Mohamed bin Zayed University of Artificial Intelligence - MBZUAI

Catalogue 2020 – 2021

Dear students,

Welcome aboard!

It gives me great pleasure to welcome you into our community here at Mohamed bin Zayed University of Artificial Intelligence (MBZUAI), the world's first graduate-level, research-based artificial intelligence (AI) university. I hope you are excited to explore your new campus – a place where you'll be presented with tremendous knowledge and unlimited opportunities.

MBZUAI is more than a university; it complements the ambitions of Abu Dhabi, and the UAE, to use the transformative potential of AI to support economic diversification. Our goal is to introduce a new model of academia and research in the field of AI. As part of our campus in Masdar City, Abu Dhabi, you will have a role to play in shaping not only this new academic model, but the future of our AI-driven society.

We want to demonstrate the immense potential of AI and foster a workforce that leverages AI for advancement across different industries and businesses. We will do that by encouraging the development of real-world AI applications in collaboration with industry and public institutions.

Moreover, we will create experiences for you that bridge the gap between the classrooms and workforce of future. By doing so, MBZUAI will enable you to explore AI's potential to the fullest, providing you with the tools to become a trusted advisor in global matters related to AI.

The University is proud to have a student body and faculty comprising a very diverse mix of cultures and backgrounds. Your MBZUAI experience will include meeting talented people like yourself, from around the globe. Our international composition contributes immensely to the academic and social fabric of daily life here. Mutual respect among colleagues of differing social, religious, and ethnic values. We hope that you contribute to and embrace the intercultural environment of MBZUAI.

Walk the campus, ask questions, meet faculty and staff, and learn all you can about your university. Study hard, make new friends, get involved and have fun. These are the best of times for you. We are here to help in any way we can so you can reach your goals and realize all your dreams.

Yours sincerely,

Professor Sir Michael Brady

Board of Trustees

University Leadership

Professor Ling Shao

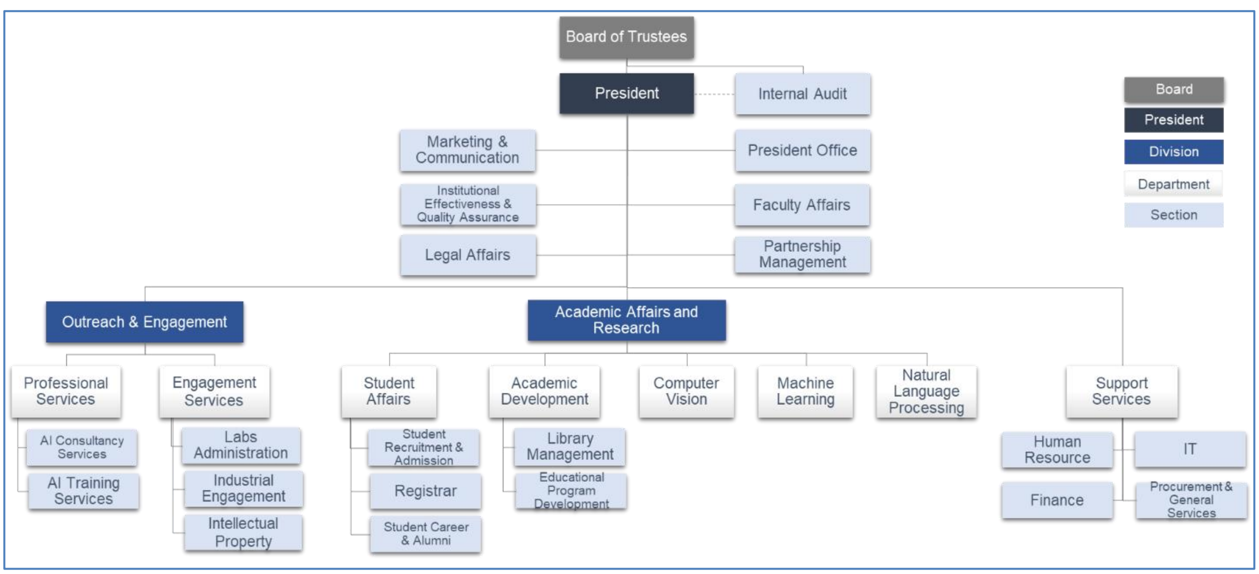
Executive Vice President and Provost

Dr. Behjat AlYousuf

Executive Vice President for Outreach & Engagement

Organizational Structure:

The following is the MBZUAI's organization structure. The structure constitutes of two main divisions (Academic Affairs and Research, Outreach and Engagement) reporting directly to the President, beside support services department and other units to support MBZUAI to deliver into its mandate.



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Definitions

Term	Definition
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.
Advisor	Faculty member/administrator assigned to counsel students on academic or other matters. The student is called an “advisee”.
Master’s Degree	Graduate degree in which a student completes 6 courses in the first year and thesis requirements in the second year which adds up to 24 months.
Doctor’s Degree	Graduate degree in which a student completes 6 courses in the first year and Thesis requirements in the following 3 years which adds up to 36 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.
Course Load	Total credits for which a student is registered in a given semester or a faculty member is assigned to teach.
Credit	A credit represents 1 hour of time in class per week over a semester of 17 weeks. This implies that one academic credit equates to a 45-hour commitment to learning over a semester.
Curriculum	A structured set of learning outcomes built in a specified set of courses.

Full Time student	Any admitted student who is eligible for MBZUAI scholarship and should be registered on full course load each semester.
Part Time student	Self-paid student who is eligible to take less credit hour load than the full-time student
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.
MBZUAI - related Research Projects and Activities	Research Projects and Activities undertaken by MBZUAI faculty and researchers that will be branded as part of the MBZUAI activities. The name of individual MBZUAI faculty members and/or researchers can but does not need to, be associated with the activity or project.
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 advisor.
Good Standing	Academic designation applied to a graduate student who has achieved a cumulative GPA of 3.0 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 3.0 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, as per the standards of CAA.
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.
Visiting Student	A student enrolled at another accredited institution who receives permission to register at MBZUAI for up to two semesters to earn credit to transfer back to his or her home institution.
Withdrawal	The act of officially leaving MBZUAI for reasons other than graduation.

- **Academic Calendar**

The academic calendar 2020–2021 of MBZUAI highlights important dates throughout the MBZUAI academic year. The MBZUAI academic year is divided into two main semesters (Fall and Spring). Classes are held Sundays through Thursdays; the weekend days are Friday and Saturday.

Due to the COVID-19 Pandemic situation and the postponement of the start date of university till January 20/21, below you can find the academic calendar of the Spring semester.

Day	Date	Event
Sun-Thu	03-07 Jan	Students Orientation
Sun	10 Jan	Start of classes
Thu	14 Jan	Last day to add/drop courses
Thu	21 Jan	Last day to Withdraw/Submit leave of absence request without penalty.
Sun-Thu	28 Mar-01 Apr	Spring Break
Sun	04 Apr	Classes resume after spring break
Thu	06 May	Last day of classes
Sat-Mon	08 till 10 May	Final examinations
Thu	20 May	Grade Announcement

Table 4 - UAE academic year 2020/2021

The official holidays observed by the University for the years 2020 and 2021 are:

Occasion	Date	Holiday Duration
Year 2021		
New Year	January 1, 2021	1 day
Eid Al Fitr*	May 11, 2021	3 days
Arafat Day*	July 19, 2021	1 day
Eid Al Adha*	July 20, 2021	3 days
Hijri New Year's Day*	August 9, 2021	1 day
Prophet Mohammed's Birthday*	October 19, 2021	1 day
Martyr's Day	December 1, 2021	1 day
UAE National Day	December 2, 2021	1 day

Table 5 - UAE Holidays 2020 and 2021

As the Islamic calendar is determined with various moon phase sightings, holiday dates marked (*) change every year. These actual dates will be officially announced by the UAE government in due time. On a few unanticipated occasions, the University may have to close, usually for a day or more, in compliance with the conventions of the community. This specifically refers to certain mourning days declared by the government. In such cases, an appropriate announcement will be issued.

MBZUAI will officially announce closure on a Religious and/or Public holiday to students and staff.

1. About MBZUAI

1.1 Overview

The Mohamed bin Zayed University of Artificial Intelligence (“MBZUAI”) is established in the Emirate of Abu Dhabi, with a clear mission to drive AI knowledge creation, development, fostering economic, social growth and positioning the UAE as a hub for the international AI community.

The university, in addition to its academic offerings, will have a direct and indirect impact on AI advancement in the UAE in multiple ways including, but not limited to:

- Attract international talents (students and faculty staff) and ensure the transition to enter the UAE market.
- Create an active AI community and collaborate in AI research and publications.
- Host conferences that attract AI experts to the UAE and the region.
- Support technology and AI related startups in the UAE.
- Support governments and businesses by providing AI consulting services and AI solutions/ applications.
- Conduct training & workshops in various AI fields for government entities and businesses.

MBZUAI will offer 3 PhD and 3 MSc programs in the 3 AI specialization, Machine Learning (ML), Computer Vision (CV), Natural Language Processing (NLP).

1.2 Institutional History

MBZUAI was established as an independent local entity in the Emirate of Abu Dhabi and shall be affiliated to the Executive Council. The University has a Board of Trustees comprising of Seven members including the Chairman of the Board.

1.3 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.

1.4 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.

1.5 Strategic Objectives

MBZUAI has the following strategic objectives:

- Support Abu Dhabi's efforts to build and sustain an AI-based knowledge economy.
- Ensure that industry & public institutions have the people, skills, and resources to be best in class at the use of AI.
- Attract the best regional and global talent focused on AI.
- Achieve research excellence in AI and develop real business applications in collaboration with industry & public institutions to enhance innovation, productivity & growth.
- Become the trusted advisor for the industry & public institutions in matters related to AI.
- Support the UAE's innovation clusters and AI start-ups.

1.6 Licensing and Accreditation

The Mohamed bin Zayed University of Artificial Intelligence, located in the Emirate of Abu Dhabi, is officially licensed from March 10, 2020 by the Ministry of Education of the United Arab Emirates to award degrees/qualifications in higher education.

1.8 Senior Leadership

1.8.1 President

The President is the chief executive officer of MBZUAI. The President is appointed by a virtue of a resolution issued by the Chairman of the Executive Council, based on the nomination of the Board of Trustees. The President shall, subject to the direction and under the supervision of the Board of Trustees, have the necessary powers to manage the University, discharge its affairs and represent it before other parties and judiciary.

1.8.2 Executive Vice President for Academic Affairs and Research

Reporting to the President, the Executive Vice President for Academic Affairs and Research oversees the academic integrity of the university and provides leadership in planning; budgeting; curriculum; and program development and research activities and ensure compliance with various accreditation agencies as well as local and international accreditation requirements and regulations.

1.8.3 Vice President for Outreach and Engagement

Reporting to the President, the Vice President for Outreach and Engagement oversees the university's non-academic mission, which outreaches the broader community, government agencies and industrial partners. It further supports the development and implementation of different research initiatives with a goal to establish and maintain a culture of compliance among all involved at the University.

1.8.4 Director of Support Services

Reporting to the President, the Director of Support Services ensures that the academic and research functions of the University have access to the administrative support and the financial, physical and human resources necessary to carry out the mission of MBZUAI. The Director of Support Services manages the IT, Finance, Human Resources, Procurement and General Services functions of MBZUAI.

1.9 Premise, resources, and physical setting

MBZUAI is based in Masdar City, one of the world's most sustainable urban communities, a low-carbon development made up of a rapidly growing clean-tech cluster, business free zone and residential neighborhood with restaurants, shops and public green spaces, surrounded by a student-friendly environment with all the needed amenities. The campus spaces designed to be fully supportive of an optimal educational experience and compliant with local authorities' regulations as well as international educational standards.

1.10 Partnerships with external institutions

MBZUAI encourages and promotes research through facilitation of joint research and other forms of collaboration with industry, international higher education institutions and government entities. MBZUAI recognizes the importance of external partnerships in transferring scientific knowledge and discoveries into products or services for the public benefit and the economic development of Abu Dhabi, the UAE and the rest of the world.

2. Admission

Student Recruitment and Admissions Office

3. MBZUAI Student Recruitment and Admissions Office oversees all aspects of the recruitment and admissions process. It is responsible for planning and implementing MBZUAI's student recruitment and admissions strategies and ensuring that the quality and volume of new students are aligning with the university's objectives.

4. Student Recruitment and Admissions Office is responsible and accountable for recruiting highly qualified and academically excellent applicants, reviewing and screening applications, determining the list of eligible applicants who are meeting the admissions criteria, and coordinating with the Admissions Committee who will finalize the list of students to be offered admission. It adopts a democratic student selection process to ensure the highest level of transparency.

Target Applicants

MBZUAI's selection of global MSc and PhD applicants is highly competitive. The Admissions Committee takes a range of factors into consideration when reviewing applications.

MBZUAI candidates should be highly qualified, talented, motivated, ambitious, outward looking, open to new ideas, and able to share insights from their own experience. Student recruitment is open for all nationalities. It is available for applicants who are satisfying the admission requirements and holding degrees in S.T.E.M. fields from recognized universities. Degrees include Computer Science, Electrical Engineering, Computer Engineering, Mathematics, Physics and other relevant Engineering majors with programming & coding skills.

Admission Requirements

3.1 The admissions standards for the Master's degree in Computer Vision, Machine Learning and Natural Language Processing are as follows:

1. Completed Degree: Bachelor's degree in S.T.E.M fields, such as Computer Science, Electrical Engineering, Computer Engineering, Mathematics, Physics and other relevant Engineering majors, from an accredited university or college recognized by the UAE Ministry of Education, without the need of prior work experience.

2. Knowledge & competencies demonstrate evidence of skills acquired in some of the following subjects:

- Programming skills such as Python or C or C++ or MatLab

- Math skills such as:
  - **a.** Data Structures and Algorithms
  - **b.** Linear Algebra
  - **c.** Probability and Statistics
  - **d.** Calculus

3. Academic Transcripts: Students should have a minimum CGPA of 3.2 (on a 4.0 scale) or equivalent or top 20% of the university's grading scale.

4. English Language Proficiency Certificate

    - TOEFL iBT with a minimum total score of 90 or IELTS Academic with a minimum overall score of 6.5.

    - English Language Proficiency Certificate should be valid during the application process.

    - Waiver requests from applicants who are citizens (by passport or nationality) of UK, USA, Australia, and NZ who completed their studies from K-12 until Bachelor's degree, and Master's degree (if applicable) from those same countries will be processed. Students need to 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.

5. Graduate Record Examination (GRE) General Score (optional)

The admission standards for the Doctorate degree in Computer Vision, Machine Learning and Natural Language Processing are as follows:

1. Completed Degree: Bachelor's and Master's degree in S.T.E.M fields, such as Computer Science, Electrical Engineering, Computer Engineering, Mathematics, Physics and other relevant Engineering majors, from an accredited university or college recognized by the UAE Ministry of Education, without the need of prior work experience.

2. Knowledge & Competencies: Demonstrate evidence of skills acquired in some of the following subjects:

    - Programming skills such as Python or C or C++ or MatLab

    - Math skills such as:
        a. Data Structures and Algorithms
        b. Linear Algebra
        c. Probability and Statistics
        d. Calculus

3. Academic Transcripts: Student should have a minimum CGPA of 3.2 (on a 4.0 scale) or equivalent or top 20% of the university's grading scale for both degrees.

4. English Language Proficiency Certificate

    - TOEFL iBT with a minimum total score of 90 or IELTS Academic with a minimum overall score of 6.5.
    - English Language Proficiency Certificate should be valid during application process.
    - Waiver requests from applicants who are citizens (by passport or nationality) of UK, USA, Australia, and NZ who completed their studies from K-12 until Bachelor's degree, and Master's degree (if applicable) from those same countries will be processed. They need to 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.

5. Graduate Record Examination (GRE) General Score (optional)

3.2 Application Procedures

Application for admission to graduate programs must be submitted online through www.mbzuai.ac.ae/register with the following:

- Online application
- Official and attested university degrees and transcripts translated to English
- Valid English Language Proficiency Certificate (IELTS Academic or TOEFL iBT)
- Resume
- Statement of Purpose
- Minimum of two recommendations with at least one from previous professor/academic advisor. MBZUAI will contact nominated referees directly to complete recommendation forms for the applicant
- Research proposal (for PhD applicants)
- Valid passport
- Copy of Emirates ID (if applicable)

Scholarship

All students admitted on a **full-time** basis are provided a full scholarship which includes:

- 100% tuition fee
- Monthly stipend (amount is as per the scholarship contract)
- Hostel accommodation
- Annual airfare to origin country
- Health insurance coverage
- UAE visa sponsorship

All benefits are only for students and do not include their beneficiaries, if any.

Full-time students are expected to maintain a cumulative GPA (CGPA) of at least 3.0/4.0, complete the degree requirements within the specified duration for the programs from their admitted semester (2 years for MSc and 4 years for PhD), and maintain a clean deed record with no evidence of dishonest or unethical behavior in order to maintain their full scholarships.

Deferment of Admission

Admission is only effective for the academic semester specified in the offer letter. If an applicant is granted admission and aims to join the university in the following semester, he/she must complete the "Admission Deferment Request Form" and submit it to the Student Recruitment and Admissions Office. The request to start the study for the following semester is not automatically approved but will instead be subject for another round of approvals and be decided on a case-by-case basis.

It is the applicant's responsibility to contact the Student Recruitment and Admissions Office prior to the admission deadline of the targeted semester which the student had opted to join. The applicant will be notified once the final decision is secured.

Transfer students

MBZUAI will be accepting transfer students for its programs, who meet the following guidelines:

1.1 Course credits earned outside the student's program, may be transferred to a graduate program at MBZUAI subject to the approval of the Admission Committee at the time of admission.

1.2 Students transferring from a federal or licensed institution in the UAE, or a foreign higher education institution based outside the UAE and accredited in its home country, are eligible for transfer credit.
1.3 Students must meet the English language proficiency requirements for the program to which they seek to transfer.
1.4 Students must present certification (TOEFL or IELTS) demonstrating the required scores for full admission per the admission guidelines.
1.5 Students must submit official transcripts showing all past academic work attempted at all institutions attended.
1.6 Students must be of “Good standing” Status.
1.7 Students are allowed to transfer credits which may be applied to a specific degree program to 6 credit hours for Masters, and 9 credit hours for PhD.
1.8 Students can only transfer graduate level courses.
1.9 MBZUAI will accept the transfer of graduate program 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.
1.10 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 GPA calculation.
1.11 MBZUAI will prohibit accepting credit twice for substantially the same course taken at two different institutions.
1.12 The course transfer credits may not have been used previously in any graduate program to fulfill the requirement of any other graduate degree.
1.13 The course credits must have been completed no more than a maximum of (2) years prior to the student’s acceptance into the program of MBZUAI.
1.14 MBZUAI Admission Committee will have the ultimate right to reject the transfer requests for any student.

Pre-requisite waiver Policy

4.1 The granting of pre-requisite for previously achieved learning is an acknowledgement by the university that students have gained the knowledge, understanding and skills equivalent to the stated learning outcomes of a course.
4.2 Applicants for pre-requisite waiver may request that their previous learning be assessed towards course/s offered at MBZUAI programs.
4.3 The university may grant pre-requisite waiver based on completed studies at a recognized higher education institution;

a. Previous learning can only be evaluated and recognized once. Evaluation is a case by case process and will be done only once for each applicant prior to the start of the respective course.
b. Previous learning deemed as equivalent to the stated learning outcomes for a course only.

c. Applicants must provide appropriately certified documentation to support their application for pre-requisite waiver.
d. Pre- requisite waiver entitles the student to be exempted from the pre-requisite of course/s offered within MBZUAI programs.
e. The exempted courses will be recorded on the student Information System for degree audit purposes and will have no credit value towards the degree of the student.

4.4 Pre- requisite waiver is not normally granted for studies completed 2 years prior to application.

5. Orientation Program

All new students must undergo the student orientation program as soon as they join MBZUAI and prior to starting classes. It is essential to attend the orientation program.

The goal of the orientation program is to facilitate the new students transition to graduate studies by introducing them to the values, expectations, and resources at the MBZUAI community which will be their home for the duration of their degree program. It will also focus on professional as well as personal development.

7.9 Student ID

Every student at MBZUAI receives an MBZUAI Identity Card after being admitted and enrolled. The card is valid until the students complete their studies. These cards are issued by the Student Affairs Department. ID cards will be distributed to all students during orientation week.

The Student should ensure to carry his/her card at all times around the university and should not allow anyone else to use this card.

In case of losing the ID card or facing a problem with usage of the card, students should contact the Student Affairs Department.

5.1 Language of Instruction

All courses in MBZUAI programs offered in English Language ONLY.

5.4 Academic Credit Hours

In defining standards, a credit represents 1 hour of time in class per week over a semester of 17 weeks. This implies that one academic credit equates to a 45-hour commitment to learning over a semester. For laboratory-based courses, 1-semester credit normally is given for two hours of laboratory time per week over a 17-week semester. It is assumed that a student spends two hours outside of class in independent learning or specific course assignments for every hour in class.

MBZUAI adheres to the standards as set by CAA.

6. Scholarship Policy:

1. All admitted students (on full time basis) are granted full scholarship upon acceptance.
2. The scholarship includes 100% tuition fees, accommodation, health insurance and a competitive monthly stipend plus other benefits.

3. Students should fulfill certain requirements to maintain this grant during their study tenure:

   a. Students to maintain a cumulative GPA of 3.0 and above.
   b. Students must complete their degree requirements within the expected duration.
   c. Students must maintain a clean deed record, and with no evidence of dishonest or unethical behavior.

1. To maintain the scholarship, students must achieve a cumulative GPA of 3.0 and above at all times:
   a. "Good standing" is the academic designation applied to a graduate student who has achieved a cumulative GPA of 3.0 or higher.
   b. "Academic Probation" is the academic designation applied to a graduate student who has achieved a cumulative GPA less than 3.00.

2. If the student did not maintain a CGPA of 3.0 and above, then he/she will be placed on academic probation:
   a. The student should retake the course/s which led to the drop of the CGPA.
   b. The student should pay the tuition fees of the repeated course/s only.
   c. The student should report on a bi-weekly basis to the primary advisor and must not achieve less than (CGPA => 3) by end of the semester.
   d. The student will maintain the other scholarship benefits in that semester which are: the monthly stipend, accommodation and health insurance.

3. If the student could not raise his/her CGPA to 3 in the following semester, then he/she will be assigned "Academic Dismissal" status.
   a. The student may appeal the dismissal, and if appealed and granted the appeal, then the academic committee decision will be followed (academic and financial impacts).
   b. The academic standing will be assigned as "Special Probation" for that semester.

4. Students who fail a course will face several consequences:
   a. A student who receives an "F" grade (GPA 0.00) in any course, will be automatically placed on academic probation.
   b. The student will have to repeat the course in the following semester.
   c. The student will also have to bear the costs of retaking the course.
      - If the student fails the repeated course, then the student will be dismissed from the program. Yet, the student may appeal the dismissal, and if granted the appeal, then the academic committee decision will be followed (academic and financial impacts) and the academic standing will be assigned as "Special Probation**".**
      - If the student passes the repeated course, and maintains a "B"(GPA>=3), then the student will remain in the program and he/she will be on "Good Academic" standing.
   d. A student under academic probation will need to report on a bi-weekly basis to his/her primary advisor and should achieve a (CGPA => 3) by the end of the semester to remain in the program.
   e. A student is allowed to receive two "C" grades in courses throughout a program. If the student receives a third "C" grade, his/her academic status will lead automatically to academic probation. A student under academic probation will need to report on a bi-

weekly basis to their primary advisor and a grade of "B" (CGPA => 3) by the end of the semester to remain in the program.

5. Completion duration of programs:
   Students who are enrolled in an MBZUAI program must complete it in due time:
   a. The expected time for students to complete each program is as follows:
      - 2 years to complete the MSc program (24 months)
      - 4 years to complete a PhD program (48 months)
   b. Failure to complete the program within the allocated time will automatically put a stop on the monthly stipend allowance being given after the following month of the allocated time of the program (after 24 or 48 months).
   c. The student will have to bear the costs beyond that time .
      a. The student may submit an appeal to the academic committee. The academic committee decision will be followed (academic and financial impacts).

6. Students who fail to maintain a clean deed record, or are found to show any forms of cheating, misconduct, deception and other forms of unethical behavior, will automatically encounter a hold on the monthly stipend allowance and may face disciplinary actions. Disciplinary actions will be left to the discretion of the academic committee on a case by case basis.

Cost per program are as follows:

Program	**Course /Credit**
MSc	AED 5,000 per credit
PhD	AED 6,600 per credit

Procedure:

These procedures explain the financial impacts on MBZUAI students in certain situations.

1. **Full Time Students:**

   1.1 Retake of a course: The action of registering a course for a second time to raise the GPA.
   a. The tuition fees of the retake course should be paid by the student.
   b. Below is a clear timeline structure of the percentage that should be paid by the student in case he/she withdrew from the course:

Deadline	Payment % to be paid by the student
First week	0%

Second week	25%
Third week	50%
Fourth Week	75%
After fourth week	100%

1.2 Course Withdrawal: The action of withdrawing from a course in a semester for certain reasons. The financial impact on the student will be left to the discretion of the academic committee (based on the rationale submitted by the student- extenuating circumstances)

1.3 Leave of absence:

Definition: Students may face unforeseen circumstances which could require them to take some time off.

Procedure: A student may request a leave of absence for one semester to be approved by the academic committee.

The financial impact on the student, will be left to the discretion of the academic committee (based on the rationale submitted by the student- extenuating circumstances).

2. Part time Students:

2.1 Payment Plan for Part time Students:

Tuition fees payment plan per semester

End of add/drop week	50% paid by cheque or cash 25% postdated cheque by end of month 2 25% postdated cheque by end of month 3

2.2 Seat Holding Fees: Part time students should pay a seat holding fee upon admission, to reserve their seat and be eligible to join the program at MBZUAI. The seat holding fees should be paid according to the following conditions:

a. Amount to be paid: 5,000 AED
b. Deadline:
   To be paid within 7 calendar days from the student's acceptance of the admission offer.
c. If the student does not join MBZUAI:
   The seat holding fees are non-refundable.
d. If the student joins MBZUAI:

-The fees will be forwarded to his MBZUAI account.

