This is a preliminary list of classes for the 2024-2025 academic year. This document will be updated periodically. If you wish to attend a class, please contact the designated reference persons as soon as possible.

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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, andrea.orlandini@istc.cnr.it, umbrico.alessandro@gmail.com	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	June 2025 (ask for details)	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, anna.maria.pastorini@unige.it, valentina.pasquale@iit.it	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 2025 (ask for details)	English	yes	CROSSUOVER
Modern C++	Marco Accame, Valentina Gaggero, Nicolò Genesio, marco.accame@iit.it, valentina.gaggero@iit.it	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 2025	English	yes	BASIC

Mechanical Drawing Fundamentals	Diego Torazza, diego.torazza@iit.it	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 2025	English	yes	BASIC
ComputerAided Design	Diego Torazza, diego.torazza@iit.it	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 2025	English	yes	ADVANCED
Perceptual systems	Monica Gori, Alessia Tonelli, monica,gori@iit.it, alessia.tonelli@iit.it	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, small and taste. Moreover, it will be explain the	yes	March 2025	English	yes	ADVANCED

			process of multisensory integration and cross-modal interaction.					
Robotic Virtual Prototyping Design	Ferdinando Cannella, Mariapaola D'Imperio (TA: Gabriele Marchello), ferdinando.cannella@iit.it	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 2025	English	yes	CROSSOVER
Mechatronics and AI	Ferdinando Canella, Gabriele Marchello, ferdinando.cannella@iit.it	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 2025	English	yes	ADVANCED

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, paolo.bardella@polito.it	30	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. During this course, many common methods used in Scientific Computing will be presented, with particular attention to the most recent programming techniques in MATLAB. 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.	yes	Jan/Feb 2025	English	yes	ADVANCED
Development and management of data-acquisition systems	Alessio Carullo, alessio.carullo@polito.it	25	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	No	Jun 2025	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, sandro.cumani@polito.it	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 2025	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 2025	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, federico.bella@polito.it	11	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 2025	English	yes	CROSSOVER
Facing the scientific publishing world	Federico Bella, federico.bella@polito.it	12	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 2025	English	yes	CROSSOVER
Research communication and relationships with companies and organizations	Diana Caterina Nada Massai diana.massai@polito.it,	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	March 2025	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 2024	English	yes	CROSSOVER
Innovation management	Francesca Montagna, francesca.montagna@polito.it	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 2024	English	yes	CROSSOVER

			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&D and innovative processes, product and service development.					
Intellectual Property Rights and Innovation	Federico Caviggioli, federico.caviggioli@polito.it	6	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.	No	Mar 2025	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.					
Creativity and idea generation techniques	Buiatti Eleonora, eleonora.buiatti@polito.it	20	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 10etworks10ic 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.	No	Mar 2025	English	yes	CROSSOVER

Scuola Superiore Sant'Anna (SSSA)

Referenti: Arianna Menciassi <arianna.menciassi@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, Calogero.Oddo@santannapisa.it	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	Dec 2024/Jan 2025	English	yes	CROSSOVER
Graphical programming for measurement, test, and control systems in bioengineering	Calogero Maria Oddo, Calogero.Oddo@santannapisa.it	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	Oct 2025	English	yes	BASIC

Neural Networks and Deep Learning: Theoretical Foundations	Giorgio Buttazzo, giorgio.buttazzo@santannapisa.it	20	The objective of the course is to provide key concepts and methodologies to understand neural networks, explaining how to use them for pattern recognition, image classification, signal prediction, system identification, and adaptive control. Topic will include fully connected networks, unsupervised learning, self-organizing maps, clustering algorithms, autoencoders, reinforcement learning, supervised learning, multi-layer networks, Backpropagation, radial basis function networks, recurrent networks, attention mechanism.	Yes	Starts on 7th January 2025	English	yes	BASIC
Neural Network and Deep Learning: Deep Networks	Giorgio Buttazzo, giorgio.buttazzo@santannapisa.it	20	This module presents the foundations for understanding deep neural networks and deep learning algorithms. Topics include convolutional networks for classification, detection and segmentation, deep reinforcement learning, generative adversarial networks and transformers.	Yes	Starts of 4th February 2025	English	Si	CROSSOVER
Neural Network and Deep Learning: Advanced Topics	Giorgio Buttazzo, giorgio.buttazzo@santannapisa.it	20	This module presents recent techniques proposed to improve neural models and overcome their limitations. Topics include model compression, semi-supervised learning, anchor-free object detection, neural object tracking, adversarial attacks and defense methods, methods for explainable AI and anomaly detection.	Yes	Starts of 4th February 2025	English	Si	ADVANCED
Neural Networks and Deep Learning: Implementation Issues	Giorgio Buttazzo, giorgio.buttazzo@santannapisa.it	30	The objective of the course is to present practical and implementation issues useful to deploy neural networks on a variety of embedded platforms using different languages and development environments. Topics include implementing neural networks from	Yes	Starts on 1st April 2025	English	yes	ADVANCED

