Polytechnic School

Department of Informatics, Bioengineering, Robotics and Systems Engineering

Master's degree in Computer Engineering - Class LM-32

DEGREE REGULATIONS - General part

These regulations were approved by the Degree Programme Board in the meeting held on April 21th 2023 and by the DIBRIS Department Board on May 16th 2023

Cohort 2023-2025

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Art. 1 Premise and area of competence

These Regulations, in accordance with the Statute and the University Didactic Regulations (general part and special part), discipline the organizational aspects of the teaching activity of the Master's Degree Programme in Computer Engineering, as well as any other subject devolved to it by other legislative and regulatory sources.

The Degree Regulatiosn of the Master's degree course in Computer Engineering are resolved, pursuant to article 25, paragraphs 1 and 4 of the University Degree Regulations, general part, by the Degree Programme Board (DPB) of Computer Engineering to the majority of the members. After this, they are submitted for the approval of the Board of the reference Department (and of the Boards of possible associated Departments), after consultation with the Polytechnic School, with the prior favourable opinion of the Joint Committee of the School and the Department, if provided.

DPB can also take resolutions in "online mode" according to the above-mentioned regulations and, in particular, of Article 14 "meetings in online mode" of the current University General Regulations (in force since 19/12/2018).

Art. 2 Admission requirements and procedures for verifying individual preparation

Admission to the Master's degree course in Computer Engineering is subject to the possession of a) specific curricular requirements, b) adequate personal preparation and c) knowledge of English language.

a) With reference to the curricular requirements, admission to the Master's Degree in Computer Engineering requires knowledge equivalent to that provided for by the general training objectives of the Information Engineering Class Degrees (Class L-8 of Ministerial Decree No. 270/2004 or equivalent degrees ex Interministerial Decree of 9 July 2009) and the Computer Science and Technology Class (Class L-31 of Ministerial Decree No. 270/2004 or equivalent degrees ex Interministerial Decree of 9 July 2009).

All the following curricular requirements will be requested, without exclusion:

- possession of a Degree or Master's Degree ex DM 270/2004 obtained at an Italian University (or equivalent degree ex Interministerial Decree 9 July 2009), or equivalent foreign qualifications. The equivalence will be assessed on the basis of the degree's type and the transcript of records;
- possession of at least 36 ECTS, or equivalent knowledge, acquired in any university course in the scientific-disciplinary fields indicated for the basic training activities provided for by Class L-8 Information Engineering Degrees and Class L-31 Degrees in Computer Science and Technology;
- possession of at least 42 ECTS, or equivalent knowledge, acquired in any university course in the scientific-disciplinary fields indicated for the core training activities provided for by the L-8 Information Engineering Degrees and the L-31 Class Degrees in Computer Science and Technology.

Candidates holding the following first level Degrees awarded by the University of Genoa meet the curricular requirements:

- Electronic Engineering and Information Technology
- Computer Engineering
- Biomedical Engineering
- Computer Science
- Management Engineering

In the case of degrees other than those indicated in these regulations, the DPB will verify the presence of the curricular requirements or equivalent knowledge, on the basis of the exams taken by the student in the Degree Course of origin, as well as the presence of any extracurricular exams, internship activities and work experience gained.

b) With reference to the assessment of individual preparation, it is immediately achieved by all Italian students with a Bachelor's degree obtained in the above admitted classes with a mark equal to or higher than 9/10 of the maximum mark provided for by their degree and all students who have obtained a Bachelor's degree from the University of Genoa class L9 ex D.M. 509/99 with an assessment equal to or higher than 99/110.

Students who are not immediately admitted must submit the documentation (listed at point **d)** to the assessment of the Teaching Committee, which will determine the adequacy of their individual preparation using the criteria reported at point **e** and scores established by Annex A of these Regulations.

c) Knowledge of the English language

Students must demonstrate sufficient knowledge of the English language to enable them to make proper use of the content provided in the course that, at least, corresponds to level B2. This requirement is immediately accredited to all students who can exhibit a certificate attesting such level of knowledge, and to all those who have got their high school degree from an Italian institution

(Legislative Decree 226 October 17/ 2005, Art. 5 and annex D)

and have obtained a first level academic qualification containing an English language exam or, in the case of students with a foreign high school degree, to those who have obtained a bachelor's degree where the all the courses were taught in English.

For students not included in the above cases, the requirement can be met by passing the B2 test provided by the Language Skills Development Sector of the University.

d) Documentation for the verification of individual preparation

For all candidates:

- degree certificate/s with the relevant score/s
- the list of exams taken (transcript of records)
- resume

For foreign candidates only:

- brief description of the University where the academic degree/s was/were obtained
- syllabus of the courses of the obtained degree/s
- possible certification of knowledge of the Italian language at B1 level.

For applicants from non-EU countries, with foreign residence and having a diploma not issued by an EU country, the application procedure for checking eligibility takes place on an online portal, annually published on institutional web sites and on the Degree Course web site, according to a timetable and deadlines established annually and duly communicated to students.

Following the upload of the required documentation on the portal, the following checks will be carried out:

- completeness of documents
- verification of curricular requirements
- verification of knowledge of the English language.

Candidates who pass the requirements check, will be evaluated with regards to the individual preparation.

e) Evaluation criteria:

- adequate knowledge of English and Italian (Italian for foreign candidates only)
- academic potential (average grades, class rank, GPA...: max. rating 50)
- relevance of the first level qualification (max evaluation 30, students with less than 6 semesters of academic studies will not be considered)
- quality of the University that has awarded the academic degree/s (max. evaluation 20, only for foreign Universities)
- other aspects of the Curriculum Vitae (other qualifications, work experience, professional qualifications, motivation letter, cover letter, etc.) (max. evaluation 10)

Students with a score of at least 85 (considering that Italian Universities will obtain the maximum score for the assessment of quality) will be admitted to the Master's Degree in Computer Engineering. The specific criteria for the determination of scores and the procedures are listed at the end of these regulations in Annex A.

For all foreign students with a qualification obtained abroad, the lack of a certificate of knowledge of the Italian language will not prevent enrolment, but will entail the need to include at least one exam dedicated to learning the Italian language during the course.

The analysis of the titles will determine whether the enrolment is admissible. The result of the test only includes the words "passed", "not passed".

Art. 3 Training activities

The list of teaching units and other possible training activities, in the cohort 2023-2025, is given in the dedicated annex (Annex 1) which constitutes an integral part of these regulations.

A professor is appointed in charge of each teaching unit.
The professor in charge of a course is the one who holds it according to the law, that is, the one to whom the Department Board has assigned that responsibility when allocating teaching tasks to professors.

The language used to provide training activities (lessons, exercises and workshops) shall be English.

Art. 4 Enrolment in individual training activities

In accordance with Article 5 of the University Regulations for students, in order to enrol in individual training activities you must have a qualification that allows access to the university.

Art. 5 Curricula

The Master's degree course in Computer Engineering is structured in three curricula:

- ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING
- COMPLEX SYSTEMS ENGINEERING
- SOFTWARE PLATFORMS AND CYBERSECURITY

Art. 6 Total time commitment

The definition of the hourly fraction dedicated to lessons or equivalent teaching activities is established, for each teaching unit, by the DPB and specified in the special part of these regulations (Annex 1). In any case, we assume the following interval of variability between classroom hours/ECTS: 8 ÷ 10 (understanding by "classroom hours" the hours of lesson or assisted teaching activity).
The definition of the assumed total time commitment, dedicated to personal study or other training activities of an individual type, is established, for each teaching unit, in the annex (Annex 1) to these regulations.
The head of the Department of Computer Science, Bioengineering, Robotics and Systems Engineering (DIBRIS) and the coordinator of the DPB shall be responsible for verifying compliance with the above provisions.

Art. 7 Study plans, prerequisites and incompatibility for simultaneous enrolments

Students can enrol full-time or part-time; for the two types of students there are different rights and duties.

The student chooses the type of registration simultaneously with the presentation of the study plan.