2.3 Retake of a course: The action of registering a course for a second time to raise the GPA. Course Withdrawal: The action of withdrawing from a course in a semester for certain reasons.

- Below is a clear timeline structure of the percentage that should be paid by the student in case he/she withdraws from the course:

Deadline	Payment % to be paid by the student
First week	0%
Second week	25%
Third week	50%
Fourth Week	75%
After fourth week	100%

2.4 Leave of Absence:

Definition: Students may face unforeseen circumstances which could require them to take some time off.

Procedure: A student may request a leave of absence for one semester to be approved by the academic committee. (Impact on the seat holding payment and the class size)

- The tuition fees amount (excluding the seat holding fees) will be credited to the student's MBZUAI account if the request was submitted during the first semester. In addition, the payment penalty applies based on the timeline of the request.
- If the student does not come back and decides to withdraw, the seat holding fees will not be refunded.
- If the student submits a leave of absence during his study tenure, and after completing the first semester, penalty payment applies according to the request timeline .

2.5 Complete Withdrawal : The action of completely withdrawing from the university (this request is strictly applicable for part time students ONLY).
The penalty payment of the semester tuition fees will apply as per the below table.

Deadline	Payment % to be paid by the student
First week	0%
Second week	25%
Third week	50%
Fourth Week	75%
After fourth week	100%

2.6 Suspension and Dismissal from MBZUAI: If the student is suspended or dismissed, then the academic committee decision will be applied in terms of both the academic and the financial impacts.

5.2 Class Size Policy

3.1 Class size maximum and minimum limits have been determined based on a number of considerations including:

3.1.1 Best practices in learning and pedagogy which allows achieving high levels of student learning.

3.1.2 The nature of specializations and levels of degrees/programs offered at the university.

3.1.3 Instructional methods (format) and mode.

3.1.4 To create a close student-faculty relationship.

3.1.5 Other factors such as limits set by accrediting bodies, health safety and environment policies.

3.2 The maximum and minimum number of students to be allocated to a class in any subject taught in the MSc or PhD programs has been set as follows:

Maximum and minimum class size		
Class Type	**Maximum Enrollment**	**Minimum Enrollment**
Lecture, Laboratory, Seminar	20	5

3.3 Under particular circumstances, it may be necessary to go beyond the maximum or less than the minimum limits. Should an exception to this policy be necessary, a request from the chair of the respective department should be submitted and an approval must be given by the Executive Vice President for Academic Affairs and Research.

3.4 The following will be considered exceptions to the minimum class enrollment requirement:

- Thesis
- Research
- Student teaching supervision
- Honors seminars and key-note speakers lecture
- Internships
- Projects
- Independent/Directed Research

3.5 The department with approval of the Executive Vice President for Academic Affairs and Research may offer courses below the minimum class size requirements when:

- The course is required for graduation and suitable substitutions cannot be made for students.
- First-time offering of the course and time is needed to assess its potential.

3.6 Faculty members who will be teaching courses which are granted approval to be offered below the minimum class size requirements, will need to ensure that study plans are remedied to accommodate a very small group of students.

Procedures:

The following procedures should be followed:

1. The Registrar's Office will provide class status reports a week prior to the start of the classes to each department chair and the Executive Vice president for Academic Affairs and Research, to review and decide the courses which will be cancelled and/or granted an exception.

2. The department chair will send a list of canceled classes to the Registrar which will immediately notify the students that the class/s has been canceled and take any other appropriate action regarding the scheduling of the classes.

3. Students which are impacted with class cancellation will need to contact their advisors and agree to register in an alternative suitable course if needed

6.1 Advising

Student Advising Services

The purpose of this Policy is to detail the provisions the University shall put in place to ensure that appropriate and high-quality advice is available to students to assist with the planning, execution and successful completion of their University studies.

This policy and its procedures are to provide a framework and mechanism for the advising available for students who have registered in any program at MBZUAI to support them in enhancing their academic standing and progress toward the degree.

The scope of this policy applies on prospective students, admitted students to the University programs, faculty, staff and administrators involved in the students advising process.

6.1.1 Policies

Student Advising is a lively process which entails multiple components and involves various stakeholders. In addition to the Students, the University allocates its internal resources to support this process through its Administrators, Academic Advisors and staff within the Student Affairs Department.

1. MBZUAI recognizes that good student advising is integral to the quality of student learning and satisfactory student outcomes while pursuing their degrees and preparing for their professional careers.
2. MBZUAI will provide the appropriate infrastructure to allow students to complete their education and research in a timely and productive manner
3. All new students must undergo the student orientation program as soon as they join MBZUAI and prior to resuming classes.
4. The goal of the orientation program is to facilitate the new students transition to graduate studies by introducing them to the values, expectations, and resources at the MBZUAI community which will be their home for the duration of their degree program. It will also focus on professional as well as personal development.
5. All available advising services and resources available to the student will be highlighted during the sessions which will take place as part of the new student orientation program.
6. Student advising shall be impartial and focus on students' needs rather than those of individual departments or the University.
7. Each student will have a thesis/research committee (referred to hereunder as Supervisory Committee) assigned to him with a primary role of ensuring a student's program learning outcomes, measured through coursework evaluation and research deliverables, are met.
8. The Supervisory Committee shall comprise 2-3 internal faculty members who hold a full-time or adjunct faculty appointment at the university which shall consist of an Academic Primary Advisors (referred to hereunder as Academic Advisor) and a Secondary Advisor and potentially a Committee member.
9. The Academic Affairs and Research Division and Department Chairs will assist students with the selection of their Supervisory Committee members (Please refer to procedures section for further details)
10. The Academic Advisor, Secondary Advisor and members of the Supervisory Committee will be drawn from faculty within the Academic Department and should be familiar with the teaching, support and administrative arrangements of the program of study.
11. Students will normally have the same Academic Advisor, Secondary Advisor and members of the Supervisory Committee throughout the duration of their study; where there are unavoidable reasons for changing an Academic Advisor, Secondary Advisor or any member of the Supervisory Committee such as the Advisor/Supervisor Committee member leaving the University, care will be taken to ensure a structured handover to the newly allocated Academic Advisor, Secondary Advisor and any member of the Supervisory Committee.

12. The student handbook that describes the important and useful information for the student should be available to all students as soon as they are admitted into the university and should be updated regularly.
13. Student advising shall be available from the Academic Advisers and Secondary Advisor and members of the Supervisory Committee and other University resources on an ongoing basis throughout the year.
14. Student advising opportunities will be well publicized and Students will be encouraged to seek advice and be made to feel comfortable in seeking such advice.
15. The Student is responsible for his or her own decisions. Academic Advisors and Secondary Advisors exist because students require information and assistance to navigate the University system and to make appropriate decisions. The student's role is to explore academic, career and personal goals (Please refer to roles & responsibilities section for further details)
16. Academic Advisors may offer group meetings additional to the group and individual meetings required by the policy, such as to address matters of generic interest or develop peer support.
17. Students may – in special cases – request to change or replace their advisor at different time points in their program, Student requests for a change of Academic Advisor will be given due consideration and changes made if feasible. It may not be possible to meet such requests.
18. As part of the Faculty Induction, relevant information, guidance, support and training will be provided for Academic Advisors, Secondary Advisor and members of the Supervisory Committee. During the induction, a full set of instructions will be provided to each Academic Advisor, Secondary Advisor and members of the Supervisory Committee explaining the role and responsibilities, the meeting frequency, the escalation procedure, and the paperwork requirements in the process.
19. Department Chairs will decide on number of advisees assigned to each faculty member dependent on cohort sizes, time and resources.
20. A faculty member at MBZUAI is expected to be involved in primary supervision of not more than 6 students, secondary supervision of not more than 6 students and be a member of supervisory committee of not more than 6 students at any point of time.
21. Any faculty member with no previous advising experience will be shadowing one of the experienced faculty members in advising for a full semester prior to be assigned as an Academic Advisor.
22. Faculty or staff who are not designated as Academic Advisers or Secondary Advisors may provide students with study-related information in their area of expertise but should, where required, refer students to appointed Advisors for assistance with course planning

23. The Academic Advisor and other relevant stakeholders involved in advisory services will be providing additional assistance and support to students with competency problems who are deficient in meeting program expectations and not making timely progress through their programs.
24. Students who are deficient in meeting program expectations and put under academic probation (as defined in P&P AAD4 - Student Examination and Assessment) should be provided with a remediation plan by their academic department in coordination with the Academic Advisor.
25. Academic Advisors, Secondary Advisor and members of the Supervisory Committee have the right to access the student advisee academic records to be able to provide informed recommendations and direction to the student.
26. The quality of academic advising will be included as part of the annual assessment of the faculty.
27. Every student will be required to complete the end of year academic advising satisfaction survey.
28. The implementation of this policy and the quality of academic advising process effectiveness and outcomes will be regularly evaluated through the Institutional Effectiveness and Quality Assurance Section.

Roles and Responsibilities

Academic Advisors are to:

1. Inform students of the nature of the advisor/student advisee relationship.
2. Designate and communicate hours available for advising and ensure you are available during publicized office hours.
3. Help students define and develop realistic educational goals and set clear expectations for students regarding their academic performance and research progress.
4. Be supportive, equitable, accessible, encouraging, respectful and serve as intellectual and professional mentors to their students.
5. Clarify the student’s academic program of study requirements, degree requirements and advise students on the selection of an appropriate thesis topic.
6. Monitor designated educational transactions, e.g. course selection, changes of major, graduation requirements, etc.
7. Assist students in monitoring and evaluating their educational progress and meet regularly and often with them to provide feedback on progress and research activities.
8. Schedule regular meetings to discuss various topics of importance to the student such as research, professional development, career objectives and opportunities, etc.

9. Help to prepare students to be competitive for employment and ensure they receive training in the skills needed for a successful career in their discipline, including oral and written communication and grant preparation as appropriate.
10. Support the student to evaluate and realize career options, provide career advice, offer help with interview and application preparation, and write letters of recommendation in a timely manner.
11. Encourage participation in professional and specialized Conferences, Workshops or Seminars and try to secure funding for the student to attend such activities.
12. Provide and discuss clear criteria for authorship at the beginning of all collaborative projects.
13. Provide knowledgeable support concerning the academic and non-academic policies and procedures that pertain to students.
14. Assist the student in identifying appropriate institutional resources, faculty and staff and make appropriate referrals as needed.
15. Maintain a confidential, accurate and up-to-date advising record for each student.

Secondary Advisors are to:

1. Offer an independent perspective on student's research.
2. Provide direct supervision if the primary supervisor is absent, and play a broader supportive role.

Members of the Supervisory Committee are to:

1. Ensure that students rights are taken care of, ensure transparency, fairness, and overall auditing of the supervisory process.

2. In coordination with student's Academic Advisor (who is part of the Committee), ensure that the student has research advise commensurate to their level of experience or expertise. For example, provide frequent and generous research advise in the student's beginning years, and slowly scale back to ensure student eventually develops into a mature thinker capable of thinking independently and working interdependently.

3. Advise the student on participating in the key professional events, workshops, seminars, internships, or external training programs (e.g. summer schools) that will significantly enhance the student's ability to conduct and present their research.

4. Provide a non-judgmental safe-space for the student to express themselves in terms of their aspirations, difficulties with research, or difficulty in working with colleagues or their primary advisor.

5. Counsel the student in their choice of career towards the later stage of their degree program. Provide them with resources to understand the elements of a successful career in academia, industry, not-for-profit organizations, government positions, etc.

6. Counsel the student on the different landmarks of the degree program – the qualifying exam, thesis proposal exam, and thesis defense exam.

The student's responsibility is to:

1. Act professionally and in an ethical, professional, and courteous manner toward other students, staff, faculty and advisor when moving through the advising process
2. Clearly articulate, to the best of one's ability, personal values, abilities, interests, goals, and areas of challenge.
3. Fully understand requirements for the degree, program of study, research and graduation and adhere to institutional policies, procedures, and deadlines.
4. Recognize that they bear the primary responsibility for the successful completion of their degree.
5. Take responsibility for actions and decisions that affect academic progress.
6. Understand the role of the Academic Advisor.
7. Be proactive in seeking help and advice early in the semester and know that advisors are helpful and available during class registration and non-registration periods.
8. Schedule and arrive on time for appointments with your advisor and come prepared for each advising session with your questions and create a course schedule before the meeting when you will discuss registration.
9. Make notes and keep all paperwork and forms from advising sessions.
10. Know your current grade point average, enrolled credits, and earned credit hours.
11. Follow through on actions identified during each advising session
12. Follow departmental and university deadlines and take responsibility for meeting those deadlines.
13. Be proactive about communicating with the advisor, understanding that communication is a two-way endeavor.

14. Inform the advisor of potential and/or existing conflicts and work toward their resolution and seek mentoring and support resources beyond their faculty advisor, including other faculty members, peers, and organizations.
15. Be considerate of other time constraints imposed on faculty and staff, including competing demands.
16. Be familiar with the Student Career and Alumni Section and other campus resources and use those resources to explore and prepare for careers.
17. Clearly communicate with their advisor regarding their career preferences and take an active role in identifying and pursuing professional development opportunities.
18. Be proactive about improving their research skills, including written and oral presentation skills.
19. Obtain outside help from department chairs, or other faculty if conflicts arise with their advisor and be aware that if they feel compelled to change advisors or research direction, they have options and should consult with their advisor, other mentors, or department officers.

The Student Affairs Department is to:

1. Continuously facilitate the registration process for the student and accommodate special requirements whenever possible.
2. Support Student applicants in determining a suitable Academic Advisor in coordination with Department Chairs.
3. Conduct and manage career services programs including career activities, workshops and events.
4. Support and ensure that students are coached, prepared and obtain the techniques for attending interviews, seeking job search and are capable of writing appealing resumes.
5. Build a database of internship and career opportunities both locally and internationally and communicate opportunities to Student’s on regular basis.
6. Secure the appropriate internships and vacancies for students and university alumni according to their qualifications and career goals.
7. Inform Students of the relevant career fairs and alumni events.
8. Recommend appropriate informational and training resources for students, as per the pre-determined training needs; evaluate their effectiveness and monitoring their results.

6.1.2 Procedures

Procedure for Assigning an Academic Advisor

1. Potential students who are applying for admission to any academic program at the University are requested to identity an Academic Advisor from the faculty prior to submitting their application.
2. Once the potential student has identified a suitable faculty member (from the faculty profiles available on the University website), s/he should establish contact with him/her and obtain his approval and agreement on becoming their Academic Advisor.
3. If the chosen Academic Advisor is not available or not able to accept due to workload or any other valid reason, the student should inform the Student Affairs Department so that a suitable Academic Advisor is assigned to him.
4. If a Student is unable to identify an Academic Advisor, the Student Affairs Department will communicate with the Department Chair and request from him/her to assign a suitable Academic Advisor for the Student.
5. The Department Chair will assign a faculty member as the Student Academic Advisor after reviewing the Students' profile, application and research interests and communicate that with the Student Affairs Department
6. Students will receive the contact details of their Academic Advisor prior to induction (new starts) from the Student Affairs Department. Arrangements will be made for late registrations to receive details of their Academic Advisor in a timely manner.
7. The Academic Advisor to support the student throughout the application and admission process.
8. Academic Advisors will meet with all of their advisees (new starts) either individually or as a group during orientation week or the first week of teaching. Attendance at this is compulsory and will be monitored. Students who miss this session will be required to attend a follow-up session.

Procedure for Assigning a Secondary Advisor and Members of the Supervisory Committee

1. The admissions committee will nominate up to 2-3 faculty members to be appointed in the Supervisory Committee.
2. After the student's admission formalities are complete and the student has arrived on campus, the student will be free to accept the admission's committee nominations, or to identify other faculty members who may be willing to participate in the student's Supervisory Committee.
3. In an event, the student is unable to find any replacement for the initially nominated faculty members by the department within the first 2 months of their program, the student will begin the program with initially assigned committee.

4. The committee members will participate as long as the student remains enrolled at the university.
5. The committee members may be replaced under the circumstances listed hereunder, with the department chair's approval under specific circumstances listed hereunder.

Procedures for the Advising Process

1. Student to contact assigned Academic Advisor
2. Student to agree with Academic Advisor on the date and time of the first advising session
3. Academic Advisor and student to conduct first advising session
4. Academic Advisor to inform student of the nature of the advisor/student advisee relationship and both should agree on the ground rules of the advising sessions, roles & responsibilities and frequency of meetings.
5. Academic Advisor and student to meet and conduct the advising session throughout the academic year as per the agreed frequency.
6. Student to complete the end of year academic advising satisfaction survey.

Procedures for Changing or Replacing the Academic Advisor

1. In the case that the Student Advisee would like to change the Academic Advisor, s/he shall contact the Department Chair and submit an official request by filling an Academic Advisor Change form and clarifying the reasons for this request.
2. The Department Chair will meet with Student and Academic Advisor to discuss the request prior to making his decision and assigning a replacement.
3. In the case of the Academic Advisor not being able to continue advising the Student for any reason, the Academic Advisor shall inform the Department Chair immediately of the decision and the reasons
4. In both cases, The Department Chair will assign a new Academic Advisor within a period of five (5) working days after consulting with the Student.
5. Both the new Academic Advisor and the previous one should conduct a meeting with the presence of the Student Advisee to brief the new advisor on the Student status and ensure proper handover of the Student 's Advising Records.

Procedures for Changing or Replacing Supervisory Committee Members

1. It is permitted to request to change or replace members of the Supervisory Committee in the following circumstances:

- The student will receive another opportunity to identify replacements for their committee 3 months before they are due to appear in their thesis proposal exam. Any request to change the supervisory committee members after the first appointment must be approved by the department chair and should be justified by the student and their Academic Advisor.
- In an event one of the committee members is no longer able to participate in the student's committee due to prohibiting circumstances (e.g. left the university, death, significant health deterioration, etc), the student may ask another faculty member at MBZUAI to participate in their committee following the approval of the department chair.
- In an event the student and/or the committee members find that the level of participation by one of the committee members (including themselves) is lacking or is not conducive for the student's development, the student and/or committee members may seek the department chair's approval in replacing such a committee member.
- If the student changes their research direction during the course of the program in a manner that makes the expertise of their committee members to not be in line with their new chosen direction, the student and/or committee members may seek the department chair's approval in appointing new committee members.

2. In the case that the Student Advisee would like to change a member of the Supervisory Committee, s/he shall contact the Department Chair and submit an official request by filling an Academic Advisor/Supervisory Committee Member Change form and clarifying the reasons for this request.
3. The Department Chair will meet with Student and Academic Advisor to discuss the request prior to making his decision and assigning a replacement.
4. In the case of the Committee Member is not able to continue advising the Student for any reason, the Committee Member shall inform the Department Chair immediately of the decision and the reasons
5. In both cases, The Department Chair will assign a new Committee Member within a period of 5 working days after consulting with the Student.
6. The Academic Advisor and the newly appointed committee member should conduct a meeting with the presence of the Student Advisee to brief the newly appointed committee member on the Student status and ensure proper brief is provided.

7.2 Registration

1.1 The university shall use the credit hours as the basis of its programs and shall organize its educational process on a semester basis.

1.2 Students Course registration

a. A student must be officially registered in a program course to earn academic credits.
b. A student is expected to attend all classes. The instructor will ultimately keep track of attendance through attendance tracking application.

1.3 The student is responsible to be aware of university policies, academic requirements program, calendar events and/or changes in academic status.

1.4 Communications and notifications sent to students MBZUAI email account are considered official.

1.5 The student is responsible to confirm withdrawal from the program

Procedures:

2. Academic Advising
The student must meet with their Primary Supervisor during the announced registration period to agree on the courses to be registered.

3. Registration

3.1 The student shall register during the designated registration period as published in the university calendar each term until the degree has been formally awarded.

3.2 Registration is not official until the student is listed on the official class roster.

4. A student may only change his/her schedule during the add/drop period as designated in the university calendar. If the deadline has passed, the student can't change their class schedule unless they provide evidence for extenuating circumstances and after the approval of the Primary Supervisor and the Registrar.

5. MSc students shall earn 35 credits in total, in order to fulfill the requirements of the degree

6. PhD students shall earn 59 credits in total, in order to fulfill the requirements of the degree.

7. Course Load

7.1 Students at MBZUAI MSc and PhD programs are required to maintain full-time status. A minimum of 11/12 credit hours per semester during the first year. In exceptional circumstances, a student may be approved to carry a reduced load of courses after the approval of the Primary Supervisor, Registrar and the Executive Vice President of Academic Affairs and Research.

8. Course Withdrawal

8.1 The student who encounters unanticipated difficulty in a course may withdraw from a course until the end of the first week from the start of the semester (as per the university calendar) through a "Course withdrawal Request Form" signed by the student's Primary

Supervisor and approved by the Executive Vice President of Academic Affairs and Research.

8.2 Withdrawing a course after the deadline results in grade of “W” and requires the approval of the Primary Supervisor and the Executive Vice President of Academic Affairs and Research through submitting the “Course withdrawal Request Form”.

9. Leave of absence

9.1 A student may request a leave of absence for six months only during the period of study at MBZUAI for extenuating circumstances through submitting the “Leave of Absence Request Form”, approved by the Primary Supervisor and the Executive Vice President of Academic Affairs and Research.

9.2 If the student exceeds the approved leave of absence duration without a formal notification, he/she will be considered withdrawn from the university.

10. Resuming Studies

A student who has been on a “leave of absence” or “suspension” status for a semester or more and would like to resume his/her studies, should submit a “Resume Study Request Form” to the Registrar’s Office.

11. Transfer students

MBZUAI will be accepting transfer students for its programs, who meet the following guidelines:

11.1 Course credits earned outside the student’s program, may be transferred to a graduate program at MBZUAI subject to the approval of the Admission Committee at the time of admission.

11.2 Students transferring from a federal or licensed institution in the UAE, or a foreign higher education institution based outside the UAE and accredited in its home country, are eligible for transfer credit.

11.3 Students must meet the English language proficiency requirements for the program to which they seek to transfer.

11.4 Students must present certification (TOEFL or IELTS) demonstrating the required scores for full admission per the admission guidelines.

11.5 Students must submit official transcripts showing all past academic work attempted at all institutions attended.

11.6 Students must be of “Good standing” Status.

11.7 Students are allowed to transfer credits which may be applied to a specific degree program to 6 credit hours for Masters, and 9 credit hours for PhD.

11.8 Students can only transfer graduate level courses.

11.9 MBZUAI will accept the transfer of graduate program 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.

11.10 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 GPA calculation.

11.11 MBZUAI will prohibit accepting credit twice for substantially the same course taken at two different institutions.

11.12 The course transfer credits may not have been used previously in any graduate program to fulfill the requirement of any other graduate degree.

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

11.14 MBZUAI Admission Committee will have the ultimate right to reject the transfer requests for any student.

7.7 Academic Progress Policy

3.1 MBZUAI shall establish and enforce standards of student academic performance to govern satisfactory progress toward degree completion.

3.2 At the end of each semester, students' academic standing will be determined by the students' Cumulative Grade Point Average (CGPA). A student is expected to maintain a good academic standing of a CGPA of 3.0 and above.

3.3 Students' academic standing at the end of a semester will determine the students' eligibility to continue their progress towards earning their degree at MBZUAI.

Procedures

1. Academic Standing:

1.1 Good Standing: Students shall be considered in Good Academic Standing if they maintain a minimum Cumulative Grade Point Average (CGPA) of 3.00.

1.2 Academic Probation: A student will be placed on Academic Probation for a semester if:

a. The CGPA is lower than 3.0
b. The student receives a third (C) grade during his study tenure
c. The student receives an F in any course in any semester

1.3 Academic Dismissal: A student will be given academic dismissal from MBZUAI if her/his CGPA remains lower than 3.0 for two consecutive semesters. A student who has been given an academic dismissal from MBZUAI may submit an “Academic Appeal Request”. Please refer to (AAD-15 Student Grievances Policy)

1.4 Special Probation: A student who has been granted an academic appeal against dismissal will be placed on “Special Probation” for one semester. The student should achieve a minimum CGPA of 3.0 for that semester to be placed in good standing and continue his/her studies at MBZUAI. If the student could not achieve the required CGPA, then he/she will be academically dismissed, and he/she will not be entitled for any further appeals.

7.7 Student Records

3.1 The Registrar is responsible for maintaining all students’ personal and academic records, ensuring the privacy and confidentiality of these records, and ensuring compliance with the policies and regulations of MBZUAI. Electronic files are to be secured with restricted access.

3.2 Students have the right to review their personal information, academic and educational records, and to update or change their personal data and contact details through the “Change of Contact Information Form”.

3.3 The Registrar Office is the only unit who has the authority to print official transcripts, through submitting an “Official Transcript Request Form”.

3.4 Disclosure of information of educational records to anyone within or outside MBZUAI, except as indicated in this policy, requires the student’s written consent.

3.5 MBZUAI may have access, without the student’s prior consent and without a record being made, to specific student records in which they have a legitimate educational interest. For this purpose, university officials include both academic and administrative personnel. Only those University officials who need to obtain information about the student may have access to that information. For example, academic advisors may have access to relevant educational records of their advisees.

3.6 Educational records may be disclosed, with a student’s prior consent, to officials of another educational institution in which the student seeks or intends to enroll, or in which the student is enrolled concurrently. Non-personally Identifiable Information may be released to statistical agencies with approval from the Academic Affairs and Research Division.

3.7 Information related to grades, finances and some personal information is considered to be private. MBZUAI is responsible for the appropriate protection of private information, and holds the individuals who enter, maintain and review this data accountable in this regard.

3.8 Any document that contains non-public information about students or applicants especially sensitive items such as admission applications, letters of recommendation, grades, or private addresses, should receive special handling when retention is no longer needed. It should either be shredded or destroyed in some way that maintains its confidentiality.

3.9 MBZUAI will comply with all applicable laws and regulations in the emirate of Abu Dhabi and the UAE, governing the privacy and integrity of student information.

