-1L10	S-2L10	-	-	-
PLO3	K-1L10	S-2L10	AR-1L10	-	SD-1L10
PLO4	-	S-2L10	-	RC-2L10	SD-3L10
PLO5	K-1L10	S-1L10	-	-	SD-1L10
PLO6	-	-	AR-1L10	-	-
PLO7	K-2L10	S-1L10	-	RC-2,3L10	SD-1,3L10
PLO8	K-2L10	S-3L10	-	RC-1,2L10	-
PLO9	-	S-1L10	AR-2L10	RC-1,2L10	SD-2,3L10

Aligning PLOs for Doctor of Philosophy in Machine Learning to QF Emirates Level 10 Framework.

Program study plan

Students are expected to complete coursework in the first year of their degree and focus more on the research project and thesis writing in the second year. However, this is an indicative plan and students have the flexibility to take a light course load in the second year as well and similarly can start research in the first year (e.g., literature review, background study, data collection or initial framework design) with the approval of their supervisory panel.

A typical study plan is as follows:

SEMESTER 1	
ML801	Foundations & Advanced Topics in Machine Learning
	+ 2 electives
SEMESTER 2	
ML814	Selected Topics in Machine Learning
	+ 2 electives

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SUMMER	
INT899	Ph.D. Internship (up to four months)
SEMESTER 3	
RES899	Advanced Research Methods
ML899	Machine Learning Ph.D. Research Thesis
SEMESTER 4	
ML899	Machine Learning Ph.D. Research Thesis
SEMESTER 5	
ML899	Machine Learning Ph.D. Research Thesis
SEMESTER 6	
ML899	Machine Learning Ph.D. Research Thesis
SEMESTER 7	
ML899	Machine Learning Ph.D. Research Thesis
SEMESTER 8	
ML899	Machine Learning Ph.D. Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Doctor of Philosophy in Machine Learning is 60 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	2	8
Electives	4	16
Internship	1	2
Advanced Research Methods	1	2
Research Thesis	1	32

Program courses

Core courses

The Doctor of Philosophy in Machine Learning is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take ML801, ML814, INT899 and RES899 as mandatory courses. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
ML801	Foundations and Advanced Topics in Machine Learning	4
ML814	Selected Topics in Machine Learning	4
INT899	Ph.D Internship	2
RES899	Advanced Research Methods	2
ML899	Machine Learning Ph.D. Research Thesis	32

Elective courses

Students will select a minimum of four elective courses, with a total of sixteen (or more) credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel.

Students must select at least two courses from ML803, ML804, ML805, ML818 or ML820 and the other two electives can be any of the others on the list.

The elective courses available for the Doctor of Philosophy in Machine Learning are listed in the tables below.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
ML803	Advanced Probabilistic and Statistical Inference	4
ML804	Advanced Topics in Continuous Optimization	4
ML805	Advanced Machine Learning	4
ML806	Advanced Topics in Reinforcement Learning	4
ML807	Federated Learning	4
ML808	Advanced Topics in Causality and Machine Learning	4
ML809	Advanced Learning Theory	4
ML812	Advanced Topics in Algorithms for Big Data	4
ML813	Topics in Dimensionality Reduction and Manifold Learning	4
ML815	Advanced Parallel and Distributed Machine Learning Systems	4
ML817	AI for Science and Engineering	4
ML818	Emerging Topics in Trustworthy Machine Learning	4
ML819	TinyML and Large Language Models	4
ML820	Machine Learning for Industry	4
CV801	Advanced Computer Vision	4
CV802	Advanced 3D Computer Vision	4
CV803	Advanced Techniques in Visual Object Recognition and Detection	4
CV804	3D Geometry Processing	4
CV805	Life-long Learning Agents for Vision	4
CV806	Advanced Topics in Vision and Language	4
CV807	Safe and Robust Computer Vision	4
NLP804	Deep Learning for Natural Language Generation	4
NLP805	Natural Language Processing-Ph.D.	4
NLP806	Advanced Natural Language Processing	4
NLP807	Speech Processing	4
NLP808	Current Topics in Natural Language Processing	4
NLP809	Advanced Speech Processing	4
NLP810	Robust and Trustworthy Natural Language Processing	4

Research thesis

The Ph.D. research thesis exposes students to cutting-edge and unsolved research problems in the field of machine learning, 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. For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
ML899	Machine Learning Ph.D. Research Thesis	32

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Doctor of Philosophy in **Natural Language Processing**

NLP

Mode Full-time

Credits 60

Location On-campus

Program aims

NLP enables computers to communicate with people using everyday language. Large language models (LLMs), in particular are key drivers of language based interaction, potentially including extra data modalities such as structured data or images. Such systems also enable sophisticated tasks such as language translation, semantic understanding, text summarization, and natural language dialogue. Applications of NLP include interactive speech-based applications, automated translators, digital personal assistance and chat bots.

National Qualifications Framework – five strands

The Program Learning Outcomes (PLOs) are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Self-development (SD), and Role in context (RC).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Devise cutting-edge NLP algorithms with applications to real-life. Implement, evaluate, and benchmark existing state-of-the-art NLP scholarly publications.
2. Identify open research problems, and the gaps in the existing body of knowledge, to formulate high impact research questions.
3. Independently develop innovative solutions, through extensive research and scholarship, to resolve unsolved research problems in high impact real-life applications of NLP.
4. Invent innovative, sustainable, and entrepreneurial state of the art solutions to existing open research problems.
5. Pursue an NLP project either independently, or as part of a team in a collegial manner, with minimal supervision.
6. Initiate, manage, and complete research manuscripts that demonstrate expert self-evaluation and advanced skills in scientifically communicating highly complex ideas.
7. Initiate, manage and complete multiple project reports and critiques, on a variety of NLP problems.

The PLOs are mapped to a level 10 qualification according to the 5 strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	-	S-1L10	AR-1L10	-	-
PLO2	K-1L10	S-1,3L10	-	**RC-1L10**	SD-1L10
PLO3	K-1L10	S-1,2L10	-	-	SD-1L10
PLO4	K-2L10	S-1,2L10	AR-1L10	-	SD-1L10
PLO5	K-2L10	S-1L10	**AR-1,2L10**	-	-
PLO6	-	-	AR-1L10	**RC-2,3L10**	-
PLO7	K-2L10	S-3L10	-	**RC-1L10**	SD-2,3L10
PLO8	-	-	AR-1,2L10	-	SD-1,2L10

Aligning PLOs for Doctor of Philosophy in Natural Language Processing to QF Emirates Level 10 Framework.

Program study plan

Students are expected to complete coursework in the first year of their degree and focus on the research and thesis writing in the subsequent three years. Students must successfully pass a qualifying exam (QE) at the end of the first year to progress to the research component of the Ph.D. At the end of the second year, which is focused on research, students must present evidence of satisfactory research progress at a candidacy exam (CE) to progress to the final two years of research.

A typical study plan is as follows:

SEMESTER 1	
NLP805	Natural Language Processing-Ph.D.
	+ 2 electives
SEMESTER 2	
NLP806	Advanced Natural Language Processing
NLP807	Speech Processing
	+ 1 elective
SUMMER	
INT899	Internship (up to four months)
SEMESTER 3	
RES899	Advanced Research Methods
NLP899	Natural Language Processing Ph.D. Research Thesis
SEMESTER 4	
NLP899	Natural Language Processing Ph.D. Research Thesis
SEMESTER 5	
NLP899	Natural Language Processing Ph.D. Research Thesis
SEMESTER 6	
NLP899	Natural Language Processing Ph.D. Research Thesis
SEMESTER 7	
NLP899	Natural Language Processing Ph.D. Research Thesis
SEMESTER 8	
NLP899	Natural Language Processing Ph.D. Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Doctor of Philosophy in Natural Language Processing is 60 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	3	12
Electives	3	12
Internship	1	2
Advanced Research Methods	1	2
Research Thesis	1	32

Program courses

Core courses

The Doctor of Philosophy in Natural Language Processing is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take NLP805, NLP806, NLP807, INT899 and RES899 as mandatory courses. They can select three electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with the students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project. For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
NLP805	Natural Language Processing-Ph.D.	4
NLP806	Advanced Natural Language Processing	4
NLP807	Speech Processing	4
INT899	Ph.D Internship	2
RES899	Advanced Research Methods	2
NLP899	Natural Language Processing Ph.D. Research Thesis	32

Elective courses

Students will select a minimum of two elective courses, with a total of 8 (or more) credit hours, based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Doctor of Philosophy in Natural Language Processing are listed in the tables below.