Full-time students carry out their training activity considering the study plan prepared by the Master's degree course, which is organised by years of the course programme and published in the Degree Programme Table. The study plan formulated by the student must contain an indication of the training activities, with the related credits that he intends to achieve, provided for by the official study plan for this teaching period. The Degree Program Table indicates up to a maximum of 65 credits provided in each year. Cases of transfer from other universities will be evaluated individually.

Students can include in the first-year study plan 12 credits corresponding to second-year elective teaching activities. The following teaching units are recommended:

- 90538 DATA PROTECTION & PRIVACY
- 90535 HIGH PERFORMANCE COMPUTING
- 111104 MOBILE SECURITY
- 90530 NETWORK ANALYSIS

(Schedule compatibility cannot be guaranteed during the first year for the following training activities: 90535 HIGH PERFORMANCE COMPUTING, 90538 DATA PROTECTION AND PRIVACY and any elective credits chosen from other Degree Programmes.)

The student may enter extra-curricular teaching units up to a maximum of 12 ECTS. Those ECTS are not taken into account in the total amount of ECTS nor for the global average.

Part-time students are required to submit an individual study plan specifying the number of credits they intend to enter in compliance with the University Tuition Fee Regulations. More information is available at the following link: https://www.studenti.unige.it/iscrizioni/tempo_pienoparz/.

The enrolment of full-time and part-time students is regulated by the University Regulations for students considering the operational provisions resolved by the Central government bodies and indicated in the Student Guide (published annually and available at the Guidance Service Office, at the Student Office of the Polytechnic School and on the University's website).

The educational path of the student can be constrained by a system of prerequisites, mentioned for each teaching unit in the special part of these Regulations (Annex 1). A study plan to be completed in a shorter time than the standard one must be approved by the DPB and by the Department Board.

The method and deadline for the presentation of the study plan are established on a yearly basis by the Polytechnic School and reported on the Master's degree web page (https://corsi.unige.it/en/corsi/11160).

Referring to the Programme Table for the cohort of this document, the Master Course in Computer Engineering is recognized as incompatible for simultaneous enrolment with any LM32 course and with the following Master Courses of the University of Genoa:

- Computer Science

For other study courses belonging to different classes, including those of other universities, the compatibility analysis will be carried out as follows (DM 930/2022 and subsequent ministerial clarifications):
Initially, the basic and characterizing scientific disciplinary sectors of the two courses of study are considered. If the credits in common are more than 40, the two courses are incompatible for simultaneous enrolment. If from the previous analysis it appears that the credits in common are less than 40, the analysis of the learning outcomes and of further available information on the content of each teaching unit will be carried out to highlight common topics covered in courses characterized by different scientific disciplinary sectors. If even after this analysis the credits in common are less than 40, the two courses are declared compatible for simultaneous enrolment. In the event of the presence of more than one curriculum, the calculation will be made in the least favourable case, i.e. the one characterized by the greatest number of common credits.

Art. 8 Attendance and methods of carrying out teaching activities

The courses may take the form of: (a) lectures, including distance online learning; (b) practical exercises; (c) laboratory exercises; (d) seminars.

The nature of the lessons taught in the Master's degree courses make the attendance to the training activities strongly recommended for an adequate understanding of the topics and therefore for a good success in the exams.

The schedule of classes is divided into semesters. As a rule, the semester is divided into at least 12 weeks of lesson plus at least 4 weeks overall for verification tests and profit exams. The period for profit exams ends with the beginning of the lessons of the following semester. During the semester, the normal teaching activity (lessons, exercises, laboratories) can be suspended allowing graduation exams, intermediate tests, exams for late students, seminars, tutoring activities and recovery teaching activities.
The lesson schedule for the entire academic year is published on pages of the University's website relevant to the Master's degree course before the start of the lessons of the academic year.

The schedule of classes guarantees the possibility of attendance of the compulsory courses of each year of the course programme provided for by the current Degree Programme Table of the Degree Course. For practical reasons, the compatibility of the timetable for all formally possible optional teaching choices is not guaranteed. Students must then formulate their study plan taking into account the class schedule.

Art. 9 Examinations and other profit exams

Profit exams can be carried out in written, oral, or written and oral, according to the methods indicated in the sheets of each teaching unit published on the pages of the website of the University related with the Master's degree course. On request, specific learning verification arrangements may be provided which take into account the needs of students with disabilities and specific learning disorders (D. S. A.), in accordance with art. 20 paragraph 4 of the University Didactic Regulations.

In the case of teaching units structured in modules with several professors, they participate collectively in the overall evaluation of the student's profit which cannot, however, be split into separate evaluations on the individual modules.

The calendar of profit exams is established within the ministerial due date for the following academic year and is published on the pages of the website of the University related with the Master's degree course. The calendar of any intermediate verification tests is established by the DPB and communicated to the students at the beginning of each teaching cycle.

Examinations are held in periods in which classes are suspended. Examinations may be planned during the period of the classes only for students who, in the current academic year, have not included training activities in their study plan. The result of the examination, with the vote obtained, is verbalized in accordance with art. 20 of the University Degree Regulations.

The examination boards are appointed by the Director of the Department or on his delegation by the Degree Programme Coordinator and are made up of at least 3 members. At each examination session at least two members will be present. The professor responsible for the teaching unit is a member with the function of chairman. Experts on the subject identified by the Degree Programme Board on the basis of criteria that ensure the possession of scientific, teaching or professional requirements can be part of the examination board; these requisites can be assumed to be possessed by retired university professors. At least one alternate chairman must be identified for each commission at the time of appointment. In each examination session, the examination boards are chaired by the chairman or an alternate.

Art. 10 Recognition of credits

The Degree Programme Board decides on the approval of applications for change or transfer from another degree course of the university or other universities in accordance with the rules provided for in the University Didactic Regulations, art. 18. It may also approve the recognition, as training credits and as activity of choice, for a maximum number of 12 ECTS, of professional knowledge and skills certified in accordance with the current legislation.

The evaluation of applications for change will take into account the details and the newness of the educational content of the individual exams taken, reserving the right to establish any forms of verification and supplementary exams on a case-by-case basis.

Within the framework of the national and regional legislation on education/work integration, it is possible for the degree programme to provide, for selected students, learning paths that also take into account work experience carried out at companies under contract.

Art. 11 Mobility, studies abroad, international exchanges

Students enrolled in the Master's Degree in Computer Engineering are offered the opportunity to apply for the dual degree courses affiliated with the Degree Course and in particular the course with the University of Technology in Compiègne, the course with the Polytechnic of Barcelona and the course with the Polytechnic of Tirana.

The DPB strongly encourages international activities, in particular students' participation in mobility and international exchange programmes. For this purpose, it shall ensure, in accordance with the rules in force, the recognition of the training credits obtained within these programmes and shall organise the training activities as appropriate in such a way as to make these activities easier and effective.

The DPB recognizes enrolled students who have regularly completed a period of study abroad the exams taken off-site and the achievement of the related credits with which the student intends to replace the exams

of his own study plan. For the purposes of the recognition of these examinations, when compiling the plan of training activities he intends to follow at the University abroad, the student must produce suitable documentation proving the equivalence of content between the teaching unit abroad and the teaching unit that he intends to replace taught in the Master's degree course in Computer Engineering. Equivalence shall be evaluated by the DPB. The conversion of marks will take place according to criteria approved by the DPB, in accordance with the European ECTS system.

In addition, as stated in Art. 12 below, the certification of the training activities carried out abroad for a period of no less than 100 hours, will lead to a better final evaluation through a higher minimum increase assigned at the end of the final examination.

Art. 12 Procedures for the final examination

The final examination consists in the discussion of a written thesis, aimed at ascertaining the candidate's technical-scientific and professional preparation.