Procedures:

1. Students can request an official transcript by submitting an “Official Transcript Request Form”. They can also review and print unofficial copies of their academic records.

2. To disclose information in educational records to people outside MBZUAI, the Registrar will send a standard email on behalf of the Academic Affairs and Research Division requesting the student’s written consent. The written consent must be signed and dated and must include a specification of the records to be disclosed, the purpose of the disclosure, and the party to whom the disclosure may be made. The Registrar holds a record of each request and of each disclosure.

3. The Registrar will send a standard email on behalf of the Academic Affairs and Research Division notifying students of disclosure of personal information to third parties and the Registrar shall provide a student with copies of the disclosed records if he or she requests them. The disclosed material should contain a statement to the effect that acceptance of these materials constitutes an agreement to abide by this condition.

5.5 Student Examination and Assessment

3.1 All courses are to have an approved student evaluation and course evaluation methodology. Student evaluations will be performed as per the specific grading scale.

3.2 It is the responsibility of the relevant faculty to include student assessment and course evaluation methodology in the course syllabus and communicate the same, including deadlines, to students at the beginning of the course.

3.3 Faculty members have the right to evaluate students’ performance in their classes freely by using a variety of assessment tools. Assessment methods include but are not limited to written examinations, papers, presentations and projects.

3.4 Faculty members shall keep records of student assessments to ensure the accurate calculation of student performance and as a reference in the event of an appeal.

3.5 Course work submission deadlines are assigned by the faculty members and indicated in the course syllabus. In the event of late submission of coursework, the faculty member shall decide whether to accept the coursework, apply a penalty for late submission or reject it.

3.6 All courses at the MBZUAI adopt a course credit system which is in compliance with the Ministry of Education (MOE) requirements.

3.7 In-class examinations shall be overseen by the faculty members or their designees. In all assessments, students shall strictly comply with the policies on academic integrity.

3.8 Students are expected to complete their course(s) in the semester in which it is assigned and agreed. In exceptional circumstances, a student may be allowed to complete a course in the following semester after securing permission from the course faculty member through an "Incomplete Grade Request Form". A grade of "I" (incomplete) will be assigned for the course. Students must complete the course requirements no later than the first week of the following semester. Failure to meet the deadline, will cause the student to receive a grade of "F" for the course.

3.9 All final grades shall be submitted by faculty members into the Student Information System within the deadlines specified by the Registrar.

3.10 A student may appeal a grade issued by MBZUAI. The students' ability to appeal a grade once submitted, is strictly controlled in the context of the AAD 15 - Student Academic Grievance policy.

Grading Policy

3.1 The following grades and guidelines are used at MBZUAI:

Grade	Grade Points	Percentage	New Grade definition
A	4.0	95-100	Exceptional
A-	3.7	89-94	Excellent
B+	3.3	83-88	Very Good
B	3.0	77-82	Good
B-	2.7	71-76	Average
C+	2.3	65-70	Below Average
C	2.0	59-64	
C-	1.7	50-58	
F	Fail	Less than 50	
W	Withdrawal after the add/drop week		

3.2 Additional letter grades are used to denote special cases. These letter grades do not have corresponding grade points, and hence are not used in calculating a student's grade point average.

Incomplete	I	Transfer	TC
In Progress	IP	Withdraw	W

3.3 Incomplete Grade:

Students are expected to complete their course(s) in the semester in which it is assigned and agreed. In exceptional circumstances, a student may be allowed to complete a course in the following semester after securing permission from the course instructor and approval from the academic committee. A grade of I (incomplete) will be assigned for the course. Students must complete the course requirements no later than the 1st week of the following semester. Failure to meet the deadline will cause the student to receive a grade of "F" for the course.

3.4 Grade Point Average

3.4.1 **Term or Semester Grade Point Average (SGPA)**

The grade point average for a term or semester is calculated by dividing the sum of the quality points earned in that term or semester by the number of credit hours attempted.

3.4.2 **Cumulative Grade Point Average (CGPA)**

The cumulative grade point average is calculated by dividing the sum of the quality points earned in all terms and semesters by the credit hours attempted in all those terms and semesters. This average is used to assess the student's overall academic standing at the university.

3.4.3 At the end of each semester, student grade point averages are used in determining academic actions (Good Standing, probation, dismissal, etc.) and scholarship decisions.

Conversely, academic actions and scholarship decisions will be updated if a student's grade point average is altered due to approved faculty grade changes.

Procedures:

1. All final grades shall be submitted by faculty members to the Registrar within the deadlines specified by the Registrar.
2. Grades submitted to the Registrar by the faculty member are considered final.

3. Grade Appeal:

Stage 1

3.1 If a student suspects that an error has been made in recording a final grade, the initial recourse for the student should be to formally contact the faculty (via email). A student must be able to provide copies of graded assignments along with any other relevant documents to support the appeal. If an error is detected, faculty members should submit a "Change Grade Request Form" to the Registrar with justification copying the Department Chair within 2 working days from the date of posting the grade.

Stage 2

3.2 If a meeting and thorough discussions with the faculty member alone does not resolve the student's concern, the student should formally (via email) contact the department chair. The department chair will meet with the student and the faculty member, providing an independent review. If an error is detected, faculty members should submit a "Change Grade Request Form" to the Registrar with justification copying the department chair within 5 working days from the date of posting the grade.

3.3 If after having completed both levels of communication, the dispute persists, a student wishing to formally challenge a final grade, must meet all of the following requirements:

a. A student must be able to demonstrate having followed the above required channels of communication with both the faculty member and department chair.
b. A student must demonstrate that communication with the faculty member regarding the grade was initiated within 5 working days of when the final grade was posted.
c. A student must be able to provide copies of graded assignments along with any other relevant documents to support the appeal.

Stage 3

3.4 The student should submit an "Appeal Statement Form" within 7 working days of when the final grade was posted to the Academic Committee, chaired by the Executive Vice President of Academic Affairs and Research.

3.5 The student's submission should describe in detail the conditions and factors that led to the perceived grievance and the actions taken during the resolution process.

3.6 If a member of the Academic Committee was in any way involved in a student grievance, they shall recuse themselves and a replacement will be randomly selected from MBZUAI faculty or staff.

3.7 The committee investigates and consults with all the parties involved and after consideration of the case, the committee by a majority vote decides on an appropriate action:

a. Dismiss the grievance.
b. Uphold the grievance and address it by instructing appropriate reparations including changes in the student's academic record no later than the end of drop/add week of the following semester as indicated in the university academic calendar.
c. Decision of the Committee is final.

5.7 Student Grievances

3.1 MBZUAI supports a process where grievances of all types are resolved.

3.2 Grievances must be handled within an appropriate time frame having due regard to procedural fairness and to the specific requirements of different policy or procedures for managing such grievances.

3.3 All parties involved in a grievance must be treated with respect and impartiality, and any relevant issues put forward by the complainant, such as the existence of a disability or medical condition, will be taken into consideration.

3.4 Confidentiality must be observed by all participants and at all stages of the grievance process.

3.5 All participants must be informed of the progress, the outcome of the grievance and provided with reasons for the outcome reached.

3.6 A grievant may withdraw his/her grievance from further consideration at any time, by submitting a written request to the administrator with whom the grievance was originally filed. No reason needs to be given for such a request. Upon receipt of a request to withdraw the grievance, the administrator will notify all involved parties and administrators in writing that the grievance has been withdrawn and that the grievance process is terminated.

Procedures:

- **Grievances against grading or evaluation of academic work**

Stage 1

1.1 If a student suspects that an error has been made in recording a final grade, the initial recourse for the student should formally contact the faculty(via email) . A student must be able to provide copies of graded assignments along with any other relevant documents to support the appeal. If an error is detected, faculty members should submit a “Change Grade Request Form” to the Registrar with justification copying the department chair within 2 working days from the date of posting the grade.

Stage 2

1.2 If a meeting and thorough discussions with the faculty member alone does not resolve the student’s concern, the student should formally (via email) contact the department chair. The department chair will meet with the student and the faculty member, providing an independent review. If an error is detected, faculty members should submit a “Change Grade Request Form” to the Registrar with justification copying the department chair within 5 working days from the date of posting the grade.

1.3 If after having completed both levels of communication, the dispute persists, a student wishing to formally challenge a final grade, must meet all of the following requirements:
   a. A student must be able to demonstrate having followed the above required channels of communication with both the faculty member and department chair.
   b. A student must demonstrate that communication with the faculty member regarding the grade was initiated within 5 working days of when the final grade was posted.
   c. A student must be able to provide copies of graded assignments along with any other relevant documents to support the appeal.

Stage 3

1.4 The student submits an “Appeal Statement Form” within 7 working days of when the final grade was posted to the Academic Committee, chaired by the Executive Vice President of Academic Affairs and Research.
1.5 The student’s submission should describe in detail the conditions and factors that led to the perceived grievance and the actions taken during the resolution process.
1.6 If a member of the Academic Committee was in any way involved in a student grievance, they shall recuse themselves and a replacement will be randomly selected from MBZUAI faculty or staff.
1.7 The committee investigates and consults with all the parties involved and after consideration of the case, the committee by a majority vote decides on an appropriate action:
   a. Dismiss the grievance.
   b. Uphold the grievance and address it by instructing appropriate reparations including changes in the student’s academic record no later than the end of drop/add week of the following semester as indicated in the university academic calendar.
   c. Decision of the committee is final.

- **Grievances against dismissal, suspension and withdrawal from a program.**

2.1 The student submits a “Dismissal/Suspension/Withdrawal Appeal Form” within 3 working days from posting the academic standing to the Academic Committee.
2.2 The student’s submission should describe in detail the conditions and factors that led to the perceived grievance and the actions taken during the resolution process.
2.3 The committee investigates and consults with all the parties involved and after consideration of the case on an appropriate action as below:
   a. Dismiss the grievance.
   b. Uphold the grievance and address it by instructing appropriate reparations including changes in the student’s academic record no later than the end of drop/add week of the following semester as indicated in the university academic calendar.
   c. Decision of the committee is final.

- **Grievances against withholding or termination of the scholarship.**

3.1 The student submits a "Withholding/Termination of Scholarship Appeal Form" within 3 working days from posting the decision which led to the withholding or termination of Scholarship to the Academic Committee.

3.2 The student's submission should describe in detail the conditions, evidence and factors that led to the perceived grievance.

3.3 The committee investigates and consults with all the parties involved and after consideration of the case on an appropriate action as below:

a. Dismiss the grievance.
b. Uphold the grievance and address it by instructing appropriate reparations including changes in the student's academic and financial records.
c. Decision of the committee is final.

3.4 The final decision should be communicated to all concerned parties no later than the end of drop/add week of the following semester as indicated in the university academic calendar.

Graduation and Commencement

3.1 Graduation Requirements

3.1.1 Students must have an overall cumulative grade point average of 3.0 or better in order to qualify for graduation with a graduate degree.

3.1.2 The student must successfully pass all program components (taught courses and thesis) within the allowed time to completion.

3.2 Master's Degree:

3.2.1 A Masters degree consists of 35 credit hours.

3.2.2 The normal time to complete a Masters program is two years, and the maximum time to complete is (4 years), inclusive of any approved leave of absence.

3.3 Doctoral Degree:

3.3.1 A PhD degree consists of 59 credit hours.

3.3.2 The normal time to complete a PhD program is four years, and the maximum time to complete is (6 years), inclusive of any approved leave of absence

Procedures:

1. Commencement Guidelines

   1.1 To participate on the commencement, students must register for their final courses/thesis in what they expect to be their final semester of study and be confirmed for graduation by their Department Chair and Registrar's Office.

   1.2 The name that appears on students' degrees will be consistent with the name that appears in the student's passport.

   1.3 Diplomas shall be produced by the Registrar's Office and shall be signed by the President and Chairman. Students will be conferred their diplomas by the President during the graduation ceremony.

Curriculum Development

Policies

1. MBZUAI adheres to a curriculum development policy which includes all changes, additions and/or eliminations with respect to an academic program, credit-bearing courses in an academic program.
2. An idea or suggestion for curriculum or course modification, or for new courses or programs, can be originated by anyone, be it student, faculty member, staff member, administrator or advisor.
3. Curriculum adjustments can take any of the following four forms:
   1) A new course that does not currently exist in the MBZUAI curriculum.
   2) A significant modification to an existing course, characterized by any of the following
      a. The proposed modification affects other courses and or programs
      b. The proposed modification reflects a change in status, e.g., credit hours, prerequisites, course name or course code.
      c. The proposed modification includes a change in the mode of delivery or change of the main textbook or assigned materials.
   3) A new program that does not currently exist in the MBZUAI curriculum.
   4) A significant program modification that can include, but is not limited to, alterations that substantially change the stated requirements of an existing and already registered program e.g., curricular changes of over 25 % of existing courses (or credit hours) in the already registered program.

4. A proposal for a new course or significant course modification needs to include supporting documentation providing adequate reasoning as well as the budgetary impact of the change
5. Executive Committee must seek approval from the Commission for changes to its academic programs that significantly modify a program's goals or learning outcomes, or its basic structure.
6. A credit represents fifteen classroom contact hours and thirty non-contact hours. For example, a course worth 3 credits would require three contact hours per week and six non-contact hours per week over a 15-week semester.
7. Credits are linked to the assessment of the course learning outcomes.

Procedures

1. Proposals for new courses and new programs for the AI degrees, as well as a significant course or program modifications, will be submitted to the Academic Affairs and Research Division. The Academic Affairs and Research Division shall submit the proposal to the Academic Committee.
2. The Academic Committee will forward its recommendation to the Executive Committee for approval.
3. The decision of the Executive Committee shall be communicated to all academic staff of the MBZUAI as well as the Head of Marketing and Communication and other relevant parties.

Use of Graduate Assistants

Policies

The use of graduate assistants is important for MBZUAI. It contributes to students' professional development through assisting Faculty members in their different tasks.

1. MBZUAI will use the Graduate Assistantship program to recruit highly talented students for the benefit of the academic community and can result in developing future faculty members for the university.
2. Graduate Assistants should promote teaching and research objectives shared by MBZUAI. Moreover, they commit to respect university's rules and policies relative to research, academic and usage of university's facilities.
3. The supervisor of the graduate Program will assign appropriate tasks to the Graduate Assistant in terms of Research, Teaching and Administrative tasks.

4. Students are selected based on their academic results during their undergraduate or graduate studies if they already hold a graduate degree, and their soft skills and proficiency. Thus, to be eligible to the Graduate Assistantship program, students must fulfill the following criteria:
   a. At least B+ in the course that assistant will contribute in.
   b. Proficiency in terms of soft skills (E.g. Communication and social skills, character or personality traits). Students will be evaluated through an interview conducted by the concerned Faculty member.
   c. Additional criteria set by the Executive Vice President for Academic Affairs and Research and approved by the President such as previous experience in similar projects or courses, experience in carrying out literature searches, etc.
5. The selection of graduate assistants is made by the Executive Vice President for Academic Affairs and Research, after recommendations from the Chair of Academic Departments and the concerned supervisor.
6. Selected students will receive a financial compensation on hourly basis, decided by the Executive Vice President for Academic Affairs and Research
7. The duration of the Graduate Assistantship program for each student will be renewed after semester end, upon recommendations from the Chair of the concerned Academic Department based on feedback from the concerned supervisor, and the approval of the Executive Vice President for Academic Affairs and Research.
8. To renew a student’s Graduate Assistantship program, he/she must demonstrate improvements in his/her performance and maintain the level or requirements mentioned in policy number 4.
9. The Graduate Assistantship can be canceled at any moment if the student fails to demonstrate his/her dedication to tasks he/she is assigned to. The cancelation will be based on feedback from the concerned supervisor, and after review of the Chair of the concerned Academic Department, and approval of Executive Vice President for Academic Affairs and Research.
10. The use of graduate assistants should not exceed 6 hours per week of his/her time.
11. Every Graduate Assistant will work under the concerned supervisor who will provide him/her guidance and oral and written feedback at the end of every semester that will be considered as a formal evaluation.
12. Prior to resuming duties and conducting assigned tasks, the graduate assistants must undergo graduate teaching assistant training to ensue building the necessary capabilities which would enable them to carry out their duties effectively.

13. The supervisor might assign different tasks to the Graduate Assistant that include, but not limited to:
    a. Preparation of laboratory material.
    b. Assistance in students' assignments.
    c. Assistance in exams' organization.
    d. Other relevant tasks.
14. Graduate Assistantships opportunities will be announced to students through the formal communication channels used by the university once they are available. Students who wish to apply to the Graduate Assistantship Program should complete and submit the application form to the Chair of the concerned Academic Department.

Procedure

The following procedure describes the steps of awarding the Graduate Assistantship:

1. The supervisor (faculty member) will send a request for Graduate Assistant to his academic department' Chair.
2. The Chair of the concerned Academic Department reviews the request and send it to the Executive Vice President for Academic Affairs and Research for approval.
3. The Academic Affairs and Research Division announces opportunities for Graduate Assistantship to all students at the beginning of each semester. The announcement includes description of expected tasks and the hourly financial compensation.
4. The student, guided by his/her advisor, will complete application form and submit it to the Chair of the concerned Academic Department. Student's advisor will ensure that applicants comply, at the minimum, to the criteria required by the Graduate Assistantship program and embeds his/her recommendations.
5. The Chair of the concerned Academic Department reviews received applications and sends eligible ones to the Executive Vice President for Academic Affairs and Research for his selection and approval.
6. The Non-eligible applicants will be notified with reasons of the rejection of their application.
7. The Executive Vice President for Academic Affairs and Research notifies the chair of concerned academic department about selected applicants.
8. The chair of concerned academic department will notify the selected applicants and allocate them to their concerned supervisors.
9. The selected applicants will attend the graduate assistants training program which consists of series of workshops on topics that include grading, dealing with student problems, preparing

and delivering effective class and lab sessions, and using instructional and course management technology.

a. Sessions incorporated within the program will include the following topics:
b. Focus on building a good relationship with the supervising instructor.
c. Communication/presentation skills
d. Critical thinking
e. Measurement and evaluation
f. Foundation of Teaching
g. Helping students in office hours
h. Proctoring and grading tests,
i. Covering lectures
j. Identifying relevant resources (print, electronic, and human) for research/course topic.

10. To meet the different needs of all graduate assistants in a limited number of hours, the university will provide each of them with useful resources and handouts which offer guidance and tips addressing the different responsibilities they may assume during the period they are assigned as graduate assistants, which are largely self-explanatory.
11. Every Graduate Assistant will be paid 100 AED per hour.
12. Mentoring will be an ongoing process where the responsible faculty member will act as a Supervisor who advises or guides the graduate assistant in matters relating to academic achievements, career development plans, creating an agenda for working toward his/her professional development goals and to provide the mentee with insights into the process of building successful teaching career.
13. The Supervisor will assess the specific specialized needs of the graduate assistant and recommend to the Chair of the Department to allow the use of follow-up seminars or workshops to address those needs.

7. Academic Programs

7.1 Master of Science in Computer Vision

7.1.1 Program Objectives

The primary mission of the Department of Computer Vision is to advance the frontiers of Computer Vision through high-quality teaching, high-impact and visionary research, and dedicated service to the community. In order to actively advance our mission, the offered graduate program in Computer Vision has the following objectives:

a. Prepare students for careers in the field by offering a comprehensive set of graduate courses focusing on the existing and newly emerging computer vision topics.
b. Train students to develop practical skills through hands-on experience on computer vision projects in real-world settings.
c. Produce researchers and innovators who can investigate unsolved issues in computer vision research and creatively develop and evaluate novel state-of-the-art solutions.
d. Equip graduates with effective communication, collaboration and team-work skills as researchers and practitioners which facilitates documentation and publication of their work in highly reputed venues.
e. Prepare graduates to exhibit a reasoned understanding of professional ethics, the ability to work independently and to function responsibly within the guidelines while conducting research or leading/managing projects.

7.1.2 Program Learning Objectives

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

Seq.	Program Learning Objectives
PLO1	Exhibit comprehensive and highly specialized knowledge of computer vision in line with the underlying mathematical and computational principles. (**Knowledge**)
PLO2	Perform critical literature survey and develop new ideas by integrating multidisciplinary knowledge. (**Knowledge + Skill**)
PLO3	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. (**Skill**)
PLO4	Become highly skilled in initiating, managing, and completing multifaceted computer vision projects, and be able to clearly communicate concepts, complex ideas and conclusions both orally and in the form of technical reports. (**Skill + Role in Context**)

PLO5	Function independently and in a team to address computer vision problems under complex and unpredictable real-world settings. (**Autonomy and Responsibility**)
PLO6	Demonstrate a fundamental understanding of computer vision discipline at an advanced level suitable to pursue a PhD degree and contribute to cutting-edge computer vision research to produce new knowledge or take responsibility to lead innovative and impactful computer vision projects in industry. (**Self-Development, Knowledge + Role in Context**)
PLO7	Manifest the right learning attitude during coursework and research that clearly shows ownership, personal and technical growth and responsibility. (**Self-development**)
PLO8	Understand legal, ethical, environmental and socio-cultural ramifications of computer vision technologies, and be able to make informed and fair decisions on complex practical issues. (**Autonomy and Responsibility + Self-development**)

Table 8.1.1 – Program Learning Outcomes for Master of Science in Computer Vision

The program outcomes are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes streams: Knowledge (K), skills (S), Autonomy and Responsibility (AR), Self-Development (SD), and Role in Context (RC). The PLOs are mapped to level 9 according to the 5 strands of learning outcomes as per the National Qualifications Framework set by the UAE Ministry of Higher Education and Scientific Research (MoHESR):

Program Learning Objectives	Knowledge	Skill	Aspects of Competence		
			Autonomy and Responsibilities	Role in Context	Self-Development
PLO1	**K1-L9**	**-**	**-**	**-**	**-**
PLO2	**K2-L9**	**S1-L9**	**-**	**-**	**-**
PLO3	**-**	**S2-L9**	**-**	**-**	**-**
PLO4	**-**	**S3-L9**	**-**	**RC1-L9**	**-**
PLO5	**-**	**-**	**AR1-L9**	**-**	**-**
PLO6	**K3-L9**	**-**	**-**	**RC2-L9**	**SD1-L9**
PLO7	**-**	**-**	**-**	**-**	**SD2-L9**

PLO8	**-**	**-**	**AR2-L9**	**-**	**SD3-L9**

Aligning Program Learning Outcomes for Masters in Computer Vision to QF Emirates Level 9 Framework

7.1.3 Program Degree Requirements

7.1.3.1 Completion Requirements

The minimum degree requirements for the "Master of Science in Computer Vision" are 35 Credits, distributed as follows:

Core Courses	(4) Courses	(15) Credit Hours
Elective Courses	(2) Courses	(8) Credit Hours
Research Thesis	(1) Course	(12) Credit Hours

Table 8.1.3 – Degree Requirements for Master of Science in Computer Vision

7.1.3.2 Minimum GPA

The students are required to have a cumulative GPA of 3.0 or above to be able to graduate.

7.1.3.3 Duration

The students are required to complete all program requirements within two (2) years.

7.1.4 The Program Curriculum

7.1.4.1 Core Courses

MS 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 COM701, and other core courses as mandatory courses. Students are also expected to take two additional elective courses from a wide pool of electives 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 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: Courses Description*:

Code	Course Title	Credit Hours
COM701	Research Communication and Dissemination*	3
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4

Table 8.1.4 – Core Courses for Master of Science in Computer Vision. All core courses are mandatory.

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

7.1.4.2 Elective Courses

Students will select a minimum of 2 elective courses, with a total of 8 (or more) credit hours (CH) from a list of available elective courses based on interest, proposed research thesis, and career perspectives, in consultation with their supervisory panel. The elective courses available for the Master of Computer Vision are listed in below table. For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

Code	Course Title	Credit Hours
MTH701	Mathematical Foundations for Artificial Intelligence	4
MTH702	Optimization	4
AI701	Artificial Intelligence	4
AI702	Deep Learning	4
DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics and Analysis	4
ML701	Machine Learning	4
ML702	Advanced Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP 703	Speech Processing	4

Table 8.1.5 – Elective Courses for Master of Science in Computer Vision

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses*

Syllabi.

7.1.4.3 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 1 year. Master's thesis research helps train graduates to pursue more advanced research in their PhD degree. For further details on research thesis, *please refer to Appendix 1: Courses Description*:

Code	Title	Credit Hours
CV699	Masters Research Thesis	12

Table 8.1.6 – Research Thesis for Master of Science in Computer Vision

For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

7.1.4.4 Mapping of Courses to Program Learning Outcomes

All courses have been developed with the aim to ensure that students completing the degree program achieve the above stated program learning outcomes. All course learning outcomes correspond partially or fully to one or more of the program learning outcomes, as depicted in the table below. For full descriptions of courses and its learning outcomes, *please refer to Appendix 1: Courses Description*:

Code	Title	Program Learning Outcomes							
		PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
COM701	Research Communication and Dissemination*	-	F	-	F	-	-	P	-
CV701	Human and Computer Vision	F	F	F	F	P	P	P	P
CV702	Geometry for Computer Vision	F	F	F	F	P	P	P	P

CV703	Visual Object Recognition and Detection	**F**	**F**	**F**	**F**	**P**	**P**	**P**	**P**

CV699	Research Thesis	**F**	**P**	**P**	**F**	**P**	**F**	**F**	**F**

Table 8.1.7 – Mapping of courses to PLOs for Master of Science in Computer Vision (F: Full, P: Partial)

7.1.4.5 Language of Instruction

All courses in Master of Computer Vision will be offered in English Language ONLY.

7.1.5 General Education

Not Applicable.

7.1.6 Degree Plan

A tentative plan for course offering is given below:

Semester 1	Semester 2
Core Courses: • COM701: Research Communication and Dissemination • CV701: Human and Computer Vision	Core Courses: • CV702: Geometry for Computer Vision • CV703: Visual Object Recognition and Detection

Elective Courses: • MTH701: Mathematical Foundations for Artificial Intelligence • AI701: Artificial Intelligence • DS701: Data Mining • ML701: Machine Learning • NLP701: Natural Language Processing	Elective Courses: • MTH702: Optimization • AI702: Deep Learning • DS702: Big Data Processing • HC701: Medical Imaging: Physics and Analysis • ML702: Advanced Machine Learning • ML703: Probabilistic and Statistical Inference • NLP702: Advanced Natural Language Processing • NLP703: Speech Processing
Research Thesis: CV699: Masters Research Thesis	Research Thesis: CV699: Masters Research Thesis

Table 8.6.8 – Academic Calendar 2020 – 2021 for Master of Science in Computer Vision

7.1.7 Internship

If student's thesis is in collaboration with an industrial partner, the student will have a flexibility to spend time at the industry. The appropriate time allocation will be decided in consultation with students' supervisory panel.