For full descriptions of courses, please refer to Appendix 1: Course descriptions

Code	Course title	Credit hours
CV801	Advanced Computer Vision	4
CV802	Advanced 3D Computer Vision	4
CV803	Advanced Techniques in Visual Object Recognition and Detection	4
CV804	3D Geometry Processing	4
CV805	Life-long Learning Agents for Vision	4
CV806	Advanced Topics in Vision and Language	4
CV807	Safe and Robust Computer Vision	4
ML801	Foundations and Advanced Topics in Machine Learning	4
ML803	Advanced Probabilistic and Statistical Inference	4
ML804	Advanced Topics in Continuous Optimization	4
ML805	Advanced Machine Learning	4
ML806	Advanced Topics in Reinforcement Learning	4
ML807	Federated Learning	4
ML808	Advanced Topics on Causality and Machine Learning	4
ML809	Advanced Learning Theory	4
ML812	Advanced Topics in Algorithms for Big Data	4
ML813	Topics in Dimensionality Reduction and Manifold Learning	4
NLP804	Deep Learning for Natural Language Generation	4
NLP808	Current Topics in Natural Language Processing	4
NLP809	Advanced Speech Processing	4
NLP810	Robust and Trustworthy Natural Language Processing	4

Research thesis

Ph.D. 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 three to four years.
For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
NLP899	Natural Language Processing Ph.D. Research Thesis	32

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Doctor of Philosophy in **Robotics**

Mode Full-time | **Credits** 60 | **Location** On-campus

Program aims

The goal of the Ph.D. program in Robotics is to prepare the next generation of world-class researchers, industry leaders, academics, and educators in the field of robotics and autonomous systems.

The Ph.D. in Robotics focuses on human-centered and autonomous robotics research and prepares exceptional students for careers at the cutting edge of academia, industry, and government. Our world-leading robotics researchers, students and industry partners collaborate to advance discoveries in various aspects of robotics, such as perception and applied machine learning, human robot interaction, cognitive and soft robotics, and swarm intelligence. Ph.D. students in Robotics enjoy the unique experience of conducting world-class research with the state-of-the-art equipment and under the guidance of internationally renowned experts.

National Qualifications Framework – five strands

The Program learning outcomes (PLOs) are aligned with the Emirates Qualifications Framework and as such are divided into the following learning outcomes strands: Knowledge (K), Skills (S), Autonomy and responsibility (AR), Role in context (RC), and Self-development (SD).

Program learning outcomes

Upon completion of the program requirements, graduates will be able to:

1. Analyze a problem and apply an appropriate selection of advanced methods in robotics and autonomous systems.
2. Design and integrate advanced software and hardware to realize autonomous robotic solutions, in teams and individually.
3. Critically evaluate the practical and entrepreneurial feasibility for innovations in multi-robot systems, robotics, and autonomous systems across a range of sustainable applications.
4. Review and critically appraise current research topics, problems, and challenges within robotics and autonomous systems.
5. Discover, interpret, and communicate new knowledge orally and through novel research of top-tier publishable quality.

The PLOs are mapped to a level ten (10) qualification according to the five strands of learning outcomes as per the National Qualifications Framework set by the UAE National Qualifications Centre (NQC) and the Ministry of Education (MoE):

Program Learning Outcomes	Knowledge	Skill	Aspects of competence		
			Autonomy and responsibility	Role in context	Self-development
PLO1	K-1L10	S-1L10	AR-1L10	RC-2L10	SD-1,2,3L10
PLO2	-	S-2L10	AR-1L10	RC-2,3L10	-
PLO3	K-1L10	S-1,2,3L10	AR-2L10	-	SD-1,2L10
PLO4	K-1,2L10	S-1,3L10	-	RC-1L10	SD-1L10
PLO5	K-2L10	S-2,3L10	AR-1L10	-	SD-1,3L10

Aligning PLOs for Doctor of Philosophy in Robotics to QF Emirates Level 10 Framework.

Program study plan

Students are expected to complete coursework in the first year of degree and focus on the research and thesis writing in the subsequent three years. Students must successfully pass a qualifying exam (QE) at the end of the first year to progress to the research component of the Ph.D. At the end of the second year, which is focused on research, students must present evidence of satisfactory research progress at a candidacy exam (CE) to progress to the final two years of research.

A typical study plan is as follows:

SEMESTER 1	
ROB801	Advanced Robotic Motion Planning
ROB802	Advanced Topics in Robotics: Multi-Robot Systems
	+ 1 elective

SEMESTER 2	
ROB803	Advanced Humanoid Robotics
ROB804	Vision for Autonomous Robotics
	+ 1 elective
SUMMER	
INT899	Ph.D. Internship (up to four months)
SEMESTER 3	
RES899	Advanced Research Methods
ROB899	Ph.D. Robotics Research Thesis
SEMESTER 4	
ROB899	Ph.D. Robotics Research Thesis
SEMESTER 5	
ROB899	Ph.D. Robotics Research Thesis
SEMESTER 6	
ROB899	Ph.D. Robotics Research Thesis
SEMESTER 7	
ROB899	Ph.D. Robotics Research Thesis
SEMESTER 8	
ROB899	Ph.D. Robotics Research Thesis

Program degree requirements

Completion requirements:

The minimum degree requirements for the Doctor of Philosophy in Robotics is 60 credits, distributed as follows:

Core courses	Number of courses	Credit hours
Core	4	16
Electives	2	8
Internship	1	2
Research Methods	1	2
Research Thesis	1	32

Program courses

Core courses

The Doctor of Philosophy in Robotics is primarily a research-based degree. The purpose of coursework is to equip students with the right skillset, so they can successfully accomplish their research project (thesis). Students are required to take ROB801, ROB802, ROB803, ROB804, RES899 and INT899 as mandatory courses. They can select two electives. To accommodate a diverse group of students, coming from different academic backgrounds, students have been provided with flexibility in course selection. The decision on the courses to be taken will be made in consultation with students' supervisory panel, which will comprise of two or more faculty members. Essentially, the student's supervisory panel will help design a personalized coursework plan for each individual student, by looking at their prior academic track record and experience, and the planned research project.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

The following core courses must be taken by all students:

Code	Course title	Credit hours
ROB801	Advanced Robotic Motion Planning	4
ROB802	Advanced Topics in Robotic: Multi-Robot Systems	4
ROB803	Advanced Humanoid Robotics	4
ROB804	Vision for Autonomous Robotics	4
INT899	Internship	2
RES899	Advanced Research Methods	2
ROB899	Robotics Ph.D. Research Thesis	32

Elective courses

Students will select a minimum of two elective courses, with a total of eight (or more) credit hours based on interest, proposed research thesis, and career aspirations, in consultation with their supervisory panel. The elective courses available for the Doctor of Philosophy in Robotics are listed in the table below.

For full descriptions of courses, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
CV804	3D Geometry Processing	4
CV806	Advanced Topics in Vision and Language	4
ML806	Advanced Topics in Reinforcement Learning	4
ML807	Federated Learning	4
ML808	Advanced Topics on Causality and Machine Learning	4
ML809	Advanced Learning Theory	4
ML813	Topics in Dimensionality Reduction and Manifold Learning	4
NLP804	Deep Learning for Natural Language Generation	4
NLP805	Natural Language Processing-Ph.D.	4
NLP806	Advanced Natural Language Processing	4
NLP807	Speech Processing	4
NLP808	Current Topics in Natural Language Processing	4
NLP809	Advanced Speech Processing	4
NLP810	Robus and Trustworthy Natural Language Processing	4

Research thesis

The Ph.D. research thesis exposes students to cutting-edge and unsolved research problems in the field of robotics, 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.

For further details on the research thesis, please refer to Appendix 1: Course descriptions.

Code	Course title	Credit hours
ROB899	Ph.D. Research Thesis	32

Appendix 1:

Faculty

MBZUAI is continually recruiting outstanding Faculty. Please refer to Faculty Directory https://mbzuai.ac.ae/study/faculty-directory/ to review their research interests, education and research achievements.

Abdalla Swikir
Assistant Professor

Abdulrahman Mahmoud
Assistant Professor

Alham Aji
Assistant Professor

Anqing Duan
Assistant Professor

Aziz Khan
Assistant Professor

Celine Lee
Instructor

Chih-Jen Lin
Professor

Chun Jason Xue
Professor

Dezhen Song
Deputy Department Chair of Robotics, Professor

Eduardo Da Veiga Beltrame
Assistant Professor

Edward Briscoe
Deputy Department Chair of Natural Language Processing, Professor

Ekaterina Kochmar
Assistant Professor

Elizabeth Churchill
Department Chair of Human Computer Interation, Professor

Eric Moulines
Professor

Eric Xing
President and Professor of Computer Science.