			scratch in C, TensorFlow, Keras, and PyTorch. Neural 13etworks for autonomous driving. Model optimization for embedded platforms. Accelerating deep networks on GPGPUs and FPGA.					
Fundamentals of Surgical and Interventional Robotics	Arianna Menciassi, arianna.menciassi@santannapisa.it	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: • the design principles behind robotic technology for MIS; • different technologies and paradigms for autonomous, teleoperated, hand held robots for minimally invasive surgery; • actuation technologies for robotic tools for minimally invasive surgery.	Yes	Feb-Apr 2025	English	yes	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, alessandro.ridolfi@unifi.it	3	The course describe the state of the art of research in Marine Robotics and suggests hot fields of investigation	yes	Autumn/Winter 2024	English	Yes	BASIC
Maneuverability Analysis of Underwater Vehicles	Benedetto Allotta, benedetto.allotta@unifi.it	3	The course describes how to evaluate the dynamic maneuverability of underwater vehicles starting from the vehicle dynamic model and the thruster model	yes	Spring/Summer 2025	English	Yes	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
Ethics and Bioethics in Bioengineering and Robotics	Linda Battistuzzi, linda.battistuzzi@unige.it	21	*Can ethical considerations be incorporated into the design of novel artifacts? What duties and obligations do researchers have towards research participants? How can we develop models of human-robot interaction that preserve human values?* 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: to develop PhD students' sensitivity to the ethical issues that arise in research and professional practice, and to provide them with knowledge and tools that will help them navigate ethically complex scenarios. 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 research project - apply an ethical decision-making framework to ethically problematic scenarios involving questions that are relevant to their research interests.	Ask the teacher	January 17 (15.30 - 17:30) January 20 (15.30 - 17:30) January 22 (15.30 - 17:30) January 24 (15.30 - 17:30) January 27 (15.30 - 17:30) February 7 (15.00 - 17:30) February 10 (15.00 - 17:30) February 12 (15 - 18) February 14 (15 - 18)	English	Yes	CROSSOVER

Paper Writing	Mario Marchese, mario.marchese@unige.it	12	*The course aims to provide some basic elements to:* - choose a research topic - manage and use sources - do a novel, serious, and useful research - describe and explain a research	Ask the teacher	- Tuesday, January, 28th, 2025, 15.30-18.30 - Wednesday, January, 29th, 2025, 15.30-18.30 - Thursday, January, 30th, 2025,15.30-18.30 - Friday, January, 31st, 2025,15.30-18.30	English	Yes	CROSSOVER
Grant Writing	Cinzia Leone, Cinzia.Leone@unige.it	12	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.	Ask the teacher	- October 6, 2025 (09:00-13:00) - October 8, 2025 (09:00-13:00) - October 10, 2025 (09:00-13:00)	English	Yes	CROSSOVER
Open Science and Research Data Management (OS&RDM)	Anna Maria Pastorini, annamp@unige.it; Valentina Pasquale, valentina.pasquale@iit.it	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	Ask the teacher	10, 11, 12 ,13, 14 February 2025 (10:00 – 12:00)	English	Yes	CROSSOVER

Course	Teacher	Hours	Description		Schedule	Language		Level
			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.					
Science with Arduino	Carlo Canali, carlo.canali@iit.it	12	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). 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.	Ask the teacher	- May 16th, 2025 morning - May 23rd, 2025 morning - June 6th, 2025 afternoon - June 13th, 2025 afternoon - June 20th, 2025 afternoon	English	Yes	BASIC
Mechanical Drawing Fundamentals	Diego Torazza, Diego.Torazza@iit.it	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 needs 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	Ask the teacher	Monday, 7th January 2025, 9-13 Tuesday, 8th January 2025, 9-13 Wednesday, 9th January 2025, 9-13 Thursday, 10th January 2025, 9-13	English	Yes	BASIC

			setups, scientific devices, and the writing/understanding of technical specifications.		Friday, 13th January 2025, 9-11			
C++ programming techniques	Fabio Solari, fabio.solari@unige.it, Manuela Chessa, manuela.chessa@unige.it	20	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.	Ask the teacher	January 27 to 31, 09.00 – 13.00, a room on the second floor, via Dodecaneso 35.	English	Yes	BASIC
Computational models of visual perception	Fabio Solari, fabio.solari@unige.it	20	This course introduces paradigms and methods that allow students to develop computational models of visual perception, which are based on hierarchical networks of interacting neural units, mimicking biological processing stages. Case studies on computer vision applications and mixed reality systems are considered.	Ask the teacher	February 17 – 21, 14.00 – 18.00, a room on the second floor, via Dodecaneso 35	English	Yes	BASIC
Effective habits and skills for successful young scientists	Fabio Roli, fabio.roli@unige.it	20	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 Professor Randy Pausch, and the paradigm of atomic habits 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	Ask the teacher	23-27 June 2025, 09:00-13:00	English	Yes	BASIC

