

INTENDED LEARNING OUTCOMES OF THE BSC IN MATHEMATICAL AND COMPUTING SCIENCES FOR ARTIFICIAL INTELLIGENCE

| THEORY AND CONTENTS AREA | |
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| Knowledge and understanding | |
| The graduate will have acquired knowledge related to: | Knowledge and Understanding will be achieved through the following courses: |
| <ul style="list-style-type: none"> – mathematical sciences, in particular the main structures, methods and results related to: real mathematical analysis with one and n variables, unconstrained and constrained optimization, Lebesgue measure and integration, elements of logic, main algebraic structures, linear algebra, geometry in Euclidean spaces, combinatorics, probability calculus, discrete and continuous random variables, limit theorems, differential equations, elements of complex and functional analysis, convex optimization, dynamic programming; | <ul style="list-style-type: none"> – Mathematical Analysis – Module 1, Mathematical Analysis – Module 2, Algebra and Geometry, Probability, Advanced Analysis and Optimization – Module 1, Advanced Analysis and Optimization – Module 2 |
| <ul style="list-style-type: none"> – computer science, in particular the main structures and methods related to: programming, algorithms and their analysis, data structures, graph theory, computational complexity, advanced programming, optimization algorithms, elements of cryptography; | <ul style="list-style-type: none"> – Computer Science – Module 1, Computer Science – Module 2, Advanced Programming and Optimization Algorithms |
| <ul style="list-style-type: none"> – physical and economic sciences, in particular the basic structures and methods related to: <ul style="list-style-type: none"> – classical mechanics, thermodynamics, waves, electromagnetism, special relativity, elements of analytical mechanics, statistical mechanics, quantum mechanics; – microeconomics, equilibrium theory, game theory, mechanism design. | <ul style="list-style-type: none"> – Foundations of Physics I, Foundations of Physics II, Statistical and Quantum Physics – Foundations of Economic Sciences, Game Theory and Mechanism Design |
| <ul style="list-style-type: none"> – the use of one European Union language (Italian is mandatory for non-native speakers), besides English (the teaching/learning language of the degree). | <ul style="list-style-type: none"> – One EU language |
| Ability to apply knowledge and understanding | |
| The graduate will be able to: | Ability to Apply Knowledge and Understanding will be achieved through the following courses: |
| <ul style="list-style-type: none"> – apply in the mathematical practice all theoretical and structural knowledge acquired in the different fields of mathematical sciences; understand mathematical proofs and develop them autonomously. | <ul style="list-style-type: none"> – Mathematical Analysis – Module 1, Mathematical Analysis – Module 2, Algebra and Geometry, Probability, Advanced Analysis and Optimization – Module 1, Advanced Analysis and Optimization – Module 2 |
| <ul style="list-style-type: none"> – apply in the computational practice all theoretical and structural knowledge acquired in the different fields of computational sciences; understand the internal logic of computational constructs and | <ul style="list-style-type: none"> – Computer Science – Module 1, Computer Science – Module 2, Advanced Programming |

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| <p>develop them autonomously; apply computational tools, also as a support to mathematical methods for the solution of complex problems.</p> | <p>and Optimization Algorithms</p> |
| <p>– correctly interpret some physical and economical phenomena, and correctly apply the quantitative laws that govern them. Formalize and solve fundamental quantitative problems in physics and economics, adopting when needed a problem solving setting and the modern methods that are typical of the two disciplines, and learning how to use algorithmic tools in the case of complex problems or problems involving a large amount of data. Correctly capture the main aspects of the mathematical, computing and modelling methods involved and correctly interpret the obtained information and results.</p> | <p>– Foundations of Physics I, Foundations of Physics II, Statistical and Quantum Physics, Foundations of Economic Sciences, Game Theory and Mechanism Design</p> |
| <p>– effectively interact in one European Union language (besides English), both in study abroad contexts and professional contexts, through the use of “general” language.</p> | <p>– One EU language</p> |