To be admitted to a particular final examination session, all profit examinations of training activities must be passed by the student before the due date fixed by the Student Office of the Polytechnic School and reported in the 'reminder for students' present on the pages of the website of the University related with the Master's degree course.
For the purposes of obtaining a Master's Degree, the final examination requires of the writing of a theoretical, experimental or application-oriented thesis, elaborated by the student in an original way under the guidance of one or more supervisors, on subjects defined as relevant to a discipline for which the candidate has passed the exam; the thesis must in any case be consistent with the arguments discussed during the Master's degree. The supervisors must include at least one lecturer from the Polytechnic School or of the Master's degree course.

The thesis must be carried out in English.
The thesis must reveal the student's ability to deal with research and/or application issues. The thesis must consist of a project and/or the development of an application that proposes innovative solutions with respect to the state of the art and it must be uploaded on the Master's Degree Aulaweb website (Upload thesis) of the degree programme, at least 20 days before the graduation session, for the counter-report.

The thesis must also reveal:

- adequate preparation in the disciplines characterising the Master's Degree;
- adequate engineering preparation;
- correct use of sources and bibliography;
- systematic and argumentative skills;
- clarity in the exposition;
- design and experimental skills;
- critical skills.

The Committee for the final examination is composed of at least five members, the majority of whom must be tenured professors and researchers and it is appointed by the Director of the DIBRIS Department or by the delegated coordinator of the Degree Programme. The procedure for the final examination consists of the oral presentation of the thesis by the student to the Final Examination Committee, followed by a discussion of any questions raised by the members of the Committee. The final mark will be set using the following criteria:

1) In the final evaluation for the purpose of awarding the qualification, the Committee attributes an increase, varying from a minimum of 0 to a maximum of 6, established by the Polytechnic School in agreement with the Departments and reported in the Degree Programme Table, to the weighted and normalized (in one hundred and tenths) average of the marks reported in the verification tests relating to training activities that require a final grade, taking as weight the number of credits associated with the individual training activity;

2) If the student has carried out training activities abroad (in relation to the thesis or other activities) for at least the equivalent of 100 hours of commitment (certified by the responsible person(s) of any foreign institution), the minimum increase will be set to 2 points;

3) The Committee, without prejudice to the maximum final grade of one hundred and ten, may, if voted unanimously, award “Cum Laude” the student who, on the basis of the increases referred to in the previous paragraphs, has a score equal to or greater than one hundred and eleven, before any rounding up;

4) Furthermore, the "dignity of publication" may be conferred by the Committee if voted unanimously and if the scientific value of the thesis has been certified by at least one publication in an international journal/conference that provides for the peer-review of the full paper and officially accepted before the time of discussion.

Art. 13 Guidance services and tutoring

The Polytechnic School, in agreement with the DIBRIS Department, organizes and manages a tutoring service for the welcome and support of students, in order to prevent dispersion and delay in studies and to promote a profitable active participation in university life in all its forms.

Art. 14 Verification of the obsolescence of credits

Credits acquired within the framework of the Master’s degree course may be reconsidered after 6 years. If the DPB recognizes the obsolescence of even a single part of the relative educational content, the DPB itself establishes the supplementary tests that must be taken by the student, defining the topics and the methods of verification.

Once the required tests have been passed, the DPB validates the credits acquired with a resolution. If the related training activity provides for a mark, it may be varied from the one previously obtained, on a proposal from the Examination Committee which carried out the verification.

Art. 15 Degree Programme Table

The DIBRIS Department, after consulting the School, publishes annually the Degree Programme Table on the pages of the University website related with the Master’s degree course. In the Degree Programme Table are indicated the main provisions of the didactic system and the Degree Regulations of the Master’s degree course, to which additional information may be added. The Degree Programme Table of the Master’s degree course contains the list of the teaching units activated for the academic year in question. The individual teaching sheets are published on the pages of the University website related with the Master’s degree course.

Approved by resolution of the Degree Programme Board on 21st April 2023 and of the DIBRIS Department Board on 16th May 2023

ANNEX A. CRITERIA FOR THE EVALUATION OF THE DOCUMENTATION SUBMITTED FOR ADMISSION THE MASTER'S DEGREE IN COMPUTER ENGINEERING Cohort 2023-25

According to Art. 2 of the Degree Regulations, candidates must submit the following documents (foreign students must apply via the online portal, annually published on institutional web sites and on the Degree Programme web site):

FOR ALL CANDIDATES:

- degree certificates with the relevant marks
- the list of exams taken (transcript of records)
- optional curriculum vitae

FOR FOREIGN CANDIDATES ONLY:

- brief description of the University where the bachelor and or master's degree was obtained
- syllabus of the courses of the obtained degree/s
- possible certification of knowledge of the Italian language at B1 level. (The lack of a certificate of knowledge of the Italian language will not prevent enrolment, but will entail the need to include at least one exam dedicated to learning the Italian language during the course).

CAREER ASPECTS ASSESSED FOR ADMISSION TO THE COURSE - ADMISSION THRESHOLD: 85/110 POINTS:

1. adequate knowledge of English language (admitted/not admitted)
2. academic potential (average of grades, class rank, GPA...: max evaluation 50)
3. relevance of the first level qualification (max evaluation 30)
4. quality of the University that has awarded the first level degree (max evaluation 20 and only for foreign Universities)
5. other aspects of the Curriculum Vitae (other qualifications, work experience, professional qualifications, etc.) (max. evaluation 10)

In order to be admitted to the Degree Programme, the qualifications will first be evaluated according to the criteria specified below. Eligibility is achieved with a minimum score of 85 (taking into account that Italian Universities awarding the first level degree will be evaluated with the maximum score of 20 as to point 4).

The following rules will be applied when assessing the documentation submitted by candidates:

1. KNOWLEDGE OF ENGLISH LANGUAGE (ADMITTED/NOT ADMITTED)

i. A student who has a language certification of at least B2 will be assessed as eligible and admitted.
ii. A student who attended an Italian high school and has obtained a first academic level qualification containing an English exam, will be assessed as eligible and admitted.
iii. A student who has completed his first academic level studies with all the courses taught in English will be assessed as eligible and admitted.
iv. A student who has none of the above-mentioned certification but passes the B2 English test provided by the Language Skills Development Sector (of the University) will be assessed as eligible and admitted.

2. ACADEMIC POTENTIAL (MAX. 50):

The score for academic potential will be awarded according to the following table

Graduation mark in 110th					
	> 106	97-106	87-96	66-86	
Academic score	**50/50**	**45/50**	**40/50**	**35/50**	

The degree's score of foreign students will be recomputed in 110th as follows

$$\mathbf{Mark_{110} = max\ (round\ (110^{*}\ mark/max\_mark),66)}$$

Where mark is the mark obtained in the foreign country and max_mark is the maximum obtainable mark in that country ('round' is the usual rounding operation and max(a,b) takes the maximum value between a and b). Only students with at least 6 semesters of studies will be evaluated.

3 - RELEVANCE OF THE QUALIFICATION (MAX. 30):

Score	Type of Degree
30	Italian First level degrees belonging to the class L8 or L31 or other titles (including foreign titles) with at least 45% ECTS in computer science, automatic, mathematical, physics contents.
20	Titles (including foreign ones) with between 40% and 44% ECTS in computer science, automatic, mathematical, physics content
15	Other titles (including foreign ones) with between 30% and 39% ECTS in computer science, automatic, mathematical, physics content

4. RANKING OF THE UNIVERSITY WHERE THE FIRST LEVEL QUALIFICATION WAS OBTAINED (MAX. 20):

Since in Italy the legal value of the title holds, the score of the Italian universities will be set at 20. For non-Italian universities, the score will be assessed according to the international rankings given by the site http://www.webometrics.info/en. In particular:

20 if the institute is among the top 500 in the international ranking,
18 if the institute is between 501 and 1000,
15 if the institute is between 1001 and 1500,
11 if the institute is between 1501 and 2000,
6 if the institute is between 2001 and 2500,
0 over 2500 or absent from the ranking of the above site

5. OTHER ASPECTS OF CURRICULUM VITAE (other qualifications, work experience, professional qualifications, motivation letter, cover letter, etc.) (MAX.10):

The curriculum vitae of the candidate will be evaluated with respect to particular professional/academic experience e.g. language skills, additional qualifications, certified professional qualifications etc.