			and intellectual abilities, and that good habits and skills of personal and time management are extremely important for young scientists.						
Robot programming with ROS	Carmine Tommaso Recchiuto, carmine.recchiuto@dibris.unige.it	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 (classes I – II- III), and it will then deal with some specific aspects (class IV-V), in particular, 3D simulations with ROS and ROS2. The course is particular 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.	Ask the teacher	3 Sep 2025, 09:00 - 12:00 3 Sep 2025, 14:00 - 17:00 4 Sep 2025, 09:00 - 12:00 4 Sep 2025, 14:00 - 17:00 5 Sep 2025, 09:00 - 12:00	English	Yes	BASIC
Modern C++	Marco Accame : marco.accame@iit.it Valentina Gaggero: valentina.gaggero@iit.it Nicolò Genesio:	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, its application with modern SW development techniques and finally they will challenge themselves with an online assignment where they will put in practice what learnt.	Ask the teacher	5 May 2025, 1000-1300 7 May 2025, 1000-1300 8 May 2025, 1000-1300 12 May 2025, 1000-1300	English	Yes	BASIC

	nicolo.genesio@iit.it				14 May 2025, 1000-1300 15 May 2025, 1000-1300 19 May 2025, 1000-1300 These dates may vary due to ICRA Conference 21 May 2025, 1000-1300 These dates may vary due to ICRA Conference 22 May 2025, 1000-1300 These dates may vary due to ICRA Conference 29 May 2025, 1000-1300			
Computer Aided Design	Diego Torazza, Diego.Torazza@iit.it	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).	Ask the teacher	11th, 12th, 13th June 2025, h 9-13	English	Yes	BASIC
Perceptual Systems	Monica Gori, monica.gori@iit.it; Alessia Tonelli, alessia.tonelli@iit.it	12	From birth, we interact with the world through our senses. One of the main questions in experimental psychology is how the brain processes and transforms sensory signals into perceptual outputs. The course aims 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	Ask the teacher	27 March 2025 – from 9 a.m. to 12 p.m., IIT-Erzelli 31 March 2025 – from 9 a.m. to 12	English	Yes	BASIC

			peripheral sensory apparatus in a hierarchy that organizes complex behaviour. In the last part of the course, these topics will be described concerning cross-sensory interaction and multisensory integration in the adult and the developing brain. Students will learn how the primary sensory systems function, i.e., vision, audition, touch, smell, and taste. Moreover, it will explain the multisensory integration and cross-modal interaction process.		p.m., IIT-Erzelli 1 April 2025 – from 2 p.m. to 5 p.m., IIT-Erzelli 3 April 2025 – from 2 p.m. to 5 p.m., IIT-Erzelli			
Optics for Microscopy and Spectroscopy	Dr. Eli Slenders, eli.slenders@iit.it; Dr. Alessandro Zunino, alessandro.zunino@iit.it	12	Light is an essential tool for many important scientific applications, such as optical microscopy and spectroscopy. This course is intended to provide the essential theoretical background of optics and imaging. In particular, the course will focus on both traditional and state-of-the-art optical techniques. Additionally, students will have the opportunity to attend a demonstration with custom-built optical setups. The student will acquire a general overview of the physical principles of modern optical techniques and their most relevant applications.	Ask the teacher	March 17, 2025 (15:00-17:00) March 18, 2025 (15:00-17:00) March 19, 2025 (15:00-17:00) March 20, 2025 (15:00-17:00) March 21, 2025 (15:00-17:00) March 24, 2025 (15:00-17:00)	English	Yes	BASIC
Electronics and Circuits	Marco Sartore, sartore@elbatech.com	48	This course offers detailed knowledge and very practical skills about the electronics circuits and systems that Ph.D. students in the Engineering fields are likely to need during their research studies. The approach totally differs from standard electronics courses where a strong theory hides the useful circuitry and methods of analysis in	Ask the teacher	January 13th: from 3 PM to 6 PM January 14th to 16th: from 9 AM to 12	English	Yes	BASIC

| | | | hard-to-find sections and endnotes, thus leaving the practicing Engineer weak in circuit design.

Attending the whole course (4 modules) is strongly reccommended to take the most benefit from the addressed topics, because each class relies on the preceding one and it is a basis for the next one, in a progressive scheme. Nevertheless, students are allowed to attend just single modules. | | AM & from 2 PM to 5 PM

January 17h: from 8.30 AM to 11.30 AM

February 3rd: from 3 PM to 6 PM

February 4th to 6th: from 9 AM to 12 AM & from 2 PM to 5 PM

February 7h: from 8.30 AM to 11.30 AM | | | |
|---|---|---|---|---|---|---|---|---|
| Motion control drivers | Marco Sartore, sartore@elbatech.com | 48 | This course offers detailed knowledge about the correct way to drive the main motor types utilized in Robotics, exploring the driver circuits and highlighting the related insights, namely Stepper and Brushless motors (despite DC Motors are not explicitly included, the students will however get the necessary skills to deal with them too).