| MODELLING - APPLICATIONS AND PERSONALIZED AREA | |
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| Knowledge and understanding | |
| The graduate will have acquired knowledge related to: | Knowledge and Understanding will be achieved through the following courses: |
| <ul style="list-style-type: none"> – further modelling and applications, in particular: statistical inference, stochastic processes, main numerical methods, numerical simulation of complex physical systems, basic modelling for economic and financial systems (decision theory, stochastic control, theory of finance); | <ul style="list-style-type: none"> – Mathematical Statistics, Stochastic Processes and Simulation in Natural Sciences, Decision Theory and Human Behaviour, Mathematical Modelling for Finance, Mathematical Modelling for Neuroscience; |
| <ul style="list-style-type: none"> – some specific AI fields (such as machine learning, learning algorithms and knowledge representation, computational optimization techniques, artificial neural networks, elements of logic programming); | <ul style="list-style-type: none"> – Mathematical Modelling in Machine Learning, Machine Learning and Artificial Intelligence (and other courses where AI topics are introduced in a coordinate way); |
| <ul style="list-style-type: none"> – other topics chosen by students depending on their personal interest, to widen their knowledge towards other disciplinary fields, in particular within social sciences (e.g. management, economics, marketing, accounting, finance, etc.), that have evolved and have become a potential ground for modelling and AI methods. | <ul style="list-style-type: none"> – Electives |
| Ability to apply knowledge and understanding | |
| The graduate will be able to: | Ability to Apply Knowledge and Understanding will be achieved through the following courses: |
| <ul style="list-style-type: none"> – use the further theoretical and structural knowledge acquired in the different fields of mathematical, computational, physical and economic sciences. Formalize and solve quantitative problems involving large amounts of data in the main areas of natural and social sciences. Interpret in a correct way the obtained information and results. | <ul style="list-style-type: none"> – Mathematical Statistics, Stochastic Processes and Simulation in Natural Sciences, Decision Theory and Human Behaviour, Mathematical Modelling for Finance, Mathematical Modelling for Neuroscience; |
| <ul style="list-style-type: none"> – use the further theoretical and structural knowledge acquired in the different fields of mathematical, computational, physical and economic sciences, as a basis towards the comprehension and design of some modern Artificial Intelligence tools and towards the application of these tools to the main areas of natural and social sciences. | <ul style="list-style-type: none"> – Mathematical Modelling in Machine Learning, Machine Learning and Artificial Intelligence (and other courses where AI topics are introduced in a coordinate way); |
| <ul style="list-style-type: none"> – formalize and solve quantitative problems of varying complexity and involving large amounts of data in other disciplinary fields. | <ul style="list-style-type: none"> – Electives |

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| Making judgments | <p>Graduates will be able to collect and interpret information and data referring to natural and social phenomena or to their modeling, and make adequate individual judgments. In particular, thanks to curricular courses that foster competence on contents and methods, graduates will develop critical thinking skills to be applied to new scenarios of various complexity.</p> |
| Communication | <p>Graduates will develop their written communication skills as well as their oral skills (face-to-face and in public). Such abilities will be developed through attending teaching activities related to courses, completing assignments given by faculty members and taking exams. The empowering of communication skills, written and oral, is further stimulated through compulsory student participation in curricular seminars on the development of soft skills (digital ethics, effective communication, teamwork), as well as in seminars organized with external parties to further analyze issues related to the mathematical and computational modelling of problems of various nature.</p> <p>Communication skills are particularly oriented towards interaction and teamwork, with specialist and non-specialist audiences belonging to various company functions at companies working in multicultural settings. The class composition, with students coming from a variety of different countries, helps to foster the development of communication and relational skills in international and multicultural settings. We give a particular attention to developing the ability to communicate problems, ideas and solutions using a correct level of mathematical formalization, in order to interact constructively with experts and technicians belonging to various disciplinary sectors and with audiences belonging to various company functions.</p> <p>Written and oral communication skills in a foreign language may be reinforced through foreign language curricular courses as well as a study abroad period, while the ability to communicate in a work environment can be practiced on the field through an internship. Lastly, graduates will perfect their written communication skills through the writing of the final work.</p> |
| Lifelong learning skills | <p>Graduates will have the analytical and cognitive tools that allow them to autonomously approach the evolution of the problems to be faced in a global landscape in a fast-changing context, characterized by a progressive internationalization and product & process innovation. Thanks to an academic education that focuses on critical and methodological aspects, graduates will easily adapt to new problems and rapidly acquire further specific knowledge. Moreover, they will also be able to develop their own methods for managing knowledge, useful for professional development (lifelong learning) and to undertake education at a higher level. Such ability will be strengthened also thanks to active participation in project-oriented laboratories focused on Artificial Intelligence issues.</p> |