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. ROBERTO TONELLI
HEAD DEPARTMENT	DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
DURATION	3 years
LEARNING OUTCOMES AND RESEARCH TOPICS	The PhD programme in Mathematics and Computer Science covers a broad spectrum of disciplines, connected to each other on the cultural, methodological and applicative levels. The doctorate, through the practice of scientific research in leading sectors of Mathematics and Computer Science, aims to train people of an adequate cultural level, able to contribute to the current needs of innovation and development of the industry and the information society, both on the level of scientific creativity, and of design ability. In particular, the doctoral course is aimed at training specialists with advanced methodological and technical knowledge, as well as with adequate linguistic preparation. The doctoral activity is supported by professors and researchers belonging to groups actively engaged in research at international level, ensuring ample opportunities for exchange of doctoral students with prestigious Italian and foreign universities, research bodies and companies. The investigation themes offered by the three available curricula (Mathematics, Computer Science and Big Data) largely refer to the research activities of the members of the teaching staff, and concern both the fundamental and application aspects of many sectors of Mathematics and Information Technology. The training acquired during the PhD programme will allow our graduates to autonomously perform research and development in universities, in public and private research institutions, and in the industrial sector. In particular, the main employment opportunities envisaged are the continuation of university research activities, the coordination and direction of research and development activities in industries, public bodies or national and international research centers. The analysis and elaboration skills acquired by training through research will also allow to take paths leading to managerial tasks in both the private and public sectors, or to undertake your own activities as a consultant for public bodies, companies and software houses. The PhD programme in Mathematics and Computer Science covers a wide spectrum of disciplines connected to each other both on a cultural, methodological and applicative level. The doctorate, through the practice of scientific research in leading sectors of Mathematics and Computer Science, aims to train people of an appropriate cultural level to contribute to the current demands for innovation and development of industry and the information society, both in terms of scientific creativity and design capacity. The Doctorate is able to propose numerous study paths aimed at training personnel specialized in applied and industrial research, able to operate in work situations of excellence in the areas of specialization established. The articulation of the doctoral courses will be oriented to the achievement of useful and innovative results. Some of the possible paths are described on

	the site and are summarized succinctly below: research activities in the fields of computer vision and geometry processing with direct interest in the creation and modification of digital characters, a typical problem in the entertainment industry and also repercussions on the cultural heritage sector; applications of game theory to wireless networks in which each node of the network acts as a player identifying optimal paths for the transmission of information packets; study of the use of electric vehicles in freight transport by formulating new optimization models and developing appropriate resolution algorithms; experimentation of models for the scheduling of production, distribution and packaging processes; construction of a national center for testing, validation, certification and training of unmanned aerial platforms (drones) for civil applications; research for the development of image analysis techniques to support clinical decisions in biomedicine; applications of fractional equations to biological models; analysis of the problems of planning tourist itineraries based on individual preferences regarding destinations, means of transport and time constraints. This problem falls into the class of problems known as "vehicle routing with profits"; analysis of the latest concept in blockchain platforms for practical applications to the management of online voting, the certification of agri-food supply chains, the management and certification of the production and exchange of green energy. Objectives of the course: In particular, the doctoral course is aimed at training specialists with advanced methodological and technical knowledge, as well as an adequate linguistic preparation, able to carry out research and development activities in large autonomy in the university environment, in public and private research institutions and in the industrial field. The activity of the doctorate is supported by professors and researchers who are part of groups actively engaged in research at an international level, ensuring wide opportunities for exchange and reception of doctoral students at prestigious Italian and foreign universities, research institutions and companies. The research topics offered by the three available curricula are largely related to the research activities of the members of the teaching staff and concern both the fundamental and applicative aspects of many sectors of Mathematics and Computer Science. The specific objectives are diversified according to the research areas of the teachers involved. A common guideline is achieved by specifying generic goals based on the course year. The first year will be dedicated to the analysis of the state of the art and to the formation of a solid basic preparation, as well as of course to start the research activity on the chosen theme. In the same period, in the absence of a previous certificate of knowledge of the English language at least at level B2, the PhD student will follow an English course offered by the University Language Center. The existing contacts between the professors of the college and numerous researchers operating abroad will also be exploited, in order to choose a location where doctoral students can spend a period of study and research lasting at least 6 months. Within the second year the research activity will come to life and, as soon as the first results are available, the active participation of the PhD student in national and international congresses will be planned, with the presentation of posters and / or oral communications. The PhD student will also be involved in the drafting of scientific articles to be submitted on congress proceedings or, in case of sufficiently consistent results, in international