Attending the whole course (4 modules) is strongly recommended to take the most benefit from the addressed topics, because each class relies on the preceding one and it is a basis for the next one, in a progressive scheme. Nevertheless, students are allowed to attend just single modules. | Ask the teacher | June 9th from 3 PM to 6 PM

June 10th to 12th from 9 AM to 12 AM & from 2 PM to 5 PM

June 13th from 8.30 AM to 11.30 AM

June 16th from 3 PM to 6 PM

June 17th to 19th from 9 AM to 12 AM & from 2 PM to 5 PM

June 20th 8.30 AM to 11.30 AM | English | Yes | BASIC |

Theatrical techniques for scientific presentation	Antonio Sgorbissa, antonio.sgorbissa@unige.it	12	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.	No	May 6, 2025 (09:00-12:00) May 13, 2025 (09:00-12:00) June 9, 2025 (09:00-12:00) June 16, 2025 (09:00-12:00)	English	Yes	BASIC
Polymers and biopolymers for sustainable future	Giovanni Perotto, giovanni.perotto@iit.it	12	Polymers are ubiquitous materials due to their broad range of properties, light weight and low cost. In this PhD course, we will show the main reasons that determine the final properties of polymers and how polymer composites can further expand the properties and applications of the base materials. We will describe techniques and methodologies for their fabrication, modification and characterization. Applications in the in packaging will be discussed. The fabrication methods include standard synthetic and manufacturing (e.g., extrusion, injection molding…) processes. The characterization ranges from spectroscopies, to investigate the chemical composition, the polymer structure and the molecular arrangement, to the characterization of macroscopic mechanical, thermal and functional properties. The end-of-life of polymeric material and their environmental sustainability will be discussed. An overview of the applications of polymers and their composites in different fields, such as food packaging and circular economy, will be presented. Objectives of this course are the description of the synthetic methodologies and the experimental techniques used for polymer preparation and characterization. The approach is very applied, starting from some samples concerning the fabrication of the most commonly used polymers and the	Ask the teacher	Lessons will be in April 2025. Specific dates will be decided in February (6 classes of 2 hours).	English	Yes	BASIC

			theory for each technique, leading to practical strategies for material testing, result interpretation and device design.					
Advanced EEG analyses (aEEGa)	Alberto Inuggi alberto.inuggi@gmail.com	15	Learn how to analyze EEG data, starting from artefact removal from raw data to the group statistical analysis of both sensors' and sources' data.	Ask the teacher	17/03/2025 10:00 – 13:00 19/03/2025 10:00 – 12:00 21/03/2025 10:00 – 12:00 24/03/2025 10:00 – 12:00 26/03/2025 10:00 – 13:00 28/03/2025 10:00 – 13:00	English	Yes	ADVANCED
Advanced Topics in In Vitro Neuroengineering: Techniques, Applications, and Future Directions	Martina Brofiga, martina.brofiga@dibris.unige.it	12	The PhD course is designed to provide students with a comprehensive understanding of in vitro neuroengineering, focusing on the principles, techniques, and applications of engineering approaches for studying and manipulating neuronal systems in vitro. The course will cover fundamental concepts, experimental methodologies, and cutting-edge advancements in the field, with an emphasis on multidisciplinary perspectives. Students will gain practical skills in designing and conducting experiments, and analyzing data.	Ask the teacher	8th September 2025 10:00 – 13:00 10th September 2025 10:00 - 13:00 12th September 2025 10:00 – 13:00 15th September 2025 10:00 – 13:00	English	Yes	ADVANCED
Analysis of (networks of) nonlinear oscillators	Matteo Lodi, Marco Storace,	20	This course aims to provide the students with mathematical and numerical tools for analyzing nonlinear dynamical systems, even networked, with either fixed or	Ask the teacher	21/01 9.30-12 23/01 9.30-12 28/01 9.30-12	English	Yes	ADVANCED

