

SELLO	EURO-INF
Higher Education Institution:	UNIVERSIDAD POLITÉCNICA DE MADRID
Country:	SPAIN
State/province:	Community of Madrid
Name of the programme:	MSc. in Artificial Intelligence
Degree awarded:	
Qualification Level :	Second Cycle
Programme Objectives; Profile:	<p>OBJECTIVES</p> <p>The objective of the MSc in Artificial Intelligence is: To prepare students for innovation in the area of Artificial Intelligence, in two ways: firstly, the creation of innovative techniques and methods within the research area of Artificial Intelligence and, secondly, the application of these techniques and methods relative to social and business reality as well as creating processes and innovative computer solutions.</p> <p>Consequently, a higher degree of knowledge in Artificial Intelligence will be afforded and provided to Computer Engineering and Science and Technology professionals studying this course. This will enable them to deal with and solve problems of both a scientific and technological nature using techniques and methods resulting from recent research.</p> <p>This general objective can be completed using two additional and intrinsic goals. Firstly, the idea of innovating in order to research and, simultaneously, the idea of researching in order to innovate. The first goal suggests innovative programmes, which are able to combine the specialized nature of the degree with creativity that underlies original and productive research directions. The second one is about the ability to be creative when addressing and solving problems through research.</p> <p>Therefore, the global objective is materialized in more specific objectives that are shown in the following table:</p> <ul style="list-style-type: none"> • Acquire advance training of a specialized and multidisciplinary nature, geared towards promoting the introduction to research work in Artificial Intelligence. • Provide a higher degree of knowledge in Artificial Intelligence techniques and methods, to be able to deal with and solve technological and scientific problems through the research (research in order to innovate). • Create innovative programmes that are able to combine the specialized nature of the degree with creativity that underlies original, active and productive research

	<p>directions (innovate in order to research) in Artificial Intelligence.</p> <ul style="list-style-type: none"> • Enable students to be creative in addressing and solving scientific and technological problems through research in Artificial Intelligence. <p>ACADEMIC CHARACTERISTICS</p> <p>The degree which the student holds must be in Computer Science:</p> <p>BSc in Computer Science, Computer Engineering, Technical Engineering in Computer Management, Technical Engineering in Computer Systems</p> <p>or similar:</p> <p>Technical Engineering in Telecommunications, Superior Industrial Technical Engineering, Industrial Technical Engineering, BSc degree in Mathematics, Physics or any other specialty in computers.</p> <p>With the process of adaptation of the curricula to the EHEA, academic degrees equivalent to the degrees listed above will be required.</p>
<p>Programme Duration</p>	<p>2 Semesters (1 academic year)</p>
<p>Total Number of ECTS Credits Awarded:</p>	<p>60 ECTS</p>
<p>Brief Description of the Programme:</p>	<p>The teaching plan has been structured so that in order to successfully finish their studies and obtain their respective degrees, the students will need to obtain 60 ECTS credits, distributed in the following way:</p> <ul style="list-style-type: none"> - 35 credits, relative to optional six-month modules (5 credits each), - 10 credits relative to seminars (2 credits each) - 15 credits associated with the Master's final project. <p>The 16 optative modules and seminars are grouped in 9 subjects as follows:</p> <p>M1. Fundamentals of research</p> <p>S1: Research methodology</p> <p>M2. Decision analysis</p> <p>S2: Decision analysis</p>

	<p>A1: Decision support systems</p> <p>A2: Satisficing-based methods for group decision making and negotiation</p> <p>A3: Simulation methods</p> <p>M3. Data mining</p> <p>S3: Data mining</p> <p>A4: Bayesian networks</p> <p>A5: Machine learning</p> <p>M4. Natural Computing</p> <p>S4: Natural Computing</p> <p>A6: Metaheuristic-based intelligent search</p> <p>A7: Evolutionary computation</p> <p>A8: Non-conventional computing: biomolecular and quantum computing</p> <p>M5. Logic computing</p> <p>S5: Logic computing</p> <p>A9: Logic programming</p> <p>M6. Knowledge representation and reasoning models</p> <p>S6: Knowledge representation and reasoning models</p> <p>A10: Intelligent agents and multiagent systems</p> <p>A11: Ontological engineering</p> <p>A12: Commonsense reasoning</p> <p>S7: Fuzzy logic</p> <p>M7. Robotics and computational perception</p> <p>S8: Robotics and computational perception</p> <p>A13: Computer vision</p> <p>A14: Autonomous robots</p> <p>S9: Principals of robotics locomotion</p> <p>M8. Application areas</p>
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A15: Biomedical informatics

A16: Language engineering

S10: Applications of artificial intelligence

S11: Natural language processing

S12: Automatic planning

M9. Seminars by visiting professors

The **languages used** throughout the education process are Spanish and English. A **foreign English-speaking student will be able to study the MSc course in English in its entirety.**

