UNIVERSITÀ DEGLI STUDI MILANO-BICOCCA

"GIUSEPPE OCCHIALINI" DEPARTMENT OF PHYSICS

INTERUNIVERSITY MASTER'S DEGREE PROGRAMME IN

ARTIFICIAL INTELLIGENCE FOR SCIENCE AND TECHNOLOGY

(CLASS LM-91)

Study Manifesto A.Y. 2023/2024

1. Teaching activities

In the academic year 2023-2024, the **first** and **second year** of the Interuniversity Master's Degree Programme in Artificial Intelligence for Science and Technology, Class LM-91, jointly organised by the Università degli Studi di Milano-Bicocca (UNIMIB), the Università degli Studi di Milano (UNIMI) and the Università degli Studi di Pavia, are activated.

The teaching activities activated respectively for the first and second year are listed below.

YEAR I
For students enrolling in the A. Y. 2023/2024 – degree programme's Academic Regulation (A. Y. 2023/2024)

Mandatory courses

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q001	**ADVANCED FOUNDATIONS OF MATHEMATICS FOR AI**	**6**	MAT/07	F9102Q001M	ADVANCED FOUNDATIONS OF MATHEMATICS FOR AI	6	First Semester
F9102Q002	**ADVANCED FOUNDATIONS OF STATISTICS FOR AI**	**6**	SECS-S/01	F9102Q002M	ADVANCED FOUNDATIONS OF STATISTICS FOR AI	6	First Semester
F9102Q003	**ADVANCED FOUNDATIONS OF PHYSICS FOR AI**	**6**	FIS/01	F9102Q003M	ADVANCED FOUNDATIONS OF PHYSICS FOR AI	6	First Semester
F9102Q004	**ADVANCED FOUNDATIONS OF ARTIFICIAL INTELLIGENCE**	**12**	ING-INF/05	F9102Q004M	ARTIFICIAL INTELLIGENCE	6	First Semester
			INF/01	F9102Q035M	AI FOR SIGNAL AND IMAGE PROCESSING	6	First Semester

Compulsory Application Area Selection

Students must choose one of the following Application Areas:

Application Area n. 1: **AI for Industry and Environment**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q007	**SYSTEMS FOR INDUSTRY 4.0 AND ENVIRONMENT (IoT)**	**6**	ING-INF/05	F9102Q007M	SYSTEMS FOR INDUSTRY 4.0 AND ENVIRONMENT (IoT)	6	Second semester
F9102Q008	**ADVANCED DATA MANAGEMENT AND DECISION SUPPORT SYSTEMS**	**6**	INF/01	F9102Q008M	ADVANCED DATA MANAGEMENT AND DECISION SUPPORT SYSTEMS	6	Second semester

F9102Q009	**ADVANCED ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DEEP LEARNING**	**6**	INF/01	F9102Q009M	ADVANCED ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DEEP LEARNING	6	Second semester
F9102Q029	**SENSING AND VISION FOR INDUSTRY AND ENVIRONMENT**	**12**	ING-INF/03	F9102Q029M	INTELLIGENT SENSING AND REMOTE SENSING	6	Second semester
			INF/01	F9102Q030M	VISION FOR INDUSTRY AND ENVIRONMENT	6	Second semester

Application Area n. 2: **Intelligent Embedded Systems**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q012	**EMBEDDED SYSTEMS ARCHITECTURES AND DESIGN**	**6**	ING-INF/05	F9102Q012M	EMBEDDED SYSTEMS ARCHITECTURES AND DESIGN	6	Second semester
F9102Q008	**ADVANCED DATA MANAGEMENT AND DECISION SUPPORT SYSTEMS**	**6**	INF/01	F9102Q008M	ADVANCED DATA MANAGEMENT AND DECISION SUPPORT SYSTEMS	6	Second semester
F9102Q009	**ADVANCED ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DEEP LEARNING**	**6**	INF/01	F9102Q009M	ADVANCED ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DEEP LEARNING	6	Second semester
F9102Q030	**AMBIENT INTELLIGENCE**	**12**	INF/01	F9102Q031M	ADVANCED HUMAN-SYSTEM INTERFACES	6	Second semester
			ING-INF/05	F9102Q032M	AMBIENT INTELLIGENCE AND DOMOTICS	6	Second semester

