

PhD Programme in MATHEMATICS AND COMPUTER SCIENCE Curriculum 1: MATHEMATICS Curriculum 2: COMPUTER SCIENCE Curriculum 3: BIG DATA	
DISCIPLINARY SCIENTIFIC AREAS	01 - MATHEMATICS AND INFORMATICS; 13 - ECONOMICS AND STATISTICS
COORDINATOR	PROF. ANTONIO IANNIZZOTTO
HEAD DEPARTMENT	DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
DURATA	3 YEARS
LEARNING OUTCOMES AND RESEARCH TOPICS	<p>The Doctoral Program in Mathematics and Computer Science covers a wide range of interconnected disciplines on cultural, methodological, and applicative levels. Through the practice of scientific research in cutting-edge areas of mathematics and computer science, the Doctorate aims to train researchers and professionals with a cultural level adequate to contribute to the current demands for innovation and development in industry and information society, both in terms of scientific creativity and design skills, with particular attention to fundamental, applied, and industrial research.</p> <p>The Doctorate is structured into three curricula: Mathematics, Computer Science, and Big Data. Each track offers a variety of personalized doctoral paths focused on innovative research themes related to the disciplinary areas of mathematics, computer science, and statistics.</p> <p>In particular, in the mathematical area, some of the leading themes are: numerical methods for inverse problems, integral equations; approximation theory; harmonic and biharmonic maps in differential geometry; complex and Kählerian geometry; qualitative study of partial differential equations, with applications to biological and physical models; methods of mathematical physics for relativity; inverse scattering for evolutionary equations; optimization for data analysis and combinatorial problems; manifold learning, manifold optimization; study of the problem of moments on algebraic structures and applications; analysis of point processes on configuration spaces with applications to statistical mechanics.</p> <p>In the computer science area, research topics include: computer graphics, geometry processing, human-computer interaction, digital fabrication, cybersecurity, cryptography, blockchain technologies, formal methods, artificial intelligence, machine learning, natural language processing, data mining, semantic web, sentiment analysis, IoT technologies, assistive technologies, biomedical image analysis, precision agriculture, image retrieval, computer vision, multimedia forensics, high-dimensional data analysis.</p> <p>In the statistical area: statistical modeling in classical and Bayesian frameworks with special attention to medical/epidemiological and environmental applications; selection techniques for optimal models; parametric inference methods based on the "scoring rules" theory; causal inference with special focus on individual causal inference problems; model based clustering; statistical network models; evidence measures in Bayesian framework.</p> <p>The organization of the Doctoral Program integrates educational and research activities. Educational activities include a wide range of courses and seminars taught by faculty members and researchers from the PhD Board and the</p>

	<p>Department of Mathematics and Computer Science at the University of Cagliari, as well as by a network of visiting professors from other Italian and foreign universities. Research activities include, in addition to individual or group study focused on each doctoral student's specific research project, cycles of seminars aimed at periodically sharing results, participation in conferences and schools in Italy and abroad (with appropriate financial coverage), publication of articles in scientific journals and proceedings of international conferences, periods of training abroad (lasting at least six months), collaborations with private companies and public institutes engaged in research and innovation. The research groups of the Department of Mathematics and Computer Science provide the necessary computing tools for the doctoral research.</p> <p>Starting from the academic year 2022-2023, an agreement with the University of Minho (Portugal) is in place, involving the Computer Science track. The two doctoral programs collaborate to share research themes, objectives, operational methods, activities of their doctoral programs, as well as the operational and scientific structures necessary to ensure their sustainability.</p> <p>Finally, the doctoral program includes the achievement of an English language certification of at least level B2, possibly through courses offered by the University Language Center.</p> <p>The employment opportunities of the Doctorate (which relies for this purpose on a specific Advisors' Board composed of teachers and representatives of interested third parties) are various: the course is primarily aimed at training independent and qualified researchers, capable of carrying out scientific activities in universities and research institutes, but also specialists with high technical and methodological skills, able to work in innovative companies with managerial or consultancy tasks, as well as freelancers. In this context, positions advertised in collaboration with organizations external to the University on specific research and innovation projects are of particular interest. Another opportunity is teaching STEM disciplines at primary and secondary schools.</p>
<p>ELIGIBILITY AND OTHER REQUIREMENTS FOR CANDIDATES (ART. 2 - NOTICE OF COMPETITION)</p>	<p>EVERY ITALIAN 2ND CYCLE DEGREE (<i>LAUREA MAGISTRALE/SPECIALISTICA/VECCHIO ORDINAMENTO</i>) AND EQUIVALENT AND SUITABLE FOREIGN ACADEMIC DEGREES</p>
<p>ADMISSION TESTS</p>	<p>ASSESSMENT OF QUALIFICATIONS AND CURRICULUM VITAE, AND VIDEOCONFERENCE INTERVIEW</p> <p>The interview will mainly focus on the presentation and discussion of the candidate's research project (to be written using the form available on the webpage https://unica.it/dottoratiricerca - "Instructions for registration to the competition and forms - Annex C"), in order to assess the adequacy of the profile with regard to personal competence in the disciplinary field of the project, aptitude for scientific research and linguistic knowledge (English language).</p>
<p>POSITIONS</p>	<p>2</p>
<p>SCHOLARSHIPS</p>	<p>2 funded by NRRP Ministerial Decree no. 630/2024</p>
<p>WEB SITE</p>	<p>http://dottorati.unica.it/matematicaeinformatica/</p>
<p>CONTACT PERSON</p>	<p>PROF. ANTONIO IANNIZZOTTO EMAIL: antonio.iannizzotto@unica.it – TEL: 070/675-5603</p>
<p>SCHOLARSHIPS FUNDED BY MINISTERIAL DECREE NO. 630/2024</p>	