7.1.8 Preparatory or Remedial Courses and Programs

Not applicable.

7.1.9 Class Size

A minimum of five students must be enrolled for a course to be conducted.

7.1.10 Program Effectiveness and Assessment

According to Standard 3.7, the institution's graduate programs:

3.7.1: emphasize the development of competencies in research and scholarship appropriate to the field and level of the program.

3.7.2: demonstrate that graduate courses are sufficiently rigorous, and distinctly more challenging than undergraduate courses in the same discipline.

3.7.3: may include non-credit preparatory or remedial courses for students who lack a sufficient academic background in the discipline studied.

3.7.4: require, for a master's degree or a postgraduate diploma (or equivalent), the equivalent of at least one year of full-time study.

3.7.5: require, for a doctoral degree, the equivalent of at least one year of taught course work beyond the master's level that is distinctly more challenging than master's level courses in the same discipline, training in research skills and methodology, and a research thesis or a major project appropriate to the field.

Addressing Standard 3.7 – Section 3.7.1

Students will spend most of their time for this degree program doing pure research, with an aim to solve a real-world problem in a Natural Language Processing application area and publish the outcomes in top journals or conference proceedings. Furthermore, the designed coursework is quite extensive, with significant component involving independent study. For all courses, students are given rigorous and challenging assignments and homework, in the form of solving real-life problems.

Addressing Standard 3.7 – Section 3.7.2

The designed courses are significantly rigorous and much advanced compared to content delivered in under-graduate programs. The contents being offered are quite challenging, at par with graduate courses offered at other top international academic institutes. The assessment items require independent problem-solving skills.

Addressing Standard 3.7 – Section 3.7.3

We aim to recruit only the top-quality students from the best international universities. Our admission criteria require students to be amongst the top 20% of their class, with best academic grades (minimum of CGPA of 3.5/4.00 or equivalent). We will rigorously interview students and check their academic credentials and competencies by contacting their referees. The extensive process will ensure only top-quality students, who do not require any remedial courses, will be recruited.

Addressing Standard 3.7 – Section 3.7.4

Not applicable.

Addressing Standard 3.7 – Section 3.7.5

Students will spend the first year of their degree on coursework, unless they have taken similar graduate level courses elsewhere and are eligible for credit transfer.

7.2 Master of Science in Machine Learning

7.2.1 Program Objectives

The primary mission of the Department of Machine Learning is to advance the frontiers of Machine Learning through high-quality teaching, high-impact and visionary research, and dedicated service to the community. In order to actively advance our mission, the offered graduate program in Machine Learning has the following objectives:

a. Prepare students for careers in the field by offering a comprehensive set of graduate courses focusing on the existing and newly emerging machine learning topics.
b. Train students to develop practical skills through hands-on experience on machine learning projects in real-world settings.
c. Produce researchers and innovators who can investigate unsolved issues in machine learning research and creatively develop and evaluate novel state-of-the-art solutions.
d. Equip graduates with effective communication, collaboration and team-work skills as researchers and practitioners which facilitates documentation and publication of their work in highly reputed venues.
e. Prepare graduates to exhibit a reasoned understanding of professional ethics, the ability to work independently and to function responsibly within the guidelines while conducting research or leading/managing projects.

7.2.2 Program Learning Objectives

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

Seq.	Program Learning Objectives
PLO1	Exhibit highly specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles, and empirics. (**Knowledge**)
PLO2	Achieve advanced skills in data-preprocessing and using various exploration and visualization tools. (**Skill**)
PLO3	Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms. (**Knowledge**)
PLO4	Obtain advanced capabilities to critically analyze, evaluate, and continuously improve the performance of the learning algorithms. (**Knowledge, Skill**)
PLO5	Acquire advanced abilities to analyze computational and statistical properties of advanced learning algorithms and their performance. (**Knowledge, Skill**)

PLO6	Gain expertise in using and deploying ML-relevant programming tools for a variety of complex ML problems. (**Skill**)
PLO7	Develop advanced problem-solving skills through independently applying machine learning methods to multiple complex problems and demonstrate expertise in dealing with ambiguity in a problem statement. (**Autonomy, Role in Context**).
PLO8	Apply sophisticated skills in initiating, managing, and completing multiple project reports and critiques on variety of machine learning methods, that demonstrate expert understanding, self-evaluation, and advanced skills in communicating highly complex ideas. (**Autonomy, Role in Context, Self-Development**).

Table 8.2.1 – Program Learning Outcomes for Master of Science in Machine Learning

The program outcomes are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes streams: Knowledge (K), skills (S), Autonomy and Responsibility (AR), Self-Development (SD), and Role in Context (RC). The PLOs are mapped to level 9 according to the 5 strands of learning outcomes as per the National Qualifications Framework set by the UAE Ministry of Higher Education and Scientific Research (MoHESR):

Program Learning Objectives	Knowledge	Skill	Aspects of Competence		
			Autonomy and Responsibilities	Role in Context	Self-Development
PLO1	K1-L9	-	-	-	-
PLO2	-	S1-L9	-	-	-
PLO3	K2-L9	-	-	-	-
PLO4	K3-L9	S2-L9	-	-	-
PLO5	K4-L9	S3-L9	-	-	-
PLO6	-	S4-L9	-	-	-
PLO7	-	-	AR1-L9	RC1-L9	-
PLO8	-	-	AR2-L9	RC2-L9	SD1-L9

Table 8.2.2 – Aligning Program Learning Outcomes for Master of Science in Machine Learning to QF Emirates Level 9 Framework

7.2.3 Program Degree Requirements

7.2.3.1 Completion Requirements

The minimum degree requirements for the "Master of Science in Machine Learning" are 35 Credits, distributed as follows:

Core Courses	(4) Courses	(15) Credit Hours
Elective Courses	(2) Courses	(8) Credit Hours
Research Thesis	(1) Course	(12) Credit Hours

Table 8.2.3 – Degree Requirements for Master of Science in Machine Learning

7.2.3.2 Minimum GPA

The students are required to have a cumulative GPA of 3.0 or above to be able to graduate.

7.2.3.3 Duration

The students are required to complete all program requirements within two (2) years.

7.2.4 The Program Curriculum

7.2.4.1 Core Courses

MS 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 COM701, and other core courses as a mandatory course. Students are also expected to take two additional elective courses from a pool of 15 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 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: Courses Description*:

Code	Course Title	Credit Hours
COM701	Research Communication and Dissemination	3
ML701	Machine Learning	4
ML702	Advanced Machine Learning	4
ML703	Probabilistic and Statistical Inference	4

Table 8.2.4 – Core Courses for Master of Science in Machine Learning. All core courses are mandatory.

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

7.2.4.2 Elective Courses

Students will select a minimum of 2 elective courses, with a total of 8 (or more) credit hours (CH) from a list of available elective courses based on interest, proposed research thesis, and career perspectives, in consultation with their supervisory panel. The elective courses available for the Master of Machine Learning are listed in below table. For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

Code	Course Title	Credit Hours
MTH701	Mathematical Foundations for Artificial Intelligence	4
MTH702	Optimization	4
AI701	Artificial Intelligence	4
AI702	Deep Learning	4

DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics and Analysis	4
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP703	Speech Processing	4

Table 8.2.5 – Elective Courses for Master of Science in Machine Learning

7.2.4.3 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 1 year. Master's thesis research helps train graduates to pursue more advanced research in their PhD degree. For further details on research thesis, *please refer to Appendix 1: Courses Description*:

Code	Title	Credit Hours
ML699	Masters Research Thesis	12

Table 8.2.6 – Research Thesis for Master of Science in Machine Learning

For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

7.2.4.4 Mapping of Courses to Program Learning Outcomes

All courses have been developed with the aim to ensure that students completing the degree program achieve the above stated program learning outcomes. All course learning outcomes correspond partially or fully to one or more of the program learning outcomes, as depicted in the table below. For full descriptions of courses and its learning outcomes, *please refer to Appendix 1: Courses Description*:

Code	Title	Program Learning Outcomes							
		PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
COM701	Research Communication and Dissemination*	**P**	**P**	**P**	**P**	**-**	**P**	**P**	**P**
ML701	Machine Learning	**F**	**P**	**F**	**F**	**P**	**F**	**F**	**P**
ML702	Advanced Machine Learning	**F**	**P**	**F**	**F**	**P**	**F**	**F**	**P**
ML703	Probabilistic and Statistical Inference	**F**	**P**	**F**	**F**	**P**	**F**	**F**	**P**
ML699	Research Thesis	**F**	**P**	**F**	**F**	**F**	**F**	**F**	**F**

Table 8.2.7 – Mapping of courses to PLOs for Master of Science in Machine Learning (F: Full, P: Partial)

7.2.4.5 Language of Instruction

All courses in Master of Machine Learning will be offered in English Language ONLY.

7.2.5 General Education

Not Applicable.

7.2.6 Degree Plan

A tentative plan for course offering is given below:

Semester 1	Semester 2
Core Courses: • COM701: Research Communication and Dissemination • ML701: Machine Learning	Core Courses: • ML702: Advanced Machine Learning • ML703: Probabilistic and Statistical Inference
Elective Courses: • MTH701: Mathematical Foundations for Artificial Intelligence • AI701: Artificial Intelligence • DS701: Data Mining • NLP701: Natural Language Processing • CV701: Human and Computer Vision	Elective Courses: • MTH702: Optimization • AI702: Deep Learning • DS702: Big Data Processing • HC701: Medical Imaging: Physics and Analysis • NLP702: Advanced Natural Language Processing • NLP703: Speech Processing • CV702: Geometry for Computer Vision

	• CV703: Visual Object Recognition and Detection
Research Thesis: ML699: Masters Research Thesis	Research Thesis: ML699: Masters Research Thesis

Table 8.6.8 – Academic Calendar 2020 – 2021 for Master of Science in Machine Learning

7.2.7 Internship

If student's thesis is in collaboration with an industrial partner, the student will have a flexibility to spend time at the industry. The appropriate time allocation will be decided in consultation with students' supervisory panel.

7.2.8 Preparatory or Remedial Courses and Programs

Not applicable.

7.2.9 Class Size

A minimum of five students must be enrolled for a course to be conducted.

7.2.10 Program Effectiveness and Assessment

According to Standard 3.7, the institution's graduate programs:

3.7.1: emphasize the development of competencies in research and scholarship appropriate to the field and level of the program.

3.7.2: demonstrate that graduate courses are sufficiently rigorous, and distinctly more challenging than undergraduate courses in the same discipline.

3.7.3: may include non-credit preparatory or remedial courses for students who lack a sufficient academic background in the discipline studied.

3.7.4: require, for a master's degree or a postgraduate diploma (or equivalent), the equivalent of at least one year of full-time study.

3.7.5: require, for a doctoral degree, the equivalent of at least one year of taught course work beyond the master's level that is distinctly more challenging than master's level courses in the same discipline, training in research skills and methodology, and a research thesis or a major project appropriate to the field.

Addressing Standard 3.7 – Section 3.7.1

Students will spend most of their time for this degree program doing pure research, with an aim to solve a real-world problem in a Natural Language Processing application area and publish the outcomes in top journals or conference proceedings. Furthermore, the designed coursework is quite extensive, with significant component involving independent study. For all courses, students are given rigorous and challenging assignments and homework, in the form of solving real-life problems.

Addressing Standard 3.7 – Section 3.7.2

The designed courses are significantly rigorous and much advanced compared to content delivered in under-graduate programs. The contents being offered are quite challenging, at par with graduate courses offered at other top international academic institutes. The assessment items require independent problem-solving skills.

Addressing Standard 3.7 – Section 3.7.3

We aim to recruit only the top-quality students from the best international universities. Our admission criteria require students to be amongst the top 20% of their class, with best academic grades (minimum of CGPA of 3.5/4.00 or equivalent). We will rigorously interview students and check their academic credentials and competencies by contacting their referees. The extensive process will ensure only top-quality students, who do not require any remedial courses, will be recruited.

Addressing Standard 3.7 – Section 3.7.4

Not applicable.

Addressing Standard 3.7 – Section 3.7.5

Students will spend the first year of their degree on coursework, unless they have taken similar graduate level courses elsewhere and are eligible for credit transfer.

7.3 Doctor of Philosophy in Computer Vision

7.3.1 Program Objectives

The primary mission of the Department of Computer Vision is to advance the frontiers of Computer Vision through high-quality teaching, high-impact and visionary research, and dedicated service to the community. In order to actively advance our mission, the offered graduate program in Computer Vision has the following objectives:

a. Prepare students for careers in the field by offering a comprehensive set of graduate courses focusing on the existing and newly emerging computer vision topics.
b. Train students to develop practical skills through hands-on experience on computer vision projects in real-world settings.
c. Produce researchers and innovators who can investigate unsolved issues in computer vision research and creatively develop and evaluate novel state-of-the-art solutions.
d. Equip graduates with effective communication, collaboration and team-work skills as researchers and practitioners which facilitates documentation and publication of their work in highly reputed venues.
e. Prepare graduates to exhibit a reasoned understanding of professional ethics, the ability to work independently and to function responsibly within the guidelines while conducting research or leading/managing projects.

7.3.2 Program Learning Objectives

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

Seq.	Program Learning Objectives
PLO1	Master the fundamental knowledge of computer vision and develop expertise in several specialized areas of research in computer vision. (**Knowledge**)
PLO2	Grow expertise in comprehending 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. (**Knowledge + Skill**)
PLO3	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. (**Skill**)
PLO4	Highly skilled in initiating, managing and completing technically challenging computer vision projects and be able to clearly communicate concepts, highly complex ideas and key findings in the form of technical reports, scientific publications and oral presentations at relevant technical venues. (**Skill + Autonomy**)

PLO5	Become an expert in selecting and using programming tools, libraries and other relevant resources to solve real-world computer vision problems. (**Skill**)
PLO6	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. (**Autonomy and Responsibility + Role in Context**)
PLO7	Develop deep understanding of existing body of knowledge and the ability to develop new knowledge in computer vision that makes students suitable for a role in academia or industry. (**Knowledge + Self-development**)
PLO8	Practice research ethics and commit to professional responsibilities while conducting cutting edge advancements in computer vision discipline. (**Self-development**)
PLO9	Understand legal, ethical, environmental and socio-cultural ramifications of computer vision technologies, and be able to take a lead in making informed and fair decisions on complex issues. (**Autonomy and Responsibility + Self-development**)

Table 8.4.1 – Program Learning Outcomes for PhD in Computer Vision

The program outcomes are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes streams: Knowledge (K), skills (S), Autonomy and Responsibility (AR), Self-Development (SD), and Role in Context (RC). The PLOs are mapped to level 10 according to the 5 strands of learning outcomes as per the National Qualifications Framework set by the UAE Ministry of Higher Education and Scientific Research (MoHESR):

Program Learning Objectives	Knowledge	Skill	Aspects of Competence		
			Autonomy and Responsibilities	Role in Context	Self-Development
PLO1	**K1-L10**	**-**	**-**	**-**	**-**
PLO2	**K2-L10**	**S1-L10**	**-**	**-**	**-**
PLO3	**-**	**S2-L10**	**-**	**-**	**-**
PLO4	**-**	**S3-L10**	**AR1-L10**	**-**	**-**
PLO5	**-**	**S4-L10**	**-**	**-**	**-**
PLO6	**-**	**-**	**AR2-L10**	**RC1-L10**	**-**
PLO7	**K3-L10**	**-**	**-**	**-**	**SD1-L10**
PLO8	**-**	**-**	**-**	**-**	**SD2-L10**

PLO9	**-**	**-**	**AR3-L10**	**-**	**SD3-L10**

Table 8.4.2 – Aligning Program Learning Outcomes for PhD in Computer Vision to QF Emirates Level 10 Framework

7.3.3 Program Degree Requirements

7.3.3.1 Completion Requirements

The minimum degree requirements for the “PhD in Computer Vision” are 59 Credits, distributed as follows:

Core Courses	(4) Courses	(15) Credit Hours
Elective Courses	(2) Courses	(8) Credit Hours
Research Thesis	(1) Course	(36) Credit Hours

Table 8.4.3 – Degree Requirements for PhD in Computer Vision

7.3.3.2 Minimum GPA

The students are required to have a cumulative GPA of 3.2 or above to be able to graduate.

7.3.3.3 Duration

The students are required to complete all program requirements within four (4) years.

7.3.4 The Program Curriculum

7.3.4.1 Core Courses

PhD 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 COM701, as a mandatory course. They can select three core courses from a concentration pool of 6 in the list provided below. Students are also expected to take two additional elective courses from the given pool of 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 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. Masters Leading to PhD students will be allowed to transfer credits for 3 courses.

For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

Code	Course Title	Credit Hours
COM701	Research Communication and Dissemination*	3
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
CV704	Advanced Computer Vision	4
CV705	Advanced 3D Computer Vision	4
CV706	Neural Networks for Object Recognition and Detection	4

Table 8.4.4 – Core Courses for PhD in Computer Vision. (*) indicates mandatory course.

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

1.1.1.1 Elective Courses

Students will select a minimum of 2 elective courses, with a total of 8 (or more) credit hours (CH) from a list of available elective courses based on interest, proposed research thesis, and career perspectives, in consultation with their supervisory panel. The elective courses available for the

PhD in Computer Vision are listed in below table. For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

Code	Course Title	Credit Hours
MTH701	Mathematical Foundations for Artificial Intelligence	4
MTH702	Optimization	4
AI701	Artificial Intelligence	4
AI702	Deep Learning	4
DS701	Data Mining	4
DS702	Big Data Processing	4
HC701	Medical Imaging: Physics and Analysis	4
ML 701	Machine Learning	4
ML702	Advanced Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML 704	Machine Learning Paradigms	4
ML 705	Topics in Advanced Machine Learning	4
ML 706	Advanced Probabilistic and Statistical Inference	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP 703	Speech Processing	4
NLP 704	Deep Learning for Language Processing	4
NLP 705	Topics in Advanced Natural Language Processing	4
NLP 706	Advanced Speech Processing	4

Table 8.4.5 – Elective Courses for PhD in Computer Vision

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi*.

1.1.1.2 Research Thesis

PhD thesis research 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 3 to 4 years. For further details on research thesis, *please refer to Appendix 1: Courses Description*:

Code	Title	Credit Hours
CV799	PhD Research Thesis	36

Table 8.4.6 – Research Thesis for PhD in Computer Vision

For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi*.

1.1.1.3 Mapping of Courses to Program Learning Outcomes

All courses have been developed with the aim to ensure that students completing the degree program achieve the above stated program learning outcomes. All course learning outcomes correspond partially or fully to one or more of the program learning outcomes, as depicted in the table below. For full descriptions of courses and its learning outcomes, *please refer to Appendix 1: Courses Description*:

Code	Title	Program Learning Outcomes								
		PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9
COM701	Research Communication and Dissemination*	-	-	-	F	-	-	-	P	-
CV701	Human and Computer Vision	P	F	F	F	F	F	P	P	P
CV702	Geometry for Computer Vision	P	F	F	F	F	P	F	P	P
CV703	Visual Object Recognition and Detection	P	F	F	F	F	F	F	P	P
CV704	Advanced Computer Vision	F	F	F	F	P	P	F	P	P
CV705	Advanced 3D Computer Vision	F	F	F	F	P	P	F	P	P
CV706	Neural Networks for Object Recognition and Detection	F	F	F	F	P	P	F	P	P
CV799	Research Thesis	F	F	F	F	F	P	F	P	F

Table 8.4.7 – Mapping of courses to PLOs for PhD in Computer Vision (F: Full, P: Partial)

1.1.1.4 Language of Instruction

All courses in PhD in Computer Vision will be offered in English Language ONLY.

1.1.2 General Education

Not Applicable.

1.1.3 Degree Plan

A tentative plan for course offering is given below:

Semester 1	Semester 2
Core Courses: • COM701: Research Communication and Dissemination • CV701: Human and Computer Vision • CV705: Advanced 3D Computer Vision • CV706: Neural Networks for Object Recognition and Detection	Core Courses: • CV702: Geometry for Computer Vision • CV703: Visual Object Recognition and Detection • CV704: Advanced Computer Vision
Elective Courses: • MTH701: Mathematical Foundations for Artificial Intelligence • AI701: Artificial Intelligence • DS701: Data Mining • ML701: Machine Learning • ML705: Topics in Advanced Machine Learning • ML706: Advanced Probabilistic and Statistical Inference	Elective Courses: • MTH702: Optimization • AI702: Deep Learning • DS702: Big Data Processing • HC701: Medical Imaging: Physics and Analysis • ML702: Advanced Machine Learning • ML703: Probabilistic and Statistical Inference

• NLP701: Natural Language Processing • NLP705: Topics in Advanced Natural Language Processing • NLP706: Advanced Speech Processing	• ML704: Machine Learning Paradigms • NLP702: Advanced Natural Language Processing • NLP703: Speech Processing • NLP704: Deep Learning for Language Processing
Research Thesis: CV799: PhD Research Thesis	Research Thesis: CV799: PhD Research Thesis

Table 8.6.8 – Academic Calendar 2020 – 2021 for PhD in Computer Vision

1.1.4 Internship

If student's thesis is in collaboration with an industrial partner, the student will have a flexibility to spend time at the industry. The appropriate time allocation will be decided in consultation with students' supervisory panel.

1.1.5 Preparatory or Remedial Courses and Programs

Not applicable.

1.1.6 Class Size

A minimum of five students must be enrolled for a course to be conducted.

1.1.7 Program Effectiveness and Assessment

According to Standard 3.7, the institution's graduate programs:

3.7.1: emphasize the development of competencies in research and scholarship appropriate to the field and level of the program.

3.7.2: demonstrate that graduate courses are sufficiently rigorous, and distinctly more challenging than undergraduate courses in the same discipline.

3.7.3: may include non-credit preparatory or remedial courses for students who lack a sufficient academic background in the discipline studied.

3.7.4: require, for a master's degree or a postgraduate diploma (or equivalent), the equivalent of at least one year of full-time study.

3.7.5: require, for a doctoral degree, the equivalent of at least one year of taught course work beyond the master's level that is distinctly more challenging than master's level courses in the same discipline, training in research skills and methodology, and a research thesis or a major project appropriate to the field.

Addressing Standard 3.7 – Section 3.7.1

Students will spend most of their time for this degree program doing pure research, with an aim to solve a real-world problem in a Natural Language Processing application area and publish the outcomes in top journals or conference proceedings. Furthermore, the designed coursework is quite extensive, with significant component involving independent study. For all courses, students are given rigorous and challenging assignments and homework, in the form of solving real-life problems.

Addressing Standard 3.7 – Section 3.7.2

The designed courses are significantly rigorous and much advanced compared to content delivered in under-graduate programs. The contents being offered are quite challenging, at par with graduate courses offered at other top international academic institutes. The assessment items require independent problem-solving skills.

Addressing Standard 3.7 – Section 3.7.3

We aim to recruit only the top-quality students from the best international universities. Our admission criteria require students to be amongst the top 20% of their class, with best academic grades (minimum of CGPA of 3.5/4.00 or equivalent). We will rigorously interview students and check their academic credentials and competencies by contacting their referees. The extensive process will ensure only top-quality students, who do not require any remedial courses, will be recruited.

Addressing Standard 3.7 – Section 3.7.4

Not applicable.

Addressing Standard 3.7 – Section 3.7.5

Students will spend the first year of their degree on coursework, unless they have taken similar graduate level courses elsewhere and are eligible for credit transfer.

1.2 Doctor of Philosophy in Machine Learning

1.2.1 Program Objectives

The primary mission of the Department of Machine Learning is to advance the frontiers of Machine Learning through high-quality teaching, high-impact and visionary research, and dedicated service to the community. In order to actively advance our mission, the offered graduate program in Machine Learning has the following objectives:

a. Prepare students for careers in the field by offering a comprehensive set of graduate courses focusing on the existing and newly emerging machine learning topics.
b. Train students to develop practical skills through hands-on experience on machine learning projects in real-world settings.
c. Produce researchers and innovators who can investigate unsolved issues in machine learning research and creatively develop and evaluate novel state-of-the-art solutions.
d. Equip graduates with effective communication, collaboration and team-work skills as researchers and practitioners which facilitates documentation and publication of their work in highly reputed venues.
e. Prepare graduates to exhibit a reasoned understanding of professional ethics, the ability to work independently and to function responsibly within the guidelines while conducting research or leading/managing projects.

1.2.2 Program Learning Objectives

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

Seq.	Program Learning Objectives
PLO1	Obtain rigorous mathematical background and advanced reasoning capabilities to express comprehensive and deep understanding of the pipelines at the frontier of machine learning: data, models, algorithmic principles and empirics. (**Knowledge**)
PLO2	Master a range of skills and techniques in data-preprocessing, exploration, and visualization of data-statistics as well as complex algorithmic outcomes. (**Skill**)
PLO3	Have a critical awareness of the capabilities and limitations of the different forms of learning algorithms and the ability to critically analyze, evaluate, and improve the performance of the learning algorithms. (**Knowledge, Role in context**)
PLO4	Grow expert problem-solving skills through independently applying the principles and methods learned in the program to various complex real-world problem. (**Skill**)

PLO5	Develop a deep understanding of statistical properties and performance guarantees including convergence rates (in theory and practice) for different learning algorithms. (**Knowledge, Skill**)
PLO6	Become an expert in using and deploying ML-relevant programming tools for a variety of ML problems. (**Skill**)
PLO7	Grow proficiency in identifying the limitations of existing machine learning algorithms and the ability to conceptualize, design, and implement an innovative solution for a variety of highly complex problems to advance the state-of-the-art in machine learning. (**Role in context, Autonomy**)
PLO8	Able to initiate, manage, and complete research manuscripts that demonstrates expert self-evaluation and advanced skills in communicating highly complex ideas related to machine learning. (**Role in context, Self-development**).
PLO9	Obtain highly sophisticated skills in initiating, managing, and completing multiple project reports and critiques on a variety of machine learning methods, that demonstrates expert understanding, self-evaluation, and advanced skills in communicating highly complex ideas. (**Autonomy, Role in Context, Self-Development**).