Application Area n. 3: **Sensing and Signal/Image Processing for Healthcare and Environment**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q015	**ADVANCED COMPUTATIONAL TECHNIQUES FOR BIG IMAGING AND SIGNAL DATA**	**6**	INF/01	F9102Q015M	ADVANCED COMPUTATIONAL TECHNIQUES FOR BIG IMAGING AND SIGNAL DATA	6	Second semester
F9102Q016	**SIGNAL AND IMAGING ACQUISITION AND MODELLING IN HEALTHCARE**	**6**	FIS/07	F9102Q016M	SIGNAL AND IMAGING ACQUISITION AND MODELLING IN HEALTHCARE	6	Second semester
F9102Q017	**SIGNAL AND IMAGING ACQUISITION AND MODELLING IN ENVIRONMENT**	**6**	FIS/01	F9102Q017M	SIGNAL AND IMAGING ACQUISITION AND MODELLING IN ENVIRONMENT	6	Second semester
F9102Q031	**MACHINE LEARNING FOR MODELLING**	**12**	INF/01	F9102Q033M	SUPERVISED LEARNING	6	Second semester
			ING-INF/05	F9102Q034M	UNSUPERVISED LEARNING	6	Second semester

Application Area n. 4: **Complex Systems and Quantum Technologies**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q022	**AI MODELS FOR PHYSICS**	**6**	FIS/02	F9102Q022M	AI MODELS FOR PHYSICS	6	Second semester
F9102Q023	**STATISTICAL LEARNING**	**6**	INF/01	F9102Q023M	STATISTICAL LEARNING	6	Second semester

F9102Q024	**QUANTUM SIMULATION**	**6**	FIS/03	F9102Q024M	QUANTUM SIMULATION	6	Second semester
F9102Q031	**MACHINE LEARNING FOR MODELLING**	**12**	INF/01	F9102Q033M	SUPERVISED LEARNING	6	Second semester
			ING-INF/05	F9102Q034M	UNSUPERVISED LEARNING	6	Second semester

YEAR II

For students enrolled in the A. Y. 2022/2023 – degree programme's Academic Regulation (A. Y. 2022/2023)

Compulsory Common Teaching and Training Activities

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q005	**DATA-DRIVEN ORGANIZATIONS AND MANAGEMENT**	**6**	SECS-P/10	F9102Q005M	DATA-DRIVEN ORGANIZATIONS AND MANAGEMENT	6	First Semester
F9102Q006	**ADVANCED FOUNDATIONS OF LAW AND REGULATIONS IN PRIVACY AND DATA PROTECTION**	**6**	IUS/04	F9102Q006M	ADVANCED FOUNDATIONS OF LAW AND REGULATIONS IN PRIVACY AND DATA PROTECTION	6	First Semester
Type D TAF	**FREE-CHOICE TEACHING ACTIVITIES**	**12**	NN				
F9102Q037	**STAGE**	**6**	NN				
F9102Q038	**FINAL EXAMINATION**	**21**	PROFIN_S				

Optional Common Teaching Activity

Students must choose one of the following Further Linguistic Knowledge activities:

Code	Teaching Activity	CFUs	Academic Discipline
F9102Q032	**FURTHER LINGUISTIC KNOWLEDGE - ENGLISH - C1 LEVEL (OR HIGHER)**	**3**	NN
F9102Q033	**FURTHER LINGUISTIC KNOWLEDGE - FRENCH - B2 LEVEL (OR HIGHER)**	**3**	NN
F9102Q034	**FURTHER LINGUISTIC KNOWLEDGE - GERMAN - B2 LEVEL (OR HIGHER)**	**3**	NN
F9102Q035	**FURTHER LINGUISTIC KNOWLEDGE - SPANISH - B2 LEVEL (OR HIGHER)**	**3**	NN
F9102Q036	**FURTHER LINGUISTIC KNOWLEDGE - ITALIAN - B2 LEVEL (OR HIGHER)**	**3**	NN

Optional Teaching Activity

Students must choose a teaching activity among those offered in the **second year** taking into account the Application Area selected in the first year.