SCHOLARSHIP 1 - CUP F22B24000260005	
RESEARCH PROJECT	AI for Urban Analytics
PRINCIPAL INVESTIGATOR	Prof. Lucio Davide Spano
DESCRIPTION OF DOCTORAL TRAINING	<p>The PhD research project focuses on the use of advanced computer vision techniques and user feedback to develop artificial intelligence models applied to urban design, aiming to revolutionise the approach to city planning and management through the use of AI. The main objective is to improve the quality of urban life through the analysis and evaluation of walkability and the use of sustainable means of mobility. Using deep learning algorithms and image processing techniques, the project aims to collect and analyse visual data from different sources, such as surveillance cameras, drones and satellites. This data, together with user feedback collected through various digital platforms, will be used to train AI models that can evaluate and predict urban mobility patterns. The end result will be a decision support system for urban planners, which can provide data-driven recommendations to improve walkability and promote the use of sustainable modes of transport in cities. The research will be supported by the Department of Mathematics and Computer Science, which offers expertise both in the development of artificial intelligence models and in the evaluation and collection of data through user testing. These academic skills are complemented by the industrial partnern, which deals with the analysis of large data sets and industrial automation, with a focus on inference-based policy development. Finally, the training will be complemented by the period abroad at the University of Duisburg-Essen, which is at the forefront of intelligent systems research and development under the supervision of Prof. Jurgen Ziegler.</p>
COMPANY	<p>DEWEAVE s.r.l. Address: Viale Regina Margherita 23, Cagliari, Italy</p>
NO. OF MONTHS TO BE SPENT IN THE COMPANY	6
FOREIGN INSTITUTION	<p>University of Duisburg Essen, Department of Computer Science and Applied Cognitive Science. Address: Campus Duisburg, Building LE Lotharstr. 65 47057, Duisburg, Germany Contact person: Prof. Jurgen Ziegler</p>
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6
SCHOLARSHIP 2 - CUP F22B24000260005	
RESEARCH PROJECT	Managing Big Data for Product Usage: Ensuring Quality, Monetization, and Optimization
PRINCIPAL INVESTIGATOR	Prof. Diego Reforgiato Recupero
DESCRIPTION OF DOCTORAL TRAINING	<p>The doctoral proposal focuses on managing big data related to product usage, stored in logs and various storage systems, overseeing their transformation, and subsequently managing the feed processes into both billing system and analytics system, ensuring consistency and specificity. This entails ensuring quality and swift turnaround times, accurate monetization, optimization of pricing strategies, and monitoring to enact commercial policies.</p>

COMPANY	Growens S.p.A. Address: Via Luigi Porro Lambertenghi n. 7, Milano Contact person: Clelia Gallareto - People Operations Manager
NO. OF MONTHS TO BE SPENT IN THE COMPANY	12
FOREIGN INSTITUTION	The Open University Address: Walton Hall - Milton Keynes MK7 6AA UK
NO. OF MONTHS TO BE SPENT IN THE FOREIGN INSTITUTION	6