Table 8.5.1 – Program Learning Outcomes for PhD in Machine Learning

The program outcomes are aligned with Emirates Qualifications Framework and as such are divided in the following learning outcomes streams: Knowledge (K), skills (S), Autonomy and Responsibility (AR), Self-Development (SD), and Role in Context (RC). The PLOs are mapped to level 10 according to the 5 strands of learning outcomes as per the National Qualifications Framework set by the UAE Ministry of Higher Education and Scientific Research (MoHESR):

Program Learning Objectives	Knowledge	Skill	Aspects of Competence		
			Autonomy and Responsibilities	Role in Context	Self-Development
PLO1	**K1-L10**	-	-	-	-
PLO2	-	**S1-L10**	-	-	-

PLO3	**K2-L10**	**-**	**-**	**RC1-L10**	**-**
PLO4	**-**	**S2-L10**	**-**	**-**	**-**
PLO5	**K3-L10**	**S3-L10**	**-**	**-**	**-**
PLO6	**-**	**S4-L10**	**-**	**-**	**-**
PLO7	**-**	**-**	**AR1-L10**	**RC2-L10**	**-**
PLO8	**-**	**-**	**-**	**RC3-L10**	**SD1-L10**
PLO9	**-**	**-**	**AR2-L10**	**RC4-L10**	**SD2-L10**

Table 8.5.2 – Aligning Program Learning Outcomes for PhD in Machine Learning to QF Emirates Level 10 Framework

1.2.3 Program Degree Requirements

1.2.3.1 Completion Requirements

The minimum degree requirements for the "PhD in Machine Learning" are 59 Credits, distributed as follows:

Core Courses	(4) Courses	(15) Credit Hours
Elective Courses	(2) Courses	(8) Credit Hours
Research Thesis	(1) Course	(36) Credit Hours

Table 8.5.3 – Degree Requirements for PhD in Machine Learning

1.2.3.2 Minimum GPA

The students are required to have a cumulative GPA of 3.2 or above to be able to graduate.

1.2.3.3 Duration

The students are required to complete all program requirements within four (4) years.

1.2.4 The Program Curriculum

1.2.4.1 Core Courses

PhD 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 COM701, a mandatory course. They can select three core courses from a concentration pool of 6 in the list provided below. Students are also expected to take two additional elective courses from a pool of elective 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 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. Masters Leading to PhD students will be allowed to transfer credits for 3 courses.

For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

Code	Course Title	Credit Hours
COM701	Research Communication and Dissemination*	3
ML701	Machine Learning	4
ML702	Advanced Machine Learning	4
ML703	Probabilistic and Statistical Inference	4
ML704	Machine Learning Paradigms	4
ML705	Topics in Advanced Machine Learning	4

ML706	Advanced Probabilistic and Statistical Inference	4

Table 8.5.4 – Core Courses for PhD in Machine Learning. (*) indicates mandatory course.

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

1.2.4.2 Elective Courses

Students will select a minimum of 2 elective courses, with a total of 8 (or more) credit hours (CH) from a list of available elective courses based on interest, proposed research thesis, and career perspectives, in consultation with their supervisory panel. The elective courses available for the PhD in Machine Learning are listed in below table. For full descriptions of courses, *please refer to Appendix 1: Courses Description*:

The syllabus for each course has been developed in line with Stipulation 5 of the Standards 2011. Each syllabus includes course description, code, learning objectives, stated learning outcomes, session-by-session description of course content, assessments and assignments, and completion requirements. For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

CODE	COURSE NAME	CREDIT HOURS
MTH701	Mathematical Foundations for Artificial Intelligence	4
MTH702	Optimization	4
AI701	Artificial Intelligence	4
AI702	Deep Learning	4
DS701	Data Mining	4
DS702	Big Data Processing	4

HC701	Medical Imaging: Physics and Analysis	4
CV701	Human and Computer Vision	4
CV702	Geometry for Computer Vision	4
CV703	Visual Object Recognition and Detection	4
CV704	Advanced Computer Vision	4
CV705	Advanced 3D Computer Vision	4
CV706	Neural Networks for Object Recognition and Detection	4
NLP701	Natural Language Processing	4
NLP702	Advanced Natural Language Processing	4
NLP 703	Speech Processing	4
NLP 704	Deep Learning for Language Processing	4
NLP 705	Topics in Advanced Natural Language Processing	4
NLP 706	Advanced Speech Processing	4

1.2.4.3 Research Thesis

PhD thesis research 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 3 to 4 years. For further details on research thesis, *please refer to Appendix 1: Courses Description*:

Code	Title	Credit Hours
ML799	PhD Research Thesis	36

Table 8.5.6 – Research Thesis for PhD in Machine Learning

For more details, *please refer to Accompanying Document 21: MBZUAI - Courses Syllabi.*

1.2.4.4 Mapping of Courses to Program Learning Outcomes

All courses have been developed with the aim to ensure that students completing the degree program achieve the above stated program learning outcomes. All course learning outcomes correspond partially or fully to one or more of the program learning outcomes, as depicted in the table below. For full descriptions of courses and its learning outcomes, *please refer to Appendix 1: Courses Description*:

Code	Title	Program Learning Outcomes								
		PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9
COM701	Research Communication and Dissemination*	**P**	**P**	**P**	**P**	**-**	**P**	**P**	**F**	**F**
ML701	Machine Learning	**F**	**P**	**P**	**F**	**P**	**P**	**F**	**F**	**P**
ML702	Advanced Machine Learning	**P**	**P**	**P**	**F**	**P**	**P**	**P**	**F**	**P**
ML703	Probabilistic and Statistical Inference	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**F**	**P**
ML704	Machine Learning Paradigms	**F**	**F**	**F**	**F**	**P**	**F**	**P**	**P**	**F**
ML705	Topics in Advanced Machine Learning	**F**	**P**	**F**	**F**	**P**	**F**	**F**	**P**	**F**
ML706	Advanced Probabilistic and Statistical Inference	**F**	**P**	**F**	**F**	**P**	**F**	**F**	**P**	**F**
ML799	Research Thesis	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**

Table 8.5.7 – Mapping of courses to PLOs for PhD in Machine Learning (F: Full, P: Partial)

1.2.4.5 Language of Instruction

All courses in PhD in Machine Learning will be offered in English Language ONLY.

1.2.5 Degree Plan

A tentative plan for course offering is given below:

Semester 1	Semester 2
Core Courses: ● COM701: Research Communication and Dissemination ● ML701: Machine Learning ● ML705: Topics in Advanced Machine Learning ● ML706: Advanced Probabilistic and Statistical Inference	Core Courses: ● ML702: Advanced Machine Learning ● ML703: Probabilistic and Statistical Inference ● ML704: Machine Learning Paradigms
Elective Courses: ● MTH701: Mathematical Foundations for Artificial Intelligence ● AI701: Artificial Intelligence ● DS701: Data Mining ● NLP701: Natural Language Processing ● NLP705: Topics in Advanced Natural Language Processing ● NLP706: Advanced Speech Processing CV701: Human and Computer Vision ● CV705: Advanced 3D Computer Vision ● CV706: Neural Networks for Object Recognition and Detection	Elective Courses: ● MTH702: Optimization ● AI702: Deep Learning ● DS702: Big Data Processing ● HC701: Medical Imaging: Physics and Analysis ● NLP702: Advanced Natural Language Processing ● NLP703: Speech Processing ● NLP704: Deep Learning for Language Processing CV702: Geometry for Computer Vision ● CV703: Visual Object Recognition and Detection ● CV704: Advanced Computer Vision
Research Thesis: ML799: PhD Research Thesis	Research Thesis: ML799: PhD Research Thesis

Table 8.6.8 – Academic Calendar 2020 – 2021 for PhD in Machine Learning

1.2.6 Internship

If student's thesis is in collaboration with an industrial partner, the student will have a flexibility to spend time at the industry. The appropriate time allocation will be decided in consultation with students' supervisory panel.

1.2.7 Preparatory or Remedial Courses and Programs

Not applicable.

1.2.8 Class Size

A minimum of five students must be enrolled for a course to be conducted.

1.2.9 Program Effectiveness and Assessment

According to Standard 3.7, the institution's graduate programs:

3.7.1: emphasize the development of competencies in research and scholarship appropriate to the field and level of the program.

3.7.2: demonstrate that graduate courses are sufficiently rigorous, and distinctly more challenging than undergraduate courses in the same discipline.

3.7.3: may include non-credit preparatory or remedial courses for students who lack a sufficient academic background in the discipline studied.

3.7.4: require, for a master's degree or a postgraduate diploma (or equivalent), the equivalent of at least one year of full-time study.

3.7.5: require, for a doctoral degree, the equivalent of at least one year of taught course work beyond the master's level that is distinctly more challenging than master's level courses in the same discipline, training in research skills and methodology, and a research thesis or a major project appropriate to the field.

Addressing Standard 3.7 – Section 3.7.1

Students will spend most of their time for this degree program doing pure research, with an aim to solve a real-world problem in a Natural Language Processing application area and publish the outcomes in top journals or conference proceedings. Furthermore, the designed coursework is quite extensive, with significant component involving independent study. For all courses, students are given rigorous and challenging assignments and homework, in the form of solving real-life problems.

Addressing Standard 3.7 – Section 3.7.2

The designed courses are significantly rigorous and much advanced compared to content delivered in under-graduate programs. The contents being offered are quite challenging, at par with graduate courses offered at other top international academic institutes. The assessment items require independent problem-solving skills.

Addressing Standard 3.7 – Section 3.7.3

We aim to recruit only the top-quality students from the best international universities. Our admission criteria require students to be amongst the top 20% of their class, with best academic grades (minimum of CGPA of 3.5/4.00 or equivalent). We will rigorously interview students and check their academic credentials and competencies by contacting their referees. The extensive process will ensure only top-quality students, who do not require any remedial courses, will be recruited.

Addressing Standard 3.7 – Section 3.7.4

Not applicable.

Addressing Standard 3.7 – Section 3.7.5

Students will spend the first year of their degree on coursework, unless they have taken similar graduate level courses elsewhere and are eligible for credit transfer

9 Learning Resources

MBZUAI has an equipped library and technological resource on campus to assist students in the effective completion of their academic work and research assignments. The following facilities are available to students on campus: Library, technology and computer-based services & Research Laboratories.

10.1 Library

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

Membership

The Library is open for the purpose of study and research to enrolled MBZUAI students, current faculty and staff, alumni, visiting researchers, and approved guests.

Collections

Collection development focuses on scholarly and academic publications in the field of artificial intelligence, and additional resources are collected to support professional, teaching and learning needs and interests. All resources are discoverable through the library's single-search interface and materials available for borrowing include books, periodicals, course reserve materials and equipment. All physical library items are protected against loss through the library's RFID system.

- Physical collections are classified and arranged according to the Library of Congress Classification System.
- Open collections (Main Collection, Reference, and Periodicals) are browsable.
- Access to closed collections (Course Reserve Collections, Archives & Special Collections) is mediated by library staff.
- Licensed electronic resources include bibliographic and full-text content and are available to enrolled students through university-provided credentials.
- A Digital Library (institutional repository) is maintained by the library, and curates and disseminates faculty scholarship and student research projects.
- Copies of student textbooks are not typically purchased by the library, however the library will maintain a limited number of copies of required textbooks that are **only** available in print, and make these available on short-term loans to students.

Facilities

The Library is housed in the Knowledge Center and hosts study spaces, four group study rooms, public workstations, multimedia spaces, printing, and scanning facilities. Resources are available on a first requested, first accommodated basis but use of resources for teaching and instruction is prioritized.

Services

Students are provided with personal library accounts (My Account) to renew books, place holds, review outstanding fines and fees, and create booklists. Other eServices include title recommendations, interlibrary loan requests, facility bookings, and resource and research consultations.

Librarians provide instruction, and research and resource support for MBZUAI students through scheduled classes and individual consultations, onsite and online.

Inter-library loans and document delivery services are available to support students' research needs not met by MBZUAI library, and if available from a partner library or document delivery service. Quotas may be applied, and materials obtained through ILL are strictly intended for individual use.

Loan rules and periods

Identification (University ID Card) is required to borrow physical materials and university provided credentials are required to access licensed electronic content.

- Main collection material is available for long term borrowing (three weeks or longer) by enrolled students, faculty, and staff of MBZUAI.
- High demand material, including course reserve items and equipment, is available for short term borrowing and access may be restricted to in-library use.
- Items located in Reference, Periodicals, Special Collections & Archives are normally not available for circulation outside the library (non-circulating).
- Items placed on Course Reserve are issued to students according to the periods agreed with faculty.
- Electronic Course Reserve material is hosted on the Course Management system and abides by license agreements and copyright conventions. Stable links to licensed materials are used.
- Electronic content may have indefinite or varying periods of loan.

Materials are checked-out and returned at staffed circulation desks or through available shelf-service systems. All patrons remain responsible for items checked out on their names.

- Overdue notices are sent as a courtesy.
- Fines are levied for the late return of items, in accordance with notices displayed in the Library and on the Library's website, and are charged at rates determined and approved annually by the Academic Committee.
  - Fines will continue to accumulate until an item is returned or reported missing, and up to 20 days for long-term loans and 50 hours for short-term loans, at which stage patrons will receive a statement for the replacement cost, including administrative charges and accumulated fines. Exceptions may apply.
  - Students are required to clear all outstanding fines and fees directly with Department of Finance and borrowing privileges will be suspended for students with outstanding fines and fees of AED 200.00 or more
- Items that may not be renewed online through the *My Account* service include recalled and overdue items, course reserve items, and books borrowed from another library (interlibrary loans).
- Patrons may request a hold on an item currently checked out to another patron and the library reserves the right to recall an item. All items may be recalled for inventory purposes at the end of each semester.

For more information please refer to 6.19 AAD 19 – Library Resource Access and Services policy.

Library Hours

Library opening hours support access to physical resources, facilities, and library services.

- Sunday to Thursday: 9:00 to 18:00
- Friday & Saturday: Closed
- Closed on public holidays and as announced.

- Access to electronic resources through the Library's website, is available 24/7, on and off campus.

Use of Resources and Facilities

Students are expected to acquaint themselves with the Library's access polices and regulations and refrain from any behavior that interferes with the right of others to access resources or use the library for the purpose of research and study. Library staff are empowered to interpret and enforce library policies, suspend privileges, and refer serious breaches of conduct to the Director of Student Affairs.

- Facilities and equipment, including the library workstations, are intended to support MBZUAI academic and research programs and use may be mediated to ensure equitable access and appropriate use.
- The use of computing and network resources, and licensed electronic resources must comply with the university's policies, licenses, contracts, and applicable laws.
- The use of the library's printing and scanning equipment for the reproduction of copyright protected material requires compliance with copyright laws and conventions.
- Posting notices, taking photos or video recording in the Library, requires permission from the Head of Library Management.
- With the exception of covered drinks (coffee, tea and water), no food or drinks should be consumed in the library and single-use plastic is strongly discouraged.

For more information, please refer to 6.21 AAD 21 – Use of Library Resources and Facilities policy.

7.1 *Stuedent's eServices*

7.1.1 Internet access and Student Email

Students will have access to the Internet and email while at the MBZUAI. Student Affairs staff will help set up the required username and password. It is the student's responsibility to keep their password secure and not misuse it. If a student forgets their password, they should contact IT Helpdesk (helpdesk@mbzuai.ac.ae, or call 3000). Before a student is given a password to access the Internet and their email account, he/she shall be required to sign the MBZUAI Internet Access and Electronic Mail Policy Form. Student eMail is considered an official form of communication between MBZUAI and the students.

Users of the internet are governed by the MBZUAI Internet Access and Electronic Mail Policy.

7.1.2 *MBZUAI Website and Portal*

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. Also, it has detailed information about programs, MBZUAI's policies, procedures and requirements.

The MBZUAI website has a link to the restricted access MBZUAI portal. Students can access their email through the portal, and will be offered with a full eServices Portfolio. Students gain access to the portal with their username and password. This can be done using a computer inside the university premise, at home or anywhere with an Internet connection.

10.2 MBZUAI One Stop Shop e-Services

MBZUAI will also deploy state-of-the-art technology and computer-based services. The following is a brief introduction to the list of services that will be available at MBZUAI for the students and the community:

- **Business Applications:** Covering the Student Information System (SIS), Learning Management System (LMS), Research Management, Customer Management, and Facilities / Resources Management System and Intranet based Services.
- **Premise, office, meeting and classroom supplies:** Covering Laptops, Desktops, Photocopying Machines, IP Phones, HPC, AV and Conferencing systems.
- **Subscriptions, onsite support and hosting services:** Consist of the University Subscriptions to IEEE and ICT Onsite Support and Hosting Services.
- **Support Applications:** Include the ERP, Digital Library System, email, service desk, document and content management, Identity management, system integration framework, CCTV, access cards, website BI & reporting.
- **Network & Connectivity Equipment:** Consists of all the network and infrastructure connectivity component such as switches, routers, wireless controllers, firewalls and any IT infrastructure related equipment.

For information on the related Information Technology policies, please refer to the IT Policies and Procedures as part of the Institutional policies and procedures.

10.3 Laboratories - Updated

MBZUAI has the most advanced AI labs in the region, equipped with the best in class technologies for AI and more specifically for Computer Vision, Machine Learning, and Natural Language Processing.

The labs represent a key enabler for MBZUAI learning and knowledge development. They are available for faculty and students to conduct their research and analysis work, as well as it hosts a team of scientists who have their own research agenda and initiatives.

Three types of labs will be available:

1. High Performance Computing Lab: Equipped with powerful workstations with GPUs and data storages for students used in various academic and research needs.

2. Data Acquisition Lab: Deployed with special equipment with latest technology such as camera systems, 3D printers, acquisition systems, and drones.

3. Demo/ Visualization Lab: Equipped with high-resolution tiles display monitors used for researches visualization.

7.1 Student Life Services - RO

7.1.1 Counseling Services

The counseling services role is positioned to provide support and intervention services to assist the personal growth and development of MBZUAI students. Counseling services are available through professional counselors to contribute to students' university experience at a personal and academic level and empower students to make better choices, leading to a happier and more dynamic campus life.

These services are rendered through a trustworthy, confidential and private atmosphere, where students can talk about any academic issues, personal difficulties and social problems. Any information shared within the counseling meeting will be confidential and will not be shared with administrators, professors or anyone else without the permission of the student, or unless the student poses harm to themselves or others.

All students are encouraged to make use of the Counseling Services.

The following list of counseling services is offered throughout the academic year, but not limited to:

• Provide a safe environment where students can receive the appropriate intervention to cope with challenges that impact aspects of their professional and personal lives.
• Strengthen students' personal skills, through counseling sessions, activities and workshops.
• Assist students in areas of Study Skills and Time Management that will contribute to their academic achievements.
• Assist with conflict mediation and arising misunderstandings between students and faculty/ staff.
• Help students make productive decisions and use positive problem-solving techniques.
• Transition and adjustment to the new campus life.
• Support and accommodate students with special needs.
• Help students to cope with trauma or crisis.
• Where applicable, counseling services will assist students with reported disabilities and problems such as medical, vision, hearing, speech impediments, psychiatric conditions, etc.
• When necessary, refer students with psychological/psychiatric difficulties to appropriate professional community resources.

7.1.2 Student Activities

Students enrolled at MBZUAI will be entitled to join on-campus student groups. This will allow the pursuit of interests outside the classroom and help to meet other students. A wide number of student groups with different interests will be available for students to join and take part.

1. All student entities and societies are to be formed and governed by the policies and guidelines drawn by the Student Affairs Department and MBZUAI's vision, mission and strategic objectives.
2. Student groups can apply to be registered and recognized by submitting:
   - Purpose of formation along with the group's mission and vision statements.
   - The intended organizational structure.
   - Planned activities on and off-campus.
   - Point of contact and faculty/staff advisor.

7.1.3 Student Residences

University Residences offer an environment in which students have the chance to meet and learn from one another. Student housing is available at the campus. All housing facilities are managed by on-site staff and security team.

The University offers two types of residence quarters for its students: (a) male-only; (b) female-only. Students are expected to be respectful and considerate of all different cultures, customs, and traditions.

Based on availability and demand, student housing is subject to priority allocation. Priorities are subject to change.

MBZUAI University is committed to providing safe, comfortable, and clean on campus residence accommodation for all their eligible students. The housing is gender segregated and follows strict rules of compliance which are outlined in the procedures/manual.

4.2 MBZUAI will try to accommodate the students' needs in terms of assigning rooms subject to availability as we have different types of rooms.

4.3 Resident students are:

a) Expected to abide by all the rules and regulations associated with this policy.
b) Required to pay the deposit charges as outlined in the Student Housing manual.
c) Required to be enrolled in the university.

4.4 The university has the right to terminate a student’s housing contract and to withdraw all associated housing rights if:

a) If the student is dismissed or withdrawn from the university.

b) Severe or repeated violations of the Student Code of Conduct policy are recorded.

4.5 A student has the right to appeal such a decision to the university administration.

4.6 Appeals and exceptions may be considered by the Executive Vice-President upon the recommendations of the student life director.

For further information, students are encouraged to refer to the Housing Manual.

7.1.4 Students Participation in Governance

MBZUAI strongly believes in the active participation of students in the governance of the university.

The MBZUAI Student Council will be formed by students with the objective of reflecting the positive aspects of the students’ involvement in the university, and any challenges that students may encounter during their journey.

The Student Council will serve a number of important functions, such as:

- Representing students in the Academic Integrity Committee.
- Allowing students to cast their views on all university issues.
- Utilizing opportunities to better serve the students' interests.
- Initiating programs and projects that promote leadership and teamwork.
- Nurturing students' welfare in all fields.
- Keeping the MBZUAI community up-to-date on events that affect it most.

The MBZUAI Student Council will be composed of a diverse group of individuals selected to represent the student body with a main mission of advocating for and liaising between the students, faculty and the university management around academic and research related matters and MBZUAI campus life.

The Student Council is composed of the following four positions:

- Chair of Student Council
- Council Coordinator
- Representative for Academics and Research
- Representative for Events and Activities

All MBZUAI students in good academic standing are eligible to run for the Student Council. Elections for the positions are held at the beginning of each academic year in coordination and approval from the Director of Student Affairs.

The first meeting shall be conducted after one month upon the selection of the Student Council. The Council shall hold meetings no less than once a month. Additional meetings may be called at the discretion of the Council. In the case of unusual or exceptional circumstances, the Chair of Student Council may call for an Extraordinary Meeting.

Any decision requires a simple majority (half, rounded down, plus one) of those attending, to succeed where Council members must be present at a meeting to vote on decisions. Resolutions and decisions made by the Student Council require the final approval from the Director of Student Affairs.

8 Residential Life and Facilities

8.1 Accommodation

MBZUAI provides student housing. Living at MBZUAI residences offers students the opportunity to develop their social skills in tandem with their academic potential, while forging lasting friendships and participating in social activities.

Students enrolled at MBZUAI will be entitled to on-campus accommodation for the duration of their study. Recreation facilities at MBZUAI are limited, but there are a variety of options for sports, leisure and cultural activities exist in the surrounding Masdar community.

They will be provided with accommodation containing en-suite facilities, kitchen and living area with TV and internet connection. Facilities on campus for all students include a gym, multi-purpose areas for sports activities, restaurants, coffee shops, laundry, plus a canteen that is open for breakfast, lunch, and dinner.

When visiting the campus the students must collect the key to their on-campus accommodation from the Student Affairs department.

8.2 Masdar City

The University is located in Masdar City, a well-situated, thriving area which is home to more than 450 global and local companies. Masdar City features a growing selection of outlets such as banking branches, shopping malls, supermarkets, medical services, pharmacies, restaurants, and cafes. It as an attractive community in which people can live, work, learn and enjoy a variety of recreational activities.

Masdar City is one of the world's most sustainable urban communities, a low-carbon development made up of a rapidly growing clean-tech cluster, business free zone and residential neighborhood with restaurants, shops and public green spaces. For more information visit https://masdar.ae/en/masdar-city/the-city

8.3 Banking Facilities

Bank	Telephone	Web Site
First Abu Dhabi Bank	Tel: 02 6811511	https://www.bankfab.ae
Abu Dhabi Commercial Bank	Tel: 02 6720000	www.adcb.com
Abu Dhabi Islamic Bank	Tel: 02 6100600	https://www.adib.ae
Citibank	Tel: 02 6742484	www.citibank.com/uae
HSBC	Tel: 600 554722	www.hsbc.ae

Table 3: Banking Facilities

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

8.4 Retail

Visit Retail list in https://masdar.ae/en/masdar-city/the-city/recreation

8.5 Restaurants and Cafes

Visit Dining list in https://masdar.ae/en/masdar-city/the-city/recreation

8.6 Transportation

Masdar City is walkable and pedestrian friendly. It features an integrated and smart network of transportation options to create an accessible, livable community designed to encourage and promote low-carbon public transportation.

8.7 Parking

Car parking is provided for all registered students and available for guests at the North car park. North car park is located next to MBZUAI buildings within walking distance (200 M approx.). Shuttle services are provided from the parking to main entrance.

8.8 Masdar Park

Masdar Park is now double the size at 2,500 square meters. Open daily from 9am-10pm, 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' made from recycled building materials. The Tree of Light changes colors when touched. For more information visit https://masdar.ae/en/masdar-city/the-city/recreation

8.9 Travel and Tourism

The Abu Dhabi Department of Culture & Tourism and Visit Abu Dhabi contain lots of information regarding travel and tourism:

http://visitabudhabi.ae/en/default.aspx

https://www.abudhabi.ae/portal/public/en/homepage

9 Administration and Important Information

9.1 UAE Entry Permit and Residency Visa

Students must have a valid Entry Visa to enter the UAE (Depending on their nationality). This permit will be issued and sent prior to leaving home. The validity of the visa depends on rules at the current time; they may be valid for 30 or 60 days from the date of issue. Therefore, entry to the UAE must be within this period.