DEGREE REGULATIONS

– Special part

List of training activities and related training objectives

Track	Academic Year	Code	Name	ECTS	SSD (Disciplinary scientific area)	Type	Area	Language	Training objectives	Hours reserved to assisted teaching activities	Hours reserved to personal study
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	61884	ADVANCED DATA MANAGEMENT	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	Students will be provided with a sound grounding on theoretical, methodological, and technological fundamentals concerning data management for advanced data processing architectures, with a specific reference to large-scale distributed environments. Students will learn key elements of NoSQL and stream-based systems as well as basic issues in parallel and distributed query processing, multi-query processing, and high-throughput transactional systems. Students will be involved in project activities.	56	94
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	80156	COMPUTER SECURITY	9	ING-INF/05	CORE	Computer Engineering	English	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in transit, in	72	153

									implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access control in information systems and most relevant access control models and mechanisms.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	80158	HUMAN COMPUTER INTERACTION	6	ING-INF/05	CORE	Computer Engineering	English	The course provides the student with the methodology, the theory, and the techniques for the design of interactive products to support the way people communicate and interact in their everyday and working lives. This relies on the mastery of the development process for the understanding of the capabilities and desires of people and on the kinds of technology available to interaction designers, together with a knowledge of how to identify requirements and develop them into a suitable design. The course will cover standard techniques as well as an introduction to advanced topics, including sound and music computing (as a complementary component of visual and haptic interfaces), and emotional and social interfaces.	48	102

									A coursework devoted to the realization of the development process of a concrete interaction design project of an interactive product will be implemented during the whole semester, in a simulated working environment typical of Startups. Further, students will learn to design and manage motion capture sessions using the Qualisys industry standard motion capture system available at Casa Paganini-InfoMus. Finally, students will learn techniques to present their results, including elevator pitches and reporting to stakeholders.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	90530	NETWORK ANALYSIS	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	Learning algorithms and techniques for large scale graph analytics, including centrality measures, connected components, graph clustering, graph properties for random, small-world, and scale free graphs, graph metrics for robustness and resiliency, and graph algorithms for reference problems.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111095	INDUSTRIAL AUTOMATION	6	ING-INF/04	CORE	Computer Engineering	English	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95	48	102

									international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	86798	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CORE	Computer Engineering	English	Students will be provided with advanced skills related to machine learning and data analysis. Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.	72	78
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111097	OPERATIONS RESEARCH	6	MAT/09	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and	48	102

									modelling a decision process in terms of an optimization problem by defining the decision variables, the cost function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111100	SOFTWARE ENGINEERING LAB	3	ING-INF/05	OTHER	Other work-oriented knowledge	English		24	51
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111102	SOFTWARE ENGINEERING	6	ING-INF/05	CORE	Computer Engineering	English	Software Engineering is a discipline that rules every aspect of the software development process. In other word is the application of Engineering to the Software. It is concerned with requirement specification, design, models, writing documentation and also writing unit tests, not just coding. Moreover it also provide metrics to quantify the quality of the product, i.e. the software developed. Software Development Templates, Requirement Analysis, UML Modeling Systems, Design Patterns, Verification and	48	102

									Validation, Time Template Specification Languages, Temporary Property Verification Algorithms, Modeling and Case Resolution using Model Checkers "		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111103	ARTIFICIAL INTELLIGENCE	9	ING-INF/05	CORE	Computer Engineering	English	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the “deductive” side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.	72	78
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111104	MOBILE SECURITY	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The course aims to introduce the main security mechanisms of mobile operating systems and applications and present the core techniques, methodologies and tools for the vulnerability assessment and penetration testing of Android and iOS applications. The course involves both lectures and practical sessions for students.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	80164	MULTIMODAL SYSTEMS	6	ING-INF/05	CORE	Computer Engineering	English	This course provides students with foundational conceptual knowledge, methodologies, and tools for designing, implementing, and evaluating computer systems that can capture, represent, and	48	102

									automatically analyze the behavior of their users (e.g., in terms of gesture, movement, facial expressions, speech) and interact with them by generating multisensory feedback (e.g., images, sounds, control of actuators) in real-time.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	80394	MASTER THESIS	27		FINAL EXAMINATION	For the final examination	English		0	675
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	80459	AUGMENTED AND VIRTUAL REALITY	6	ING-INF/05	CORE	Computer Engineering	English	In this course, you will learn the fundamentals of Semantic Web technologies. You will learn how to collect information form linked data and metadata to represent knowledge an build knowledge bases, and how to access and benefit from semantic web technologies applied to smart applications in a H2020 perspective.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	OTHER	Further language knowledge	Italian (English upon request)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	90535	HIGH PERFORMANCE COMPUTING	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	Learning the main aspects of modern high-performance computing systems (pipeline/superscalar processors,shared-memory/message-passing multiprocessors, vector processors, GPUs) and basic programming skills for high-	48	102

									performance computing (cache optimization, OpenMP, MPI, OpenCL).		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	90538	DATA PROTECTION & PRIVACY	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	Students will learn key elements in data protection and privacy: data privacy and anonymity, metrics and techniques; macro and microdata protection; data protection in outsourcing scenarios; privacy on the web; advanced access control. Students will be involved in project activities.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	94977	ENGLISH LANGUAGE B2	3		OTHER	Further language knowledge	English	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: - understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers effortlessly for both parties; - produce a clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.	30	45

ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	108606	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/05	CORE	Computer Engineering	English	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition, spam filtering, and malware detection	48	102
COMPLEX SYSTEMS ENGINEERING	1	80156	COMPUTER SECURITY	9	ING-INF/05	CORE	Computer Engineering	English	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in transit, in	72	153

									implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access control in information systems and most relevant access control models and mechanisms.		
COMPLEX SYSTEMS ENGINEERING	1	80158	HUMAN COMPUTER INTERACTION	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The course provides the student with the methodology, the theory, and the techniques for the design of interactive products to support the way people communicate and interact in their everyday and working lives. This relies on the mastery of the development process for the understanding of the capabilities and desires of people and on the kinds of technology available to interaction designers, together with a knowledge of how to identify requirements and develop them into a suitable design. The course will cover standard techniques as well as an introduction to advanced topics, including sound and music computing (as a complementary component of visual and haptic interfaces), and emotional and social interfaces. A coursework devoted to the realization of the	48	102

									development process of a concrete interaction design project of an interactive product will be implemented during the whole semester, in a simulated working environment typical of Startups. Further, students will learn to design and manage motion capture sessions using the Qualisys industry standard motion capture system available at Casa Paganini-InfoMus. Finally, students will learn techniques to present their results, including elevator pitches and reporting to stakeholders.		
COMPLEX SYSTEMS ENGINEERING	1	80190	EMBEDDED SYSTEMS	6	ING-INF/04	CORE	Computer Engineering	English	This course presents the fundamentals of embedded systems. After a brief review of the most relevant architectures, the course focuses on microcontroller programming for control applications, with a particular attention on peripheral configuration, real time and event-based programming techniques.	48	102
COMPLEX SYSTEMS ENGINEERING	1	90530	NETWORK ANALYSIS	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	Learning algorithms and techniques for large scale graph analytics, including centrality measures, connected components, graph clustering, graph properties for random, small-world, and scale free graphs, graph metrics for robustness and resiliency, and graph algorithms for reference problems.	48	102

COMPLEX SYSTEMS ENGINEERING	1	90545	MULTIAGENTS SYSTEMS	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	Getting acquainted with the concept of an agent and multiagent system, and learning how to design intelligent autonomous agents and how to deal with the main implementation issues.	48	102
COMPLEX SYSTEMS ENGINEERING	1	111095	INDUSTRIAL AUTOMATION	6	ING-INF/04	CORE	Computer Engineering	English	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95 international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.	72	78
COMPLEX SYSTEMS ENGINEERING	1	86798	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CORE	Computer Engineering	English	Students will be provided with advanced skills related to machine learning and data analysis. Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.	72	78

