

Some information is missing in the tables, including the schedule of lessons. Please, contact reference persons as soon as possible if you want to attend a class.

## Consiglio Nazionale delle Ricerche (CNR-ISTC and CNR-STIIMA)

Reference person: Andrea Orlandini <andrea.orlandini@istc.cnr.it>, Nicola Pedrocchi <nicola.pedrocchi@stiima.cnr.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Automated Planning	Andrea Orlandini, Alessandro Umbrico	10	The course presents Artificial Intelligence automated planning. It introduces models and resolution approaches for both "classic" and temporal planning. Different methodologies for the synthesis of action plans and their execution will be presented, as well as applications in relation to the control of autonomous robots.	yes	May-June 2023/2024	English	yes	BASIC

## Istituto Italiano di Tecnologia (IIT)

Reference person: Lorenzo Natale <Lorenzo.Natale@iit.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Open Science and Research Data Management (OS&RDM)	Anna Maria Pastorini, Valentina Pasquale	10	This training module for PhD Students aims to introduce early-career researchers to the principles of scholarly communication, Open Science and Research Data	yes	Feb 2023/2024	English	yes	CROSSOVER

			Management. Students will gain a better understanding of the available research e-infrastructures, tools, and services for Open Access publishing, Research Data Management and FAIR Data. Students will also learn the importance and the transformative potential of Open Science practices in research, especially to improve reproducibility and increase research integrity. They will learn what means to make data FAIR, as required by many funders, including the European Commission, and how to draft a data management plan. Finally, they will have the chance to practice on common tools for Research Data Management, like Data Stewardship Wizard, Zenodo, and Dataverse.					
Data Acquisition and Data Analysis Methods	Carlo Canali, Alessandro Pistone	15	The course is aimed at students who intend to acquire knowledge to develop measurement systems and data analysis algorithms to be adopted in general applications (robotics, test benches, sensor data acquisition). This course presents an overview about data acquisition and data analysis methods. In a first part methods used in modern data acquisition systems will be described with a special focus on hardware and electronics. The second part will focus on the data analysis side of a measurement process. The aim is to learn how to get the information hidden inside the data, even in presence of noise, using statistical and computing methods.	No	May 2023/2024	English	yes	ADVANCED
Modern C++	Marco Accame, Valentina Gaggero, Nicolò Genesio, Davide Tomè	30	The students will learn the new syntax and philosophy of Modern C++ (releases C++11, -14, -17, -20) with hands on the code at every lesson.	yes	May-Jun 2023/2024	English	yes	BASIC

Mechanical Drawing Fundamentals	Diego Torazza	18	This course provides an introduction to Mechanical Technical Drawing with mention to manufacturing techniques. The aim of the course is to give a base knowledge in understanding and preparing mechanical technical drawings, so there is no need of prior background of mechanical drawing. Mechanical drawing is the main way to communicate design need to technicians, workshops, suppliers. A base knowledge of rules and methods helps the researcher, even if not directly engaged in mechanical design, to better contribute to interdisciplinary team working when involved in the design of experimental setups, scientific devices, and the writing/understanding of technical specifications.	No	Jan 2023/2024	English	yes	BASIC
ComputerAided Design	Diego Torazza	12	The aim of the course is to gain and apply knowledge of 3D CAD concepts and techniques by using high-end CAD systems (PTC Creo).	No	Jun 2023/2024	English	yes	ADVANCED
Perceptual systems	Monica Gori, Alessia Tonelli	12	From birth, we interact with the world through our senses. How the brain process and transform sensory signals into perceptual outputs is one of the main questions in the field of experimental psychology. The goal of the course is to present the perceptual from the anatomical, physiological, and functional points of view. A particular focus will be on how physical stimuli are transduced into sensory signals by our peripheral sensory apparatus in a hierarchy organize complex behaviour. In the last part of the course, these topics will be described in relation with cross-sensory interaction and multisensory integration in the adult and the developing brain. Students will learn how the functioning of the main sensory systems, i.e. vision, audition, touch, smell and taste. Moreover, it will be explain the	yes	May 2023/2024	English	yes	ADVANCED

			process of multisensory integration and cross-modal interaction.					
Cognitive Robotics for Human-Robot Interaction	Francesco Rea	15	The participants will learn the key aspects regulating the interaction between human and robots, and will have an overview of good features and limitations of currently available platforms for HRI. Students will learn how to conduct an HRI study and which metrics are appropriate to characterize the interaction. Participants will be provided with an overview of some computer vision useful to make robots able to understand the nonverbal behaviors of the human partner (e.g. facial expressions and body movements) and other perceptual models of cognitive robotics. Further the participants will be provided with an overview on how actions can close the action-perception loop with human partners and how these models integrate in broader cognitive architectures for HRI. The survey across cognitive models of perception and action will give to the participants the opportunity to successfully design new behaviors for interacting robots. Moreover, participants will have the chance to program the humanoid robot iCub.	yes	Sep 2023/2024	English	yes	ADVANCED
Robotic Virtual Prototyping Design	Ferdinando Canella, Mariapaola D'Imperio (TA: Gabriele Marchello)	18	The aim of the Robotic Virtual Prototyping Design course is to give the basic knowledge about the Finite Element Analysis (FEA) and Multi-Body Simulations (MBS) applied to the robotics. These computational techniques predict the behavior of physical systems: joined together permit to study the dynamics taking in account the body flexibility, the control and optimization. It will be introduced mainly applied to the mechanical field, in particular to the robotic anthropomorphic arm. The student gets 6 credits if he/she attends the entire course and accomplishes the final project.	yes	May-Jun 2023/2024	English	yes	ADVANCED