Application Area n.1: **AI for Industry and Environment**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q010	**INTELLIGENT MONITORING AND CONTROL SYSTEMS**	**6**	**ING-INF/04**	F9102Q010M	INTELLIGENT MONITORING AND CONTROL SYSTEMS	6	First Semester
F9102Q011	**ENVIRONMENTAL MONITORING AND MANAGEMENT**	**6**	**ING-INF/03**	F9102Q011M	ENVIRONMENTAL MONITORING AND MANAGEMENT	6	First Semester

Application Area n.2: **Intelligent Embedded Systems**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q013	**EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS**	**6**	**ING-INF/06**	F9102Q013M	EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS	6	First Semester
F9102Q014	**INTELLIGENT CONSUMER TECHNOLOGIES**	**6**	**INF/01**	F9102Q014M	INTELLIGENT CONSUMER TECHNOLOGIES	6	First Semester

Application Area n.3: **Sensing and Signal/Image Processing for Healthcare and Environment**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q018	**PHYSICAL SENSORS AND SYSTEMS FOR BIOMEDICAL SIGNALS**	**6**	**FIS/03**	F9102Q018M	PHYSICAL SENSORS AND SYSTEMS FOR BIOMEDICAL SIGNALS	6	First Semester
F9102Q019	**PHYSICAL SENSORS AND SYSTEMS FOR ENVIRONMENTAL SIGNALS**	**6**	**FIS/03**	F9102Q019M	PHYSICAL SENSORS AND SYSTEMS FOR ENVIRONMENTAL SIGNALS	6	First Semester
F9102Q020	**PHYSICAL SENSORS AND SYSTEMS FOR BIOMEDICAL IMAGING**	**6**	**FIS/07**	F9102Q020M	PHYSICAL SENSORS AND SYSTEMS FOR BIOMEDICAL IMAGING	6	First Semester
F9102Q021	**PHYSICAL SENSORS AND SYSTEMS FOR ENVIRONMENTAL IMAGING**	**6**	**FIS/07**	F9102Q021M	PHYSICAL SENSORS AND SYSTEMS FOR ENVIRONMENTAL IMAGING	6	First Semester

Application area n.4: **Complex Systems and Quantum Technologies**

Code	Teaching Activity	CFUs	Academic Discipline	Module Code	Module	CFUs	Semester
F9102Q025	**ADVANCED STATISTICAL MECHANICS AND DISORDERED SYSTEMS**	**6**	**FIS/02**	F9102Q025M	ADVANCED STATISTICAL MECHANICS AND DISORDERED SYSTEMS	6	First Semester
F9102Q026	**QUANTUM INFORMATION AND ALGORITHMS**	**6**	**INF/01**	F9102Q026M	QUANTUM INFORMATION AND ALGORITHMS	6	First Semester
F9102Q027	**STATISTICAL MECHANICS OF NEURAL NETWORKS**	**6**	**FIS/02**	F9102Q027M	STATISTICAL MECHANICS OF NEURAL NETWORKS	6	First Semester
F9102Q028	**QUANTUM COMPUTERS AND TECHNOLOGIES**	**6**	**FIS/02**	F9102Q028M	QUANTUM COMPUTERS AND TECHNOLOGIES	6	First Semester

2. Enrolment

To be admitted to the Master's Degree Programme in Artificial Intelligence for Science and Technology, students must achieve a bachelor's degree, a three-year university diploma, or a degree obtained abroad and recognised as suitable by the Evaluation Committee.

Basic knowledge of Computer Science, Mathematics, Statistics and Physics is crucial. Therefore, the possession of at least 30 total credits (CFUs) is required in the following academic disciplines: INF/01, ING-INF/05, ING-INF/03, from MAT/01 to MAT/09, from SECS-S/01 to SECS-S/06, from FIS/01 to FIS/08.

Once the curricular requirements have been verified, admission to the course is conditional on the assessment of the adequacy of the students' academic preparation.
The academic preparation will be evaluated through an admission interview by the Evaluation Committee. The interview will assess applicants' basic knowledge in Computer Science, Mathematics, Statistics and Physics.
Knowledge of the following subjects will be tested:

- Computer Science: Programming, Algorithms, Data Structures, Artificial Intelligence.
- Mathematics: Linear Algebra, Differential and Integral Calculus in one or more variables, Numerical Series.
- Statistics: Descriptive Statistics, Probability, Random Variables, Inference, Linear Model.
- Physics: elements of Statistics, Dynamics, Energy, Thermodynamics, Electromagnetism, and Optics.

Students who meet the curricular requirements and who have obtained a bachelor's degree with a grade equal to or higher than 100/110 or who have obtained a master's degree in one of the following classes are exempted from interviews: LM-17, LM-18, LM-21, LM-25, LM-27, LM-32, LM-35, LM-40, LM-44, LM-66, LM-82, LM-91.

The interviews will be held remotely.