Fahad Khan
Deputy Department Chair of Computer Vision, Professor

Fajri Koto
Assistant Professor

Fakhreddine Karray
Professor

Gus Xia
Associate Professor

Hanan Al Darmaki
Assistant Professor

Hao Li
Professor

Hisham Cholakkal
Assistant Professor

Hosni Ghedira
Professor

Ian Reid
Department Chair of Cpmputer Vision, Professor

Iryna Gurevych
Professor

Ivan Laptev
Professor

Jin Tian
Professor

Karthik Nandakumar
Associate Professor

Ke Wu
Assistant Professor

Kentaro Inui
Professor

Kun Zhang
Acting Department Chair of Machine Learning, Professor

Le Song
Professor

Martin Takac
Deputy Department Chair of Machine Learning, Associate Professor

Maxim Panov
Assistant Professor

Michael Jordan
Professor

Michalis Vazirgiannis
Professor

Min Xu
Associate Professor

Mingming Gong
Associate Professor

Mohammad Yaqub
Associate Professor

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Appendix 1:

Faculty

Mohsen Guizani
Professor

Monojit Choudhury
Professor

Muhammad Abdul-Mageed
Associate Professor

Muhammad Haris Khan
Assistant Professor

Muhammad Imran Razzak
Associate Professor

Natasa Przulj
Professor

Nils Lukas
Assistant Professor

Nizar Habash
Professor

Pengtao Xie
Assistant Professor

Praneeth Vepakomma
Assistant Professor

Preslav Nakov
Department Chair of Natural Language Processing, Professor

Qiang Sun
Associate Professor

Qirong Ho
Assistant Professor

Rao Anwer
Assistant Professor

Salem Lahlou
Assistant Professor

Salman Khan
Associate Professor

Sami Haddadin
Vice President for Research, Professor

Samuel Horvath
Assistant Professor

Shady Shehata
Associate Professor

Shahrukh Hashmi
Professor

Shih-Hao Hung
Professor

Sir Michael Brady
Professor

Souhaib Ben Taieb
Associate Professor

Thamar Solorio
Senior Director, Graduate Student Affairs, Professor

Timothy Baldwin
Provost, Professor

Ting Yu
Program Director, Applied Master of Science of AI (MAAI), Professor

Tongliang Liu
Associate Professor

Veselin Stoyanov
Professor

Xiaodan Liang
Associate Professor

Xiaojun Chang
Professor

Xiaosong Ma
Department Chair of Computer Science, Professor

Xiuying Chen
Assistant Professor

Xue (Steve) Liu
Associate Vice President for Research, Professor

Yoshihiko Nakamura
Department Chair of Robotics, Professor

Youcheng Sun
Assistant Professor

Yova Kementchedjhieva
Assistant Professor

Yuanzhi Li
Assistant Professor

Yutong Xie
Assistant Professor

Zhiqiang Shen
Assistant Professor

Zhiqiang Xu
Assistant Professor

Appendix 2: Short course descriptions

Teaching plan of courses throughout a semester:

Two lectures per week, each lecture of 1.5 hours, one lab per week of two hours.

Course descriptions

AI701 Foundations of Artificial Intelligence (4CR)

Prerequisites:	Basic concepts in calculus, linear algebra and programming
Core course for:	M.Sc. in Machine Learning, M.Sc. in Natural Language Processing M.Sc. in Robotics
Elective course for:	None

This course provides a comprehensive introduction to artificial intelligence. It builds upon fundamental concepts in machine learning. Students will learn about supervised and unsupervised learning, various learning algorithms, and the basics of the neural network, deep learning, and reinforcement learning.

AI702 Deep Learning (4CR)

Prerequisites:	Basics of linear algebra, calculus, probability and statistics Proficiency in Python
Core course for:	None
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing

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 networks, 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.

CS701 Advanced Algorithms and Data Structures (4CR)

Prerequisites:	None
Core course for:	M.Sc. in Computer Science
Elective course for:	None

We study techniques for the design of algorithms (such as dynamic programming) and algorithms for fundamental problems – such as fast Fourier transform (FFT). In addition, we explore computational intractability, specifically, the theory of NP-completeness. The key topics covered in the course are: dynamic programming; divide and conquer, including FFT; randomized algorithms, including RSA cryptosystem; graph algorithms; max-flow algorithms; linear programming; and NP-completeness.

CS702 Theory of Computer Science (4CR)

Prerequisites:	None
Core course for:	M.Sc. in Computer Science
Elective course for:	None

This course uncovers the science behind computing by studying computation abstractly without involving any specifics of programming languages and/or computing platforms. Specifically, it studies finite automata that capture what can be computed using constant memory, the universal computational model of Turing machines, the inherent limits of what can be solved on a computer (undecidability), the notion of computational tractability, and the P vs NP question. Finally, the course also involves Boolean circuits, cryptography, polynomial hierarchy, rigorous thinking and mathematical proofs.

Course descriptions

CS703 Operating Systems (4CR)

Prerequisites:	MTH703 and CS701
Core course for:	M.Sc. in Computer Science
Elective course for:	None

This course discusses the advanced concepts in operating system design and implementation. The operating system provides a convenient and efficient interface between user programs and the hardware of the computer on which they run.

CS704 Programming Languages and Implementation (4CR)

Prerequisites:	None
Core course for:	None
Elective course for:	M.Sc. in Computer Science

This course aims at uncovering the fundamental principles of programming language design, semantics, and implementation.

CS705 Distributed and Parallel Computing (4CR)

Prerequisites:	None
Core course for:	None
Elective course for:	M.Sc. in Computer Science

Parallel and distributed systems are ubiquitous in many applications in our daily life including AI, online games, social networks, web services and healthcare simulations. These systems distribute computation over many computing units because they must sustain massive workloads that cannot fit into a single computer. Designing efficient, easy-to-maintain and correct parallel and distributed systems is challenging. In this course, we specifically study distributed computing, consistency, remote procedure calls, logging, recovery, and MapReduce. Further, we will cover instruction-level parallelism, parallel programming, cache coherence, memory consistency, and synchronization implementation.

CS799 Computer Science Master's Research Thesis (8CR)

Prerequisites:	Coursework
Core course for:	M.Sc. in Computer Science
Elective course for:	None

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute toward 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 pursue an industrial project involving a research component independently.

CS801 Advanced Complexity (4CR)

Prerequisites:	CS701 or equivalent, and CS702 or equivalent
Core course for:	Ph.D. in Computer Science
Elective course for:	None

The course covers the following topics:
- The theory of NP-completeness and its relationship to the complexity classes P and NP.
- Circuit complexity and alternations.
- SAT, the complexity of counting, and algebraic circuit complexity.
- Circuit complexity lowerbound, hardness vs randomness, ironic complexity, and interactive proof systems.

Course descriptions

CS802 Advanced Data Structures (4CR)

Prerequisites:	CS701 or equivalent, MTH703 or equivalent
Core course for:	Ph.D. in Computer Science
Elective course for:	None

This course covers a broad overview of the many diverse types of data structures, including persistent, retroactive, geometric data structures, like a map, and temporal data structures, as in storage that happens over a time series. A comprehensive study of these data structures is a vital component of this subject. It also covers dictionaries, static trees, strings, succinct structures, and dynamic graphs. Finally, the course will cover the major directions of research for a wide variety of such data structures.

CS803 Randomized Algorithms (4CR)

Prerequisites:	MTH703 or equivalent, CS701 or equivalent
Core course for:	Ph.D. in Computer Science
Elective course for:	None

Randomized algorithms went from being a tool in computational number theory to finding wide-spread application in many types of algorithms. Two benefits of randomization have spearheaded this growth: simplicity and speed. This course discusses the basic and advanced concepts of randomized algorithms. Specifically, it includes random sampling, tail inequalities, probabilistic methods, algebraic methods, and random walks. Further, it also covers linear programming, graph algorithms and approximate counting topics.

CS804 Combinatorial Optimization (4CR)

Prerequisites:	MTH703 or equivalent, CS701 or equivalent
Core course for:	Ph.D. in Computer Science
Elective course for:	None

This course covers the topic of polyhedra, including various mathematical concepts and algorithms such as Farkas lemma, duality, complementary slackness, and decomposition of polyhedra. The course also covers topics like integer polyhedra, matrices, matching (bipartite and non-bipartite), graphs, matroids, polymatroids and submodular functions. The course will also cover the application of these concepts in machine learning.

CS899 Computer Science Ph.D. Research Thesis (32CR)

Prerequisites:	Coursework + pass in qualifying exam
Core course for:	Ph.D. in Computer Science
Elective course for:	None

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute toward 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.

CV701 Human and Computer Vision (4CR)

Prerequisites:	Basics of linear algebra, calculus, probability and statistics Proficiency in Python
Core course for:	M.Sc. in Computer Vision
Elective course for:	M.Sc. in Natural Language Processing; M.Sc. in Machine Learning

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.

Course descriptions

CV702 Geometry for Computer Vision (4CR)

Prerequisites:	CV 701: Human and Computer Vision (or equivalent) Hands-on experience with Python and Pytorch
Core course for:	M.Sc. in Computer Vision
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Natural Language Processing

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.