	marco.storace@unige.it		changing parameters (in the latter case the lessons' topic will be the so-called bifurcation analysis). In particular, the lessons will focus on geometrical methods for qualitative analysis and the most diffused numerical methods for quantitative analysis. The main theoretical results will be applied to dynamical systems from different fields and illustrated through computer demos in the MATLAB programming environment.		30/01 9.30-12 3/02 9.30-12 5/02 9.30-12 10/02 9.30-12 12/02 9.30-12			
Analytical and computer aided modelling for biomedical engineers: a practical manual to survive	Chiara Magliaro, chiara.magliaro@unipi.it	15	The course aims at introducing the students to the physics and multi-physics based modelling, focusing on applications in the field of biomedical engineering and biotechnology. The first part of the course will provide basics about advanced in vitro models (e.g., organoids, spheroids, scaffold-based constructs), focusing then on Multi-physics software for modelling physical phenomena, in particular transport and reaction of chemical species, heat transfer and fluidics. Then, the last part of the course will be devoted to hands-on using the software, identifying exercises close to the activities of the students during their PhD experience.	Ask the teacher	2 July, 9.30-12.30 (3h) and 14.30-17.30 (3h) 3 July, 9.30-12.30 (3h) and 14.30-17.30 (3h) 4 July, 9.30-12.30 (3h)	English	Yes	ADVANCED
An introduction to Body-Machine Interface	Camilla Pierella, camilla.pierella@edu.unige.it	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.	Ask the teacher	July 7, 2025 (09:00 - 13:00) July 8, 2025 (09:00 - 13:00) July 9, 2025 (09:00 - 13:00) July 10, 2025 (09:00 - 13:00)	English	Yes	ADVANCED

| A journey through Deep Learning | Matteo Moro, matteo.moro@unige.it, Nicoletta Noceti, nicoletta.noceti@unige.it, Francesca Odone, francesca.odone@unige.it, Vito Paolo Pastore, vitopaolo.pastore@unige.it | 40 | Deep Learning (DL) is a branch of Machine Learning that has been driving breakthroughs across a wide range of field.

This intensive school will offer a comprehensive introduction to DL, combining foundational theory with practical, hands-on experience.

The program will cover the fundamental principles of deep learning, delve into various architectures, and present the most widely used tools and frameworks. A key feature of the course is the integration of theory with practice, through hands-on lab sessions using the Python language, and relying on popular frameworks like Tensorflow and PyTorch. In the practical sessions, we will focus in particular on Computer Vision tasks, one of the domains where DL has provided the most astonishing results.

In addition to well-established approaches, the school will also present current research trends, challenges and open problems that may shape prospective lines of research.

During the week, a dedicated poster session will provide participants with the opportunity to showcase their work, foster collaboration, and engage in insightful discussions with peers. | Ask the teacher | 16-20 June 2025 | English | Yes | ADVANCED |
| Computational models of visual attention | Lucia Schiatti, lucia.schiatti@iit.it | 12 | By the end of the course, students will be able to:

- Describe the basic mechanisms of human visual attention based on eye movements.

- Design an experimental protocol with eye-tracking and select suitable outcome measures. | Ask the teacher | April 7, 2025 (9:00-12:00)

April 8, 2025 (9:00-12:00)

April 9, 2025 (9:00-12:00) | English | Yes | ADVANCED |

			- Identify, train and visualize the output of ANNs suitable to model human visual attention. - Discuss the choice of different ANNs architectures based on a specific application. - Present a project idea and discuss their scientific hypothesis and methodological choices.		April 11, 2025 (9:00-12:00)			
Functional quantitative assessment in sport, ergonomics and rehabilitation	Jacopo Zenzeri, jacopo.zenzeri@rewingtech.com	12	The present course will introduce the topic of functional quantitative assessment. This subject is becoming fundamental in all the fields where is important to understand human sensorimotor performance and in general in all the applications where the human is physically in the loop, such as collaborative robotics, wearable robotics, rehabilitation robotics, and many others. The difficulty to quantify human performance is due to the complexity of human behaviour. In fact, the human nervous system is capable of a simultaneous, integrated, and coordinated control of 100-150 mechanical degrees of freedom via tensions generated by about 700 muscles. There is also a different number of sensors (visual, auditory, proprioceptive) and actuators (muscles and skeletal system) to take into account. The course will initially review the traditional techniques adopted to quantitatively assess human sensorimotor performance in the fields of sport, rehabilitation and ergonomics. In the second part of the course will be deeply analysed all the potential technologies that can be exploited to innovate the traditional	Ask the teacher	June 25, 26, 27 2025, 9 -13	English	Yes	ADVANCED