	scientific journals. The PhD student will also begin the period of stay abroad. The third year will see the realization of the project envisaged by the course, and will lead to the publication of the results in international journals, favoring those indexed on the main scientific databases. The PhD student will continue his activity abroad in a more independent way, in order to establish collaborative relationships with researchers working in his area of interest.
ELIGIBILITY AND OTHER REQUIREMENTS FOR CANDIDATES (ART. 2 - NOTICE OF COMPETITION)	EVERY ITALIAN 2ND CYCLE DEGREE (*LAUREA MAGISTRALE/SPECIALISTICA/VECCHIO ORDINAMENTO*) AND EQUIVALENT AND SUITABLE FOREIGN ACADEMIC DEGREES
ADMISSION TESTS	ASSESSMENT OF QUALIFICATIONS AND CURRICULUM VITAE, AND INTERVIEW During the interview, the candidate will discuss his/her 3-year research project. The project (preferably written in English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (Annex A "Titoli valutabili e Curriculum Vitae'; Annex B 'Dichiarazione sostitutiva di certificazioni del/i titolo/i di accesso con esami e voti'; two-sided coloured scanned copy of a valid ID, with a clear photo), within the deadline (file name: progetto_di_ricerca_surname_name - formatting requirements: min. 8,000 max 16,000 characters including spaces - excluding title, schemes, charts and bibliographic references). The project will be evaluated during the interview exclusively and must include: i) purpose of the proposed research project and the related curriculum; ii) state of the art of research; iii) detailed workplan; iv) expected results; v) motivation letter, i.e. max. 1,000 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme. The interview will be mainly in English and will: verify the candidate's capacity of orientating among the main study fields of the PhD programme; assess the candidate's methodological knowledge and his/her analytical, elaboration and communicative skills; discuss with the Selection Committee the content of the research project. The interview can be carried out remotely in the case of candidates not resident in Cagliari unable, for justified reasons, to support it at the insolvency venue.
ADMISSION TESTS FOR FOREIGN CANDIDATES APPLYING FOR RESERVED POSITIONS SUPPORTED BY A SCHOLARSHIP	ASSESSMENT OF QUALIFICATIONS AND CV, VIDEO CONFERENCE INTERVIEW During the interview, the candidate will discuss his/her 3-year research project. The project (preferably written in English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (*certificate attesting the award of a 2nd level foreign degree needed to access a PhD programme, including exams and marks, with a translation in Italian or English; certificate attesting the award of a 1st level foreign degree, including and marks, with a translation in Italian or English; signed Curriculum Vitae preferably in EU format, in English or Italian; up to 3 reference letter(s), in English or Italian, on institutional letterhead paper, dated and signed by a university professor or expert in the PhD scientific area(s), following the prescriptions of each annex; additional qualifications, certifications, publications (up to 5) and work experiences, detailed in English or in Italian; two-sided coloured scanned copy of a valid ID, with a clear*

	photo), within the deadline (file name: progetto_di_ricerca_surname_name - formatting requirements: min. 8,000 max 16,000 characters including spaces - excluding title, schemes, charts and bibliographic references). The project will be evaluated during the interview exclusively and must include: i) purpose of the proposed research project and the related curriculum; ii) state of the art of research; iii) detailed workplan; iv) expected results; v) motivation letter, i.e. max. 1,000 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme. The interview will be in English and will: - verify the candidate's capacity of orientating among the main study fields of the PhD programme; - assess the candidate's methodological knowledge and his/her analytical, elaboration and communicative skills; - discuss with the Selection Committee the content of the research project. Reference letters (up to 3) must be written in English, using the form available on the webpage https://unica.it/dottoratiricerca (How to apply for PhD selection: Guidelines and forms- Annex C), by a university professor or an expert in the research fields of the PhD programme, on letterhead of their institution, dated and signed. Evaluators will send their letters directly to the email address phdcall_referenceletter@unica.it (object: surname and name of the candidate being evaluated and name of the PhD programme for which he/she is applying).
POSITIONS	6
SCHOLARSHIPS	4 funded by MUR PL, 1 of which reserved for foreign candidates with a degree awarded abroad 1 funded by A.S.I - Italian Space Agency (Project HERMES PATHFINDER). Research topic: *Study, development and implementation of algorithms for the data analysis of the Hermes Scientific Pathfinder space mission. In particular, the selected candidate will work on the scientific validation of the algorithms for determining the position of bright and impulsive astrophysical events (Gamma Ray Burst) and on the development of new approaches to the problem and their implementation in pipeline that will be used by the scientific community* (Contact person: Prof. Alessandro Riggio). The scholarship on specific subject of research will be awarded to the candidate usefully placed in the merit ranking who has obtained the best score and a positive evaluation regarding the adequacy of the curriculum for the purpose of carrying out the specific research topic related to the use of the scholarship.
POSITIONS WITHOUT SCHOLARSHIP	1
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