Mechatronics and AI	Ferdinando Canella, Gabriele Marchello	18	The aim of the Mechatronics and Artificial Intelligence (AI) course is to give the basic knowledge about AI and Deep Learning (DL) applied to mechatronics. The course will provide the students with an overview of AI, DL and the possible applications, and will focus in the last lectures on reinforcement learning (RL) techniques. AI, DL and especially RL can be adopted to control the behavior of mechatronic systems acting in complex environment, and solving tasks too hard to be tackled with traditional approaches. The student gets 6 credits if they attend the entire course and passes the final project.	yes	Jun 2023/2024	English	yes	ADVANCED
Bioinspired systems	Barbara Mazzolai		The course introduces the basic concepts of bioinspired systems and biomimetics and it is mainly focused on the synthesis of mechanical systems taking inspiration from biological world. The course mainly focuses on problems related to kinematics and dynamics of motion (locomotion, flight, swimming, growing), handling, sensing, force generation and amplification. Although the course has a strong mechanical connotation, bioinspiration is an interesting approach that can be profitably applied to many fields. For this reason, an insight of bioinspired approaches applied to very different disciplines (eg. Architecture, design, electronics, soft computing, chemistry, etc.) will be presented by invited speakers. Contents will be supported by critical analyses of case studies		2023/2024			ADVANCED
Cognitive Ergonomics and Human-Technology Integration	Barresi	24	The lectures will introduce the methodologies constituting the approach of cognitive ergonomics, the discipline investigating mental processes underlying the interactions between humans and other elements of a system (indeed, people are considered special components of the	yes	April 2023/2024	English	yes	ADVANCED

			<p>latter). In particular, the students will learn how cognitive ergonomics can be applied to the design and evaluation of interactive systems, especially considering phenomena of human-technology integration like presence (the feeling to share time and space with another individual, object, or event through a medium) and embodiment (the feeling that an external item like an artificial limb is part of our own body) with their psychological and ethical aspects, pondering their value in perspectives like the ones of accessibility and inclusion. The course will point at the implications and applications of such concepts for the improvement of the relationships between human and technology, with special attention to robotic systems and their impact on the quality of people's life. The students will acquire theoretical knowledge and practical skills alongside the technical language and methods of cognitive ergonomics and related disciplines like neuroergonomics (in topics like mental workload). Real cases, based on the professional activity of the teacher in human-robot interaction and extended reality for biomedical applications, will integrate the lectures.</p>					
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# Politecnico di Torino (Polito)

Reference person: Giuseppe Quaglia <giuseppe.quaglia@polito.it>, Carmen Visconte <carmen.visconte@polito.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Advanced scientific programming in matlab	Paolo Bardella	30	<p>The course aims to provide advanced skills in scientific programming, and to teach sound methodologies for the development of reliable, optimized and maintainable codes. A basic knowledge of MATLAB and the C language represents a prerequisite of this course.</p> <p>During this course, many common methods used in Scientific Computing will be presented, with particular attention to the most recent programming techniques in MATLAB.</p> <p>At the end of the course, the student will have expanded his/her knowledge of MATLAB and will be able to choose the best approach for the solution of numerical problem he/she will face.</p>	yes	Jan/Feb 2023-2024	English	yes	ADVANCED
Development and management of data-acquisition systems	Alessio Carullo	25	<p>The course, open to all those who perform experimental activity and do not have specific knowledge on analogue and digital electronic circuits, is conceived to analyze and study multi-channel data-acquisition systems, to develop the know-how required for choosing and configuring the components of the measuring chain according to the requirements. Sensors and circuitry commonly employed in the industrial field to adapt the sensor output signals to the analogue-to-digital converter will be studied. Furthermore, the performance of different architectures of data-acquisition systems will be analyzed</p>	No	Jun 2023-2024	English	yes	ADVANCED

			(dedicated systems, data-acquisition boards for personal computer, micro-controller based boards), also revising the most common development environments. Eventually, guide lines for the estimation of the expected uncertainty will be provided. Laboratory experiments will be arranged in order to develop and analyze some case studies.					
Machine learning for pattern recognition	Sandro Cumani	20	This course gives a broad yet rigorous introduction to machine learning and statistical pattern recognition. It focuses on supervised generative and discriminative learning models, analyzing some important topics such as model architectures, training and evaluation techniques. The course will compare different models and classification approaches on the popular MNIST digit recognition dataset. It will also discuss about the applications of the proposed machine learning approaches to image, speech, and speaker recognition. Students will be asked to apply the acquired knowledge to develop their own classification system using labeled training and evaluation data provided during the course. Each system will then be evaluated on another unlabeled and previously unseen data set.	yes	Jun 2023-2024	English	yes	ADVANCED
Principles, materials and applications of robotics in biomedicine	Alberto Arezzo	20	Robotic technologies for minimally invasive surgery and diagnosis is the focus of this course. Clinical needs in extra-, endo- and trans-luminal access approaches are identified. Various engineering solutions are discussed and their evolution over time is presented and justified. Discussed topics, technologies and methodologies include, but are not limited to: history of surgical robots, commercial surgical robots, research robotic systems, gastrointestinal robots, advances in soft robots fabrication, sensing and actuation, cancer detection robots, perceptual human-robot interfaces,	yes	Feb 2023-2024	English	yes	ADVANCED



			data- and AI-driven operating theatres, etc with the major scientific players worldwide in their respective fields of competence.					
Research design and methodology	Federico Bella	8	This course is intended to explain to PhD students how high-quality scientific research can be carried out during the three years of the doctorate course. The lessons will address the path that goes from the assignment of the research project to the literature analysis, from the design of research activities to the interaction with other scientists, from the production of tangible results to the analysis of the metrics commonly adopted to assess the quality of research and researchers. The overall aim of the course is that of making PhD students aware of what a PhD is and which is the spirit required to face it.	No	Mar 2023/2024	English	yes	CROSSOVER
Facing the scientific publishing world	Federico Bella	10	This course is intended to introduce the world of scientific publishing to PhD students starting their academic career. The lessons will address the main pillars of this sector, from the fundamentals of journals organization to the rational construction of an article, from the peer-review process to the evaluation of research and researchers through internationally recognized metrics. The main aim of this course is to make PhD students aware of the international scientific publishing system.	No	Mar 2023/2024	English	yes	CROSSOVER
Research communication and relationships with companies and organizations	Diana Massai, Caterina Nada	10	The objective of the course is to provide the PhD students the essential tools for improving their skills in communicating the scientific research to the business world, particularly focusing on the relationships with start-ups, PMIs, large companies and public organizations. By attending the course, the PhD students will increase their communication skills for interacting with professionals from the business world, with the final aims of promoting the	No	May-June 2023-2024	English	yes	CROSSOVER