			techniques, with special emphasis on robotic technologies.					
The 3Rs approach in biomedical research and advanced 3D in vitro tissue models	Laura Pastorino, laura.pastorino@unige.it, Donatella Di Lisa, Donatella.Dilisa@edu.unige.it	12	Replacement, Reduction, and Refinement: 3Rs methods are becoming an essential element in the whole field of biomedical research, from its most fundamental aspects to its daily applications. Today 3Rs methods represent a multidisciplinary scientific area comprising animal science, basic biology, test development, pharmacology, toxicology, regulations and regulatory practices, as well as ethics and behavioral sciences. The aim of the course is to raise consciousness for the scientific soundness of the 3Rs methodology. Advanced 3D in vitro models: Bioprinting can be applied to engineer 3D in vitro tissue models by mimicking the structure and function of native tissue through the precise assembly of materials and cells. This approach allows the spatiotemporal control over cell–cell and cell–extracellular matrix communication and thus the recreation of tissue-like structures. Tissue models are applied in regenerative medicine, pharmaceutical, diagnostic, and basic research, reducing the use of laboratory animals according to the 3Rs principle. According to European Directive 2011/63/eU1, all personnel working with experimental animals should be educated to be competent to work with animals.	Ask the teacher	July 14, 16, 18 - 2025 (09:00-13:00)	English	Yes	ADVANCED
Technologies and methods for medical and surgical training	Serena Ricci, serena.ricci@unige.it	12	Technology has been increasingly used in healthcare education. As an example, adult learning theories support the use of immersive technologies such as Virtual Reality, Augmented Reality and Mixed Reality, for the training and evaluation of	Ask the teacher	January 7, 2025; h 15 - 18	English	Yes	ADVANCED

			medical students, healthcare providers, patients and caregivers. Indeed, the use of different technologies (i.e., computer based-simulations, low-cost electronics) provide a riskless, controlled and personalized environment, that might also be realistic and engaging for the user. Another important advantage of using technology in medical education concerns the possibility of assessing the users in an objective and quantitative way, as most of the evaluations are currently based on instructor observations. Medical training covers a broad range of very different abilities: form theoretical and procedural knowledge, manual skills, and non-technical skills (e.g., stress management, communication). Therefore, it is crucial to select and use the most appropriate technology, considering the end user and the skill to be trained and/or evaluated. The course provides an overview of healthcare simulation, and how different technologies and methods can improve the training and evaluation of medical and surgical skills. The course includes an introduction on the theories supporting medical education, followed by a part on simulation methodologies and technologies and how they are used in different specialties.		January 8, 2025; h 15 - 18 January 10, 2025; h 15 - 18 January 21, 2025; h 15 - 18			
Trustworthy Artificial Intelligence	Luca Oneto, luca.oneto@unige.it	20	It has been argued that Artificial Intelligence (AI) is experiencing a fast process of commodification. This characterization is of interest for big IT companies, but it correctly reflects the current industrialization of AI. This phenomenon means that AI systems and products are reaching the society at large and, therefore, that societal issues related to the use of AI and Machine Learning (ML) cannot be ignored any longer. Designing	Ask the teacher	July 2025	English	Yes	ADVANCED

| | | | ML models from this human-centered perspective means incorporating human-relevant requirements such as reliability, fairness, privacy, and interpretability, but also considering broad societal issues such as ethics and legislation. These are essential aspects to foster the acceptance of ML-based technologies, as well as to be able to comply with an evolving legislation concerning the impact of digital technologies on ethically and privacy sensitive matters. | | | | | |

Università degli studi di Milano Bicocca (UNIBM)

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

To be defined

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, silrossi@unina.it	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 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.	yes	Spring/Summer 2025	English	yes	CROSSOVER

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, stefano.tortora@unipd.it	20	**Aim**: 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.
			
			Topics:
			
			1- Introduction to the Python Programming Language
			
			    o What is different in Python?
			
			    o The Python Language Syntax
			
			    o Basic and advanced data structures
			
			2- Modules and Packages
			
			    o NumPy and SciPy: Numerical and Scientific Python
			
			    o Pandas: Labeled Column-Oriented Data
				yes	Mar/Apr 2025	English	yes	BASIC

			o Matplotlib: MATLAB-style scientific visualization o Scikit-learn: Basics of Machine Learning in Python					

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 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.	yes	Mar/Apr 2025	English	yes	CROSSOVER

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
Least Squares optimization on Factor Graphs, an overview	Giorgio Grisetti, Barbara Bazzana, Luca di Giammarino	20	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. 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. We plan to present several worked out examples, with small projects covering: Calibration, Point-Cloud Registration and Pose-Graph Optimization. https://sites.google.com/diag.uniroma1.it/onfactorgraphs/home	yes	May 2025	English	yes	ADVANCED
An introduction to PDEs and their applications in robotics	Andrea Cristofaro, Marilena Vendittelli	16	The scope of the course is to provide the basic knowledge to handle dynamical systems characterized by spatial distributed phenomena and governed by partial differential equations. After reviewing the needed theoretical background material, stability analysis and control design tools will be illustrated. Finally, in the second part of the course, applications to robotics and biomedical engineering will be considered, such as manipulation of flexible	yes	Monday 18/11/2024 ore 14:00-18:00 Wednesday 20/11/2024 14:00-18:00 Monday 25/11/2024 09:00-13:00	English	yes	ADVANCED

			materials or control of heat transfer in organic tissues. Detailed Program: 1) Introduction: motivations and practical examples. Background tools: recalls on finite-dimensional systems, Banach and Hilbert spaces, functional spaces, linear functionals and linear operators. 2) Semigroup theory and infinite-dimensional linear dynamical systems. Well-posedness. Examples of classical PDEs: reaction-diffusion equation, wave equation, beam equation. Spectral analysis: eigenvalues and eigenfunctions. Stability and stabilization based on modal decomposition. 3) Lyapunov based stability analysis. Boundary control. Observer design. Coupling with ODEs at the boundary: example of a flexible robot arm. Approximations and simulations: finite elements, spectral decomposition. 4) Applications: non-invasive internal temperature estimation in superficial hyperthermia, haptic interaction with virtual deformable structures.		Wednesday 27/11/2024 12:00-16:00			

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).