Furthermore, the student must attend five **seminars**. The seminars offered in the Master's degree course are all optional, except S1: *Research Methodology*, which is mandatory. All seminars are organized into three categories:

- *Seminars whose name match the subject to which they belong (S2, S3, S4, S5, S6 and S8).* If the student decides not to be taught any module belonging to M2 to M7, then the student must take this seminar. In these seminars the student will acquire general knowledge about the respective subject.
- *Seminars that complement modules (S7, S9, S10, S11 and S12).* These are aimed at covering some disciplines of Artificial Intelligence which are not studied in the modules.
- *Seminars by visiting professors,* in which the student acquires advanced or specialized knowledge about any of the subjects taught within the course.

The Master's degree suits **two student profiles**:

- Those students interested in **specializing** in one or more concrete disciplines of AI. They must study every module and seminar in the chosen subject area. In order to cover all the competencies of the degree, in the remaining subjects in which there is a seminar whose name matches the subject name, the student must take it.
- Those students who seek a **broader perspective and are wanting to** obtain an extensive knowledge about the whole of AI. They must study modules covering all subjects. In those subjects in which the student does not choose any modules, the student must take the seminar whose name matches the subject name.

Examples of Very Good Practice:

Universidad Politécnica de Madrid (UPM) is ranked among the 100-150 best universities in the world in the area of Computer Science according to **Shanghai ranking** (2012, 2013, 2014 and 2015) and among the best 150-200 according to the **QS 2015 ranking**.

The **Escuela Técnica Superior de Ingenieros Informáticos (ETSI-INF)** of the UPM, in which the master is taught, belongs to Campus Montegancedo, distinguished as **Campus of Excellence in Research and Technology Transfer** in the area of information and communications technology by the Spanish Ministry of Science and Innovation since 2009.

ETSI-INF has been designated as the **best School of Computer Science of Spain** for the past 7 years according to the "Ranking of Spanish Universities" prepared by the "El Mundo" newspaper.

The **Departamento de Inteligencia Artificial (DIA)** of the ETS-INF, which owns all the teaching staff of MAI, stands out for its quality research activity.

According to the study elaborated in 2009 by the *Instituto de Estudios Documentales sobre Ciencia y Tecnología (IEDCYT)*, the *Centro de Ciencias Humanas y Sociales (CCHS)* and the *Consejo Superior de Investigaciones Científicas (CSIC)*, entitled "Science production indicators in the Community of Madrid during the period 2004-2008", DIA is mentioned as the UPM department with the **highest number of scientific publications with high impact** during that period.

DIA members have taken part in several research projects:

- Competitive National Calls: 53 research projects. Obtained Funding: **2.027.788,00 €**
- Competitive European Calls (FP7, H2020): 37 research projects. Obtained Funding: **11.892.093,00 €**
- Contracts with public and private organizations: 140 research contracts. Obtained Funding: **6.935.254,00 €**

The **MSc in Artificial Intelligence (MAI)** has occupied **one of the top 3 positions** during the last 5 years in the "**250 Masters and MBA Complete Guide**" ranking published by "El Mundo" newspaper, currently ranked second in the *specialized computer* section.

The **languages used** throughout the education process are Spanish and English. A **foreign English-speaking student will be able to study the MAI in English in its entirety**.

MAI teachings are supported by a **virtual classroom system** based on the **Moodle platform**. Thus, all modules in the MAI have a space in the Virtual Classroom of the UPM (there is a Moodle course for each module of MAI) to interact with the

students.

Guidance process and Mentoring. The Academic Board for the MSc in Artificial Intelligence (CAMIA) will assign, to each enrolled student, a supervisor among the teaching and research staff of the MSc, for the entire period in which the student remains enrolled. The list of assigned supervisors to each enrolled student will be prepared once the registration process is closed, and it will be made available for consultation via the dissemination channels that the MSc organization has at their disposal.

The CAMIA will assign a "mentor" to each enrolled student. Mentors are students that are in a research period of a PhD in Artificial Intelligence at the School of Computer Science. The mentor has the task of facilitating guidance within the academic, social, and administrative issues that a new student may have.

For more than 15 years, the MAI annually invites **visiting professors of international prestige** in the area of Artificial Intelligence from foreign universities to deliver lectures and seminars to MAI students and doctorates. Among them, we can highlight:

- John McCarthy, Stanford
- Herbert Simon, Carnegie Mellon (Nobel Prize)
- Jaime Carbonell, Carnegie Mellon
- Marvin Minsky, MIT
- Mark Musen, Stanford
- Casimir Kulikowski, Rutgers
- Raúl Rojas, Universidad Libre de Berlín

IBM has joined as a partner company in the MAI, participating in the delivery of a new seminar "Cognitive Science" (pending approval by ANECA), focused on the Artificial Intelligence tools **IBM Watson** and **IBM Bluemix**.