			collaboration between academia and industry and supporting the technology transfer. A dedicated webpage will be available with news, alerts, materials, links, and useful information for the course attendance and work progress. The course is limited in number to 50 participants: registration is required in the manner indicated by the Nucleo Dottorato di ricerca.					
Writing research proposal and EU projects		10	The figure of the researcher has become more complex. In addition to knowing how to do research and translate the results of their efforts into scientific papers, the researcher must possess project management skills that include knowing how to monitor European, national, and regional funding opportunities, as well as how to write project proposals in response to such calls. The ongoing European programming 2021-2027 offers considerable opportunities for the researcher who aspires to obtain more funds to finance its own research. Although only an introduction, this course aims to help PhD candidates develop certain project management skills, i.e., the search of funding opportunities, the analysis of the essential elements and requirements of the calls, and the preparation of a project proposal.	No	Nov 2023-2024	English	yes	CROSSOVER
Innovation management	Francesca Montagna	8	Innovation Management is nowadays a recognized discipline that concerns scientific knowledge and professional skills. In the current economic environment, the transfer of technological development results into products and services, which must be both profitable for businesses and useful to society, is in fact not immediate and requires special capabilities. These required capabilities and skills are transversal and common to the different expressions of technology, as well as to	No	Nov 2023-2024	English	yes	CROSSOVER

			<p>various disciplines and industrial sectors. In this sense, they constitute a fundamental professional and cultural background for Engineers, Architects and Designers. Innovation management covers both strategic and technical-operational decisions, as well as the definition of those core competences for the management and support of innovation processes and product and service development. The course mainly aims at blending a managerial perspective, so to make the doctoral student capable of understanding the innovation process, to the more traditional perspectives from the specific design disciplines. It also provides indications on the main current research questions and on the work being carried out by researchers in the field. The course is based on lessons, with wide use of cases drawn from experience and empirical research and case studies where students are required to analyse information in a quantitative manner. At the end of the course, students will have acquired a concrete ability to analyze and manage business and design decisions related to technological innovation in both strategic and operational terms. They also acquire full mastery of approaches for the management of R&amp;D and innovative processes, product and service development.</p>					
Intellectual Property Rights and Innovation	Federico Caviglioli	6	<p>This course aims to provide students with fundamental knowledge on the Intellectual Property Rights (IPRs) that are available to protect creativity and innovation. The definitions and the main characteristics of patents, trademarks, copyrights, designs, creative commons, etc. will be examined. Students will be introduced to some of the sources of IPR data which can be searched to perform preliminary prior art analyses.</p>	No	Mar 2023-2024	English	yes	CROSSOVER

			In particular, the course will focus on patent data as a source of information which could help the researchers in developing new technical developments from a scientific perspective and improve their understanding of a technological field. The definition of such a technology landscape can be also useful for supporting the communication of technology trends and their socio-economic impact, in particular for project funding.					
Social and environmental impact	Christian Campagnaro	10	The concept of social impact refers to the effects, intentional or not, of transformative interventions on contexts; as a result of the project, it describes a change that must be felt and accepted as a positive alteration of pre-existing conditions and behaviors, towards preferable situations. Furthermore, the Impact concerns the different dimensions of sustainable development - environmental, social, cultural and economic - and is characterized by an approach to the project that combines economic prosperity, well-being, inclusion and cohesion. At the base of it, there is the commitment of professionals, organisations and society for the protection and enhancement - in the short, medium and long term - of the available and potential resources, both material and intangible, as well as attention to the dignity of the person and the needs of the communities. The main objective of the laboratory is to prepare students to recognise the multidimensional impact and effects of the projects and the decisions they contribute within multidisciplinary and multi-actor working groups and to exercise roles and functions with awareness and intentionality in multistakeholder processes.	No	Sep 2023-2024	English	yes	CROSSOVER

Creativity and idea generation techniques	Buiatti Eleonora	20	<p>The main objective of this course is the generation and development of new and creative ideas by specific techniques and psychological models. The first part of the course will be dedicated to theoretical aspects related to the main mechanisms of the human mind involved in mostly automated and recursive processes: mental models, heuristics and automatisms. The sensory aspects of human perception will also be studied to show how the strategic actions are possible, during the meta-project and the design phase, in order to specifically convey particular characteristics of any artifact, interface or environment. At the same time, during the course, the main tools through which it is possible to measure perceptual aspects will be shown (Eyetracking and SounBe). Finally, the second part of the course will see students to apply creative models using innovative device based on the holographic principle. The main idea will be to create a prototype of innovative learning, taking as a specimen a course devoted to physical topics (Structural mechanics aspects), in order to apply the communicative holographic language to the students. The learners will generate the images, the 3D contents they will traduce them in holograms and they will project with the teacher a learning path for an innovative pilot course.</p>	No	Mar 2023-2024	English	yes	CROSSOVER
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# Scuola Superiore Sant'Anna (SSSA)

Referenti: Arianna Menciacchi <arianna.menciacchi@santannapisa.it> e Calogero Oddo <Calogero.Oddo@santannapisa.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Neuromorphic Computing	Calogero Maria Oddo	20	The course will explore computational and physical models that emulate the neural dynamics and the efficiency of biological neurons of peripheral and central nervous system.	yes	Sept, 2023	English	yes	Crossover
Graphical programming for measurement, test, and control systems in bioengineering	Calogero Maria Oddo	20	The main competences developed will be fundamentals and technical abilities of graphical programming for biomedical engineering. The main software used will be LabVIEW (Core 1 module), with the aim to address the following detailed topics: introduction to graphical programming; navigating the graphical programming environment; what is graphical programming; project explorer; parts of a Virtual Instrument (VI); front panel; block diagram; searching for controls, VIs, and functions; selecting a tool; dataflow; building simple VIs; troubleshooting and debugging Vis; implementing a VI; data types; documenting code; while and for loops; timing a VI and data feedback in loops; plotting data; case structures; developing modular applications; data structures: arrays and clusters; managing file and hardware resources; introduction to data exchange via UDP; Euler method for discrete fixed-step solution of differential equations and graphical implementation; hands on examples with graphical programming.	yes	Dec 6, 11, 12, 18, 2024	English	yes	Basic