CV703 Visual Object Recognition and Detection (4CR)

Prerequisites:	CV701: Human and Computer Vision (or equivalent) Basics of linear algebra, calculus, probability and statistics demonstrated through relevant coursework Proficiency in Python and Pytorch
Core course for:	M.Sc. in Computer Vision
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Natural Language Processing

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.

CV707 Digital Twins (4CR)

Prerequisites:	Basic concepts in programming
Core course for:	None
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Natural Language Processing

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, and primary predictive modeling methods, and how to implement and interact with a digital twin using different platforms.

CV799 Computer Vision Master's Research (8CR)

Prerequisites:	Coursework
Core course for:	M.Sc. in Computer Vision
Elective course for:	None

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute toward 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.

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Course descriptions

CV801 Advanced Computer Vision (4CR)

Prerequisites:	Understanding of basic image processing and computer vision concepts Hands-on experience with Python and Pytorch or equivalent language/library
Core course for:	Ph.D. in Computer Vision
Elective course for:	Ph.D. in Machine Learning, Ph.D. in Natural Language Processing

This course provides a comprehensive introduction to advanced computer vision techniques. The students will develop skills to critique state-of-the-art computer vision research papers. The course aims at building foundation concepts for modern computer vision as well as developing expertise in several specialized areas of research in computer vision. The following topics will be covered in the course:

- Deep learning for computer vision.
- Recent developments in convolutional neural networks and transformers.
- Advanced techniques in object detection and segmentation.
- Advanced vision applications such as medical image segmentation and remote sensing change detection.
- Development of efficient computer vision architectures.
- Human centric vision.
- Introduction to vision language models and diffusion models.

CV802 Advanced 3D Computer Vision (4CR)

Prerequisites:	Linear algebra, numerical methods or equivalent hands-on experience with Python and C++ or equivalent language/library Basic knowledge in computer vision
Core course for:	Ph.D. in Computer Vision
Elective course for:	Ph.D. in Natural Language Processing, Ph.D. in Machine Learning

The course exercises an in-depth coverage of special topics in 3D computer vision. Students will be able to critique state-of-the-art methods on multi-view stereo, 3D reconstruction, 3D shape analysis, 3D deep learning and synthesis. 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 assumes that the students are familiar with the basic concepts of computer vision, linear algebra and numerical methods.

CV803 Advanced Techniques in Visual Object Recognition and Detection (4CR)

Prerequisites:	CV801 or equivalent Hands-on experience with Python and Pytorch or equivalent language/library
Core course for:	Ph.D. in Computer Vision
Elective course for:	Ph.D. in Machine Learning, Ph.D. in Natural Language Processing

This course provides focused coverage of special topics on visual object recognition (image classification), detection and segmentation. The students will develop skills to critique the state-of-the-art works on visual object recognition, detection and segmentation. 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 assumes familiarity with fundamental concepts in computer vision and machine learning.

CV804 3D Geometry Processing (4CR)

Prerequisites:	Linear algebra, C/C++ programming, computer vision, basic AI/ML knowledge
Core course for:	Ph.D. in Computer Vision
Elective course for:	Ph.D. in Machine Learning, Ph.D. in Natural Language Processing, Ph.D. in Robotics, Ph.D. in Computer Science

This course introduces 3D geometry processing, an important field that intersects computer vision, computer graphics, and discrete geometry. This course will cover the mathematical foundations for studying 3D surfaces from a discrete differential geometric standpoint and present the full geometry processing pipeline: from 3D data capture, mesh smoothing, surface reconstruction, parameterization, registration, shape analysis (correspondence, symmetry, matching), data-driven synthesis, interactive manipulation, to 3D printing. This course will offer practical coding exercises to understand basic geometry processing algorithms and exciting project around data capture and geometry processing.

Course descriptions

CV805 Life-long Learning Agents for Vision (4CR)

Prerequisites:	Basics of linear algebra, calculus, computer vision/machine learning and probability and statistics demonstrated through relevant coursework Proficiency in Python and Pytorch
Core course for:	None
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Natural Language Processing; Ph.D. in Machine Learning

In the field of computer vision, models have typically been trained to perform well on a specific task or dataset by maximizing performance on a validation set. However, this approach only represents a small part of the types of scenarios that are of interest in real-world applications. In recent years, there has been growing interest in exploring different approaches to learning that can be applied in more diverse and dynamic environments. These approaches, which include lifelong learning, continual learning, meta-learning, transfer learning, multi-task learning, and out-of-distribution generalization, aim to enable models to be more robust, efficient, versatile, and well-behaved in non-stationary settings. This graduate course will focus on these emerging learning paradigms and how they can be applied to computer vision and multimodal learning tasks.

CV806 Advanced Topics in Vision and Language (4CR)

Prerequisites:	Basics of linear algebra, calculus, computer vision/machine learning and probability and statistics demonstrated through relevant coursework
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing, Ph.D. in Robotics

Vision and language encode complementary information and have long been studied together. With the advent of Large Language Models, vision-language models are now more popular than ever and represent one of the most active areas of modern computer vision. This course will cover learning methods and joint models for image and text modalities and will address a wide range of problems including vision-language pretraining, text-based image search, image and video captioning, visual question answering, visual dialog, text-to-image synthesis as well as vision-language navigation and manipulation.

CV807 Safe and Robust Computer Vision (4CR)

Prerequisites:	Knowledge of linear algebra, calculus, probability, and statistics Basics of computer vision/machine learning demonstrated through relevant coursework Proficiency in Python and Pytorch or equivalent library
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing

Computer vision/machine learning systems are typically designed to operate under benign scenarios by trusted users. Recently, several studies have shown that computer vision systems have vulnerabilities, which can be exploited by adversaries to compromise the integrity and availability of such systems. These vulnerabilities include both inference-time evasion (adversarial) attacks and training-time poisoning (backdoor) attacks. Many techniques have also been proposed to counter these threats. This advanced graduate course will focus on analyzing these adversarial security threats and potential countermeasures.

CV899 Computer Vision Ph.D. Research Thesis (32CR)

Prerequisites:	Coursework + pass in qualifying exam
Core course for:	Ph.D. in Computer Vision
Elective course for:	None

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute toward 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.

Course descriptions

DS701 Data Mining (4CR)

Prerequisites:	Discrete mathematics, probability and statistics Proficiency in Java or Python
Core course for:	None
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Natural Language Processing; M.Sc. in Robotics; M.Sc. in Computer Science

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 (4CR)

Prerequisites:	Databases Proficiency in Java or Python, basic knowledge on calculus, linear algebra, probability, and statistics
Core course for:	None
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Natural Language Processing; M.Sc. in Robotics; M.Sc. in Computer Science

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.

DS703 Information Retrieval (4CR)

Prerequisites:	Discrete Mathematics, probability and statistics Proficiency in Java or Python or C++
Core course for:	None
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Natural Language Processing

This course is an introductory course on Information Retrieval (IR). The explosive growth of available digital information (e.g., web pages, emails, news, Tweets, Wikipedia pages) demands intelligent information agents that can sift through all available information and find out the most valuable and relevant information. Web search engines, such as Google and Bing, are examples of such tools. This course studies the basic principles and practical algorithms used for information retrieval and text mining. It will cover algorithms, design, and implementation of modern information retrieval systems. Topics include: retrieval system design and implementation, text analysis techniques, retrieval models (e.g., Boolean, vector space, probabilistic, and learning-based methods), search evaluation, retrieval feedback, search log mining, and applications in web information management.

DS704 Statistical Aspect of Machine Learning / Statistical Theory (4CR)

Prerequisites:	Familiarity with the fundamental concepts of probability theory, linear algebra, real analysis A first course in statistics would be a plus ML701 or AI701
Core course for:	None
Elective course for:	M.Sc. in Machine Learning

This course covers the fundamentals of theoretical statistics, which are the foundation for the analysis of the properties of machine learning algorithms. Covered topics include statistical models, statistical inference, maximum likelihood estimation, optimal hypothesis testing, decision theory and Bayesian inference, non-parametric statistics, and Bootstrap, (generalized) linear model and high dimensional statistics. All necessary tools from Probability theory: deviation inequalities, type of convergence, law of large numbers, central limit theorem, properties of the Gaussian distribution (etc) will be introduced whenever needed and their proofs given at the end of each chapter.

Course descriptions

HC701 Medical Imaging: Physics and Analysis (4CR)

Prerequisites:	Familiarity with Python programming Undergraduate course in signal processing or signals and systems MTH701
Core course for:	None
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing; M.Sc. in Robotics

This course provides a graduate-level introduction to the principles and methods of medical imaging, with a thorough grounding in the physics of 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 the two classic problems in the analysis of medical images: segmentation and registration.

INT799 Master of Science – Internship (2CR)

Prerequisites:	Prior to undertaking an internship, students must have successfully completed 24 credit hours
Core course for:	M.Sc. Machine Learning, M.Sc. Natural Language Processing, M.Sc. Computer Vision, M.Sc. Robotics, M.Sc. Computer Science
Elective course for:	None

The MBZUAI internship with industry is intended to provide the student with hands-on experience, blending practical experiences with academic learning.