The **MAI teaching staff** has a **wide and recognized research work** directly related to the content offered in the MAI modules. Some teachers have received national and international awards:

Concepción Bielza Lozoya:
UPM Research award 2014

Asunción Gómez Pérez:
UPM Research award 2015
National award on Informatics - Aritmel Award 2015
Ada Byron award to the technological woman 2015

Manuel Hermenegildo Salinas:
National award on Informatics - Aritmel Award 2005

Pedro Larrañaga Múgica:
National award on Informatics - Aritmel Award 2013
Fellow of the ECCAI

Víctor Maojo García:
Fellow of the American College of Medical Informatics

It is required to have **at least a six-year research period** to become a member of the MAI teaching staff. The total number of six-year research periods of the MAI teaching staff is 57 (2.59 on average per teacher).

The **research groups** the MAI teaching staff belongs to provide **scholarships** to students mainly from **research projects**.

As a reference, the number of official grants from the Departamento de Inteligencia Artificial (DIA) between 2000 and 2012 is **821**, which suppose an amount higher than **3,520,000.00 euros**. Of the 821 signed scholarships, 689 of them (83.4%) have been coordinated by MAI teachers, distributed as follows among the proposed research lines:

Research line	Grants	Funds
Knowledge Representation	259	1.520.537 €
Computational Intelligence	14	118.894 €
Natural Computing	37	89.557 €
Robotics and Computational Perception	22	79.382 €
Language Engineering	74	104.592 €
Applications of AI	283	1.116.543 €

DIA awards annual scholarships **José Cuenca awards**, aimed at students (up to a maximum of 8) who are starting their studies on the MAI. The award (600 Euros) requires from the student to be a new full-time student in the MAI of any nationality and to have passed the 7 subjects enrolled in the first semester and obtained the highest qualifications (GPA of the 7 modules).

MOBILITY: Joint Master programme MAI (Universidad Politécnica de Madrid) - Master M2R IT (Universidad Paul Sabatier of Toulouse)

MAI is funded by the Spanish Ministry of Education to facilitate mobility of visiting professors and students for French-Spanish joint master programmes (*academic courses 2013/2014, 2014/2015 y 2015/2016*). MAI collaborates with the M2R IT research master at the Universidad Paul Sabatier of Toulouse:

- MAI students can enroll certain modules of the M²R IT

	<p>master at the University Paul Sabatier of Toulouse that will be taught via videoconferencing during the first semester. These modules will be included in the European diploma supplement.</p> <ul style="list-style-type: none"> MAI students have the chance to develop their Master Final Project at the University Paul Sabatier of Toulouse. They will be advised by a MAI supervisor and a M2R IT supervisor. <p>The MAI performs a detailed tracking of their graduates. A LinkedIn group has been created, which allows graduates to share job offers and allows us to implement a graduate consultation procedure.</p> <p>The technology of video-conference based on the Webex platform (Cisco) has been implemented for the defense of master final projects, following up meetings and tutorials, and attending certain seminars for those students with special mobility needs.</p> <p>CeSViMa (Supercomputing and Visualization Center of Madrid of the Universidad Politécnica de Madrid - UPM) is located at Montegancedo Campus. It provides resources for high performance computing to national and international research projects of all research areas.</p> <p>Currently, CeSViMa is integrated into the Spanish Supercomputing Network (RES), is included into the directory of Infrastructures and Laboratories Network of the Community of Madrid and is a member of the e-Ciencia Spanish Network.</p> <p>CeSViMa manages the most powerful supercomputer of Spain (2011): Magerit. It also has been the Spanish supercomputer that has reached the second better position in history on the TOP500 list of world's most powerful supercomputers. Moreover, in November 2007, Magerit ranked position 275 on the Green500 list of more respectful supercomputers with environment.</p>
<p>Accredited without / with Adjustment Requirements</p>	<p>Accredited with Adjustment Requirements</p>
<p>Adjustment Requirements:</p>	<p>Adjustment 1: Applying criteria for admission and formative complements assignment to ensure an adequate income profile of all students in order to ensure that everyone can achieve learning outcomes established by EQANIE for Masters level after completing the master.</p> <p>Adjustment 2: The University must incorporate into the curriculum skills competences regarding project management and risk control and propose training and evaluation activities</p>

	that enable their achievement. Accordingly, the competences structuring and the teaching plan should be adjusted in order to ensure the acquisition of all the learning outcomes relative to the <i>other professional competences</i> block.
Accredited by:	ANECA-IIE
Accredited	From July 27th 2016 to July 27th 2017