COMPLEX SYSTEMS ENGINEERING	1	111097	OPERATIONS RESEARCH	6	MAT/09	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and modelling a decision process in terms of an optimization problem by defining the decision variables, the cost function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.	48	102

COMPLEX SYSTEMS ENGINEERING	1	111098	SYSTEM ENGINEERING LAB	3	ING-INF/04	OTHER	Other work-oriented knowledge	English	A systems engineering laboratory is a course that teaches students how to apply systems engineering principles to the design, development, and management of complex systems. The laboratory typically covers topics such as system requirements analysis, system architecture design, system integration and testing, system optimization and performance analysis, and system risk management.	24	51
COMPLEX SYSTEMS ENGINEERING	1	111105	SYSTEM IDENTIFICATION AND OPTIMAL CONTROL	9		CORE	Computer Engineering	English		0	0
COMPLEX SYSTEMS ENGINEERING	1	111106	SYSTEM IDENTIFICATION	5	ING-INF/04	CORE	Computer Engineering	English	The goal of the course is to provide methodologies and tools for designing systems' models to be used for control, estimation, diagnosis, prediction, etc. Different identification methods are considered, both in a "black box" context (where the structure of the system is unknown), as well as in a "grey box" (uncertainty on parameters) one. Methods are provided for choosing the complexity of the models, for determining the values of their parameters, and to validate them. Moreover, state estimation problems are addressed and their connections with control and identification are considered.	40	85

COMPLEX SYSTEMS ENGINEERING	1	111107	OPTIMAL CONTROL	4	ING-INF/04	CORE	Computer Engineering	English	The course on Optimal Control is a core course in the curriculum of a Master's degree in Computer Engineering. The course is designed to provide students with a comprehensive understanding of the theory and techniques of optimal control, which is a fundamental concept in the design of control systems. The course covers various topics related to the analysis, design, and implementation of optimal control systems, including mathematical modeling, control theory, optimization techniques, and practical applications.	32	68
COMPLEX SYSTEMS ENGINEERING	2	80167	PRODUCTION SYSTEMS	6	ING-INF/04	CORE	Computer Engineering	English	Under the title 'Production Systems' one can place very many different problems. This course is related with the decomposition of a planning and control problem of a production systems in different subproblems. For any of the subproblems after a analysis process, a set of solving technques will be considered. Such solving techniques have to be integrated in possible solution of the 'main' production problem.	48	102
COMPLEX SYSTEMS ENGINEERING	2	80171	TECHNOLOGIES FOR WIRELESS NETWORKS	6	ING-INF/03	ELECTIVE	Learning activities chosen by the student	English	The course aims to provide a framework for all major network technologies that use wireless (wireless) transmissions, considering application areas and architectures both from a structural and protocollary point of view.	48	102

									More specifically, the main objective is to provide knowledge and insight on the following topics: i) Introduction to architectures with the classification of wireless networks in mobile cellular systems, technologies for wireless local area networks (LAN) and Personal-Sensor-Body Area Networks (PAN, SAN, and BAN). ii) The cellular mobile radio networks from the second generation (2G-GSM) and evolutions (GPRS and EDGE), to the third generation (3G-UMTS) and the fourth (4G, LTE) for ending with the current 5G technology. iii) The standard for IEEE802.11 (Wi-Fi) WLAN networks, described in all its evolutions starting from version 11b up to version 11ax. iv) Personal communications through the Bluetooth standard, including the latest variants like Bluetooth low-power. The result of learning is to give the student, oriented to a specific field of Engineering, the ability to understand the different technologies of wireless networks and make effective design choices for their effective use.		
COMPLEX SYSTEMS ENGINEERING	2	80172	METHODS AND MODELS FOR DECISION SUPPORT	6	MAT/09	ELECTIVE	Learning activities chosen by the student	English	The course aims at introducing the modelization and solution tools for complex decision problems: methods based on integer programming models, heuristics and metaheuristics	48	102

									for combinatorial optimization problems, the PERT method for Project Management are studied. Finally fundamental concepts for solving multi-criteria decision problems are introduced. Applications to manufacturing planning and scheduling and logistics (network flow, location and vehicle routing) will be considered.		
COMPLEX SYSTEMS ENGINEERING	2	80268	LOGISTIC SYSTEMS PLANNING AND CONTROL	6	ING-INF/04	CORE	Computer Engineering	English	The course aims to provide methodologies and tools for optimizing and controlling logistic systems (intermodal networks, container terminals, logistic centers). Referring to the planning and organization of logistic systems, the student will learn how to: - identify the decision problem type - define the most appropriate mathematical model - define the most adequate solution methodology - choose a software solution for the problem - discuss the problem relevance/effects	48	102
COMPLEX SYSTEMS ENGINEERING	2	80394	MASTER THESIS	27		FINAL EXAMINATION	For the final examination	English		0	675
COMPLEX SYSTEMS ENGINEERING	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	OTHER	Further language knowledge	Italian (English upon request)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51

COMPLEX SYSTEMS ENGINEERING	2	94977	ENGLISH LANGUAGE B2	3		OTHER	Further language knowledge	English	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: - understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers effortlessly for both parties; - produce a clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.	30	45
COMPLEX SYSTEMS ENGINEERING	2	98458	ADVANCED CONTROL SYSTEMS	6	ING-INF/04	CORE	Computer Engineering	English	The course aims at providing modeling and methodological approaches to sensing, actuation, and control in order to describe and analyze a system, and make decisions based on the available data in a distributed, predictive and/or adaptive manner, thereby performing “smart actions”. The student will approach such smart systems by studying proper models and methods in different applicative contexts, such as smart power grids, connected autonomous vehicles and platooning, energy efficient buildings, distributed logistics, and environmental monitoring.	48	102

COMPLEX SYSTEMS ENGINEERING	2	108606	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/05	CORE	Computer Engineering	English	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition, spam filtering, and malware detection	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	80156	COMPUTER SECURITY	9	ING-INF/05	CORE	Computer Engineering	English	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in transit, in	72	153

									implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access control in information systems and most relevant access control models and mechanisms.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	90538	DATA PROTECTION & PRIVACY	6	ING-INF/05	CORE	Computer Engineering	English	Students will learn key elements in data protection and privacy: data privacy and anonymity, metrics and techniques; macro and microdata protection; data protection in outsourcing scenarios; privacy on the web; advanced access control. Students will be involved in project activities.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	98460	SOFTWARE PLATFORMS	6	ING-INF/05	CORE	Computer Engineering	English	Software Platforms is a fundamental module in the software development path. The development of complex software systems does not only require proficency in programming but also the knowledge of advanced models, paradigms and tools. Software Platforms describes the models, the paradigms and the tools which support Web Applications, Web Services and Microservices, and introduces the evolution toward serverless computing.	60	88

SOFTWARE PLATFORMS AND CYBERSECURITY	1	101812	DIGITAL FORENSICS	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	Learning how to conduct digital investigations, following the standard process involving identification, acquisition, storage, and analysis of digital evidence.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	111095	INDUSTRIAL AUTOMATION	6	ING-INF/04	CORE	Computer Engineering	English	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95 international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	86798	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CORE	Computer Engineering	English	Students will be provided with advanced skills related to machine learning and data analysis. Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.	72	78

SOFTWARE PLATFORMS AND CYBERSECURITY	1	111097	OPERATIONS RESEARCH	6	MAT/09	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and modelling a decision process in terms of an optimization problem by defining the decision variables, the cost function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.	48	102