INT899 Ph.D. Internship (2CR)

Prerequisites:	Prior to undertaking an internship opportunity, students must have successfully completed 24 credit hours
Core course for:	Ph.D. Machine Learning, Ph.D. Natural Language Processing, Ph.D. Computer Vision, Ph.D. Robotics, Ph.D. Computer Science
Elective course for:	None

The MBZUAI internship with industry is intended to provide the student with hands-on experience, blending practical experiences with academic learning.

ML701 Machine Learning (4CR)

Prerequisites:	Basic concepts in calculus, linear algebra and programming
Core course for:	M.Sc. in Machine Learning
Elective course for:	M.Sc. in Computer Vision, M.Sc. in Natural Language Processing, M.Sc. in Robotics

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 the basics of learning theory, graphical models, and reinforcement learning.

ML702 Advanced Machine Learning (4CR)

Prerequisites:	Basic Machine Learning or equivalent course, and good Mathematical Foundations for Artificial Intelligence, ML701 Machine Learning or equivalent course, MTH701 Mathematical Foundations for Artificial Intelligence
Core course for:	M.Sc. in Machine Learning
Elective course for:	M.Sc. Computer Vision, M.Sc. Machine Learning, M.Sc. Natural Language Processing

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.

Course descriptions

ML 703 Probabilistic and Statistical Inference (4CR)

Prerequisites:	Familiarity with fundamental concepts in probability, linear algebra, statistics, and programming, MTH701 – Mathematical Foundations for AI
Core course for:	M.Sc. in Machine Learning
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Natural Language Processing; M.Sc. in Robotics

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. It is the foundation and an essential component of machine learning since machine learning aims to learn and improve from experience (which is represented by data). This course will cover the different modes of performing inference, including statistical modelling, data-oriented strategies, and explicit use of designs and randomization in analyses. Furthermore, it will provide in-depth treatment to 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.

ML 707 Smart City Services and Applications (4CR)

Prerequisites:	Basic concepts in calculus, linear algebra and programming, and basic AI/ML knowledge
Core course for:	None
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Natural Language Processing; M.Sc. in Robotics

This course comprehensively introduces 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 (4CR)

Prerequisites:	ML701 or CV701 or NLP701 Basic understanding of machine learning concepts and algorithms
Core course for:	None
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing; M.Sc. in Robotics

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

ML709 IoT, Smart Systems, Services and Applications (4CR)

Prerequisites:	Basic concepts in calculus, linear algebra and programming, and basic AI/ML knowledge
Core course for:	None
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing; M.Sc. in Robotics

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

Course descriptions

ML710 Parallel and Distributed Machine Learning Systems (4CR)

Prerequisites:	AI701 or equivalent, Familiarity with fundamental concepts in Machine Learning and programming
Core course for:	None
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing

As Machine Learning (ML) programs increase in data and parameter size, their growing computational and memory requirements demand parallel and distributed execution across multiple network-connected machines. In this course, students will learn the fundamental principles and representations for parallelizing ML programs and learning algorithms. Students will also learn how to design and evaluate (using standard metrics) and compare between complex parallel ML strategies composed out of basic parallel ML “aspects” and evaluate and compare between the architecture of different software systems that use such parallel ML strategies to execute ML programs. Students will also use standard metrics to explain how compilation and resource management affects the performance of parallel ML programs.

ML711 Intermediate Music AI (4CR)

Prerequisites:	Basic Music/Signal Processing Linear algebra and programming in Python Basic AI/ML knowledge
Core course for:	None
Elective course for:	M.Sc. in Computer Vision, M.Sc. in Machine Learning and M.Sc. in Natural Language Processing

What is sound and music from a computer science perspective? How can we use AI and ML to better appreciate, perform, and compose music? When music meets computer science, could computers generate something truly creative by closing the loop of analysis and synthesis? Could computers interact with our humans in real time and offer us some new experience? Let’s explore the possibilities in this course.
It is a Music AI course, but most of the content is orthogonal to programming or traditional computer science. If you are a great computer science student or even a great programmer, you will be able to use your special skills in this class to your advantage. On the other hand, if you are a musician with intro-level programming skills, you can get by without writing a lot of difficult programs. Your musical knowledge and intuition will also be of great value. Students will learn the fundamentals of digital audio, basic sound synthesis algorithms, techniques for human-computer music interaction, and most importantly, machine learning algorithms for media generation. In a final project, students will demonstrate their mastery of tools and techniques through a publicly performed music composition.

ML799 Machine Learning Master’s Research Thesis (8CR)

Prerequisites:	Coursework
Core course for:	M.Sc. in Machine Learning
Elective course for:	M.Sc. in Machine Learning

Master’s thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute toward 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.

ML801 Foundations and Advanced Topics in Machine Learning (4CR)

Prerequisites:	Linear algebra, probability Proficiency in Python Basic knowledge of machine learning
Core course for:	Ph.D. in Machine Learning
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Natural Language Processing

This course focuses on building foundations and introducing 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 basic concepts in machine learning and additionally assumes familiarity with fundamental concepts in optimization and math.
The course covers foundations and advanced topics in probability, statistical machine learning, supervised and unsupervised learning, deep neural networks, optimization, reinforcement learning, and causality. Students will be engaged through coursework, assignments, and projects.

Course descriptions

ML803 Advanced Probabilistic and Statistical Inference (4CR)

Prerequisites:	Basic knowledge of linear algebra, statistics, probability, calculus, and statistical inference
Core course for:	Ph.D. in Machine Learning
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Natural Language Processing

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.

ML804 Advanced Topics in Continuous Optimization (4CR)

Prerequisites:	Basic optimization class Basics of linear algebra, calculus, trigonometry, probability and statistics Proficiency in Python, PyTorch
Core course for:	Ph.D. in Machine Learning
Elective course for:	Ph.D. in Natural Language Processing, Ph.D. in Computer Vision

The course covers advanced topics in continuous optimization, such as stochastic gradient descent and its variants, methods that use more than first-order information, primal-dual methods, and methods for composite problems. Participants will read the current state-of-the-art relevant literature and prepare presentations to the other students.

Participants will explore how the presented methods work for optimization problems that arise in various fields of machine learning and test them in real-world optimization formulations to get a deeper understanding of the challenges being discussed.

ML805 Advanced Machine Learning (4CR)

Prerequisites:	Linear algebra, Probability Proficiency in Python Basic Knowledge of Machine Learning, ML801
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing

This course offers an in-depth exploration of foundational and cutting-edge topics within the field, including attention mechanisms and transformers, generative models, adaptive algorithms, uncertainty quantification, and the handling of various types of noise in data. Further, it delves into specialized areas such as graph machine learning, multimodal foundation models, and applications of graph generative AI in the bio/medical fields. The course also covers the basics and advancements in automated machine learning (AutoML), including hyperparameter optimization, neural architecture search, and the intersection of meta learning with AutoML, particularly in the context of Natural Language Processing (NLP). Students will engage in hands-on labs to implement algorithms and strategies discussed in lectures, enabling a deep understanding of the complexities and challenges in machine learning. The course structure is designed to foster high-level competencies in both theoretical understanding and practical application, preparing students to contribute innovatively to the field of Machine Learning.

Course descriptions

ML806 Advanced Topics in Reinforcement Learning (4CR)

Prerequisites:	Good understanding of basic RL Basics of linear algebra, calculus, trigonometry, probability and statistics Proficiency in Python and good knowledge of PyTorch library
Core course for:	None
Elective course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision; Ph.D. in Natural Language Processing, Ph.D. in Robotics

The course covers advanced topics in reinforcement learning (RL). Participants will read current, state-of-the-art relevant literature and prepare presentations to the other students. Participants will explore how the presented methods work in simplified computing environments to get a deeper understanding of the challenges that are being discussed. Topics discussed include exploration, imitation learning, hierarchical RL and multi-agent RL in both competitive and collaborative settings. The course will also explore multi-task and transfer learning in RL setting.