Neural Networks and Deep Learning: Theoretical Foundations	Giorgio Buttazzo	30	The aim of the course is to provide key concepts and methodologies to understand neural networks and deep learning models, explaining how to use them for pattern recognition, image classification, signal prediction, system identification, and adaptive control.	SI	Jan-Feb 2023/2024	English	SI	BASIC
Neural Networks and Deep Learning: Advanced Topics	Giorgio Buttazzo	30	This module presents recent techniques proposed to improve previous models and overcome their limitations. Topics include Deep Reinforcement Learning, semi-supervised learning, GANs, transformers, neural tracking, adversarial attacks and defense methods.	SI	Feb-Mar 2024/2024	English	SI	ADVANCED
Neural Networks and Deep Learning: Implementation Issues	Giorgio Buttazzo	30	The aim of the part is to discuss practical and implementation issues useful to deploy neural networks on a variety of embedded platforms using different languages and development environments.	SI	Mar-Apr 2024/2024	English	SI	ADVANCED
Fundamentals of Surgical and Interventional Robotics	Arianna Menciassi	10	The course will be focused on methodologies and guidelines related to robotic technologies for minimally invasive therapy, diagnosis and surgery. Lectures will introduce different solutions for targeted therapies both minimally invasive and no invasive, e.g. which exploit external generators of therapeutic actions. At the end of the course the student will be able to identify the most appropriate targeting/therapeutic solutions for the different human body districts, at different scales, and for different pathologies. Competence to be acquired along the course: <ul style="list-style-type: none"> <li>the design principles behind robotic technology for MIS;</li> <li>different technologies and paradigms for autonomous, teleoperated, hand held robots for minimally invasive surgery;</li> </ul>	SI	Feb-Apr 2023/2024	English	SI	CROSSOVER

			<ul style="list-style-type: none"> <li>actuation technologies for robotic tools for minimally invasive surgery.</li> </ul>					
Microscale Robotics	Stefano Palagi	20	<p>Microrobotics is an emerging field that addresses the development of (mobile) robots of microscopic size mainly intended for applications in minimally-invasive medicine. The course aims at introducing microrobotics, while encouraging you to explore and delve into the aspects that interest you the most. The classes will be interactive and include hands-on experiences and an actual research project.</p> <p><a href="https://github.com/stefanopalagi-sssa/microrobot-course">https://github.com/stefanopalagi-sssa/microrobot-course</a></p>	NO	Dic 2023 - Feb 2024	English	Sì	CROSSOVER

## Università di Firenze (UNIFI)

Reference person: Benedetto Allotta <benedetto.allotta@unifi.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Current Trends in Marine Robotics	Alessandro Ridolfi	3	The course describe the state of the art of research in Marine Robotics and suggests hot fields of investigation	sì		English	sì	Basic
Maneuverability Analysis of Underwater Vehicles	Benedetto Allotta	3	The course describes how to evaluate the dynamic maneuverability of underwater vehicles starting from the vehicle dynamic model and the thruster model	sì		English	sì	Advanced



# Università degli studi di Genova (UNIGE)

Reference person: Giorgio Cannata <giorgio.cannata@unige.it>, Antonio Sgorbissa <antonio.sgorbissa@unige.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Robot programming with ROS	Carmine Tommaso Recchiuto	15	ROS is a robotic middleware that offers a collection of packages for commonly used functionality, low-level control, hardware abstraction, and message passing. Given all these aspects, it has become a standard in robotics. The course will explore its most relevant functionalities, with the help of different examples, analyzing how the ROS framework may help in solving common problems in robotics. The course will describe in detail the ROS framework, also giving some general operative instructions, and it will then deal with some specific aspects, in particular, 3D simulations with ROS and ROS2. The course is particularly suggested to students who have never used ROS, which will receive some insights about its features. The course will foresee the usage of some commonly used robotic simulators, such as Gazebo, giving the possibility of practically testing the ROS features. During the course, a Docker image with ROS and ROS2 already installed will be given to students.	yes	Sep 2023/2024	English	yes	BASIC
Electronics and Circuits	Marco Sartore	48	Level 1: learning basic Operational Amplifier circuit design and practices; learning digital electronics basics. Level 2: understanding Analog-to-Digital and Digital-to-Analog conversion and being able to write the specifications of an analog system for signal conditioning and of a	yes	Jan-Feb 2023/2024	English	yes	BASIC

			<p>mixed-signal system (signal conditioning, data acquisition, filtering) to provide to a third-party designer or to select an off-the-shelf solution available on the market.</p> <p>Level 3: more electronic components; schematic circuit design of “standard modules” to be used as building blocks in more complex or custom systems, more advanced technical issues (e.g. circuit layout dos and don’ts), circuit design best practices.</p> <p>Level 4: learning a CAD tool for the design of circuit schematics and of the related customized Printed Circuit Boards.</p>					
Motion control drivers	Marco Sartore	48	<p>Level 1: learning how a Stepper Motor is composed and how it must be correctly driven, combining its mechanical features with driver’s requirements, up to the realization of a simple electronic circuit to interface a Stepper Motor. Level 2: understanding the insights of fine drivers for Stepper Motors, learning microstepping techniques and their practical application in the physical realization of an advanced driver. Level 3: understanding the structure of Brushless Motors as compared with the brushed ones, their driving needs and how to fulfill their requirements, with the practical realization of a simple driver using dedicated integrated circuits. Level 4: learning the details of Brushless Motors drivers up to programming a microcontroller as the smart portion of an advanced driver.</p>	yes	Jun-July 2023/2024	English	yes	ADVANCED
C++ programming techniques	Fabio Solari, Manuela Chessa	20	<p>This course introduces the specificities of C++ object oriented programming language and focuses on the use of C++ for the implementation of object-oriented software modules. In particular, programming techniques to tackle the issues of memory management, robustness and efficiency are considered</p>		Jan-Feb 2023/2024	English	yes	BASIC

Theory and Practice of Learning from Data	Luca Oneto	20	This course aims at providing an introductory and unifying view of information extraction and model building from data, as addressed by many research fields like DataMining, Statistics, Computational Intelligence, Machine Learning, and Pattern Recognition. The course will present an overview of the theoretical background of learning from data, including the most used algorithms in the field, as well as practical applications.	yes	July 2023/2024	English	yes	BASIC
An introduction to Body-Machine Interface	Camilla Pierella	12	The course will introduce the field of body-machine interface (BoMI). It will present different concepts for dimensionality reduction to be applied in the domain of biological signals to control external devices. It will also discuss current scientific and technological perspectives and limitations. Emphasis will be given to the study of the learning process while using a BoMI both from a modeling and from a data analysis point of view.	yes	July 2023/2024	English	yes	ADVANCED
Deep Learning: a hands-on introduction	Nicoletta Noceti, Francesca Odone	20	Deep Learning (DL) is a branch of Machine Learning that has recently achieved astonishing results in several different domains. This course will provide a hands-on introduction to DL, starting from its foundations and discussing the various types of deep architectures and tools currently available. The theoretical classes will be coupled with hands-on activities in lab (in Python using Keras), which will constitute an integral part of the course, giving the possibility of practicing deep learning with examples from real-world applications, with particular focus on visual data. Besides well-established approaches, the course will also highlight current trends, open problems, and potential future lines of research. Although the DL course can be taken independently, for the second year it will be held in synergy with the "Computer Vision Crash Course"	yes	Jun 2023/2024	English	yes	BASIC