SOFTWARE PLATFORMS AND CYBERSECURITY	1	111100	SOFTWARE ENGINEERING LAB	3	ING-INF/05	OTHER	Other work-oriented knowledge	English	A software engineering laboratory is a hands-on course that teaches students how to apply software engineering principles to real-world software development projects. The laboratory typically focuses on software development methodologies, software design and architecture, software testing and debugging, and project management.	24	51
SOFTWARE PLATFORMS AND CYBERSECURITY	1	111102	SOFTWARE ENGINEERING	6	ING-INF/05	CORE	Computer Engineering	English	Software Engineering is a discipline that rules every aspect of the software development process. In other word is the application of Engineering to the Software. It is concerned with requirement specification, design, models, writing documentation and also writing unit tests, not just coding. Moreover it also provide metrics to quantify the quality of the product, i.e. the software developed. Software Development Templates, Requirement Analysis, UML Modeling Systems, Design Patterns, Verification and Validation, Time Template Specification Languages, Temporary Property Verification Algorithms, Modeling and Case Resolution using Model Checkers	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	111103	ARTIFICIAL INTELLIGENCE	9	ING-INF/05	CORE	Computer Engineering	English	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the “deductive” side of the discipline. Students will learn basics in propositional and first	72	78

									order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	111104	MOBILE SECURITY	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The course aims to introduce the main security mechanisms of mobile operating systems and applications and present the core techniques, methodologies and tools for the vulnerability assessment and penetration testing of Android and iOS applications. The course involves both lectures and practical sessions for students.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	2	80394	MASTER THESIS	27		FINAL EXAMINATION	For the final examination	English		0	675
SOFTWARE PLATFORMS AND CYBERSECURITY	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	OTHER	Further language knowledge	Italian (English upon request)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51
SOFTWARE PLATFORMS AND CYBERSECURITY	2	86799	DISTRIBUTED SYSTEMS	6	ING-INF/05	CORE	Computer Engineering	English	The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and design; and how they meet the demands of contemporary distributed applications. 1. Distributed systems characterization 2. Coordination of distributed systems	48	102

									Physical and logical clock synchronization Distributed mutual exclusion Election algorithms and protocols 3. Consistency of distributed systems Data centric systemsClient centric systems Consistency protocols 4. Resilience of distributed systems Distributed process pooling and resilience Reliable distributed communication services Distributed operation commit Recovery of faulty systems 5. Case studies Hyperledger permissioned blockchains Google distributed storage and computation In memory Distributed Data Store Office online collaboration platforms		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	86800	VIRTUALIZATION AND CLOUD COMPUTING	6	ING-INF/05	CORE	Computer Engineering	English	The course provides the foundations of the main virtualization technologies at the state of the art. In detail, the course focuses on several types of virtualization, like Storage-level, OS-level, Application-level, and Enterprise-level virtualization. The course is mostly practical, with the aim to teach the student how to deal with current virtualization technologies to build actual virtualized architectures.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	2	90535	HIGH PERFORMANCE COMPUTING	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	Learning the main aspects of modern high-performance computing systems (pipeline/superscalar processors, shared-memory/message-passing multiprocessors, vector	48	102

									processors, GPUs) and basic programming skills for high-performance computing (cache optimization, OpenMP, MPI, OpenCL).		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	94977	ENGLISH LANGUAGE B2	3		OTHER	Further language knowledge	English	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: - understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers effortlessly for both parties; - produce a clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.	24	51
SOFTWARE PLATFORMS AND CYBERSECURITY	2	101811	BINARY ANALYSIS AND SECURE CODING	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	Being able to write secure code, analyze the behavior and assess security properties of source and binary programs, pinpointing and fix their vulnerabilities or apply corrective counter-measures.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	2	108606	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the	48	102

									security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition, spam filtering, and malware detection		

SCUOLA POLITECNICA
Dipartimento di Informatica, Bioingegneria, Robotica ed Ingegneria dei Sistemi

Corso di Laurea Magistrale in *Computer Engineering* Classe LM-32

REGOLAMENTO DIDATTICO – Parte Generale

Questo regolamento è stato approvato dal Consiglio di Corso di Studio nella riunione del 21 aprile 2023 e dal Consiglio di Dipartimento del DIBRIS nella riunione del 16 maggio 2023

Coorte 2023-2025

INDICE

Art. 1. Premessa e ambito di competenza

Il presente Regolamento, in conformità allo Statuto e al Regolamento Didattico di Ateneo (parte generale e parte speciale), disciplina gli aspetti organizzativi dell'attività didattica del Corso di Laurea Magistrale in Computer Engineering, nonché ogni diversa materia ad esso devoluta da altre fonti legislative e regolamentari.

Il Regolamento Didattico del Corso di Laurea Magistrale in Computer Engineering è deliberato, ai sensi dell'articolo 25, commi 1 e 4 del Regolamento Didattico di Ateneo, parte generale, dal Consiglio del Corso di Studio (CCS) di Computer Engineering a maggioranza dei componenti e sottoposto all'approvazione del Consiglio del Dipartimento di riferimento (e dei consigli degli eventuali dipartimenti associati), sentita la Scuola Politecnica, previo parere favorevole della Commissione Paritetica di Scuola e di Dipartimento, ove esistente.
Le delibere del CCS possono essere assunte anche in modalità telematica ai sensi dei sovraordinati regolamenti e, in particolare, dell'articolo 14 "Riunioni con modalità telematiche" del vigente Regolamento Generale di Ateneo (in vigore dal 19/12/2018).

Art. 2. Requisiti di ammissione e modalità di verifica

L'ammissione alla Laurea Magistrale in Computer Engineering è subordinata al possesso di a) specifici requisiti curricolari, b) adeguatezza della preparazione personale e c) conoscenza della lingua inglese.

a) In riferimento ai requisiti curriculari, per l'accesso alla Laurea Magistrale in Computer Engineering si richiedono conoscenze equivalenti a quelle previste dagli obiettivi formativi generali delle Lauree della Classe Ingegneria dell'Informazione (Classe L-8 del DM 270/2004 o lauree equiparate ex Decreto

Interministeriale 9 luglio 2009) e classe delle lauree in Scienze e tecnologie informatiche (Classe L-31 del DM 270/2004 o lauree equiparate ex Decreto Interministeriale 9 luglio 2009).

Saranno richiesti, senza esclusione, tutti i seguenti requisiti curricolari:

- possesso di Laurea o Laurea Magistrale ex DM 270/2004 conseguita presso una Università italiana (o laurea equiparata ex Decreto Interministeriale 9 luglio 2009), o titoli esteri equivalenti. L'equivalenza verrà valutata sulla base del titolo accademico e dal trascript of records.
- possesso di almeno 36 CFU, o conoscenze equivalenti, acquisiti in un qualunque corso universitario nei settori scientifico-disciplinari indicati per le attività formative di base previste dalle Lauree della Classe L-8 Ingegneria dell'Informazione e dalle Lauree della Classe L-31 in Scienze e tecnologie informatiche;
- possesso di almeno 42 CFU, o conoscenze equivalenti, acquisiti in un qualunque corso universitario nei settori scientifico disciplinari indicati per le attività formative caratterizzanti previste dalle Lauree della Classe L-8 Ingegneria dell'Informazione e dalle Lauree della Classe L- 31 in Scienze e tecnologie informatiche.

I candidati in possesso delle seguenti Lauree di primo livello erogate dall'Ateneo di Genova soddisfano i requisiti curricolari:

- Ingegneria Elettronica e tecnologie dell'Informazione
- Ingegneria Informatica
- Ingegneria Biomedica
- Informatica
- Ingegneria Gestionale

Nel caso di possesso di lauree differenti da quelle indicate nel presente regolamento, il CCS verificherà la presenza dei requisiti curricolari o delle conoscenze equivalenti, sulla base degli esami sostenuti dallo studente nel Corso di Laurea di provenienza, nonché la presenza di eventuali esami extracurricolari, le attività di stage e le esperienze lavorative maturate.

b) In riferimento alla verifica della preparazione individuale, essa è immediatamente superata da tutti gli studenti italiani in possesso di una Laurea Triennale ottenuta nelle classi ammesse di cui sopra conseguita con valutazione pari o superiore ai 9/10 del voto massimo previsto dalla propria laurea e tutti gli studenti che abbiano conseguito a Genova una Laurea Triennale classe L9 ex D.M. 509/99 con valutazione pari o superiore a 99/110.