ML807 Federated Learning (4CR)

Prerequisites:	Understanding of ML principles and basic algorithms Good knowledge of multivariate calculus, linear algebra, optimization, probability, and algorithms Proficiency in some ML framework, e.g., PyTorch and TensorFlow
Core course for:	None
Elective course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision, Ph.D. in Robotics, Ph.D. in NLP

This is a graduate course in a new branch of machine learning: federated learning (FL). In FL, machine learning models are trained on mobile devices with an explicit effort to preserve the privacy of users' data. FL combines supervised machine learning, privacy, distributed and edge computing, optimization, communication compression, and systems. This is a new and fast-growing field with few theoretical results and early production systems (e.g., Tensor Flow Federated and FedML). This course aims for students to become familiar with the field's key developments and practices, namely optimization methods for FL and techniques to address communication bottlenecks, systems and data heterogeneities, client selection, robustness, fairness, personalization and privacy aspects of FL. The evaluation of the course heavily relies on students' paper presentations and the final project selected by the student

ML808 Advanced Topics in Causality and Machine Learning (4CR)

Prerequisites:	Basics of Machine Learning Basics of Python (or Matlab) or PyTorch
Core course for:	None
Elective course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision; Ph.D. in Natural Language Processing; Ph.D. in Robotics

In the past decades, interesting advances were made in machine learning, philosophy, and statistics for tackling long-standing causality problems, including how to discover causal knowledge from observational data, known as causal discovery, and how to infer the effect of interventions. Furthermore, it has recently been shown that the causal perspective may facilitate understanding and solving various machine learning/artificial intelligence problems such as transfer learning, semi-supervised learning, out-of-distribution prediction, disentanglement, and adversarial vulnerability. This course is concerned with understanding causality, learning causality from observational data, and using it to tackle a large class of learning problems. The course will include topics such as graphical models, causal inference, causal discovery, and counterfactual reasoning. It will also discuss how we can learn causal representations, perform transfer learning, and understand deep generative models.

ML809 Advanced Learning Theory (4CR)

Prerequisites:	Understanding of ML principles Good knowledge of multivariate calculus, linear algebra, optimization, probability, and algorithm Proficiency in some ML frameworks, e.g., PyTorch and TensorFlowBasics
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing and Ph.D. in Robotics

This course is an introduction to the core ideas and theories of statistical learning theory, and their uses in designing and analyzing machine learning systems. Statistical learning theory studies how to fit predictive models to training data, usually by solving an optimization problem, in such a way that the model will predict well, on average, on new data

Course descriptions

ML 812 Advanced Topics in Algorithms for Big Data (4CR)

Prerequisites:	Good knowledge of calculus, linear algebra, probability, and statistics
Core course for:	None
Elective course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision; Ph.D. in Natural Language Processing

This course is an advanced course on algorithms for big data that involves the use of randomized methods, such as sketching and sampling, to provide dimensionality reduction. It also discussed topics such as sub-space embeddings, low rank approximation, L1 regression, and data streams. The course lies at the intersection of machine learning and statistics.

ML813 Topics in Dimensionality Reduction and Manifold Learning (4CR)

Prerequisites:	Advanced calculus, linear algebra probability Proficiency in programming Foundation of machine learning Good knowledge of optimization tools
Core course for:	None
Elective course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision; Ph.D. in Natural Language Processing and Ph.D. in Robotics

The course focuses on building foundations and introducing recent advances in dimensionality reduction and manifold learning, important topics in machine learning. This course builds upon fundamental concepts in machine learning and additionally assumes familiarity with concepts in optimization and mathematics. The course covers advanced topics in spectral, probabilistic, and neural network-based dimensionality reduction and manifold learning. Students will be engaged through course-work, assignments, and projects.

ML814 Selected Topics in Machine Learning (4CR)

Prerequisites:	Foundational knowledge in machine learning Proficiency in mathematics and statistics Strong programming skills Experience with deep learning
Core course for:	Ph.D. in Machine Learning
Elective course for:	None

This advanced course offers an in-depth exploration of state-of-the-art techniques and concepts in machine learning. Covering a broad spectrum of topics, the course delves into advanced optimization methods, causality in machine learning, and the intricacies of large model architectures. Through a combination of lectures and lab sessions, students will gain hands-on experience in designing, implementing, and optimizing cutting-edge machine learning models. The course also emphasizes critical evaluation of current research and the application of multimodal approaches to complex problems. This curriculum is tailored to equip students with the theoretical knowledge and practical skills necessary to contribute to and lead in the evolving field of machine learning.

Course descriptions

ML815 Advanced Parallel and Distributed Machine Learning Systems (4CR)

Prerequisites:	Familiarity with fundamental concepts in machine learning Familiarity with writing machine learning programs
Core course for:	None
Elective course for:	Ph.D. in Computer Science, Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing, Ph.D. in Robotics

Training the largest Machine Learning (ML) programs requires petaFLOPs (1015) to exaFLOPs (1018) of computing operations, as well as multiple terabytes (1012) of hardware accelerator memory. Accordingly, 100s to 1000s of these accelerators are needed to satisfy both the computing and memory requirements of the large-scale ML. This course covers systems architecture design, communication strategies and algorithmic modifications required to execute ML training in a parallel and distributed fashion across many network-connected hardware accelerators. In the first part of the course, students will learn a comprehensive set of principles, representations, and performance metrics for parallelizing ML programs and learning algorithms, as well as learn how to compare and evaluate different parallel ML strategies composed out of basic parallel ML “aspects”. In the second part of the course, students will apply these skills to read and critique peer-reviewed literature on parallel and distributed ML systems.

ML817 AI for Science and Engineering (4CR)

Prerequisites:	Proficiency in Python/PyTorch Solid understanding of calculus Fundamental knowledge of algebra Grasp of probability and statistics
Core course for:	None
Elective course for:	Ph.D. in Machine Learning

This comprehensive course covers a wide array of topics, including classical paradigms for AI in science, active learning, constraints handling in machine learning, AI-driven solutions for renewable energy sources and smart grids, physics-informed AI, and AI-driven approaches in material science and catalysis. Through a balanced blend of theoretical lectures and practical lab sessions, students will delve into the latest AI methodologies, learning how to apply these advanced techniques to address complex challenges in scientific research and engineering solutions. The course emphasizes hands-on experience with real-world datasets, preparing students to become leaders in leveraging AI for innovative solutions across diverse domains. It is designed for those seeking to make a significant impact at the intersection of AI and domain-specific applications such as physics, material science and renewable energy, driving forward the frontiers of research and industry practices.

ML818 Emerging Topics in Trustworthy ML (4CR)

Prerequisites:	Knowledge of linear algebra, calculus, probability, and statistics Basics of computer vision/machine learning demonstrated through relevant coursework Proficiency in Python and Pytorch or equivalent library
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, Ph.D. in Natural Language Processing, and Ph.D. in Robotics

This course will provide students with a deep dive into key issues related to trustworthy and responsible machine learning. Students will learn about adversarial/poisoning and privacy/confidentiality attacks against machine learning systems and defense mechanisms to mitigate them. The course will approach adversarial machine learning through an optimization and game-theoretic framework. The emphasis on privacy-preserving computation for data science and machine learning would be through a formal mathematical notion of privacy called differential privacy. The course will also cover other ethical issues in machine learning such as fairness, safe unbiased and responsible content generation, watermarking for content authentication and ownership verification (provenance), and attacks such as deep fakes, their detection and verification of robustness of relevant defenses (multimedia forensics).

Course descriptions

ML819 TinyML and Large Language Models (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Proficiency in Python or similar language Basic Knowledge of Machine Learning and Deep Learning
Core course for:	None
Elective course for:	Ph.D. in Computer Vision, Ph.D. in Machine Learning, and Ph.D. in Natural Language Processing

This comprehensive Ph.D.-level course explores the intricacies of modern machine learning, with a specific focus on TinyML, efficient machine learning and deep learning. Through an integration of lectures, readings, and practical labs, students will be exposed to the evolution of TinyML from its traditional roots to the deep learning era. This course will introduce efficient AI computing strategies that facilitate robust deep learning applications on devices with limited resources. We will explore various techniques including model compression, pruning, quantization, neural architecture search, as well as strategies for distributed training, such as data and model parallelism, gradient compression, and methods for adapting models directly on devices. Additionally, the course will focus on specific acceleration approaches tailored for large language models and diffusion models. Participants will gain practical experience in implementing large language models on standard laptops.

ML820 Machine Learning for Industry (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Proficiency in Python or similar language Basic Knowledge of Machine Learning and Deep Learning
Core course for:	None
Elective course for:	Ph.D. in Machine Learning

This comprehensive course delves into the intricacies of effectively working and succeeding in the industry. The course covers aspects often overlooked in traditional curriculum. This includes understanding of industrial workflows, and access to industrial problem-solving experience through real-world industrial projects and case-studies. This includes imparting an understanding of continuous integration/development workflows (referred to as CI/CD), systems aspects of using schedulers and resource management tools, Rest API infrastructures, micro-services, model deployment tools such as FLASK along with data management skills, container architectures and ML workflow management and monitoring skills needed to succeed and fit seamlessly in the industry. The course provides access to real-world industrial case studies and projects. A diverse array of industrial projects that are covered include routing and job shop scheduling problems, real-world statistical hypothesis testing with applications to identifying bad actors on social media, projects in healthcare and pharmaceutical industry such as remote healthcare monitoring, dose-response curve modeling and clinical trials for drug development, public sector projects for public safety and crime analytics, responsible AI projects for collecting demographics, privacy-preserving collection of usage-statistics from smart phones along with secure and private deployments of federated learning.