A level of English language proficiency equal to or higher than level B2 is also required for admission. The English language proficiency requirement is considered fulfilled if the candidate:

a) possesses a certification, recognised by the University, issued by an accredited body, corresponding to level B2 or higher.
b) has obtained the Bbetween English B2 Open Badge of the Università degli Studi di Milano-Bicocca, has passed the Placement test in English B2 of the Università degli Studi di Milano, or has obtained the English B2 certification of the Language Center of the Università degli Studi di Pavia.
c) has obtained a degree taught entirely (or mostly) in English.

Instructions for application, as well as the dates of the interviews will be published on the webpage dedicated to the degree programme.

3. Previous Academic Careers Recognition and Transfer Option

Students transferred from another master's degree programme or students who have lost their student status, or they possess another master's degree must request a career evaluation to verify the adequacy of personal preparation and possession of the curricular requirements. The Teaching Coordination Council will decide on the total or partial recognition of previous academic careers.
In the case of transfer from another master's degree course belonging to Class LM-91, the share of CFUs related to the same academic discipline, directly recognised to the student cannot be less than 50% of the credits already achieved (DM 16 March 2007).

According to Ministerial Decree 270/2004 and Law 240/2010, universities may recognise the professional knowledge and skills individually certified, in accordance with current legislation on the subject. As well as other knowledge and skills gained in post-secondary level educational activities whose design and implementation the University took part awarding 12 CFUs maximum, in total between degree and master's degree programmes.
Teaching activities already recognised to award CFUs in the context of degree programmes cannot be recognised twice.

Information on how to submit transfer applications is published on the following website: https://www.unimib.it/servizi/segreterie-studenti/passaggi-trasferimenti-e-rinunce

4. Teaching Activities Timetable

The lessons of the **first semester** will take place from **25 September 2023** to **22 December 2023.**
The lessons of the **second semester** will take place from **4 March to 7 June 2024.**

Class schedules will be published in the student's web calendar:
https://gestioneorari.didattica.unimib.it/PortaleStudentiUnimib/

5. Teaching Programmes

The Syllabi are available on the e-learning platform at the following link: https://elearning.unimib.it/course/index.php?categoryid=9164

6. Free-Choice Teaching Activities

For these teaching activities, at least 12 CFUs must be achieved. Students may obtain these credits by passing examinations.

The activities may be freely chosen among those activated in the Master's Degree Programme in Artificial Intelligence for Science and Technology and among those from other degree programmes offered by the University, which need to be approved in the study plan. According to current legislation, for calculating the total number of exams, the student's free-choice activities are considered as a single examination.

7. Further Linguistic Knowledge

The acquisition of 3 CFUs relating to "Further Linguistic Knowledge" takes place as described below:

Italian students:
- passing a French, Spanish or German language proficiency university test, level B2.
OR
- passing an English language proficiency university test, level C1.

Italian students who possess an Open Badge, issued by the Università degli Studi di Milano-Bicocca, or certifications issued by bodies accredited by the University, certifying at least the B2 level linguistic knowledge of French, Spanish or German, or certifying at least the C1 level linguistic knowledge of English, will be entitled to exemption from the test and recognition of the expected CFU credits.

Foreign students
- passing a university test of verification of knowledge of the Italian language, level B2.

Foreign students who achieved an Open Badge issued by the Università di Milan-Bicocca or of certifications issued by Bodies accredited by the University, certifying at least the B2 level linguistic knowledge of Italian, will be entitled to exemption from the test and recognition of the expected CFU credits.

Information on how to carry out the tests or the acquisition of credits will be available on the University website, at the following address:
https://www.unimib.it/didattica/opportunita/lingue-unimib.

8. Internship

The training activity includes a theoretical-experimental internship (6 CFUs) for the preparation of the thesis.
The internship can be carried out at universities, institutions, or companies, in Italy or abroad.
The student is followed by an internal tutor and, if s/he carries out his/her activity outside the University, by an external tutor, according to the provisions of the training program agreed between the University and the institution/company for carrying out the internship.
The recognition of the credits is subject to the achievement of the training objectives. Only if the evaluation is positive, the student obtains the corresponding credits.

9. Educational Forms

The teaching activities consist of lectures, exercises and laboratory activities.
The acquisition of knowledge and skills by the student is assessed in University Training Credits (CFUs). 1 CFU corresponds to the average time commitment for a student of the course (25 hours), including the training activities implemented by the master's degree course and the commitment reserved for personal study or other individual educational activities.