			(CVCC). Computer Vision is indeed one of the most classical and effective applications of DL in the real world. Contributions from the CVCC course will constitute a complementary deepening on basic principles of computer vision and visual perception in artificial agents, but also providing a guided tour using deep learning for computer vision problems.					
Computer Vision Crash Course	Francesca Odone, Nicoletta Noceti	20	Visual perception, as a key element of Artificial Intelligence, allows us to build smart systems sensitive to surrounding environments, interactive robots, video-cameras with real time algorithms running on board. With similar algorithms, our smart phones can log us in by recognizing our face, read text automatically, improve the quality of the photos we shoot. At the core of these applications are computer vision models, often boosted by machine learning algorithms. This crash course is conceived as a complement to the “Deep Learning: Hands on introduction” course (henceforth DL) although it can be taken independently. It covers the basic principles of computer vision and visual perception in artificial agents, including theoretical classes, application examples, hand-on activities. Within CVCC, we present elements of classical computer vision (introduction to image processing, feature detection, depth estimation, motion analysis). At the same time, by borrowing from DL, we also present deep learning approaches to computer vision problems such as image classification, detection, and semantic segmentation.	yes	Jun 2023/2024	English	yes	BASIC
Adversarial Machine Learning	Luca Demetrio	12	Today machine-learning algorithms are used for many real-world applications, including image recognition, spam filtering, malware detection, biometric recognition. In these applications, the learning algorithm can have to face intelligent and	yes	Jul 2023/2024	English	yes	ADVANCED

			<p>adaptive attackers who can carefully manipulate data to purposely subvert the learning process. As machine learning algorithms have not been originally designed under such premises, they have been shown to be vulnerable to well-crafted attacks, including test-time evasion and training-time poisoning attacks (also known as adversarial examples). In particular, the security of cloud-based machine-learning services has been questioned through the careful construction of adversarial queries that can reveal confidential information on the machine-learning service and its users. This course aims to introduce the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. We report application examples including object recognition in images, biometric identity recognition, spam and malware detection, with hands-on on attacks against machine learning and defences of machine-learning algorithms using the SecML software library, <a href="https://secml.readthedocs.io/en/v0.15/">https://secml.readthedocs.io/en/v0.15/</a>.</p>					
Effective habits and skills for successful young scientists	Fabio Roli	20	<p>Although tons of books on effective habits and soft skills have been published, they have not been thought for scientists, and, therefore, issues that are relevant for them are not easily available. This short course aims to collect spread ideas and place them in a coherent framework useful for young scientists and provide a small tactical guide for scientists at the first stages of their career. First, I review the main concepts of Steve Covey's personal and time management paradigm, the inspirational speeches of the late Professor Randy Pausch, and the paradigm of atomic habits</p>	yes	Jun 2023/2024	English	yes	CROSSOVER

			of James Clear, and discuss their utility for daily activity of a young scientist. Then, I focus on a few practical skills, namely, on how to write a great paper and give a great talk. I try to convey the message that succeeding in science and technology requires skills and habits beyond the pure intelligence and intellectual abilities, and that good habits and skills of personal and time management are extremely important for young scientists.					
Machine Learning Crash Course (MLCC)	Lorenzo Rosasco, Giovanni Alberti, Simone di Marino	20	Machine Learning is a key to develop intelligent systems and analyze data in science and engineering. Machine Learning engines enable intelligent technologies such as Siri, Kinect or Google self driving car, to name a few. At the same time, Machine Learning methods help deciphering the information in our DNA and make sense of the flood of information gathered on the web, forming the basis of a new "Science of Data". This course provides an introduction to the fundamental methods at the core of modern Machine Learning. It covers theoretical foundations as well as essential algorithms. Classes on theoretical and algorithmic aspects are complemented by practical lab sessions. This introductory course is suitable for undergraduate/graduate students, as well as professionals.	yes	25-28 Jun 2024	English	yes	BASIC
Ethics and Bioethics in Bioengineering and Robotics	Linda Battistuzzi	15	Upon successful completion of this course, students will be able to - explain some of the key ethical and bioethical issues in bioengineering and robotics - identify ethically problematic facets of a project - apply an ethical decision-making framework to a scenario in order to determine an ethically appropriate course of action. How can we develop models of human-robot interaction that preserve human	yes	Jan-Feb 2023/2024	English	yes	CROSSOVER

			<p>values? Can ethical considerations be incorporated into the design of novel artifacts? What duties and obligations do researchers have towards research participants?</p> <p>Increasingly, researchers and professionals in the fields of bioengineering and robotics are faced with ethical questions like these. The goal of this course is therefore twofold: first, to develop PhD students' sensitivity to the ethical issues that arise in research and professional practice, and, second, to provide them with the knowledge and tools that will help them navigate ethically complex scenarios and reach ethically appropriate decisions.</p>					
Grant Writing	Cinzia Leone	12	<p>The course will present and discuss guidelines on how to design a research grant proposal and on the coordination of a research grant, with a special focus on European Horizon Europe Framework Programme. The students will be invited to participate to concrete exercise and the drafting of real and possible project ideas. A part of the lessons is dedicated to participatory activities.</p> <p>A particular focus will be on project proposals to be developed by PhD students and Early Stage Researchers. Use cases of successful projects coordinated by the teacher will be studied and analysed. A short simulation of the development process of a draft research proposal will conclude the course.</p>	No	Sep 2023/2024	English	yes	CROSSOVER
Theatrical techniques for scientific presentation	Antonio Sgorbissa	12	<p>Upon successful completion of this course, students will be able to successfully prepare a scientific presentation for a specific audience, and to deliver it to the public by using their voice, their body and the space around them in the most efficient way as possible.</p> <p>Topics covered will include:</p>	No	May-Jun 2023/2024	English	yes	CROSSOVER