To be defined

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
Fundamentals of statistical estimation theory	Daniele Fontanelli, daniele.fontanelli@unitn.it	18	The course provides an overview of estimation algorithms that are most commonly applied in engineering problems. The course will improve the background knowledge to model, analyse and solve estimation problems. The course has theory and practical sections, mainly simulative. Depending on the availability of actual components, practical examples on actual software/hardware solutions are foreseen. The course covers the following topics: - Background on stochastic processes and random variables - Minimum Variance Unbiased Estimators - Cramer-Rao lower bound - Best linear unbiased estimator - Maximum Likelihood estimation - Weighted least squares solutions - Bayesian estimators All the treated topics will be given with examples and hands-on problems.	No	First or second week of September 2025	English	The final exam consists of a multiple-choice test or a project for the interested students.	BASIC
Legged Robot Control	Andrea Del Prete, andrea.delprete@unitn.it	12	The course provides an overview of state-of-the-art techniques for the dynamic control of robotic systems, with a specific focus on legged robots (bipeds and quadrupeds). The course covers both theory and implementation, relying on the Python language and some existing libraries for robot visualization, multi-body	yes	July 2025	English	Students are requires to write a report, which is evaluated with pass/no pass.	BASIC

			dynamic computation, and trajectory optimization.					
Robot learning from demonstration	Matteo Saveriano, matteo.saveriano@unitn.it	20	The course provides an overview of state-of-the-art approaches for robot learning from human demonstration. The course will focus on approaches that allow the robot to learn stable (in the sense of Lyapunov) discrete (point-to-point) and periodic (limit cycle) trajectories evolving in the Euclidean space. We then move to more complex space structures and introduce the concept of Riemannian manifold with a special focus on orientation and symmetric and positive definite matrices that are of interest in robotics. The presented mathematical tools will be then used to perform learning of motion patterns evolving on Riemannian manifolds. The course covers both theory and implementation of presented algorithms relying on existing, open-source implementations.	yes	September 2025	English	Project and report	BASIC
Factor Graphs for SLAM	Marco Camurri, marco.camurri@unitn.it	18	The course wil introduce factor graphs as a general tool to solve optimization problems and how to apply them to robot perception, with particular application to Simultaneous Localization and Mapping (SLAM) and other correlated problems such as path planning	Yes	First two weeks of June 2025	English	Oral Examination	ADVANCED

Università della Calabria (UNICAL)

Reference person: Giuseppe Carbone <giuseppe.carbone@unical.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 applied to process optimization using Matlab	Alessio Caravella, alessio.caravella@unical.it	16	The course deals with parametric optimization of processes of interest for engineers. In particular, the Students will acquire the ability of formalizing and solve problems dealing with minimization of objective functions depending on parameters to optimize. For this purpose, the commercial software MATLAB® will be used.	Ask the teacher	Jan/Feb 2025	English	No	ADVANCED
Introduction to stochastic and mathematical modelling of discrete systems	Vittorio Astarita, vittorio.astarita@unical.it	12	The course begins with some introduction to probability theory and its applications to engineering problems. This will provide the foundation for the subsequent discussion of Markov chains. The course will then focus on the theory of Markov chains, including their definition, properties, and applications. Students will learn about discrete-time Markov chains and continuous-time Markov chains, as well as methods for analyzing these chains, such as the stationary distribution, and the limiting behavior of Markov chains. The course will also cover game theory and its application to engineering problems. Students will learn about the basics of game theory, including the concept of Nash equilibrium. In addition, the course will introduce students to the Monte Carlo method, a powerful tool for solving complex engineering problems. Students will learn how to simulate random events using	Ask the teacher	Feb 2025	English	No	BASIC