For the acquisition of 1 CFU the following correspondences are provided:
- 8 hours of lectures
- 12 hours of exercises
- 12 hours of laboratory activity

The credits corresponding to each activity are attributed to the student after passing its exam or through another form of verification of the preparation and skills acquired.

10. Credits Earned in Excess of Degree Requirements *(Academic Senate Resolution 11 May 2020)*

By way of derogation from the provisions of art. 22 paragraph 3) of the Academic Regulations of the University in force, the Academic Senate, by resolution of 11 May 2020, has provided, also for students enrolled in master's degree courses, the possibility of including in their study plan activities in excess up to 16 CFUs, starting from the academic year 2019/2020.
The 16 credits earned in excess can be acquired through the recognition of examinations, Erasmus activities or transversal activities offered by the University.
The credits and grades obtained for the additional courses are not included in the calculation for the average of the grades but are recorded in the career and will be reported in the Diploma Supplement.

11. Examinations

Verification methods
The examinations involve the attribution of a mark expressed in thirtieths and can be carried out in oral and/or written form, as prescribed by the Academic Regulation of the University and by the Student Regulation. However, a written test cannot be based solely on multiple-choice questions.
Details on the method of verification and evaluation of each individual teaching activity can be found in its respective syllabus. The syllabi are published on the website of the course of study in the "Courses" section.
For the internship and for further linguistic knowledge activities the evaluation is expressed through judgment.

Teaching activities and examination sessions
The teaching activities are divided into two semesters: October-January and March-June.
They will take place in the offices of the Università degli Studi di Milano-Bicocca, Milano and Pavia, according to rules of alternation that will be promptly published on the course website.

The examination sessions, scheduled in the periods of lessons suspension, are distributed in the three periods: winter, summer and autumn. They will take place at the Università degli Studi di Milano-Bicocca.

The examination calendar is published in the student's web agenda at: http://gestioneorari.didattica.unimib.it/PortaleStudentiUnimib.

Sessions by individual activity, by Degree Programme or by Department can be displayed in the Sessions Bulletin Board.

Registration for examinations must be performed through Segreterie Online.

12. Study Plan

The study plan is the set of compulsory teaching activities, those planned as optional, and the teaching activities freely selected by the student in accordance with the degree programme's teaching regulations. A study plan is assigned at the time of enrollment in the first year, which constitutes the Statutory Study Plan. Subsequently, the student must present his/her own study plan with an indication of the optional activities and those of their choice. The Teaching Coordination Council approves the study plan, while the University defines the methods and deadlines for submitting the plan.
The right of the student to undergo verification tests related to a teaching activity is subject to the presence of the activity itself in the last approved study plan.

For further information, please refer to the Student Regulation available at the following link:
https://www.unimib.it/sites/default/files/allegati/regolazione_studenti_2019_con_decreto.pdf

More information will be published on the website: https://www.unimib.it/servizi/segreterie-studenti/piani-degli-studi/area-scienze

13. Final Examination

The Master's Degree in Artificial Intelligence for Science and Technology is achieved by passing the final exam, consisting of the presentation and discussion of a dissertation. The thesis must be developed solely by the student, under the guidance of a supervising professor, and consists of a written report on a topic chosen within the framework of the academic course of the master's degree programme and object of the theoretical-experimental internship activity. The dissertation typically describes the activities carried out by

the student, the knowledge and skills acquired in theoretical and/or experimental study, as well as the links with the current technological progress in the field of Artificial Intelligence. In particular, the scientific and technological results obtained will be presented, highlighting innovation and relevance in the specific scientific/technological field of application. The internship activity can be carried out at universities, institutions or companies, in Italy or abroad.

14. Final Examination: Rules of Conduct

The final exam, which leads to the achievement of 21 CFUs, consists of the discussion of the thesis in front a committee. The thesis must be written and discussed in English. The graduation mark is expressed in one hundred and tenths.

The session timetables, deadlines and operating instructions are published on degree programme website.

15. Contact Us

The administrative headquarters of the degree programme is the Università degli Studi di Milano-Bicocca, at the Department of Physics "Giuseppe Occhialini", Piazza della Scienza 3, 20126 Milan.

For information regarding admission, transfers and administrative procedures, please contact: segr.studenti.scienze@unimib.it

For information on the degree programme, please contact: Mail: AI4ST@unimib.it

For the procedures and deadlines of the University regarding registrations/registrations, transfers, presentation of the Study Plans consult the website www.unimib.it.

Information related to the organization of teachings and contacts will be published on the following website: https://elearning.unimib.it/course/index.php?categoryid=9164