			<ul style="list-style-type: none"> <li>• How to prepare a presentation by taking into account the scientific context and the public;</li> <li>• Structuring the presentation: the importance of the beginning and the end;</li> <li>• Scientific journals and conferences;</li> <li>• Theatrical techniques to use the space;</li> <li>• Theatrical techniques to use the body;</li> <li>• Theatrical techniques to use the voice.</li> </ul>					
Open Science and Research Data Management (OS&RDM)	Anna Maria Pastorini, Valentina Pasquale	10	This training module for PhD Students aims to introduce early-career researchers to the principles of scholarly communication, Open Science and Research Data Management. Students will gain a better understanding of the available research e-infrastructures, tools, and services for Open Access publishing, Research Data Management and FAIR Data. Students will also learn the importance and the transformative potential of Open Science practices in research, especially to improve reproducibility and increase research integrity. They will learn what means to make data FAIR, as required by many funders, including the European Commission, and how to draft a data management plan. Finally, they will have the chance to practice on common tools for Research Data Management, like Data Stewardship Wizard, Zenodo, and Dataverse.	yes	Feb 2023/2024	English	yes	CROSSOVER



# Università degli studi di Milano Bicocca (UNIBM)

Reference person: Domenico Giorgio Sorrenti <domenico.sorrenti@unimib.it>, Dimitri Ognibene <dimitri.ognibene@unimib.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Statistics: R		24			Annuale	English	yes	ADVANCED
Statistical methods		24			Annuale	English	yes	BASIC
Open Science		8			Annuale	English	No	CROSSOVER
Surfing the academic job market: how to publish in high impact international journals		8			Annuale	English	No	CROSSOVER
Understand the Mobile UX Design Process		8			Annuale	English	No	ADVANCED
Software for experiments: E-Prime/open Sesame		24			Annuale	English	No	ADVANCED
Matlab		24			Annuale	English	No	BASIC
Basics of VR/AR human-computer interactions		8			Annuale	English	No	BASIC
Image acquisition pipelines: embedded processing and post processing	Simone Bianco, Marco Buzzelli, Luigi Celona, Flavio Piccoli, Raimondo Schettini	20			February-March	English	yes	ADVANCED
Graph Theory and Algorithms	Gianluca della Vedova, Marco Viviani	20			April-June	English		ADVANCED

Data-driven Optimization	Guglielmo Lulli				July	English		ADVANCED
Causal Networks: Learning and Inference	Fabio Stella, Luca Bernardinello				September	English		ADVANCED
Human-AI interaction	Federico Cabitza				September	English		ADVANCED

## Università degli Studi di Napoli Federico II (UNINA)

Reference person: Silvia Rossi <silrossi@unina.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Social Robotics	Silvia Rossi, Alessandra Rossi	16	In this module, students will learn the key aspects of designing and developing robots' behaviours that are accepted and familiar to people. Particular attention will be given to robotics applications and scenarios where robots are expected to have close interactions with people and support therapists and caregivers. Students will be provided with an overview of the multidisciplinary aspects to consider in order to design a human-robot interaction (HRI) by discussing and learning aspects and techniques from different relevant fields, such as robotics, computer science, engineering, psychology, and artificial intelligence (AI). Students will learn how to design and conduct a HRI study, and how to choose subjective and objective measures to evaluate the interaction with the robot, and people's perception of the robot's	Si	Secondo semestre 2023/ 2024	Inglese		CROSSOVER

			<p>behaviours and their effect on users. Students will also be exposed to different robots, such as Pepper and Furhat, that are used in human-centred scenarios, such as assistive robots in private homes, care facilities and hospitals, robotic companions in home environments, and robots in rehabilitation centers.</p>					
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## Università degli Studi di Padova (UNIPD)

Reference person: Giulio Rosati <giulio.rosati@unipd.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Python programming for Data Science and Engineering	Stefano Tortora	20	<p><b>Aim:</b> Python is an easy-to-learn and powerful high-level language and it is becoming more and more popular for scientific applications such as machine learning, statistics, manipulating and transforming data, but also computer vision and robotics. The first objective of the course is to become familiar with Python syntax, environments and basic libraries. Secondly, the learner will be guided in performing basic inferential data analyses and introduced to the application of common machine learning algorithms.</p> <p><b>Topics:</b></p> <p>1- Introduction to the Python Programming Language</p> <ul style="list-style-type: none"> <li>○ What is different in Python?</li> <li>○ The Python Language Syntax</li> </ul>	yes	Mar/Apr 2023-2024	Inglese	yes	Basic

			<ul style="list-style-type: none"> <li>○ Basic and advanced data structures</li> </ul> <p>2- Modules and Packages</p> <ul style="list-style-type: none"> <li>○ NumPy and SciPy: Numerical and Scientific Python</li> <li>○ Pandas: Labeled Column-Oriented Data</li> <li>○ Matplotlib: MATLAB-style scientific visualization</li> <li>○ Scikit-learn: Basics of Machine Learning in Python</li> </ul>					
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## Università degli Studi di Palermo (UNIPA)

Reference person: Adriano Fagiolini <adriano.fagiolini@unipa.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Robot Consciousness	Antonio Chella	12	Robot Consciousness is a seminal field placed at the crossing between technical disciplines (AI, Robotics, Computer Science and Engineering), theoretical disciplines (Philosophy of Mind, Linguistic, Logic), and empirical disciplines (Psychology and Neuroscience). Robot consciousness focuses on attempts to apply the methods of AI, robotics and computer science to various ways of understanding consciousness and to examine the possible role of	yes	Mar/Apr 2023-2024	English	yes	CROSSOVER

			consciousness in robot systems. The course will present the current state of research and will discuss both the theoretical foundations and the experimental result of the emerging field of robot consciousness.					
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## Sapienza Università di Roma (UNIROMA1)

Reference person: Alessandro De Luca <deluca@diag.uniroma1.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
An overview on Least Squares optimization on Factor Graphs	Giorgio Grisetti	20	<p>Factor Graphs are graphical models that can represent a wide range of problems including, but not limited to SLAM, Visual and Lidar Odometry, Calibration, Structure from Motion, and Model Predictive Control. Effective methods to solve factor graphs are nowadays available.</p> <p>The aim of this course is to provide the students with a basic background on the formalism and on the techniques that can be used to solve these models.</p> <p>We plan to present several worked out examples, with small projects covering: Calibration, Point-Cloud Registration and Pose-Graph Optimization.</p>	Si	Secondo Semestre 2023/24	English	Si	Intermediate