Gli studenti non immediatamente ammessi dovranno sottoporre la seguente documentazione (elencata al successivo comma **d**) alla valutazione della Commissione Didattica che determinerà l'adeguatezza della preparazione individuale sulla base dei criteri riportati al comma **e)** e dei punteggi stabiliti dall'**Allegato A** in questo regolamento.

c) Conoscenza della lingua inglese

Gli studenti dovranno dimostrare una conoscenza della lingua inglese sufficiente a permettere loro una corretta fruizione dei contenuti erogati nel corso, che almeno deve corrispondere al livello B2. Tale conoscenza è immediatamente riconosciuta a tutti coloro che esibiscano un certificato che attesti una conoscenza di tale livello e a tutti gli studenti che abbiano ottenuto un diploma di scuola superiore da un'istituzione italiana
(Decreto Legislativo N. 226 del 17 ottobre 2005, Art. 5 e All. D)
e abbiano ottenuto un titolo accademico di primo livello in cui fosse presente un esame di lingua inglese o, nel caso di studenti con un diploma di scuola superiore straniero, a tutti coloro che abbiano ottenuto un titolo di laurea triennale che prevedeva tutti i corsi erogati in inglese.
Per gli studenti che non ricadono nei casi precedenti, il requisito può essere soddisfatto tramite superamento del test B2 erogato dal Settore Sviluppo Competenze Linguistiche di Ateneo.

d) Documentazione per la verifica della preparazione individuale

Per tutti i candidati:
- certificato di laurea inclusivo del voto di laurea
- elenco degli esami sostenuti (transcript of records)
- curriculum vitae

Per i soli candidati stranieri:
- breve descrizione dell'Università ove si è conseguito il titolo triennale
- programma dei corsi della/e laurea/e ottenuta/e
- eventuale certificazione di conoscenza della lingua italiana pari a livello B1.

Per i candidati provenienti da Paesi Extra EU, con residenza estera e in possesso di titolo di studio estero, la procedura di presentazione della propria candidatura ai fini della verifica dell'ammissibilità viene gestita tramite apposito portale online, pubblicizzato annualmente sui siti web istituzionali e sul sito web del CdS, secondo un calendario e con scadenze stabilite annualmente e comunicate debitamente agli studenti.

A seguito del caricamento della documentazione richiesta sul portale, verranno effettuate le seguenti verifiche:

- completezza dei documenti
- verifica dei requisiti curriculari
- verifica della conoscenza della lingua inglese.

I candidati che supereranno la verifica dei requisiti saranno valutati relativamente alla preparazione individuale.

e) Criteri di valutazione:

- adeguata conoscenza lingua inglese e italiana (per i candidati stranieri)
- potenziale accademico (media dei voti, class rank, GPA…: valutazione max 50)
- rilevanza del titolo di studio di I livello (valutazione max 30; gli studenti con meno di 6 semestri di studi universitari non saranno presi in considerazione)
- qualità dell'Università che ha erogato il titolo di I livello (valutazione max 20; solo per le università straniere)
- altri aspetti del Curriculum Vitae (altri titoli di studio, esperienza lavorativa, qualificazioni professionali, lettera di motivazione, lettera di presentazione ecc.) (valutazione max 10)

Saranno ammessi alla Laurea Magistrale in Computer Engineering gli studenti con un punteggio almeno pari a 85 (considerando che le Università italiane otterranno il massimo punteggio per la valutazione della qualità). I criteri specifici per la determinazione dei punteggi e le modalità sono riportati in calce al presente regolamento nell'Allegato A.

Per tutti gli studenti stranieri con titolo di studio conseguito all'estero, il mancato possesso di una certificazione di conoscenza della lingua italiana non impedirà l'iscrizione, ma comporterà la necessità di sostenere durante il percorso formativo almeno un esame di lingua italiana.
L'analisi dei titoli stabilirà l'ammissibilità o meno all'iscrizione. L'esito della prova prevede la sola dicitura "superato", "non superato".

Art. 3. Attività formative

L'elenco degli insegnamenti e delle altre attività formative attivabili nella coorte 2023-2025, è riportato nell'apposito allegato (ALL.1) che costituisce parte integrante del presente Regolamento.

Per ogni insegnamento è individuato un docente responsabile. È docente responsabile di un insegnamento chi ne sia titolare a norma di legge, ovvero colui al quale il Consiglio del Dipartimento di afferenza abbia attribuito la responsabilità stessa in sede di affidamento dei compiti didattici ai docenti.
La lingua usata per erogare le attività formative (lezioni, esercitazioni, laboratori) è l'inglese.

Art. 4. Iscrizione a singole attività formative

In conformità con l'articolo 5 del Regolamento di Ateneo per gli studenti, per iscriversi a singole attività formative occorre possedere un titolo di studio che permetta l'accesso all'Università.

Art. 5. Curricula

Il Corso di Laurea Magistrale è articolato in tre curricula:

- ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING
- COMPLEX SYSTEMS ENGINEERING
- SOFTWARE PLATFORMS AND CYBERSECURITY

Art. 6. Impegno orario complessivo

La definizione della frazione oraria dedicata a lezioni o attività didattiche equivalenti è stabilita, per ogni insegnamento, dal CCS e specificata nella parte speciale del presente Regolamento (Allegato 1). In ogni caso si assume il seguente intervallo di variabilità della corrispondenza ore aula/CFU: 8 ÷10 (intendendo per ore aula le ore di lezione o di attività didattica assistita).

La definizione dell'impegno orario complessivo presunto, riservato allo studio personale o ad altre attività formative di tipo individuale, è stabilito, per ogni insegnamento, nell'allegato (ALL.1) del presente Regolamento.
Il Direttore del Dipartimento DIBRIS e il Coordinatore del CCS sono incaricati di verificare il rispetto delle predette prescrizioni, anche ai fini della pubblicazione dei programmi dei corsi.

Art. 7. Piani di studio, propedeuticità e incompatibilità iscrizioni a più corsi di studi

Gli studenti possono iscriversi a tempo pieno o a tempo parziale; per le due tipologie di studente sono previsti differenti diritti e doveri.

Lo studente sceglie la tipologia di iscrizione contestualmente alla presentazione del piano di studi.

Lo studente a tempo pieno svolge la propria attività formativa tenendo conto del piano di studio predisposto dal Corso di Laurea, distinto per anni di corso e pubblicato nel Manifesto degli Studi. Il piano di studio formulato dallo studente deve contenere l'indicazione delle attività formative, con i relativi crediti che intende conseguire, previsti dal piano di studio ufficiale per tale periodo didattico, fino ad un massimo di 65 crediti previsti in ogni anno, salvo in casi di trasferimento da altri Atenei che verranno valutati singolarmente.

Si possono anticipare al primo anno 12 CFU corrispondenti ad insegnamenti a scelta del secondo anno, fra i quali si consigliano in particolare i seguenti:

- 90538 DATA PROTECTION & PRIVACY
- 90535 HIGH PERFORMANCE COMPUTING
- 111104 MOBILE SECURITY
- 90530 NETWORK ANALYSIS

(Durante il primo anno potrebbero verificarsi sovrapposizioni di orario fra i seguenti insegnamenti: 90535 HIGH PERFORMANCE COMPUTING, 90538 DATA PROTECTION AND PRIVACY e qualunque insegnamento a scelta offerto da altri corsi di laurea).

Lo studente può aggiungere al proprio piano di studio insegnamenti "fuori piano" fino ad un massimo di 12 CFU. Tali insegnamenti non sono presi in considerazione ai fini del conseguimento della laurea e non concorrono al calcolo della media dei voti.

Lo studente a tempo parziale è tenuto a presentare un piano di studio individuale specificando il numero di crediti che intende inserire secondo quanto disposto dal Regolamento per la contribuzione studentesca di Ateneo, le regole sono pubblicate sul sito Unige, sotto la voce "Iscrizioni":
https://www.studenti.unige.it/iscrizioni/tempo_pienoparz/.