For the initial processing of the Entry Permit(s) and insurance procedures, students will need to send the–Education Certificate (Bachelors/Masters), photocopy of the passport, and color passport photo with white background. Please send the requested documents to Admission@mbzuai.ac.ae.

It should be noted that there should be at least six months' validity on passports for entry into the UAE and application for the Residence Visa.

When all of the relevant documents have been received, the Admissions Office will process and email a copy of the Entry Permit(s).

Students will need to show a copy of the Entry Permit to the airline/Immigration at their point of departure. Students with certain nationalities must undergo a pre-medical test and pre-approval for the entry Permit in the home country through the UAE consulate before their departure.

Upon arrival in the UAE, PRO will handle the Residence Visa procedures. The Residence Visa will be stamped on the passport.

To start these procedures, students should report to Student Affairs Office, as soon as possible after their arrival, with the following documents:

- Original Entry Permit.
- Passport.

Public Relations Officer (PRO) will book an appointment for the medical test, Emirates ID application typing, fingerprint scan (for the Emirates ID) and issue health insurance to complete the required documents for the Residence Visa.

9.2 Emirates ID Card

As per the law of the Population Registry and the Identity Card program, all nationals and legal residents of the UAE must obtain the Emirates Identity Card.

Students will be required to obtain an Emirates ID card for themselves and MBZUAI will reimburse the cost of the Emirates ID card.

For further information, please see www.emiratesid.ae.

9.3 Driving License

To obtain a driving license, students should visit the Abu Dhabi Police Department's Office. Regulations for obtaining a driving license vary by nationality. Therefore, this department will advise of the latest regulations and provide guidance regarding the process required for obtaining a driving license.

Note: Students can only apply for a driving license when they have obtained their Residence Visa.

9.4 Embassies and Consulates

There are many foreign embassies and consulates located in Abu Dhabi and Dubai.

Embassies and consulates are generally open from 8:45 a.m.–1:30 p.m. All are closed on Fridays, and some also on Saturdays.

Some embassies have websites while others do not. For a comprehensive list of embassies and consulates in the UAE, please see:
www.indexuae.com/Top/Government/Embassies_and_Consulates.

9.5 Dress Code

MBZUAI has a multi-cultural environment that respects the norms of UAE society. Students must not behave or dress in a way that may offend cultural sensitivities. The following points must be observed regarding student dress at the university.

- No offensive wording, drawings, or pictures are allowed on clothing.
- Clothing or attire must not interfere with the safe operation of duties or equipment.
- In respect for the needs for identification and security, we request all female students to forgo the face covering veils while on campus.
- Students should not wear revealing clothes. "Revealing clothes" refers to clothing that has very sheer fabric or clothing that is tight. Blouses, etc. should have no cleavage

visible. The lower back, abdomen and upper arms should be covered. Skirts should be below the knee.

- All students are to wear appropriate business attire when representing the Institute on official trips such as conferences, summits and meetings with external organizations.

Examples of acceptable clothing:

- Female Students -UAE National attire, long skirts/pants/dresses with length that covers the knees, long sleeve blouses, smart T-Shirts, jumpers, jackets, and suits (note: no sleeveless)
- Male Students- UAE National attire, business suits, sports jackets, blazers, trousers/slacks, smart T-Shirts and shirts

9.6 Electricity

Electricity is 220 volts at 50 cycles per second. Transformers are readily available in the market for electronic equipment that runs on 110 volts. If students bring their personal computer for use in their home, they will need to purchase a transformer. Some computers switch either manually or automatically from 110 to 220 volts.

9.7 UAE Newspapers

Newspapers are readily available in both English and Arabic, and delivery is available to campus housing. To view the comprehensive list of available newspapers please view the following link: http://www.onlinenewspapers.com/une.htm

9.8 Potable water

Tap water in the Emirates is safe to drink. However, most people prefer bottled water, which can be delivered to individual house accommodations weekly, at a cost of approximately 10 Dirhams per five-gallon bottle.

9.9 Useful Websites

For additional information on working and living in the United Arab Emirates, the following websites will prove useful.

http://visitabudhabi.ae/en/default.aspx

https://www.abudhabi.ae/portal/public/en/homepage

10 Academic Integrity

MBZUAI seeks to create an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves its educational mission. MBZUAI assumes that all students come to the Institute for a serious purpose and expects them to be responsible individuals who demonstrate highest standards of ethical behavior, honesty and Academic Integrity in their pursuit of knowledge.

Unethical behavior is not worthy of members of the University community and will be dealt with severely. Academic dishonesty in any form undermines the very foundations of higher education and will not be tolerated.

Policies

1. This policy is designed to support faculty, staff and students to embed good practice and develop methods for enhancing Academic Integrity and make clear the types of behaviors that are considered to be academic misconduct as well as to ensure fair and equal treatment of all Students when considering whether Academic Integrity has been breached.
2. This policy and its procedures apply to student conduct that occurs on MBZUAI premises or at MBZUAI-sponsored activities.
3. Any act which facilitates or encourages violations of Academic Integrity by another person is itself a violation of Academic Integrity.
4. In order to demonstrate Academic Integrity, Students must produce their own work, acknowledging explicitly any material that has been included from other sources or legitimate collaboration. Students must also present their own findings, conclusions or data based on appropriate and ethical practice.
5. Behavior that infringes and impedes the educational process is unacceptable and may lead to disciplinary sanctions, including dismissal from the MBZUAI.
6. The University treats the decision as to whether minor errors, poor academic practice or dishonest academic misconduct has taken place as a matter for academic judgement and the penalties applied will vary according to the individual case and the seriousness of the offence.
7. Cases of suspected academic violations or misconduct should be evidenced and documented before the appropriate procedure is instigated.

8. The primary responsibility for bringing a charge of academic dishonesty involving academic work or other documents submitted in a course rests with the faculty or other instructors of record (hereafter called faculty). Graduate assistants, teaching assistants, research assistants or coordinators and any other persons who assist or support faculty in teaching should report suspected instances of academic dishonesty to the instructor of record.
9. The primary responsibility for bringing a charge of academic dishonesty involving a Master's or Doctoral project or thesis rests with the student's thesis or project advisor or members of the committee evaluating the thesis or project.
10. The primary responsibility for bringing a charge of academic dishonesty involving suspected falsification or use of falsified documents rests with the faculty, section head or the academic department chair who received the document in question. Any violation that is discovered in a non-academic department or section (e.g., transcripts, letters of recommendation, medical documentation) shall be reported to the appropriate instructor or academic department chair.
11. The primary responsibility for bringing a charge against a student suspected of academic dishonesty of a nature that does not clearly fall under the preceding sections, shall rest with the appropriate faculty or academic department chair involved. Any violation that is discovered in a non-academic department or section shall be reported to the appropriate instructor or academic department chair.
12. Students should strictly avoid any appearance of academic dishonesty. This includes but is not limited to: joking to others about cheating, permitting others to cheat off them, talking during examinations, plagiarizing, fabrication or falsification of information or forging documents.
13. Students should be aware and adhere to instructor guidelines for projects, papers and exam situations including use of appropriate citations. This includes the extent of independent and collaborative work allowed for an assignment. All electronic devices (cellular phones, tablets and computers) should be turned off and placed completely out of site during test situations, unless otherwise directed by the instructor.
14. When a student suspects that a violation of the Academic Integrity Policy has occurred, ideally, the student will report that violation to the instructor of record or if the instructor is not known or unavailable then to Executive Vice President for Academic Affairs and Research or the Director of Student Affairs. In this report, the student should describe the violation and what action s/he has taken, such as talking with the other student (s) involved, or with the faculty or staff member. Every effort will be made to preserve the

anonymity of the student reporting the incident; confidentiality, however, cannot be guaranteed. Students may also report anonymously to the faculty or staff member.

15. When the person who bears the primary responsibility does not bring a charge for suspected violation within a reasonable time, the Executive Vice President for Academic Affairs and Research or Department Chair may bring a charge forward should the situation become known to them.
16. Once a student is notified, orally or in writing, that a faculty member suspects academic dishonesty in a course, the student may not change his or her registration in the course while the matter is pending, or in which a finding of academic dishonesty has been made. Any attempt to withdraw from a course under these circumstances shall be considered a separate violation of this policy.
17. After the sanction has been determined, a student may withdraw from the course with the faculty permission, providing that the alleged violation occurred during the university deadline for withdrawing, and provided the sanction is not a failure for the course. Withdrawing from a class does not automatically remove the violation report.
18. A grade of F received as a result of an Academic Integrity violation cannot be removed from the calculation of the GPA should the course in question be repeated.
19. Any grade received as a result of a second Academic Integrity violation cannot be removed from the calculation of the GPA should the course in question be repeated.
20. False statements made during the course of the process may result in additional sanction(s) and a referral to the Director of Student Affairs for a Student Code of Conduct violation.
21. Academic dishonesty can take a number of forms. Please see the Academic Integrity Violations and Definitions in the proceeding section for examples.

Academic Integrity Violations and Definitions

The following violations and definitions are intended as guiding examples and they are not meant to be exhaustive. The University reserves the right to determine, in a given instance, what action or behavior constitutes a violation of Academic Integrity.

Cheating:

Cheating is using or attempting to use unauthorized materials, information, notes, study aids or other devices in any academic exercise, such as an academic assignment, examination, project, presentation, report, etc. Some examples of Cheating are:

- Fraudulent possession of a test or parts of it prior to examinations date, including discussion of the substance of examinations and tests when it is expected these will not be discussed.
- Failing to abide by the rules governing the conduct of examinations that are taken in-class, on-line or any other form of summative examination.
- Copying from or looking at another student's examination paper or receiving unauthorized assistance during a quiz, test or examination.
- Using, accessing or possessing any material or electronic devices during an exam, such as cheat sheets, notes, books, cell phones, digital cameras, data storage devices, computers, internet or other electronic devices unless expressly permitted by the instructor for the required coursework.
- Copying reports, laboratory work, computer programs or files and the like from other Students.
- Continuing to write after a timed exam has ended.
- Submission of the same term paper or other work to more than one instructor, where no prior approval has been given.
- Submission of purchased term papers or projects done by others.
- Having another student take an examination for the student.

Plagiarism:

Plagiarism is representing written, published, or creative work, research findings, ideas, words or data of another person as one's own in any academic exercise. Some forms and examples of Plagiarism are:

a. Word-for-word copying of someone else's work, in whole or in part, without acknowledgment, whether that work be an article in a newspaper or a magazine, a part of a book, another student's paper, or any other composition not one's own, that includes all information collected from any source, including the Internet.

b. An unacknowledged paraphrasing of the structure and language of another person's work. Changing a few words of another's composition, omitting a few sentences, or changing their order does not constitute original composition and therefore not acceptable.

c. Writing a paper based solely on the ideas of another person. If the thinking is clearly not one's own despite that the language is not the same.

In summary, plagiarism includes, but is not limited to:

- Using published work without proper citation, referencing or correctly presented acknowledgment.
- Verbatim or word-by word copying without using quotation marks even if the source is cited.
- Collaborating with others on papers, research or projects without authorization of the instructor.
- Copying coursework or another student's assignment, research results, computer file/program, or examination with or without permission from the author.
- Copying another student's computer program and changing only minor items such as variable names or labels.
- Paraphrasing without proper attribution.
- Using phrases from another source embedded into original material without proper attribution.
- Copying of intellectual property without proper attribution. Such as internet websites, computer programs or files, research designs, ideas and images, charts and graphs, photographs, creative works, and other types of information that belong to another.

Fabrication and Falsification

Fabrication and Falsification is presenting or making unauthorized alterations to information or inventing any information or citation in an academic exercise, such as:

- Including data or information in your work which you know to be false or incorrect.
- Making up or fabricating data, evidence, research or experimental results, references, information or procedures.
- Presenting data based on controlled investigations, experiments, surveys or analysis falsely claimed to have been carried out by you.

- Counterfeiting a record of a practicum experiences such as internship, conference, workshop or seminar experience.
- Inventing data or fabricating research procedures to make it appear that the results of one process are actually the results of several processes.
- Improper recording of data, negligence in collecting or analyzing data and selective reporting or omission of conflicting data.
- The invention of references and/or false claims.
- Altering grade reports or other academic records.
- Submitting a false excuse for absence or tardiness in a scheduled academic exercise.
- Altering a returned examination paper and seeking re-grading.
- Including selective inclusion or exclusion of research results

Recycling or Multiple Submissions

Recycling is the submission of one's previous work to count as new work. For example, submission of a student's work that has previously counted in another unit of study is not allowed, unless explicitly authorized by the faculty members of both study units. In such case, Students must reference their previous work.

Misconduct in Research

Includes any of the above examples in relation to research and/or other factors including a failure to comply with regulatory, legal and professional obligations.

Examples of misconduct in research are:

- A breach of confidentiality.
- Infringement of intellectual property rights.
- Failure to take due care for participants in research or of personal data.
- Abuse of research subjects or materials.
- Taking or releasing the data of others which were given in the expectation of confidentiality, e.g., appropriating ideas from submitted grant or contract proposals, or manuscripts for publication when one is a reviewer for granting agencies or journals

- Knowingly presenting material or publishing articles that will mislead listeners or readers, e.g., misrepresenting data (particularly its originality).
- Serving as a coauthor of a research paper or article without reviewing the material to be published.
- Failure to adhere to safe research practices or to receive the approval required for work under research regulations of federal, local or university agencies.
- Misuse of research funds.
- Unethical research practices such as failing to report episodes of misconduct or breaches of research ethics.

Academic Integrity Committee

The Academic Integrity Committee (AIC): is a standing committee that is formed on yearly basis by the president to be responsible for defining Academic Integrity and establishing policies and procedures for investigating, hearing and sanctioning alleged violations of Academic Integrity.

The committee shall conduct hearings, investigations and make determinations of alleged violations of Academic Integrity policies and invoke the appropriate sanction as stipulated by MBZUAI's policies on Academic Integrity.

Committee Formation:

The committee is formed from the following

1. Faculty membership: The committee shall include at least four faculty members (including a chair) from diverse departments. All committee members serve one–year, terms. The chair shall be elected from among the faculty members.
2. Student members: One student appointed by the Student Council, shall serve on the committee.
3. The Director of Students Affairs or their designee who shall serve as a non–voting member.

- Quorum: A quorum is necessary for all AIC business. A quorum is defined as three (3) voting members of the AIC.

- Voting privileges: Faculty and student members serve as voting members of the committee.

The Academic Integrity Committee Hearing Process

- The purpose of a hearing is to explore and investigate the incident giving rise to the appearance of academic dishonesty and to reach an informed conclusion as to whether or not academic dishonesty occurred. All persons at a hearing are expected to assist in a thorough and honest exposition of all related facts. AIC hearing proceedings are not legal proceedings.
- The sequence of a hearing is necessarily controlled by the nature of the incident to be investigated and the information to be examined. It lies within the judgment of the committee chair to determine the most reasonable approach. The following steps are generally recommended:
- The referring faculty member or academic department chair reporting an alleged violation, and then the student, will briefly present their respective cases, including any relevant information or arguments. The faculty may recommend a sanction.
- Only witnesses who have knowledge of the incident or can offer documents or other materials bearing on the case may be called.
- Members of the AIC may request additional material or the appearance of other persons, as needed.
- The referring faculty member or academic department chair reporting the allegation and the student may make brief closing statements.
- The AIC will meet privately to discuss the case and determine whether a violation has taken place based on considerable evidence.
- If the student is found in violation, the AIC will independently determine an appropriate sanction. Prior to determining the sanction, the AIC will be informed of any other violations of Academic Integrity on the part of the student, as well as past sanctions.
- The Committee Chair will provide the referring faculty or academic department chair, the student, and the President with a written report of the facts found, identifying the parts of the policy that have been violated and describing the sanction, if any, to be imposed.

The AIC Committee Chair will ensure that the following rules are observed:

- The student may be accompanied by a person of his or her choosing for emotional support only, provided that the support person is not a party to the case. This person will not actively participate in the hearing process in any way.
- Presence at a hearing lies within the judgment of the Committee Chair. A hearing requires a deliberative and candid atmosphere, free from distraction. Accordingly, it is not open to the public.
- The Committee Chair may remove from the hearing any person who disrupts or impedes the investigation, or who fails to adhere to the rulings of the Committee Chair.
- The Committee Chair will direct that persons, other than the student, who are to be called upon to provide information, be excluded from the hearing except for that purpose.
- Members of the AIC may conduct private deliberations at such times and places as they deem proper.
- Failure to appear before the AIC will not prevent them from hearing evidence and determining outcomes.
- It is the responsibility of the person desiring the presence of a witness before an AIC to ensure that the witness appears. Written statements by witnesses should not be used unless the individual cannot reasonably be expected to appear. Any written statement must be dated, signed by the person making it, and witnessed by a University employee. The work of an AIC hearing will not, as a general practice, be delayed due to the unavailability of a witness.
- A hearing is not a trial. The AIC will consider all relevant, probative, and credible evidence. The AIC chair in consultation with AIC members will determine what evidence will be considered.

Interim Action

- The President or their designee involved may suspend the student from one or more classes or labs for an interim period prior to resolution of the Academic Integrity Committee proceeding if they believe that the information supporting the allegations of academic misconduct is reliable and determine that the continued presence of the student in classes or experiential assignments poses a significant threat to any person or property.
- The President or their designee must provide a written notice of the interim suspension to the student (with a copy to the President -if issuer is the President designee) and the

Director of Student Affairs. The interim suspension will become effective immediately on the date of the written notice.

- A student who is suspended for an interim period may request a meeting with the President or their designee to review their decision and to respond to the allegations that they pose a threat, by making a written request to the President or their designee for a meeting. The President or their designee will schedule the meeting no later than five (5) working days following receipt of the written request and decide whether the reasons for imposing the interim suspension still stand or decides to revoke the suspension if the request is supported by persuasive evidence.
- The interim suspension will remain in effect until a final decision has been made on the pending academic misconduct charges or until the President or their designee, determines that the reasons for imposing the interim suspension no longer exist or are not supported by the available evidence.

Monitoring and enforcing academic integrity through faculty and student training

The university will regularly conduct various activities, trainings, initiatives and measures for its students and faculty to ensure that academic integrity is fully enforced. It will seek to spread awareness and educate students on the acceptable behavior stressing on the importance of academic integrity compliance.

Some of the measure are:

- Prior to arriving at MBZUAI, students will be asked to read the Academic Integrity Policies and the Code of Conduct. Correspondingly, they will be asked to write a brief response outlining how they intended to uphold these standards.

- Conducting specific training sessions addressing academic integrity, providing information and materials on the code of conduct as part of the student's orientation program

- Conducting Quizzes for all Students on Academic Integrity in addition to other course policies during the course orientation

- Communicating to Students -through different methods- the availability of support and mentorship on Academic Integrity through faculty, advisors and the Student Affairs Department.

- MBZUAI will be ensuring that materials and guidelines on Academic Integrity are embedded within faculty and staff induction programs

- MBZUAI will make sure that all information on the Academic Integrity Policy and Procedures are continuously updated, available and accessible to students through different printed material and online platforms (Student Handbook, Catalog, Student Learning Platforms and Systems…etc.

- On a bi-annual basis, students and faculty will be requested to read the Academic Integrity Policies and Procedures as well as the Code of Conduct. They will asked to submit a signed Affirmation Document indicating their awareness of the Academic Integrity Policies and the Code of Conduct.

  Encourage faculty and staff to discuss, in detail, about MBZUAI's Academic Integrity standards and their expectations of the student's adherence to these standards throughout the course.

- Faculty and staff are encouraged to explain the standards of Academic Integrity in their field with the students.

- Having courses specific to the Academic Integrity policies such as proper ways of scientific writing and use of sources.

- Encouraging faculty and staff to publish their expectations of Academic Integrity adherence in course work.

- MBZAUI will be conducting training sessions for all faculty members on plagiarism detection programs/systems and encouraged to use them should suspect any plagiarism case.

- Developing an online Academic Integrity training for students on the university intranet.

Important Guidelines for Faculty

- Help define and support campus-wide Academic Integrity standards.
- Recognize and affirm Academic Integrity as a core institutional value

- At the beginning of each term, discuss University policy on Academic Integrity with Students.
- Provide a clear explanation on what constitutes a violation of Academic Integrity.
- Encourage student responsibility for Academic Integrity.
- Affirm the role of faculty as guide and mentor.
- Make clear to the Students what are the expectations regarding permissible academic conduct. It is important that this be done in the context of each specific subjects.
- Teach Students proper methods of attribution. Describe and give examples of plagiarism, paraphrasing and direct citation.
- Teach Students how to successfully research and write a paper or prepare a lab report.
- In all cases of alleged violations of Academic Integrity, faculty members must maintain confidentiality and not disclose information beyond those individuals who had a need to know.
- Collect accurate records of an Academic Integrity violation and submit those records to concerned parties when needed.
- Encourage Students who have been accused of an Academic Integrity violation to contact the Director of Student Affairs or designee, who can serve as a resource and provide advice.
- Develop fair and creative forms of assessment.
- Reduce opportunities to engage in academic dishonesty.
- Change assessments each semester or create three or four versions that you rotate throughout the year.
- Prepare new exam questions each time you teach the course. If a pool of multiple-choice questions is available, rotate their use.
- Prepare in advance for Students who will report sick for exams.
- Prepare a seating plan or have Students sit in every other seat
- Make an effort to explain to Students on every occasion or the start of an examination the behavior expected of them when taking examinations or when preparing and submitting other course work.

- Ask Students to leave their bags and backpacks at the end or at the front of the room before sitting down to take exam or test.
- Require that student phones are face down on top of desks so that it's clear if a student picks up his/her phone and looks at it during an assessment is committing a violation.
- Discourage any additions after exams or tests are returned to Students, place a mark or dash at the end of each answer and/or a line through any unused sections of their examination papers or booklets.
- Consider adding a statement on all course submissions to have the Students confirm with a signature that the submitted paper, exam, assignment or any other course work, is entirely their own and does not violate MBZUAI's Academic Integrity policy.
- Discourage cheating during exams by circulating in the classroom frequently and ensure that all areas are covered and monitored.
- Collect examination papers individually.
- Prepare new assignments each semester.
- Provide specific guidelines for the format of written assignments and adhere to them when evaluating student work.
- Have Students submit an essay outline or first draft for feedback.
- Discuss areas of difficulty in assignments. Meet with Students to monitor their progress and offer feedback and support.
- Challenge academic dishonesty when it occurs.
- Deal with the problem immediately. Talk with the student about your suspicions and listen carefully to the student's response. If you still are convinced the student behaved unethically or dishonestly, pursue the matter according to your established policy.
- At their discretion, faculty may submit student work and assignments to plagiarism–detection software, browser lockdown tools, and identity detection facilities for review without prior notice to Students, to check work for copying and other fraud

Important Guidelines for Students

- Credit and acknowledge whenever:
    a. One quotes another person's actual words or replicates all or part of another's product. This includes all information gathered from any source, including the Internet.

   b. One uses another person's ideas, opinions, work, data, or theories, even if they are completely paraphrased in one's own words.

   c. One borrows facts, statistics, or other illustrative materials.

- Familiarize yourself with MBZUAI Academic Integrity Policy
- Because expectations about academic assignments vary among specializations and faculty members, consult with your instructors about any special requirements related to citation.
- Make sure you know what the standards are for the course work, essay, paper or thesis you are working on and apply it accurately
- If in doubt about what is required in any particular assignment, what referencing styles are appropriate, etc., always ask. Your instructor or supervisor will be able to point you in the direction of appropriate sources of advice and information
- Always use quotations when you are directly quoting someone
- Check the text you have paraphrased against the original text so that to ensure that you have not used the same phrases or words, and double check that the information is accurate.
- Report any incident of academic misconduct to the faculty member, instructor or Student Affairs Department.
- Promptly recorded original research results and ensure that they are kept in an organized and accessible fashion.
- In group projects, the project leader should supervise the design of experiments and the process of acquiring, recording, examining, interpreting and sorting data. (editing of manuscripts only, does not provide adequate supervision).
- Clearly define and mention in writing permitted or expected collaboration on any assignment, project or course work.
- An author submitting a paper should never include the name of a coauthor without that person's consent.
- Each coauthor should be furnished with a copy of the manuscript before it is submitted.
- Co-authorship should be offered to (and limited to) anyone who has clearly made a significant contribution to the work.

- Anyone accepting co-authorship of a paper should realize that this action implies a responsibility as well as a privilege. If a potential coauthor has serious reservations concerning a publication the individual should decline co-authorship.
- The senior author or authors of a paper should be prepared to identify the contributions of each coauthor.
- Refrain from the simultaneous submission of essentially identical manuscripts to different journals as this is considered improper.

Procedures

Procedure for Faculty Charging a Student with a Violation

When a faculty member or a department chair has evidence of an alleged violation of the Academic Integrity Policy, they should contact the AIC to determine if the student has a previous violation, in such event the case must be referred to the AIC. If the student has no previous violations, the below listed procedure should be followed:

1. To notify the student an official e-mail and/or personal communication of the allegation within ten (10) working days. Any discussion of sanctions should be reserved for the meeting.
2. Arrange a meeting with the student which is to be held as soon as possible, but at least within three (3) working days' notice to the student.
3. An exception to meeting with the student may occur at the end of a semester when a student is no longer accessible for a meeting with the faculty member. In these cases, the faculty member should make every reasonable effort to contact the student through an official e-mail to discuss the matter. If reasonable attempts to contact the student fail, the instructor may resolve the issue by submitting an Academic Integrity violation report form, which the student has the right to later appeal to the Academic Integrity Committee.
4. If the student fails to attend a scheduled initial meeting with the faculty without a compelling excuse, the student will lose their opportunity to appeal the violation report and/or sanction to the Academic Integrity Committee.
5. Both faculty and student may invite witnesses with first–hand information to the meeting who can knowledgeably provide relevant information about the alleged infraction.