## Università degli Studi di Siena (UNISI)

Reference person: Domenico Prattichizzo <dprattichizzo@unisi.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Foundation of Haptics Design and Control	Domenico Prattichizzo	20		Si	Apr 2023-24	English	Si	ADVANCED
Wearable Haptics	Domenico Prattichizzo	20		Si	Apr 2023-24	English	Si	ADVANCED
Dynamic Systems on networks	Chiara Mocenni	20	The course tackles theoretical and applicative aspects of networked dynamic systems. We start with the definition and introduction of the main properties of networked systems with time- evolving nodes.	Si	Oct 2023/2024	English	Si	ADVANCED

## Università degli Studi di Trento (UNITN)

Reference person: Daniele Fontanelli luigi.palopoli@unitn.it Luigi Palopoli Daniele Fontanelli <daniele.fontanelli@unitn.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Research Methodology		20	The goal is to teach students the fundamental notions and concepts underlying scientific and technological research, with a focus on Information and Communication Technology.	No	May 2023/2024	English	yes	CROSSOVER

			Research Methodology will be composed of a course and 2 seminars.					
Towards Brain Programming	Adriano Tavares Fausto Giunchiglia	20	This course will introduce a new computational model of the brain, called SPA (for Sensing Processing Acting) currently under development, and a platform implementing it, called FAISCA. The ultimate goal of FAISCA is to allow for the development of synthetic brains, simulating the human brain in its main functionalities. FAISCA is programmed based on the Behavioral Trees (BT) computational model.	yes	July 2023/2024	English	yes	ADVANCED
Logic Programming and Explainable AI	Fabio Aurelio D'Asaro	20	Inductive Logic Programming (ILP) is a novel logic-based approach to Machine Learning that aims to learn a logic program that explains a set of examples in the context of some pre-existing background knowledge. This course will start by introducing the basics of Answer Set Programming, a novel logic programming language, and then move on to ILASP (short for Inductive Learning of Answer Set Programming), a framework for learning programs in the form of special non-monotonic logic constructs. The students will learn how to use these tools in the context of Explainable AI (XAI) and will be introduced to recent research in this field, which aims to make Machine Learning more transparent and, to some extent, ethical. The final assessment will verify the students' practical command of these tools	yes	Sep 2023/2024	English	Si	ADVANCED
Visual Recognition beyond the Closed World	Massimiliano Mancini	20	Deep learning models achieved impressive results in many computer vision tasks. However, these successes heavily rely on a simple assumption: the training set captures all the knowledge the model needs to perform well at test time. In this course, we will discuss fundamental techniques to extend visual models beyond the closed world depicted in the training	yes	Sep 2023/2024	English	yes	ADVANCED

			set, working in the open world, i.e., when test images contain different distributions or even different semantics w.r.t. training ones.					
Legged robot control	Andrea Del Prete	20			May-Sep 2023/2024	English	yes	ADVANCED
Modeling with Partial Differential Equations	Giacomo Moretti	20			May-Sep 2023/2024	English	yes	BASIC
Neural networks for Mechanics	Gastone Pietro Rosati Papini	20			May-Sep 2023/2024	English	yes	ADVANCED
Network dynamics	Giulia Giordano	20			May-Sep 2023/2024	English	yes	ADVANCED
Non-linear hybrid dynamical systems	Luca Zaccarian	20			May-Sep 2023/2024	English	yes	ADVANCED
Robot learning from demonstration	Matteo Saveriano	20			May-Sep 2023/2024	English	yes	ADVANCED
Fundamentals of statistical estimation theory	Daniele Fontanelli	20			May-Sep 2023/2024	English	yes	ADVANCED
Virtual instruments for data acquisition and signal analysis	David Macii	20			May-Sep 2023/2024	English	yes	ADVANCED
Academic writing for science and engineering	Felicity Hope	20			May-Sep 2023/2024	English	yes	CROSSOVER



# Università Politecnica delle Marche (UNIVPM)

Reference person: Massimo Callegari <m.callegari@univpm.it>, David Scaradozzi <d.scaradozzi@univpm.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Technology Transfer and Innovation	Donato Iacobucci	24	<p><b>Aims:</b> To acquire knowledge and tools about:</p> <ul style="list-style-type: none"> <li>- mechanisms of technology transfer within universities;</li> <li>- management of technology transfer processes;</li> <li>- the valorisation of university research through patents and spin-offs</li> <li>- support services for technology transfer within the university and in the local context.</li> </ul> <p><b>Program:</b></p> <ul style="list-style-type: none"> <li>• Spin-offs and start-ups: the set-up process; the management of technology start-ups; determinants of success and growth.</li> <li>• Patenting activity: patentability conditions; application and granting process at national and international level; economic valorisation of patents.</li> <li>• University-firm collaborations: research collaborations between university and firms, intellectual property management.</li> </ul> <p><b>Methodology:</b> The course will be developed through lessons, seminars and group work.</p>	yes	Mar/Apr 2023-2024	English	yes	CROSSOVER

Design of research: European Projects	Nicola Paone	24	<ol style="list-style-type: none"> <li>1. Introduction to instruments and funding agencies for research.</li> <li>2. European research <ol style="list-style-type: none"> <li>a. European frame-work programmes and Horizon Europe</li> <li>b. Financial instruments in support of research.</li> </ol> </li> <li>3. The role of industry in framework programmes. Technology platforms.</li> <li>4. Steps in project proposal preparation <ol style="list-style-type: none"> <li>a. analysis of Call for Proposals and Workprogramme</li> <li>b. definition of objectives</li> <li>c. definition of partnership</li> <li>d. definition of impact</li> <li>e. the work-programme</li> <li>f. state of art</li> <li>g. budget and resources</li> </ol> </li> <li>5. Project proposal evaluation</li> <li>6. Marie Curie actions for mobility of researchers</li> <li>7. Project management, progress and scientific reporting. (Project meeting, deliverables, reports, etc.)</li> <li>8. Administrative/financial management: <ol style="list-style-type: none"> <li>a. financial reporting</li> <li>b. audit</li> </ol> </li> <li>9. Examples of projects.</li> <li>10. Tutorial sessions.</li> </ol>	yes	Jan/Feb 2023-2024	English	yes	CROSSOVER
Tools and methods for process representation and management	Ferruccio Mandorli	24	<p><b>Formal tools for process representation:</b> definition of IDEF0 diagrams and their use for the AS-IS and TO-BE representation of processes; definition of IDEF3 diagrams for the representation of sequences of tasks; definition of Gantt diagrams for task planning and resources allocation.</p> <p><b>Process management tools:</b> introduction to Microsoft Project; basic concepts; definition of the tasks planning; resources allocation; assessment of the scheduling of the tasks.</p>	yes (also e-learning )	Jan/Feb 2023-2024	English	yes	CROSSOVER