			Monte Carlo simulations and will apply this technique to a range of problems. Finally, the course will introduce students to Blockchain systems and digital currencies. Students will learn about the basics of Blockchain technology, including distributed ledgers and smart contracts, and will explore the potential applications of this technology to engineering problems. Throughout the course, students will be exposed to representative case studies that demonstrate the application of the aforementioned theories to real-world engineering problems. By the end of the course, students will have a better understanding of probability theory and its applications to engineering, as well as a general view on practical toolkits for solving complex engineering problems.					
Introduction to Python	Vittorio Astarita, vittorio.astarita@unical.it	12	This course is designed to provide an introduction to the fundamental concepts of the Python programming language. Students will learn the syntax and semantics of Python, including variables, data types, and control structures. The course will cover basic data structures such as lists, dictionaries, and tuples, as well as functions and modules. Students will also learn about file input/output, error handling, and debugging techniques. By the end of the course, students will have gained a solid foundation in Python programming, which they can use to solve real-world problems.	Ask the teacher	Feb/Mar 2025	English	No	BASIC
How to conduct a Systematic Literature Review: design, methods and supporting tools	Salvatore Ammirato, Marilena De Simone salvatore.ammirato@unical.it, marilena.de	8	Topics: Motivation and goals of a systematic literature review (SLR); Methodology; Literature search, Exclusion and inclusion criteria, Metadata Analysis, Synthesis and results presentation. Applications: Designing a SLR; Paper location and selection; Paper analysis; Results synthesis; Digital tools for SLR; The	Ask the teacher	Nov/Dec 2024	English	No	CROSSOVER

	simone@unical.it		MySLR digital platform; How to conduct a review with MySLR; Project works					
Spin-off creation: key fundamentals for a good plan	Gianpaolo Iazzolino, gianpaolo.iazzolino@unical.it	8	The course describes the main steps for constructing a business plan also referred to projects arising from results obtained in research. The main areas of a business plan are described with reference to the s.c. technology firms. The course proposes insights deriving from cases of spin-offs at the University of Calabria	Ask the teacher	May 2025	English	No	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

Design of research: European Projects	Nicola Paone, n.paone@univpm.it	24	1. Introduction to instruments and funding agencies for research.
			2. European research
			   a. European frame-work programmes and Horizon Europe
			   b. Financial instruments in support of research.
			3. The role of industry in framework programmes. Technology platforms.
			4. Steps in project proposal preparation
			   a. analysis of Call for Proposals and Workprogramme
			   b. definition of objectives
			   c. definition of partnership
			   d. definition of impact
			   e. the work-programme
			   f. state of art
			   g. budget and resources
			5. Project proposal evaluation
			6. Marie Curie actions for mobility of researchers
			7. Project management, progress and scientific reporting. (Project meeting, deliverables, reports, etc.)
			8. Administrative/financial management:
			   a. financial reporting
			   b. audit
			9. Examples of projects.
			10. Tutorial sessions.
				yes	Jan/Feb 2025	English	yes	CROSSOVER

Tools and methods for process representation and management	Ferruccio Mandorli, f.mandorli@ univpm.it	24	**Formal tools for process representation:** 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. **Process management tools:** introduction to Microsoft Project; basic concepts; definition of the tasks planning; resources allocation; assessment of the scheduling of the tasks. **Data elaboration tools:** 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. **Tools for data storing, query and presentation:** brief introduction to MS Access and MS Visio.	yes (also e-learning)	Jan/Feb 2025	English	yes	CROSSOVER
Project management techniques	Filippo Ciarapica, f.e.ciarapica @univpm.it	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 2025	English	yes	CROSSOVER
Virtual instruments (LabView) for monitoring and management of industrial systems	Milena Martarelli, m.martarelli @univpm.it	24	● General approach to G programming ● Troubleshooting and debug ● Implementation of a virtual instrument ● Development of modular applications ● Arrays ● Hardware e software resources ● Data Acquisition ● Data Flow	yes	Jan/Feb 2025	English	yes	BASIC

| Mathematical programming and graph theory | Fabrizio Marinelli, fabrizio.marinelli@staff.univpm.it | 24 | **Decision Problems**
● Elements and taxonomy
● Solution of a decision problem
● Easy and hard problems, exact and heuristic algorithms: hints of computational complexity theory
● Multi-objective problems: goal programming and pareto-optimality

Mathematical Programming
● Declarative languages: AMPL
● Decision problems and math. prog.
● Integer Linear Programming: features and solution methods

Modelling techniques
● binary variables for selection: covering, packing and partitioning models
● binary variables for association: assignments and permutations.
● Logic variables: fixed costs, semi-continuous sets, conditional constraints, logical predicates
● Linearization techniques: absolute values, piecewise linear functions, exponential functions

An introduction to Graph Theory
● Terminology and basic properties
● Isomorphisms and classes of graphs: paths, cycles, trees, eulerian, hamiltonian, bipartite and planar graphs
● Independent sets and covers
● Greedy algorithm and matroids
● Combinatorial Optimization and graphs
● Mathematical prog. for optimization problems on graphs | yes | Mar/Apr 2025 | English | yes | ADVANCED |

			Applications ● Scheduling, routing and packing problems					

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, Cinzia Di Dio, Federico Manzi & Giulia Peretti, antonella.marchetti@unicatt.it	16	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 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.	yes	June/July 2025	English	yes	BASIC