6. The faculty must request that a faculty representative of the AIC be present as an observer of the meeting. The request is to be submitted at least 3 working days before the scheduled meeting time. The AIC designee will:
   - Ensure that the student knows and understands the Academic Integrity Policy.
   - Inform the student about their right to appeal the violation report and/or sanction to the AIC based on the guidelines for appealing a violation report and/or sanction to the AIC.
   - Advise the instructor to submit the report of Academic Integrity violation, no later than fifteen (15) working days after the meeting.
   - Observe, but not participate in deciding whether a violation has occurred, or which sanction should be imposed.
7. In the meeting, the faculty should present the student with the allegation and all evidence in support of the charge against the student. The student should be given the opportunity to respond and, if they wish, to submit evidence refuting the allegation.
8. At the conclusion of the meeting, the faculty member determines if it is more likely than not that the student has violated the Academic Integrity Policy, and if so, the faculty member charges the student with a violation of the Academic Integrity Policy.
9. If the student is found responsible, the faculty shall impose a suitable sanction and Inform the student that they will receive a sanction letter from the AIC. Examples of common sanctions under this procedure include one or more of the following:
   - Formal warning
   - A reduction in grade for the assignment and/or reduction in the grade for the course
   - A failing grade for the assignment and/or reduction in the grade for the course
   - A failing grade in the course
   - A failing grade in the course with a transcript notation of academic dishonesty
   - Rescinding or changing a grade for a past course in which a violation occurred
   - Denial of access to internships or research programs
10. If the faculty member needs more time to decide on the case or give the student a reasonable timeframe for a response. A grade of Incomplete may also be assigned by the instructor if Academic Integrity is in question at the time grades are due and the instructor requires more time to resolve the issue.

11. The faculty member should complete the Academic Integrity violation report and submit it to the AIC.
12. The completed Academic Integrity violation report and other relevant documents must be submitted as soon as possible, but not later than fifteen (15) working days after the meeting unless there are exceptional circumstances and an extension has been granted by the AIC chair.
13. The report/documents can be sent by the faculty as a hard copy or on email. The submission of this form and documents will complete the Academic Integrity violation process for the faculty member unless the AIC finds the sanction imposed was not appropriate for the violation of Academic Integrity that occurred. The AIC Chair would send a note to the faculty member to revise the sanction.
14. The student will receive a letter of sanction from the AIC chair along with information for appealing the violation report and/or sanctions. AIC will also send a copy of the letter and the Academic Integrity violation report to the Office of the President, Director of Student Affairs and the Registrar for the record.

Procedure for Appealing to the Academic Integrity Committee

1. The student has the right to appeal the sanction within ten (10) working days from the date of the sanction letter. If s/he does not, then the case is closed permanently.
2. Any student who has received an AIC sanction letter is encouraged to schedule a meeting with the Director of Students Affairs or designee to discuss the situation prior to appealing the case.
3. If the student disagrees with the violation report, the sanction, and/or the prohibition to withdraw, the student can appeal any of the above to the AIC by writing an appeal letter addressed to the AIC chair. The appeal letter and any supporting documents can be sent via e-mail.
4. In exceptional circumstances, a student may request additional time to appeal the violation report and/or sanction by sending a request via e-mail to the AIC chair and extensions are granted at the sole non–appealable discretion of the AIC chair.
5. Requests for extensions must be made within ten (10) working days of the date of the sanction letter.
6. Appeals are not granted automatically as they must be thoughtful, well–reasoned and substantive and must demonstrate that at least one of the following criteria exists:

- New evidence not available at the time of the meeting with the faculty member/administrator has become available and is potentially sufficient to alter the faculty member/administrator decision.
- There was a substantive procedural error made in charging the student.
- The sanction(s) imposed was not appropriate for the violation of Academic Integrity that occurred.
- The facts in the case were insufficient to establish that a violation of the policy occurred.

7. Appeals must also include pertinent evidence supporting one of the above criteria and names of witnesses the student requests be called who have first–hand information about the matter. New evidence will not be accepted at the hearing unless it can be demonstrated that it could not have been known or available to the student at the time of the appeal. Evidence submitted will be reviewed by the AIC chair and may be denied if cumulative or not probative of the disputed facts or to the determination of the case.
8. The AIC chair will notify the student via official e-mail whether or not the AIC has determined that there are grounds to conduct a hearing. Should the AIC determine there are grounds to conduct a hearing, the AIC will notify the student of the hearing and where it will be held at least five (5) working days in advance of the scheduled hearing date.
9. If the AIC decides to hear the student's case, the AIC members who constitute a quorum, the Director of Student Affairs (non–voting) shall attend the hearing and following individuals will be invited to participate:
   - The student.
   - Any other persons called by the AIC chair, including material witnesses (such as the faculty member) whom the student or the AIC members deem relevant to the case.
   - The student may also invite one person to provide support (e.g., friend or family member). This support person may not speak for the student and this individual may not be an (practicing or non–practicing) attorney.
10. Should the student fail to appear at the hearing before the AIC, the AIC shall have full authority to proceed in the student's absence. Any student that misses the scheduled hearing with the AIC forfeits the right to appeal the AIC's decision to the President.
    - If for any reason, the student needs to reschedule the hearing with the AIC, the committee needs to receive a 24 hours' notice. Hearings will be rescheduled only for exceptional circumstances at the sole non–appealable discretion of the AIC chair.

11. At the start of the hearing, the student is invited to present their case. The student has the right to present relevant evidence supporting their claims that has been previously provided to the AIC in their appeal. The student should be brief, concise, and organized in presenting their case.
    - The AIC chair may conclude the hearing at any time should the committee feel that the student is straying from the relevant facts of the case or reasons for the violation report and/or sanction to be vacated.
    - Although the committee may ask the student to review briefly the events of the case, the student comments should focus primarily on specific reasons the violation report and/or sanction meet one of the above specified grounds for appeal.
    - AIC members may ask the student questions about the case for clarification
12. The student and witnesses are expected to maintain proper decorum during the proceeding or risk being excused. If a student is excused, the hearing will continue in their absence.
13. After the student has presented the case and all questions have been addressed, the student and faculty member will be excused, and the AIC will deliberate. Deliberation may result in the following:
    - A decision to uphold, modify or overturn the initial sanction. The AIC reserves the right to modify or overturn the instructor's sanction.
    - A determination that additional information is needed. In this case, the decision is suspended until all necessary information has been obtained. In this case, the student will be notified as soon as possible, but within a few no more than five (5) working days, after the meeting.

    Examples of common sanctions under this procedure include one or more of the following:

    - Formal warning
    - A reduction in grade for the assignment and/or an additional reduction in the grade for the course
    - A failing grade: 1) for the assignment and/or an additional reduction in the grade for the course; or 2) A failing grade in the course; or 3) A failing grade in the course with a transcript notation of academic dishonesty
    - Rescinding or changing a grade for a past course in which a violation has occurred

- Withdrawing admission into the university, a program or internship
- Withdrawing an academic degree or certificate
- Disciplinary probation
- Removal of the privileges This shall have a set time of duration indicating when and under what conditions the student may regain the privilege.
- Disciplinary suspension from the University for one or two semesters, excluding summer terms. Students suspended for academic dishonesty cannot transfer into MBZUAI any credits earned during the suspension.
- Dismissal from the university.

14. After the AIC makes its decision, the chair will notify the student in writing and via e-mail. Decisions of the AIC are based on the standard of proof whether it is more likely than not that the student violated the Academic Integrity Policy.

Procedure for Appealing to the President

1. If unsatisfied with the outcome of the AIC hearing to contest the violation report and/or sanction, the student may appeal the decision of the AIC to the President by sending an e-mail to the President within five (5) working days of receiving the AIC decision including the reason(s) for appeal and supporting documentation. A review will be conducted by the President or their designee.
2. In exceptional circumstances, a student may file a request to the President for an extension to the appeal period by sending an e-mail request. Requests for extensions must be made within the appeal period.
3. Appeals are not granted automatically as they must be thoughtful, well–reasoned and substantive and must demonstrate that at least one of the following criteria exists:
    - There is new and significant evidence which was not available at the time of the AIC hearing has become available and which may further clarify and support the defense of the student. In this instance, the case should be referred back to the AIC for reconsideration.
    - There was a substantive procedural error that may have prohibited the hearing from being conducted fairly in light of the violation report and/or sanction.
    - There is clear reason to believe that the sanction imposed is not appropriate or consistent with the seriousness of the violation that occurred.

- The facts in the case were insufficient to establish that a violation of the policy occurred.

4. If the appeal documentation does not fall into one of the permissible grounds or does not support the claim, the appeal shall be denied.
5. Upon appeal, the President or their designee shall review the faculty member's decision, sanctions and supporting evidence, and any evidence provided by the student, and may confer with the faculty member and the student. The President or their designee shall have the authority to uphold, modify, or overturn the AIC's decision and sanctions.
6. The President or their designee shall notify the student, the faculty member and the Director of Student Affairs in writing of their decision. The President or their designee's decision is final on all Academic Integrity Policy violation cases. No further review or consideration will be granted following this decision.

Appendix 1: Courses Description

Remedial Courses

CS701: Advanced Programming (0CR)

Course Description

This course provides a comprehensive introduction to advanced programming methods. It builds upon fundamental concepts in programming and introduces object-oriented programming, parallel programming, data structures, algorithms, and many other programming and related tools.

Course Objectives

This elective course aims to familiarize students with advanced methods in programming, including object-oriented programming, parallel programming, data structures, algorithms, and many other programming and related tools. This course aims to instill in students programming tools necessary to write better code and understanding of the concepts necessary to improve and accelerate code performance.

Learning Outcomes

CLO1: Demonstrate a strong understanding of object-oriented programming concepts and implementation

CLO2: Exhibit comprehensive skills in using the appropriate algorithms and data structures for a problem

CLO3: Demonstrate advanced skills in analyzing, optimizing, and refactoring a computational implementation for improvements in time and memory consumption

CLO4: Achieve advanced skills with converting sequential codes into their parallel form, while satisfying the time and memory consumption budget

CLO5: Practice using programming tools to help accelerate the workflow: regular expressions, debugger, etc.

CLO6: Understand and be able to implement the basics in GUI development and good practices in code sharing

CLO7: Express advanced problem-solving skills by independently applying the programming skills to solve real-world problems

CV702: Data structures and Algorithms (0CR)

Course Description

This course provides a comprehensive introduction to fundamental data structures and algorithms which are essential to design an efficient computer program. It includes basic and advanced concepts in data structures such as array-based list, linked lists, hash tables, binary trees. The course will also cover basic and advanced topics in algorithms. The students will learn the relationship between data structures, algorithms and programming, and will be introduced to various performance measures and analysis techniques.

Course Objectives

This elective course aims to familiarize students with various concepts in data structures and algorithms which are essential to design an efficient computer program.

Learning Outcomes

CLO1: Demonstrate a strong understanding of fundamental topics in data structures and algorithms.

CLO2: Master a range of concepts, theories and methods for data structures and have a solid understanding of the computational complexity and the tradeoffs involved in using each data structure.

CLO3: Demonstrate skills in tracing, analyzing and designing various algorithms and analyzing their time-space complexity.

CLO4: Practice programming tools that helps in analyzing and implementing various concepts of data structures and algorithms.

CLO5: Express advanced problem-solving skills by independently

applying the data structures and algorithms principles to solve real world problems in computationally efficient way.

CLO6: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

Master in Computer Vision

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

Research Thesis

Description

Masters 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. Masters 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.

Course Objectives

The goal of writing a research thesis is to train students to become researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

After this course. Students will be able to:

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate an understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

Master in Machine Learning

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

Research Thesis

Course Description

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of 3 to 4 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 Objectives

The goal of writing a research thesis is to train students to become independent researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through extensive experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate expert understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit highly mature understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate depth and advanced expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Achieve an expert understanding of the current state of the art in the individual research area, and the ability to identify new problems arising from recent developments in and related to the chosen research domain within the discipline and propose new solutions which contribute to a wider body of knowledge.

CLO7: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, the proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

Master in Natural Language Processing

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

Research Thesis

Course Description

Masters 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. Masters 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.

Course Objectives

The goal of writing a research thesis is to train students to become researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate an understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

Ph.D. in Computer Vision

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

CV704: Advanced Computer Vision (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the algorithms for image restoration and enhancement, hand-crafted features, and visual target tracking, so the students become capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Comprehensive knowledge of properties of human vision, and strong theoretical and empirical foundations of advanced computer vision methods.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge on image restoration and enhancement, and visual object tracking, and the ability to propose novel ideas to make advancements in the field.

CLO3: Ability to apply advanced problem-solving skills in the development of real-world systems and applications for image restoration and enhancement, and visual target tracking.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to implement advanced computer vision algorithms.

CLO5: Develop advanced skills in leading complex projects by conceptualizing, formulating, setting up experimental protocols and achieving desired results on both low-level and high-level vision tasks.

CLO6: Demonstrate advanced skills in communicating highly-complex ideas, concepts, critique on approaches and key findings of the projects both orally and in the form of reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on advanced computer vision.

CV705: Advanced 3D Computer Vision (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the algorithms for 3D reconstruction, 3D scene understanding, and multi-view stereo so the students are capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Develop overarching knowledge of theoretical principles and methods for the following specialized topics in 3D computer vision: 3D reconstruction, 3D scene understanding, and multi-view stereo.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge and advance the cutting-edge research on 3D object detection and semantic segmentation, 3D reconstruction of dynamic scenes, and depth and motion estimation from stereo images.

CLO3: Demonstrate mastery in a chosen special topic by comprehending, investigating, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to solve complex 3D vision problems.

CLO5: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, and critique approaches and key findings of the projects both orally and in the form of reports.

CLO6: Ability to act professionally and engage actively in teams towards the completion of projects on 3D computer vision.

CV706: Neural Networks for Object Recognition and Detection (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of algorithms for image classification, object detection, instance segmentation, semantic segmentation and panoptic segmentation, so the students can become capable of doing research in these specialized topics and can implement these methods for building systems for real-world scene understanding. A significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Demonstrate strong theoretical and empirical understanding of conventional as well as deep learning based methods for visual object recognition and detection.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for image classification, object detection and segmentation, and be able to find potential research directions and open problems whose solution could create new knowledge.

CLO3: Demonstrate mastery in core visual recognition topics by conceptualizing, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Expertise in designing, training, and improving the performance of deep neural network architectures for visual recognition tasks.

CLO5: Develop advanced skills in solving complex real-world problems related to visual object recognition and detection by integrating knowledge from different fields such as image processing, computer vision and machine learning.

CLO6: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, critiques on approaches and key findings of the projects both orally and in the form of scientific reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on visual object recognition and detection.

Research Thesis

Description

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of 3 to 4 years. Ph.D. thesis research helps train graduates to become leaders in their chosen area of research through a partly-supervised study, eventually transforming them into researchers who can work independently or interdependently to carry out cutting edge research.

Course Objectives

The goal of writing a research thesis is to train students to become independent researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through extensive experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate expert understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit highly mature understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate depth and advanced expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Achieve an expert understanding of the current state of the art in the individual research area, and the ability to identify new problems arising from recent developments in and related to the chosen research domain within the discipline, propose new solutions which contribute to a wider body of knowledge.

CLO7: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, the proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

ML704: Machine Learning Paradigms (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course aims to train students to the level of expertise in learning algorithms in supervised, unsupervised, and semi-supervised domains, in addition to providing significant exposure to topics in transfer learning, multi-task learning, online learning, active learning, meta learning, and variational inference. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate comprehensive and deep understanding of the pipelines at the frontier of machine learning: data, models, algorithmic principles and empirics.

CLO2: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, unsupervised, semi-supervised, active, online, meta learning and other learning paradigms.

CLO3: Critically analyze, evaluate, and understand the performance of the different learning algorithms.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex real-world problem.

CLO5: Conceptualize, design, and implement a solution for a highly complex problem by applying principles learned in the course.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML705: Topics in Advanced Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will cover advanced topics in statistical machine learning, unsupervised learning, high-dimensional statistics, and reinforcement learning. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical understanding in topics from statistical machine learning, unsupervised learning, and high-dimensional statistics.

CLO2: Strong theoretical and empirical understanding of modern reinforcement learning methods and principles.

CLO3: Critique the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course, and identify avenues for improvement in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and executing theoretical or computational analysis of a complex problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML706: Advanced Probabilistic and Statistical Inference (4CR)

Course Description

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.

Course Objectives

During this course, the students will master some of the most important techniques for probabilistic and statistical inference and develop a broad understanding of the overall area. The specialized skill set developed in this course with be useful for making informed choices in analysing real-world data. The goal of this course is to master the state-of-the-art methods, promote discussions among students and motivate the students about the practical and scientific significance of reasoning about uncertainty. This course will provide the necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop comprehensive and deep understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Achieve critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspective.

CLO3: Develop expertise in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Demonstrate expertise in a chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem where noise and uncertainty are inherent in the data.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Develop a thorough understanding of the state-of-the-art as well as seminal literature in specialized topics covered in the course and demonstrate the ability to critique the existing body of knowledge, identify research gaps and come up with novel ideas at least at the conceptual level to address those open issues.

CLO7: Initiate, manage, and complete a project report along with a scientific talk including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

NLP704: Deep Learning for Language Processing (4CR)

Course Description

This course focuses on recent advances in Natural Language Processing and on developing skills for performing research to advance the state of the art in Natural Language Processing. This course builds upon concepts from Natural Language Processing (NLP 701) and assumes familiarity with fundamental concepts in Word Embedding, Information Extraction and Machine Translation.

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of language modelling, information extraction and machine translation tasks.

CLO2: Develop expertise in quantitatively analyzing and evaluating the various deep learning models for NLP problems.

CLO3: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, distant supervised and unsupervised learning methods.

CLO4: Critically analyze, evaluate, and improve the performance of the considered models.

CLO5: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to complex real-world NLP problems, in the shape of a project.

CLO6: Conceptualize, design, and implement an innovative solution for a highly complex NLP problem by applying principles learned in the course.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP705: Topics in Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate highly advanced ability and critical thinking in analyzing the computational properties and overcoming performance bottlenecks of complex NLP problems.

CLO2: Comprehensive understanding of how core machine learning concepts are used in NLP problems.

CLO3: Critique the latest body of knowledge in an advanced NLP sub-topic, chosen by the student during the course, and identify avenues for creating new knowledge in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to an NLP project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP706: Advanced Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Speech Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of the principles in probabilistic modelling and its application to Speech Processing problems.

CLO2: Develop expertise in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO3: Demonstrate a critical understanding of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Demonstrate a comprehensive and deep understanding of the pipelines at the frontier of Speech Processing (e.g., data, including models, algorithmic principles and empirics), enlisting their strengths and limitations, as well as the ability to propose ideas to address existing limitations.

CLO6: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

Ph.D. in Machine Learning

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

ML704: Machine Learning Paradigms (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course aims to train students to the level of expertise in learning algorithms in supervised, unsupervised, and semi-supervised domains, in addition to providing significant exposure to topics in transfer learning, multi-task learning, online learning, active learning, meta learning, and variational inference. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate comprehensive and deep understanding of the pipelines at the frontier of machine learning: data, models, algorithmic principles and empirics.

CLO2: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, unsupervised, semi-supervised, active, online, meta learning and other learning paradigms.

CLO3: Critically analyze, evaluate, and understand the performance of the different learning algorithms.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex real-world problem.

CLO5: Conceptualize, design, and implement a solution for a highly complex problem by applying principles learned in the course.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML705: Topics in Advanced Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will cover advanced topics in statistical machine learning, unsupervised learning, high-dimensional statistics, and reinforcement learning. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical understanding in topics from statistical machine learning, unsupervised learning, and high-dimensional statistics.

CLO2: Strong theoretical and empirical understanding of modern reinforcement learning methods and principles.

CLO3: Critique the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course, and identify avenues for improvement in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and executing theoretical or computational analysis of a complex problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML706: Advanced Probabilistic and Statistical Inference (4CR)

Course Description

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.

Course Objectives

During this course, the students will master some of the most important techniques for probabilistic and statistical inference and develop a broad understanding of the overall area. The specialized skill set developed in this course with be useful for making informed choices in analysing real-world data. The goal of this course is to master the state-of-the-art methods, promote discussions among students and motivate the students about the practical and scientific significance of reasoning about uncertainty. This course will provide the necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop comprehensive and deep understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Achieve critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspective.

CLO3: Develop expertise in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Demonstrate expertise in a chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem where noise and uncertainty are inherent in the data.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Develop a thorough understanding of the state-of-the-art as well as seminal literature in specialized topics covered in the course and demonstrate the ability to critique the existing body of knowledge, identify research gaps and come up with novel ideas at least at the conceptual level to address those open issues.

CLO7: Initiate, manage, and complete a project report along with a scientific talk including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

Research Thesis

Course Description

Masters 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. Masters 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.

Course Objectives

The goal of writing a research thesis is to train students to become researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate an understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, the proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

CV704: Advanced Computer Vision (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the algorithms for image restoration and enhancement, hand-crafted features, and visual target tracking, so the students become capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Comprehensive knowledge of properties of human vision, and strong theoretical and empirical foundations of advanced computer vision methods.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge on image restoration and enhancement, and visual object tracking, and the ability to propose novel ideas to make advancements in the field.

CLO3: Ability to apply advanced problem-solving skills in the development of real-world systems and applications for image restoration and enhancement, and visual target tracking.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to implement advanced computer vision algorithms.

CLO5: Develop advanced skills in leading complex projects by conceptualizing, formulating, setting up experimental protocols and achieving desired results on both low-level and high-level vision tasks.

CLO6: Demonstrate advanced skills in communicating highly-complex ideas, concepts, critique on approaches and key findings of the projects both orally and in the form of reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on advanced computer vision.

CV705: Advanced 3D Computer Vision (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the algorithms for 3D reconstruction, 3D scene understanding, and multi-view stereo so the students are capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Develop overarching knowledge of theoretical principles and methods for the following specialized topics in 3D computer vision: 3D reconstruction, 3D scene understanding, and multi-view stereo.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge and advance the cutting-edge research on 3D object detection and semantic segmentation, 3D reconstruction of dynamic scenes, and depth and motion estimation from stereo images.

CLO3: Demonstrate mastery in a chosen special topic by comprehending, investigating, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to solve complex 3D vision problems.

CLO5: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, and critique approaches and key findings of the projects both orally and in the form of reports.

CLO6: Ability to act professionally and engage actively in teams towards the completion of projects on 3D computer vision.

CV706: Neural Networks for Object Recognition and Detection (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of algorithms for image classification, object detection, instance segmentation, semantic segmentation and panoptic segmentation, so the students can become capable of doing research in these specialized topics and can implement these methods for building systems for real-world scene understanding. A significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Demonstrate strong theoretical and empirical understanding of conventional as well as deep learning based methods for visual object recognition and detection.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for image classification, object detection and segmentation, and be able to find potential research directions and open problems whose solution could create new knowledge.

CLO3: Demonstrate mastery in core visual recognition topics by conceptualizing, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Expertise in designing, training, and improving the performance of deep neural network architectures for visual recognition tasks.

CLO5: Develop advanced skills in solving complex real-world problems related to visual object recognition and detection by integrating knowledge from different fields such as image processing, computer vision and machine learning.

CLO6: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, critiques on approaches and key findings of the projects both orally and in the form of scientific reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on visual object recognition and detection.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

NLP704: Deep Learning for Language Processing (4CR)

Course Description

This course focuses on recent advances in Natural Language Processing and on developing skills for performing research to advance the state of the art in Natural Language Processing. This course builds upon concepts from Natural Language Processing (NLP 701) and assumes familiarity with fundamental concepts in Word Embedding, Information Extraction and Machine Translation.

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of language modelling, information extraction and machine translation tasks.

CLO2: Develop expertise in quantitatively analyzing and evaluating the various deep learning models for NLP problems.

CLO3: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, distant supervised and unsupervised learning methods.

CLO4: Critically analyze, evaluate, and improve the performance of the considered models.

CLO5: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to complex real-world NLP problems, in the shape of a project.

CLO6: Conceptualize, design, and implement an innovative solution for a highly complex NLP problem by applying principles learned in the course.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP705: Topics in Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate highly advanced ability and critical thinking in analyzing the computational properties and overcoming performance bottlenecks of complex NLP problems.

CLO2: Comprehensive understanding of how core machine learning concepts are used in NLP problems.

CLO3: Critique the latest body of knowledge in an advanced NLP sub-topic, chosen by the student during the course, and identify avenues for creating new knowledge in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to an NLP project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP706: Advanced Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Speech Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of the principles in probabilistic modelling and its application to Speech Processing problems.

CLO2: Develop expertise in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO3: Demonstrate a critical understanding of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Demonstrate a comprehensive and deep understanding of the pipelines at the frontier of Speech Processing (e.g., data, including models, algorithmic principles and empirics), enlisting their strengths and limitations, as well as the ability to propose ideas to address existing limitations.

CLO6: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

Ph.D. in Natural Language Processing

Core Courses

COM701: Research Communication and Dissemination (3CR)

Course Description

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

Course Objectives

The aim of this course is to help students develop strong written and oral communication skills that can be applied to effectively publicize their research findings. In addition, students will become familiarized with how the manuscript selection process works, and what it takes to get published in top journals and conferences.

Learning Outcomes

CLO1: Understand the objective of research communication, including how to plan, conduct, and document experiments with scientific communication as an end goal.

CLO2: Understand how a manuscript is organized, and the role of different sections.

CLO3: Acquire a strong understanding of how the publication process is managed at top conferences and journals and what are the elements of success.

CLO4: Achieve advanced ability to prepare and deliver a scientific talk, appropriately designed for the audience.

CLO5: Exhibit advanced understanding of how to organize sentences, paragraphs, and sections for smooth flow of arguments in a manuscript.

NLP701: Natural Language Processing (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the foundations of core Natural Language Processing algorithms.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern natural language processing pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in text processing – tokenization, segmentation, lemmatization and stemming.

CLO3: Gain proficiency in using various NLP tools - NLTK and CoreNLP.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, distant supervised and unsupervised learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world NLP problem.