ML899 Machine Learning Ph.D. Research Thesis (32CR)

Prerequisites:	Coursework + pass in qualifying exam
Core course for:	Ph.D. in Machine Learning
Elective course for:	None

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute toward 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 of Artificial Intelligence (4CR)

Prerequisites:	None
Core course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing
Elective course for:	M.Sc. in Robotics

This course provides a comprehensive mathematical foundation for the field of artificial intelligence. It builds upon fundamental concepts in linear algebra, probability theory, statistics, and calculus. Students will learn how these mathematical concepts can be used to solve problems frequently encountered in AI applications.

Course descriptions

MTH702 Optimization (4CR)

Prerequisites:	Linear algebra, matrix analysis, probability, and statistics
Core course for:	None
Elective course for:	M.Sc. in Machine Learning, M.Sc. Computer Vision and M.Sc. Natural Language Processing

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, first order and second order optimization methods, problems with equality and/or inequality constraints, and other advanced problems.

MTH703 Mathematics for Theoretical Computer Science (4CR)

Prerequisites:	None
Core course for:	M.Sc. in Computer Science
Elective course for:	None

The course is designed to comprehensively understand various mathematical concepts and their applications for theoretical computer science. The lectures will cover topics such as asymptotics, the central limit theorem, Chernoff bounds, mathematical problem solving, computational models, spectral graph theory, linear programming, semidefinite programming, error correcting codes, derandomization, expander graphs, constraint satisfaction problems, treewidth, analysis of Boolean functions, communication complexity, information theory, LP hierarchies and proof complexity, quantum computation, cryptography, hardness assumptions, and the sketch of the PCP theorem.

NLP701 Natural Language Processing (4CR)

Prerequisites:	Basic concepts in linear algebra, calculus, probability and statistics Programming in Python or similar language
Core course for:	M.Sc. in Natural Language Processing
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Robotics; M.Sc. in Computer Science

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 (4CR)

Prerequisites:	NLP701, Basic concepts in linear algebra, calculus, probability and statistics Programming in Python or a similar language
Core course for:	M.Sc. in Natural Language Processing
Elective course for:	M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Robotics; M.Sc. in Computer Science

This course provides a methodological and an in-depth background on key core natural language processing areas based on deep learning. It builds upon fundamental concepts in natural language processing and assumes familiarity with mathematical and machine learning concepts and programming.

NLP703 Speech Processing (4CR)

Prerequisites:	NLP701 Basic concepts in linear algebra, calculus, probability and statistics Programming in Python or a similar language
Core course for:	None
Elective course for:	M.Sc. in Natural Language Processing; M.Sc. in Computer Vision; M.Sc. in Machine Learning; M.Sc. in Computer Science; M.Sc. in Robotics

This course provides a comprehensive introduction to speech processing. It builds upon fundamental concepts in speech processing and assumes familiarity with mathematical and signal processing concepts.

Course descriptions

NLP799 Natural Language Processing Master Research Thesis (8CR)

Prerequisites:	Coursework
Core course for:	M.Sc. in Natural Language Processing
Elective course for:	None

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 1 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.

NLP804 Deep Learning for Natural Language Generation (4CR)

Prerequisites:	Basic concepts in linear algebra, calculus, probability and statistics Programming skills in Python
Core course for:	Ph.D. in Natural Language Processing
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

The course introduces students to the emerging topic of natural language generation and prepares them to perform research to advance the state of the art in this research area.

NLP805 Natural Language Processing-Ph.D. (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Programming in Python or similar language
Core course for:	Ph.D. in Natural Language Processing
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

This course focuses on recent research in natural language processing and on developing skills for performing research to advance the state of the art in natural language processing.

NLP806 Advanced Natural Language Processing (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Programming in Python or similar language
Core course for:	Ph.D. in Natural Language Processing
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

This course focuses on recent topics in natural language processing and on developing skills for performing research to advance the state of the art in natural language processing. Specifically, this course will cover fundamentals of LLMs such as transformers architecture, methods on training and evaluating LLMs via distributed training and efficiency methods, and application in multilinguality, translation and multimodality.

NLP807 Speech Processing-Ph.D. (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Programming in Python or similar language
Core course for:	Ph.D. in Natural Language Processing
Elective course for:	Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

This course provides a comprehensive introduction to speech processing. It focuses on developing knowledge about the state of the art in a wide range of speech processing tasks, and readiness for performing research to advance the state of the art in these topics. Topics include speech production, speech signal analysis, automatic speech recognition, speech synthesis, neural speech recognition and synthesis, and recent topics in foundation models and speech processing.

Course descriptions

NLP808 Current Topics in Natural Language Processing (4CR)

Prerequisites:	Understanding of calculus, algebra, probability, and statistics Programming in Python or similar language
Core course for:	None
Elective course for:	Ph.D. in Natural Language Processing, Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

This course focuses on recent topics in natural language processing and on developing skills for performing research to advance the state of the art in natural language processing.

NLP809 Advanced Speech Processing (4CR)

Prerequisites:	NLP807, Understanding of calculus, algebra, probability, and statistics Programming in Python or similar language
Core course for:	None
Elective course for:	Ph.D. in Natural Language Processing, Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

This course explores the cutting-edge techniques and methodologies in the field of speech processing. The course covers advanced topics such as automatic speech recognition, language modeling and decoding, speech synthesis, speaker identification, speech diarization, paralinguistic analysis, speech translation & summarization, multilinguality and low-resource languages and spoken dialog systems. Students will delve into modern models and frameworks for the different speech tasks. The course emphasizes both theoretical understanding and practical implementation, fostering skills necessary for innovative research and development in speech technologies.

NLP810 Robust and Trustworthy Natural Language Processing (4CR)

Prerequisites:	NLP806 or CV801 or ML814 Basic Concepts in Linear Algebra, Calculus, Probability and Statistics Programming skills in Python Deep Learning in NLP
Core course for:	None
Elective course for:	Ph.D. in Natural Language Processing, Ph.D. in Computer Vision; Ph.D. in Machine Learning; Ph.D. in Robotics; Ph.D. in Computer Science

The course introduces students to advanced topics in natural language processing concerning the robustness and trustworthiness of language models (LMs), specifically world knowledge in LMs, safety and inclusivity of LMs and inner workings of LMs. The course prepares them to perform research that advances the state of the art in these research areas.

NLP899 Natural Language Processing Ph.D. Research Thesis (32CR)

Prerequisites:	Coursework and pass in qualifying exam
Core course for:	Ph.D. in Natural Language Processing
Elective course for:	None

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute toward 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.

Course descriptions

RES799 Introduction to Research Methods (2CR)

Prerequisites:	None
Core course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision, M.Sc. in Robotics; M.Sc.. in Natural Language Processing; M.Sc. in Computer Science
Elective course for:	None

This course focuses on teaching students how to develop innovative research-based approaches that can be implemented in an organization. It covers various research designs and methods, including scientific methods, ethical issues in research, measurement, experimental research, survey research, qualitative research, and mixed methods research. Students will gain knowledge in selecting, evaluating, and collecting data to address specific research questions. Additionally, they will learn design thinking skills to connect their research-based topic to practicality. After completing the course, students will have the skills to develop a full research topic that can be innovative, entrepreneurial, and sustainable and can be applied in any organization related to the topic of research.

RES899 Advanced Research Methods (2CR)

Prerequisites:	None
Core course for:	Ph.D. in Machine Learning; Ph.D. in Computer Vision, Ph.D. in Robotics; Ph.D. in Natural Language Processing; Ph.D. in Computer Science
Elective course for:	None

This course will prepare students to produce professional-quality academic research and solve practical research challenges based on innovative, sustainable, and ethical research principles. This course will provide exposure to a variety of research topics related to AI, research integrity, AI ethics, and organizational challenges. Students will learn to assess their own research projects and scrutinize the research methods and metrics used in their research, and critically examine the ethical implications of their work. They will learn about the peer-reviewing process, participate in reviewing their classmates work, and learn best-practice for oral and written presentation of research. After completing the course, students will have the skills to develop a research methodology and conduct research that is rigorous, entrepreneurial, and ethical.

ROB701 Introduction to Robotics (4CR)

Prerequisites:	Basics of linear algebra, calculus, trigonometry, probability and statistics Proficiency in Python
Core course for:	M.Sc. in Robotics
Elective course for:	M.Sc. in Machine Learning; M.Sc. in Computer Vision; M.Sc. in Natural Language Processing, M.Sc. in Computer Science

The course covers the mathematical foundation of robotic systems and introduces students to the fundamental concepts of robot operating system (ROS) as one of the most popular and reliable platforms to program modern robots. It also highlights techniques to model formally and study robot kinematics, dynamics, perception, motion control, navigation, and path planning. Students will also learn the interface of different types of sensors, read and analyze their data, and apply it in various robotic applications.