			<p><b>Data elaboration tools:</b> advanced use of Excel; advanced query and selection functions; advanced filters; pivot tables; how to use the solver; introduction to the VBA framework for macro development and use of ActiveX controls.</p> <p><b>Tools for data storing, query and presentation:</b> brief introduction to MS Access and MS Visio.</p>					
Project management techniques	Filippo Ciarapica	24	Understanding Project Life Cycle and Project Portfolio Management Processes. Project Scope Management. WBS: creating the Work Breakdown Structure. Resource planning and estimating. Time estimating techniques. Cost estimating techniques. Project Business Plan. Risk management planning: qualitative and quantitative risk analysis.	yes	Jan/Feb 2023-2024	English	yes	CROSSOVER
Virtual instruments (LabView) for monitoring and management of industrial systems	Milena Martarelli	24	<ul style="list-style-type: none"> <li>● General approach to G programming</li> <li>● Troubleshooting and debug</li> <li>● Implementation of a virtual instrument</li> <li>● Development of modular applications</li> <li>● Arrays</li> <li>● Hardware e software resources</li> <li>● Data Acquisition</li> <li>● Data Flow</li> </ul>	yes	Jan/Feb 2023-2024	English	yes	BASIC
Advanced virtual instruments (Labview - Matlab) for simulation and control of complex systems	David Scaradozzi	24	<ul style="list-style-type: none"> <li>● Auto-index, clusters e type definition</li> <li>● File I/O</li> <li>● State machines</li> <li>● Data flow with variables</li> <li>● Async communication</li> <li>● Design pattern</li> <li>● User interface</li> <li>● VI optimization</li> <li>● LabVIEW RealTime</li> <li>● Design of a control system</li> <li>● Simulation of a complex system</li> </ul>	yes	Jul/Aug 2023-2024	English	yes	ADVANCED
Mathematical programming and graph theory	Fabrizio Marinelli	24	<p><b>Decision Problems</b></p> <ul style="list-style-type: none"> <li>● Elements and taxonomy</li> <li>● Solution of a decision problem</li> </ul>	yes	Mar/Apr 2023-2024	English	yes	ADVANCED

			<ul style="list-style-type: none"> <li>• Easy and hard problems, exact and heuristic algorithms: hints of computational complexity theory</li> <li>• Multi-objective problems: goal programming and pareto-optimality</li> </ul> <p><b>Mathematical Programming</b></p> <ul style="list-style-type: none"> <li>• Declarative languages: AMPL</li> <li>• Decision problems and math. prog.</li> <li>• Integer Linear Programming: features and solution methods</li> </ul> <p><b>Modelling techniques</b></p> <ul style="list-style-type: none"> <li>• binary variables for selection: covering, packing and partitioning models</li> <li>• binary variables for association: assignments and permutations.</li> <li>• Logic variables: fixed costs, semi-continuous sets, conditional constraints, logical predicates</li> <li>• Linearization techniques: absolute values, piecewise linear functions, exponential functions</li> </ul> <p><b>An introduction to Graph Theory</b></p> <ul style="list-style-type: none"> <li>• Terminology and basic properties</li> <li>• Isomorphisms and classes of graphs: paths, cycles, trees, eulerian, hamiltonian, bipartite and planar graphs</li> <li>• Independent sets and covers</li> <li>• Greedy algorithm and matroids</li> <li>• Combinatorial Optimization and graphs</li> <li>• Mathematical prog. for optimization problems on graphs</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Scheduling, routing and packing problems</li> </ul>					
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Open Source scientific software: Octave	Linda Senigagliaesi	24	<b>Octave:</b> <ul style="list-style-type: none"> <li>- Introduction to Octave</li> <li>- Obtaining and installing Octave</li> <li>- Variables, structures and cell arrays</li> <li>- Operations with variables</li> <li>- Scripts</li> <li>- Control statements</li> <li>- Debugger</li> <li>- Reading and writing files</li> <li>- User defined functions</li> <li>- Plotting tools</li> <li>- Evaluation of functions</li> <li>- Numerical solution, integration and optimization</li> <li>- Examples and exercises</li> </ul> <b>Reference books</b> <ul style="list-style-type: none"> <li>- Jesper Schmidt Hansen, "GNU Octave Beginner's Guide"</li> </ul>	yes	Jan/Feb 2023-2024	English	yes	BASIC
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Tutti gli insegnamenti prevedono 8 lezioni da 3 ore

## Università Cattolica Milano (UNICATT)

Reference person: Antonella Marchetti <antonella.marchetti@unicatt.it>

The courses can be Basic (to establish cultural foundations), Advanced (advanced study of specific topics), Crossover (on interdisciplinary subjects).

Name	Teacher	Ore	Class description	Available online	Time of the year (please check)	Language	Final evaluation	Level
Developing In Human-Robot Interaction	Antonella Marchetti, Davide Mssaro, Cinzia Di Dio & Federico Manzi	18	Social robots represent the new frontier of interactions. We are looking at a future in which these entities will be included and integrated within many types of everyday activities, where they will be our new friends, collaborators, educators, and care assistants. In this course we will therefore offer a look at the state of the art in the development of robots as socially effective	sì		English	sì	Basic

			agents in psychology, highlighting their strengths, and trying to project our thinking into a future where these entities can be perceived as social partners. We will approach to the main psychological developmental steps in early infancy (e.g., gaze, imitation, action understanding), embodied cognition, social cognition (i.e., Theory of Mind) with respect to social and educational robotics. These will help to better understand the role of developmental psychology in AI and Human-Robot Interaction.					
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