CLO7: Gain proficiency in implementing neural networks

NLP702: Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to instil a deeper and thorough understanding of advanced Natural Language Processing algorithms, to equip students with capabilities of researching, developing and implementing these algorithms.

Learning Outcomes

CLO1: Demonstrate advanced ability to analyze computational properties and overcome performance bottlenecks of five advanced core NLP areas: word embedding, information extraction, machine translation, question answering and conversational agents

CLO2: Ability to critically understand currently existing advanced deep learning methods that are used to solve underlying challenges in the five core NLP areas.

CLO3: Ability to implement a language independent conversational agents' system, using state-of-the-art NLP techniques.

CLO4: Experimentally evaluate numerous advanced deep learning algorithms and summarize their results to solve problems related to five core NLP areas.

CLO5: Critique the latest body of knowledge in an advanced NLP sub-topic chosen by the student during the course.

CLO6: Demonstrate expertise in the chosen sub-topic by completing a novel theoretical or computational analysis of a relevant problem.

CLO7: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex NLP problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO8: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP703: Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate level course aims to equip students with deep understanding of foundations of core speech processing algorithms.

Learning Outcomes

CLO1: Demonstrate a deep and comprehensive understanding of the human hearing and speech system.

CLO2: Demonstrate a critical understanding of properties of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO3: Develop advanced skills in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world problem.

CLO6: Initiate, manage, and complete a technical report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation.

NLP704: Deep Learning for Language Processing (4CR)

Course Description

This course focuses on recent advances in Natural Language Processing and on developing skills for performing research to advance the state of the art in Natural Language Processing. This course builds upon concepts from Natural Language Processing (NLP 701) and assumes familiarity with fundamental concepts in Word Embedding, Information Extraction and Machine Translation.

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of language modelling, information extraction and machine translation tasks.

CLO2: Develop expertise in quantitatively analyzing and evaluating the various deep learning models for NLP problems.

CLO3: Demonstrate a critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, distant supervised and unsupervised learning methods.

CLO4: Critically analyze, evaluate, and improve the performance of the considered models.

CLO5: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to complex real-world NLP problems, in the shape of a project.

CLO6: Conceptualize, design, and implement an innovative solution for a highly complex NLP problem by applying principles learned in the course.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP705: Topics in Advanced Natural Language Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Natural Language Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate highly advanced ability and critical thinking in analyzing the computational properties and overcoming performance bottlenecks of complex NLP problems.

CLO2: Comprehensive understanding of how core machine learning concepts are used in NLP problems.

CLO3: Critique the latest body of knowledge in an advanced NLP sub-topic, chosen by the student during the course, and identify avenues for creating new knowledge in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to an NLP project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

NLP706: Advanced Speech Processing (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced Speech Processing methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Develop a comprehensive and deep understanding of the principles in probabilistic modelling and its application to Speech Processing problems.

CLO2: Develop expertise in quantitatively analyzing and evaluating the acoustic-phonetic properties of the speech signal.

CLO3: Demonstrate a critical understanding of the statistical models used in human speech recognition, speech synthesis and spoken dialogue systems.

CLO4: Demonstrate a critical awareness of the capabilities and limitations of the different forms of computational techniques for analyzing speech signals.

CLO5: Demonstrate a comprehensive and deep understanding of the pipelines at the frontier of Speech Processing (e.g., data, including models, algorithmic principles and empirics), enlisting their strengths and limitations, as well as the ability to propose ideas to address existing limitations.

CLO6: Achieve advanced problem-solving skills by independently implementing the speech recognition algorithms learnt in the course to a complex real-world project and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

Research Thesis

Description

Ph.D. thesis research exposes students to cutting-edge and unsolved research problems, where they are required to propose new solutions and significantly contribute towards the body of knowledge. Students pursue an independent research study, under the guidance of a supervisory panel, for a period of 3 to 4 years. Ph.D. thesis research helps train graduates to become leaders in their chosen area of research through a partly-supervised study, eventually transforming them into researchers who can work independently or interdependently to carry out cutting edge research.

Course Objectives

The goal of writing a research thesis is to train students to become independent researchers in the process. Thesis research equips students with capabilities to undertake an unsolved problem, explore relevant literature, propose a solution, and validate it through extensive experimental evaluations. Finally, the research findings and solutions are shared with the academic community in the form of scientific research papers.

Learning Outcomes

CLO1: Propose a research hypothesis and plan, manage and execute all experiments necessary to test the hypothesis.

CLO2: Demonstrate expert understanding of relevant literature along with the shortcomings and strengths of existing approaches.

CLO3: Master the methods relevant to solving the thesis research problem, along with their evaluation, critique, and implementation.

CLO4: Exhibit highly mature understanding in evaluation, interpretation, and presentation of results.

CLO5: Demonstrate depth and advanced expertise in the insights developed into the research problem by interpreting the results and drawing conclusions to validate or discard the hypothesis.

CLO6: Achieve an expert understanding of the current state of the art in the individual research area, and the ability to identify new problems arising from recent developments in and related to the chosen research domain within the discipline and propose new solutions which contribute to a wider body of knowledge.

CLO7: Express strong skills in communicating (orally and in writing) to researchers working in the relevant field, the research objectives, motivation, existing limitations, the proposed solution, its technical correctness, and validation through experimental evaluations.

Elective Courses

MTH701: Mathematical Foundations for Artificial Intelligence (4CR)

Course Description

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

Course Objectives

This elective course aims to familiarize students with mathematical foundations of artificial intelligence.

Learning Outcomes

After this course. Students will be able to:

CLO1: Master a range of concepts, theories and methods for linear algebra, probability theory and basic statistics used in Artificial Intelligence (AI).

CLO2: Demonstrate a deep understanding of the mathematical methods for current main AI research.

CLO3: Express advanced problem-solving skills by independently applying the mathematical principles to solve basic machine learning problems.

CLO4: Develop advanced abilities in abstract thinking, spatial imagination, logical reasoning and judgment.

MTH702: Optimization (4CR)

Course Description

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

Course Objectives

This course aims to inculcate a deeper understanding of the optimization methods, so the students are capable of researching, developing, and implementing these methods for solving various problems, including the ones frequently encountered in Machine Learning.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical thinking in analyzing the optimization programs with and without equality or inequality constraints.

CLO2: Achieve strong understanding of optimization algorithms required to solve optimization programs, along with their implementation, with and without equality or inequality constraints.

CLO3: Be able to describe and implement first and second-order optimization methods.

CLO4: Achieve comfort and fluency with software packages required to implement optimization methods.

CLO5: Exhibit strong understanding of how to correctly cast problems into an optimization framework and solve them using a software package.

AI701: Artificial Intelligence (4CR)

Course Description

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

Course Objectives

The aim of this course is to provide students with a comprehensive understanding of the modern development of AI foundations and techniques. Students will be able to develop advanced skills to build AI-based solutions for practical problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of basic terminologies, theories and methods related to artificial intelligence (AI).

CLO2: Ability to critique the capabilities and limitations of existing AI techniques and determine their suitability for different application domains such as natural language processing and robotics.

CLO3: Develop advance knowledge of search strategies, knowledge representation, probabilistic reasoning, planning and decision-making of intelligent agents.

CLO4: Express advanced skills in independently designing, developing, and evaluating AI-based solutions to practical problems.

CLO5: Develop advanced skills in using programming tools, libraries and other relevant resources in order to build and improve the performance of complex AI systems.

CLO6: Communicate effectively, act professionally and engage actively to promote the application of AI methods to various problems.

AI702: Deep Learning (4CR)

Course Description

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 deep models: convolutional neural networks, autoencoders, recurrent neural network, and deep generative models. Students will work on case studies of deep learning in different fields such as computer vision, medical imaging, natural language processing, etc.

Course Objectives

This course aims to familiarize students with the foundations of deep learning and its application domains. Specifically, students will be able to build, train, evaluate, and improve appropriate deep learning models for different problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop highly-specialized knowledge of different terminologies, theories, methods, and empirics related to deep learning.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing deep learning techniques and determine their suitability for different domains such as computer vision, healthcare, finance, and natural language processing.

CLO3: Grasp the skill of training and modeling with deep architectures; and have hands-on experience in using deep learning frameworks for this purpose.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources in order to train, and improve the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing, evaluating and deploying systems for image and video analysis, audio and speech analysis, financial data analysis, and medical imaging.

CLO6: Communicate effectively, act professionally and engage actively in a team towards the completion of the project.

DS701: Data Mining (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the modern development of data mining foundations and techniques. Students will be able to develop advanced skills to solve a wide range of unsupervised learning problems, such as frequent pattern mining and data clustering.

Learning Outcomes

CLO1: Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules. Identify efficient pattern mining methods, such as Apriori, ECLAT, and FPgrowth.

CLO2: Compare pattern evaluation issues, especially several popularly used measures, such as lift, chisquare, cosine, Jaccard, and Kulczynski, and their comparative strengths.

CLO3: Compare mining diverse patterns, including methods for mining multi-level, multi-dimensional patterns, qualitative patterns, negative correlations, compressed and redundancy-aware top-k patterns, and mining long (colossal) patterns.

CLO4: Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan. Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases. Learn constraint-based pattern mining, including methods for pushing different kinds of constraints, such as data and pattern-based constraints, anti-monotone, monotone, succinct, convertible, and multiple constraints. Learn pattern-based classifications, including CBA, CMAR, PatClass, and DPClass.

CLO5: Explore further topics on pattern analysis, such as pattern mining in data streams, software bug mining, pattern discovery for image analysis, and privacy-preserving data mining. Enjoy

various pattern mining applications, such as mining spatiotemporal and trajectory patterns and mining quality phrases.

CLO6: Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies. Learn multiple distance or similarity measures for cluster analysis, including Euclidean and Minkowski distances; proximity measures for symmetric and asymmetric binary variables; distance measures between categorical attributes, ordinal attributes, and mixed types; proximity measures between two vectors – cosine similarity; and correlation measures between two variables – covariance and correlation coefficient.

CLO7: Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms. Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach. Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS. Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE.

CLO8: Study concepts and methods for clustering evaluation and validation by introducing clustering validation using external measures and internal measures, and the measures for evaluating cluster stability and clustering tendency

DS702: Big Data Processing (4CR)

Course Description

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.

Course Objectives

The aim of this course is to provide students with the comprehensive understanding of the academic and industrial development of big data processing foundations and techniques. Students will understand the basic concepts of parallel computing, big data, MapReduce, Hadoop, etc. and will be able to develop advanced skills to solve practical big data processing problems.

Learning Outcomes

CLO1: Understand the basic concepts, motivations and brief histories of parallel computing and big data. Understand the general divide-and-conquer methodology of MapReduce big data processing. Understand the abstract Map and Reduce modules and their roles in the MapReduce problem-solving methodology.

CLO2: Understand the basic concepts, architecture, and working principles of Google MapReduce. Obtain basic knowledge of the distributed file system GFS and its working principle. Obtain basic knowledge of the distributed structured data storage Bigtable.

CLO3: Understand the basic concepts, architecture, and working principles of the open-sourced Hadoop MapReduce. Obtain basic knowledge of the Hadoop distributed file system HDFS.

CLO4: Understand the basic concepts, architecture, and working principles of the HDFS-based database system HBase and the HDFS-based data warehouse Hive.

CLO5: Know how to install and setup Hadoop in a single machine and in a cluster of machines. Learn to use the MapReduce divide-and-conquer methodology to solve practical problems such as sorting and archive analysis.

CLO6: Know how to program with HBase and Hive to solve data-intensive problems.

CLO7: Learn advanced MapReduce programming techniques. Know how to use user-defined functions, complex I/O operations, and composite key-value pairs to represent and solve complex problems. Know how to use the Partitioner and Combiner to solve complex problems.

Know how to design and implement iterative algorithms and chaining jobs. Acquire advanced skills such as linking multiple data sources and passing global parameters and data.

CLO8: Know how to implement the MapReduce versions of basic data mining algorithms such as k-means clustering, kNN classification, and the PSON algorithm for frequent itemset mining.

HC701: Medical Imaging: Physics and Analysis (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the fundamentals of Medical Imaging and its analysis. The course introduces the physics behind various imaging modalities such as x-ray, CT, MRI, Ultrasound, and PET and presents an overview of the 3D geometry relevant to medical image analysis from the perspective of solving registration and segmentation problems.

Learning Outcomes

CLO1: Demonstrate strong understanding of imaging modalities and the underlying physics.

CLO2: Gain strong understanding of safety issues in medical imaging, related to both patients and operators.

CLO3: Achieve ability to explain 3d image geometry in the context of medical images.

CLO4: Exhibit fluency in using existing medical image analysis tools to visualize and analyze medical images.

CLO5: Be able to pick and apply the right segmentation and registration tools and understand their strengths and limitations.

CV701: Human and Computer Vision (4CR)

Course Description

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 Objectives

This graduate level course will provide a coherent perspective on the different aspects of human and computer vision and give students the ability to understand state-of-the-art computer vision literature and implement components that are essential to many modern machine vision systems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Develop a comprehensive understanding of fundamental properties of human vision, and the process of image formation in cameras.

CLO2: Demonstrate highly-specialized knowledge of methodologies for extracting and processing low-level image features to develop modern computer vision applications.

CLO3: Ability to perform critical analysis and thorough evaluation of the existing body of knowledge and be able to determine novelty, gain insights and improve the performance of the computer vision approaches.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to implement complex computer vision algorithms.

CLO5: Express advanced skills by independently designing, developing and deploying solutions to complex real-world image processing and computer vision problems.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of computer vision projects and disseminate key findings through technical report writing.

CV702: Geometry for Computer Vision (4CR)

Course Description

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.

Course Objectives

This graduate level course aims to familiarize students with the fundamental concepts and techniques of geometric computer vision and introduce to them several real-world computer vision applications involving geometry.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate comprehensive understanding of the underlying theoretical principles of geometric computer vision.

CLO2: Express advanced skills in analyzing and solving various problems in geometric computer vision by applying principles and methods from differential geometry, numerical analysis and related fields learned in the course.

CLO3: Understand recent algorithms for 3D computer vision and be able to implement them in a programming language.

CLO4: Develop advanced skills in using programming tools, libraries and other relevant resources to develop complex geometry-aware 3D machine vision algorithms and applications.

CLO5: Ability to act autonomously in developing real-world applications for practical domains such as medical imaging, graphics and robotics.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of complex projects within 3D computer vision and disseminate key findings through scientific report writing.

CV703: Visual Object Recognition and Detection (4CR)

Course Description

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.

Course Objectives

The aim of this course is to enable students to build state-of-the-art systems for automatic image and video understanding to answer complex questions such as, what objects are present in a complex scene and where are they located? Students will be equipped with the skills for designing, implementing, training and evaluating complex neural network architectures to solve visual object recognition and detection problems.

Learning Outcomes

After this course. Students will be able to:

CLO1: Demonstrate highly-specialized understanding of different terminologies, theories and methods for recognition and detection of objects in images.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for object recognition, detection, segmentation and tracking.

CLO3: Ability to integrate knowledge from different fields (such as image processing, computer vision, machine learning, etc.) for solving complex problems related to visual object recognition, detection, segmentation and tracking.

CLO4: Become proficient in designing, training, and improving the performance of deep neural network architectures.

CLO5: Ability to act autonomously in developing and evaluating systems for image classification, object detection, segmentation and tracking in video sequences.

CLO6: Communicate effectively, act professionally and engage actively in teams towards the completion of visual recognition and detection projects and disseminate key findings through scientific report writing.

CV704: Advanced Computer Vision (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the algorithms for image restoration and enhancement, hand-crafted features, and visual target tracking, so the students become capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Comprehensive knowledge of properties of human vision, and strong theoretical and empirical foundations of advanced computer vision methods.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge on image restoration and enhancement, and visual object tracking, and the ability to propose novel ideas to make advancements in the field.

CLO3: Ability to apply advanced problem-solving skills in the development of real-world systems and applications for image restoration and enhancement, and visual target tracking.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to implement advanced computer vision algorithms.

CLO5: Develop advanced skills in leading complex projects by conceptualizing, formulating, setting up experimental protocols and achieving desired results on both low-level and high-level vision tasks.

CLO6: Demonstrate advanced skills in communicating highly-complex ideas, concepts, critique on approaches and key findings of the projects both orally and in the form of reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on advanced computer vision.

CV705: Advanced 3D Computer Vision (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of the algorithms for 3D reconstruction, 3D scene understanding, and multi-view stereo so the students are capable of researching, developing, and implementing these methods for solving computer vision problems of real-world scale. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Develop overarching knowledge of theoretical principles and methods for the following specialized topics in 3D computer vision: 3D reconstruction, 3D scene understanding, and multi-view stereo.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge and advance the cutting-edge research on 3D object detection and semantic segmentation, 3D reconstruction of dynamic scenes, and depth and motion estimation from stereo images.

CLO3: Demonstrate mastery in a chosen special topic by comprehending, investigating, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Develop expertise in using programming tools, libraries and other relevant resources to solve complex 3D vision problems.

CLO5: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, and critique approaches and key findings of the projects both orally and in the form of reports.

CLO6: Ability to act professionally and engage actively in teams towards the completion of projects on 3D computer vision.

CV706: Neural Networks for Object Recognition and Detection (4CR)

Course Description

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

Course Objectives

This PhD course aims to inculcate a deeper understanding of algorithms for image classification, object detection, instance segmentation, semantic segmentation and panoptic segmentation, so the students can become capable of doing research in these specialized topics and can implement these methods for building systems for real-world scene understanding. A significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects and develop their communication and analytical skills by engaging them in reading group activities.

Learning Outcomes

CLO1: Demonstrate strong theoretical and empirical understanding of conventional as well as deep learning based methods for visual object recognition and detection.

CLO2: Demonstrate critical awareness of the strengths and weaknesses of the existing body of knowledge for image classification, object detection and segmentation, and be able to find potential research directions and open problems whose solution could create new knowledge.

CLO3: Demonstrate mastery in core visual recognition topics by conceptualizing, designing and implementing novel solutions to the relevant challenging problems.

CLO4: Expertise in designing, training, and improving the performance of deep neural network architectures for visual recognition tasks.

CLO5: Develop advanced skills in solving complex real-world problems related to visual object recognition and detection by integrating knowledge from different fields such as image processing, computer vision and machine learning.

CLO6: Demonstrate advanced skills in independently communicating highly-complex ideas, concepts, critiques on approaches and key findings of the projects both orally and in the form of scientific reports.

CLO7: Ability to act professionally and engage actively in teams towards the completion of projects on visual object recognition and detection.

ML701: Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate level course aims to familiarize students with foundations of core machine learning algorithms. This course aims to instill in students a strong grasp of supervised and unsupervised as well as the variants of learning algorithms. In addition, this course aims to expose students to the basics of learning theory, graphical models, and reinforcement learning.

Learning Outcomes

CLO1: Demonstrate highly-specialized understanding of the modern machine learning pipeline: data, models, algorithmic principles and empirics.

CLO2: Develop advanced skills in data-preprocessing – handling missing data, noisy labels, dimensionality reduction, working with ordinal, categorical, and continuous data.

CLO3: Gain proficiency in using data exploration and visualization tools.

CLO4: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, including supervised, unsupervised, generative, and discriminative learning.

CLO5: Critically analyze, evaluate, and improve the performance of the learning algorithms.

CLO6: Express advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex real-world problem.

CLO7: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates insights and expert self-evaluation.

ML702: Advanced Machine Learning (4CR)

Course Description

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 Objectives

This graduate-level course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will aim to instill in students a strong grasp of the following topics: kernel methods, statistical complexity, statistical decision theory, computational complexity of learning algorithms, and reinforcement learning. Additionally, a goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Achieve strong understanding of kernel methods, statistical complexity, statistical decision theory, and reinforcement learning.

CLO2: Understand in depth the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course.

CLO3: Demonstrate expertise in completing a theoretical or computational analysis of an advanced machine learning problem.

CLO4: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML703: Probabilistic and Statistical Inference (4CR)

Course Description

Probabilistic and statistical inference is the process of drawing useful conclusions about data populations or scientific truths from uncertain and noisy data. This course will cover 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 an 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.

Course Objectives

During this course, the students will develop an understanding of the broad field of probabilistic and statistical inference and use this information for making informed choices in analysing data. The goal of this course is to introduce basic concepts, motivate the students about the practical and scientific significance of reasoning about uncertainty and provide necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop a comprehensive understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Gain critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspectives.

CLO3: Develop advanced skills in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem where noise and uncertainty are inherent in the data.

CLO5: Initiate, manage, and complete a project report including a critique on approaches and outcomes in the project that demonstrates expert understanding and self-evaluation.

ML704: Machine Learning Paradigms (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course aims to train students to the level of expertise in learning algorithms in supervised, unsupervised, and semi-supervised domains, in addition to providing significant exposure to topics in transfer learning, multi-task learning, online learning, active learning, meta learning, and variational inference. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate comprehensive and deep understanding of the pipelines at the frontier of machine learning: data, models, algorithmic principles and empirics.

CLO2: Demonstrate critical awareness of the capabilities and limitations of the different forms of learning algorithms, and expertise in applying supervised, unsupervised, semi-supervised, active, online, meta learning and other learning paradigms.

CLO3: Critically analyze, evaluate, and understand the performance of the different learning algorithms.

CLO4: Express advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex real-world problem.

CLO5: Conceptualize, design, and implement a solution for a highly complex problem by applying principles learned in the course.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML705: Topics in Advanced Machine Learning (4CR)

Course Description

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

Course Objectives

This graduate course aims to inculcate a deeper understanding of the advanced machine learning methods, so the students are capable of researching, developing, and implementing these methods for solving real-world problems. This course will cover advanced topics in statistical machine learning, unsupervised learning, high-dimensional statistics, and reinforcement learning. Additionally, a significant goal of this course is to enhance students' teamwork skills by requiring them to participate in group projects.

Learning Outcomes

CLO1: Demonstrate advanced ability and critical understanding in topics from statistical machine learning, unsupervised learning, and high-dimensional statistics.

CLO2: Strong theoretical and empirical understanding of modern reinforcement learning methods and principles.

CLO3: Critique the latest body of knowledge in an advanced machine learning sub-topic, chosen by the student during the course, and identify avenues for improvement in this area.

CLO4: Demonstrate expertise in the chosen sub-topic by conceptualizing, designing, and executing theoretical or computational analysis of a complex problem.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learnt in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Initiate, manage, and complete project reports including a critique on approaches and outcomes in the projects that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

ML706: Advanced Probabilistic and Statistical Inference (4CR)

Course Description

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.

Course Objectives

During this course, the students will master some of the most important techniques for probabilistic and statistical inference and develop a broad understanding of the overall area. The specialized skill set developed in this course with be useful for making informed choices in analysing real-world data. The goal of this course is to master the state-of-the-art methods, promote discussions among students and motivate the students about the practical and scientific significance of reasoning about uncertainty. This course will provide the necessary background in frequentist and Bayesian approaches to statistical inference.

Learning Outcomes

CLO1: Develop comprehensive and deep understanding of the principles of probabilistic modeling and its application to machine learning problems.

CLO2: Achieve critical insights into the mathematical underpinnings of the statistical inference process from Bayesian and frequentist perspective.

CLO3: Develop expertise in analyzing and evaluating the computational implementation of probabilistic modeling and evaluate the challenges in scaling probabilistic models to high dimensional spaces.

CLO4: Demonstrate expertise in a chosen sub-topic by conceptualizing, designing, and implementing a novel theoretical or computational analysis of a relevant problem where noise and uncertainty are inherent in the data.

CLO5: Achieve advanced problem-solving skills by independently applying the principles and methods learned in the course to a complex problem and demonstrate expertise in dealing with ambiguity in a problem statement.

CLO6: Develop a thorough understanding of the state-of-the-art as well as seminal literature in specialized topics covered in the course and demonstrate the ability to critique the existing body of knowledge, identify research gaps and come up with novel ideas at least at the conceptual level to address those open issues.

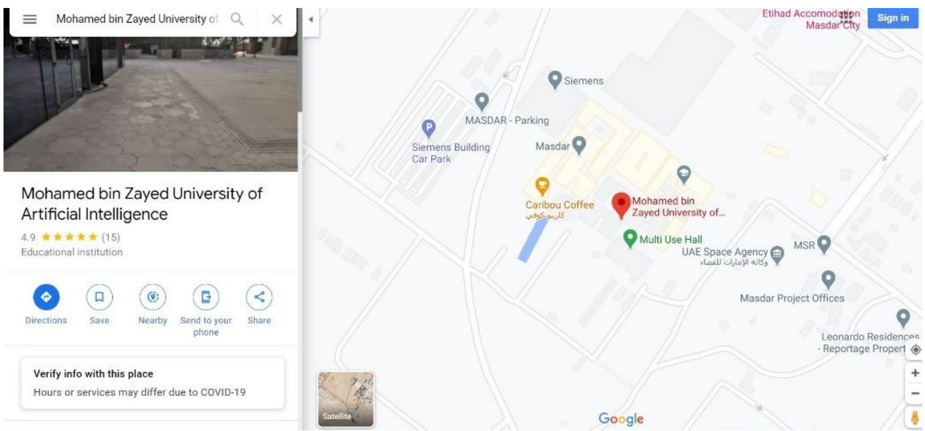
CLO7: Initiate, manage, and complete a project report along with a scientific talk including a critique on approaches and outcomes in the project that demonstrates expert self-evaluation and advanced skills in communicating highly-complex ideas.

11 Where to find further Information

For any other further inquiries, please find below the list of contacts:

Admission	admission@mbzuai.ac.ae
Career Services	careerservices@mbzuai.ac.ae
IT Helpdesk	Helpdesk@mbzuai.ac.ae
HR Department	hr@mbzuai.ac.ae
Finance Department	payments@mbzuai.ac.ae
Registrar Office	registrar@mbzuai.ac.ae
Office of the President	President@mbzuai.ac.ae
Marketing and Communication Department	communications@mbzuai.ac.ae
Research	research@mbzuai.ac.ae
Facilities management (Maintenance)	facilities@mbzuai.ac.ae
Security	Security@mbzuai.ac.ae

Where to find us



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