Course descriptions

ROB702 Robotic Vision and Intelligence (4CR)

Prerequisites:	AI701, and ROB701, Basics of linear algebra, calculus, probability and statistics. Proficiency in Python and ROS/Gazebo
Core course for:	M.Sc. in Robotics
Elective course for:	None

Robots must be able to sense and learn from experience to achieve autonomy. The most frequently used sensing technique is vision. We will explore both the fundamental techniques used in image processing and computer vision analysis (localize objects, recognize objects, segment images) together with advanced tools that allow robots to estimate the motion of objects, estimate depth or reconstruct 3D scenes from a set of images. To give robots the ability to learn, we will explore reinforcement learning (RL). RL is a subfield of ML that is inspired by how humans learn. The RL agent interacts with its environment, observes the impact of its actions, and receives rewards (positive or negative, depending on how well it accomplishes a given task). We cover both the fundamental and advanced RL algorithms and discuss their advantages and disadvantages in various robotics settings.

ROB703 Robot Localization and Navigation (4CR)

Prerequisites:	ROB701 , Basics of linear algebra, calculus, probability and statistics Proficiency in Python and ROS/Gazebo
Core course for:	M.Sc. in Robotics
Elective course for:	None

The course covers different topics and techniques within the context of mapping, localization, and navigation. It highlights simultaneous localization and mapping (SLAM) methods using various types of filters, such as Kalman filter, extended Kalman filter (EKF) and particle filter. It investigates grid- and graph-based SLAM and data association. It puts in perspective map-based and reactive navigation techniques. To reinforce these concepts and methods, they are applied within robot operating system (ROS) through dedicated state-of-the-art ROS packages, such as the tf package, AMCL, and mapping.

ROB799 Robotics M.Sc. Research Thesis (8CR)

Prerequisites:	None
Core course for:	M.Sc. in Robotics
Elective course for:	None

Master's thesis research exposes students to an unsolved research problem, where they are required to propose new solutions and contribute toward 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 pursue an industrial project involving a research component independently.

ROB801 Advanced Robotic Motion Planning (4CR)

Prerequisites:	ROB701 or equivalent Basics of linear algebra, calculus, probability and statistics Proficiency in programming (data structures, algorithms) and ROS/Gazebo
Core course for:	Ph.D. in Robotics
Elective course for:	None

Motion planning is an integral component of robotic applications. It helps the robot to decide strategically on its future moves and when to take them. The course covers state-of-the-art motion planning techniques along with their applications to different kinds of robots (e.g., ground, aerial, marine, humanoid, manipulator). It provides a theoretical in-depth analysis of such methods and teaches students how to implement them through several programming-based assignments.

Course Descriptions

ROB802 Advanced Topics in Robotics: Multi-Robot Systems (4CR)

Prerequisites:	ROB701 or equivalent Basics of linear algebra, calculus, probability and statistics Proficiency in Python and ROS/Gazebo
Core course for:	Ph.D. in Robotics
Elective course for:	None

The course covers the foundations of multi-robot systems. It introduces students to state-of-the-art, multi-robot research through a combination of classical teaching and seminar-style lectures and labs. Students will learn how to apply a consortium of techniques, such as stochastic processes, graph theoretic methods, geometric concepts, and optimization principles, to model, analyze, and drive multi-robot systems.

ROB803 Advanced Humanoid Robotics (4CR)

Prerequisites:	ROB701 or equivalent Basics of linear algebra, calculus, probability and statistics Proficiency in programming in Python or C/C++ Experience with ROS/Gazebo
Core course for:	Ph.D. in Robotics
Elective course for:	None

Humanoid robots have become more and more prevalent with the increase in the demand of service and human-assistive robots. This specialized course covers various advanced topics in state-of-the-art humanoid robots, such as their kinematics, dynamics, modeling, control, motion planning, object grasping and manipulation, perception, learning, and interaction with humans. The course provides a blend of theoretical in-depth analysis of such techniques and hands-on practice through simulation and hardware implementation.

ROB804 Vision for Autonomous Robotics (4CR)

Prerequisites:	Hands-on experience with Python and Pytorch, or equivalent language/library Basics of linear algebra, calculus, probability and statistics
Core course for:	Ph.D. in Robotics
Elective course for:	Ph.D. in Computer Vision

This Ph.D. course focuses on the key advanced computer vision techniques utilized in autonomous robotics, such as image formation, feature detection and description, multiple view geometry, dense reconstruction, tracking, event-based vision, visual-inertial odometry, visual simultaneous localization and mapping (SLAM), locomotion concepts, and deep learning based visual positioning.

ROB899 Robotics Ph.D. Research Thesis (32CR)

Prerequisites:	Coursework and pass in qualifying exam
Core course for:	Ph.D. in Robotics
Elective course for:	None

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute toward 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.

Appendix 3:

Definitions

Academic integrity
Refers to ethical behavior and principles such as honesty, responsibility, respect and fairness that guides conduct in an academic setting.

Non-academic research
Is any type of non-peer reviewed research activity such as outreach to the broader community, engagement with government agencies and industrial partners.

Academic standing
Determined by regulations governing good standing, probation, and dismissal.

Academic year
The period of time beginning with the first day of classes of a fall semester and the final day of the spring semester.

Add and drop
A period of time at the beginning of each semester when students can adjust schedules by dropping or adding course/s.

Supervisor
Faculty member/ administrator assigned to counsel students on academic or other matters. The student is called an “advisee”.

Master degree
Graduate degree in which a student completes six courses in the first year and thesis requirements in the second year which adds up to 24 months.

Doctoral degree
Graduate degree in which a student completes six courses in the first year and thesis requirements in the following three years which adds up to 48 months.

Academic calendar
Annual listing of all official important dates and deadlines for the academic year.

Course
A unit of study that may utilize lecture, discussion, laboratory, research, recitation, seminar, workshop, studio, independent study, internship or other similar teaching formats to facilitate learning for a student. A course consists of a number of instructional activities over a prescribed period of time. It deals with a single subject and is commonly described by title, number, credits, and expected learning outcomes in the institution’s catalogue.

Course load
Total credits for which a student is registered in a given semester or a faculty member is assigned to teach.

Credit
One semester credit equals approximately 1 hour of time in class per week over a semester of 15 weeks or longer. It is assumed that a student spends two hours outside of class in independent learning or specific course assignments for every hour in class. This implies that one academic credit equates to a 45-hour commitment to learning over a semester.

Curriculum
The term refers both to the range of courses offered by an institution, and to a set of related courses constituting an area of specialization, such as the computer science curriculum or the machine learning curriculum.

Internship
The term applies to an experience in which a student has a program-related assignment involving attachment to a recognized business, agency or organization.

Full-time student
Any admitted student who is eligible for MBZUAI scholarship and should be registered on full course load each semester.

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Appendix 3:

Definitions

Dismissal
The involuntary separation of a student from MBZUAI for unacceptable conduct or unsatisfactory academic achievement. A student is academically dismissed when he/she fails to achieve academic good standing in two consecutive semesters.

Educational records
Records directly related to the education and academic performance of a student that are maintained by the Registrar’s Office.

Elective course
A course selected at a student’s discretion after consultation with the academic Supervisor.

Good standing
Academic designation applied to a graduate student who has achieved a cumulative GPA of 3.3 or higher.

GPA
Grade point average of the grades earned in MBZUAI courses.

Grade points
The numerical value associated with each grade.

ID card
University student identification card providing and controlling access to University facilities and services.

Prerequisite
A course required to be completed prior to registration in an advanced course.

Academic probation
Status of any graduate student who has less than 3.3 cumulative GPA.

Registration
The process of enrolling students in classes.

Reinstatement
The exceptional act of approving an academically dismissed student to resume studies following dismissal. Academically dismissed students who have been away longer than one semester may not apply for reinstatement.

Readmission
The act of admitting a student back into the MBZUAI through the admissions office after an interruption of studies. Academically dismissed students are not eligible for readmission.

Required courses
Courses necessary for the completion of a particular program.

Classes schedule
A list of courses offered during a semester that specifies the days, hours, and locations of classes and the names of the instructors.

Student schedule
A listing of courses a student is taking in a given semester that specifies the dates, hours, locations of classes and the names of the instructors.

Suspension
The involuntary separation of a student from the University for unacceptable conduct. Suspension extends from one semester to a maximum of one calendar year.

Syllabus
Descriptive outline and summary of topics to be covered in a course offered at MBZUAI.

Semester
Either of the two periods of instruction into which the academic year is divided.

Transcript
A student’s historical academic record.

Transfer credit
Credit from course work completed at another institution that is accepted at MBZUAI and which may or may not be applicable toward a specific MBZUAI degree.

Tuition
Fees charged for courses each semester.

Withdrawal
The act of officially leaving MBZUAI for reasons other than graduation.

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