L’iscrizione degli studenti a tempo pieno e a tempo parziale è disciplinata dal Regolamento di Ateneo per gli studenti tenuto conto delle disposizioni operative deliberate dagli Organi centrali di governo ed indicate nella Guida dello studente (pubblicata annualmente e disponibile presso il Servizio Orientamento, lo Sportello dello Studente della Scuola Politecnica e sul sito web dell'Università).
Il percorso formativo dello studente può essere vincolato attraverso un sistema di propedeuticità, indicate per ciascun insegnamento nel presente Regolamento (parte speciale). Un piano di studio da completare in un tempo più breve rispetto a quello standard deve essere approvato dal CCS e dal Consiglio di Dipartimento.
La modalità e il termine per la presentazione del piano di studio sono stabiliti annualmente dalla Scuola Politecnica e riportate sul sito web del CdS (https://corsi.unige.it/en/corsi/11160).

In riferimento all’offerta formativa per la coorte a cui questo regolamento si riferisce, il Corso di Studio in Computer Engineering è riconosciuto incompatibile per l'iscrizione simultanea a qualsiasi corso LM32 e con i seguenti Corsi di studio dell'Università di Genova:

- Computer Science

Per altri corsi di studio appartenenti a classi diverse, compresi quelli di altre università, l'analisi di compatibilità sarà effettuata come segue (DM 930/2022 e successivi chiarimenti ministeriali): Inizialmente, vengono considerati i settori disciplinari scientifici caratterizzanti dei due corsi di studio. Se i crediti in comune sono più di 40, i due corsi sono incompatibili per l'iscrizione simultanea. Se dall'analisi precedente risulta che i crediti in comune sono meno di 40, l'analisi dei risultati di apprendimento e di ulteriori informazioni disponibili sul contenuto di ogni unità didattica sarà effettuata per evidenziare gli argomenti comuni trattati in corsi caratterizzati da diversi settori disciplinari scientifici. Se anche dopo questa analisi i crediti in comune sono inferiori a 40, i due corsi sono dichiarati compatibili per l'iscrizione simultanea. In caso di presenza di più curricula, il calcolo sarà effettuato nel caso meno favorevole, ossia quello caratterizzato dal maggior numero di crediti comuni.

Art. 8. Frequenza e modalità di svolgimento delle attività didattiche

Gli insegnamenti possono assumere la forma di:
(a) lezioni, anche a distanza mediante mezzi telematici; (b) esercitazioni pratiche; (c) esercitazioni in laboratorio; (d) seminari.

Il profilo articolato e la natura impegnativa delle lezioni tenute nell’ambito dei vari corsi di studio offerti dalla Scuola Politecnica rendono la frequenza alle attività formative fortemente consigliata per una adeguata comprensione degli argomenti e quindi per una buona riuscita negli esami.
Il calendario delle lezioni è articolato in semestri. Di norma, il semestre è suddiviso in almeno 12 settimane di lezione più almeno 4 settimane complessive per prove di verifica ed esami di profitto. Il periodo destinato agli esami di profitto termina con l’inizio delle lezioni del semestre successivo. Durante il semestre, la normale attività didattica (lezioni, esercitazioni, laboratori) può essere interrotta per lo svolgimento di esami di laurea, prove in itinere, sessioni d’esame straordinarie, seminari, attività di tutorato e attività didattica di recupero.
L’orario delle lezioni per l’intero anno accademico è pubblicato sulle pagine del sito web di Ateneo relative al CdS prima dell’inizio delle lezioni dell’anno accademico.

L’orario delle lezioni garantisce la possibilità di frequenza per anni di corso previsti dal vigente Manifesto degli Studi. Per ragioni pratiche non è tuttavia garantita la compatibilità dell'orario per tutte le scelte formalmente possibili tra gli insegnamenti opzionali. Gli studenti devono quindi formulare il proprio piano di studio tenendo conto dell’orario delle lezioni.

Art. 9. Esami e altre verifiche del profitto

Gli esami di profitto possono essere svolti in forma scritta, orale, o scritta e orale, secondo le modalità indicate nelle schede di ciascun insegnamento pubblicate sulle pagine del sito web di Ateneo relative al CdS. A richiesta, possono essere previste specifiche modalità di verifica dell’apprendimento che tengano conto delle esigenze di studenti con disabilità e con disturbi specifici dell’apprendimento (D.S.A.), in conformità all’art. 20 comma 4 del Regolamento Didattico di Ateneo.

Nel caso di insegnamenti strutturati in moduli con più docenti, questi partecipano collegialmente alla valutazione complessiva del profitto dello studente che non può, comunque, essere frazionata in valutazioni separate sui singoli moduli.
Il calendario degli esami di profitto è stabilito entro la scadenza ministeriale per l'anno accademico successivo e viene pubblicato sul pagine del sito web di Ateneo relative al CdS. Il calendario delle eventuali prove di verifica in itinere è stabilito dal CCS e comunicato agli studenti all'inizio di ogni ciclo didattico.

Gli esami si svolgono nei periodi di interruzione delle lezioni. Possono essere previsti appelli durante il periodo delle lezioni soltanto per gli studenti che, nell'anno accademico in corso, non abbiano inserito attività formative nel proprio piano di studio. L'esito dell'esame, con la votazione conseguita, è verbalizzato secondo quanto previsto all'art. 20 del Regolamento Didattico di Ateneo.

Le commissioni di esame di profitto sono nominate dal Direttore del Dipartimento o su sua delega dal Coordinatore del corso di studio e sono composte da almeno 3 membri. Ad ogni sessione di esame saranno presenti almeno due membri. Il docente responsabile dell'insegnamento è membro con funzione di presidente. Possono essere membri della commissione cultori della materia individuati dal consiglio del corso di studio sulla base di criteri che assicurino il possesso di requisiti scientifici, didattici o professionali; tali requisiti si possono presumere posseduti da parte di docenti universitari a riposo. Per ogni commissione all'atto di nomina va individuato almeno un presidente supplente. In ogni sessione di esame le commissioni sono presiedute dal presidente o da un presidente supplente.

Art. 10. Riconoscimento di crediti

Il CCS delibera sull'approvazione delle domande di passaggio o trasferimento da un altro Corso di Studi dell'Ateneo o di altre Università secondo le norme dal Regolamento Didattico di Ateneo, art. 18. Delibera altresì il riconoscimento, quale credito formativo e come attività a scelta, per un numero massimo di 12 CFU, di conoscenze e abilità professionali certificate ai sensi della normativa vigente.

Nella valutazione delle domande di passaggio si terrà conto delle specificità didattiche e dell'attualità dei contenuti formativi dei singoli esami sostenuti, riservandosi di stabilire di volta in volta eventuali forme di verifica ed esami integrativi.
Nel quadro della normativa nazionale e regionale su alternanza formazione/lavoro, è possibile per il Corso di Studio prevedere, per studenti selezionati, percorsi di apprendimento che tengano conto anche di esperienze lavorative svolte presso aziende convenzionate.

Art. 11. Mobilità, studi compiuti all'estero, scambi internazionali

Agli studenti iscritti alla laurea magistrale in Computer Engineering è offerta la possibilità di candidarsi ai percorsi a doppio titolo convenzionati con il Corso di Laurea e segnatamente il percorso con l'University of Technology in Compiègne, il percorso con il Politecnico di Barcellona ed il percorso con il Politecnico di Tirana.

Il CCS incoraggia fortemente le attività di internazionalizzazione, in particolare la partecipazione degli studenti ai programmi di mobilità e di scambi internazionali. A tal fine garantisce, secondo le modalità previste dalle norme vigenti, il riconoscimento dei crediti formativi conseguiti all'interno di tali programmi, e organizza le attività didattiche opportunamente in modo da rendere agevoli ed efficaci tali attività.

Il CCS riconosce agli studenti iscritti, che abbiano regolarmente svolto e completato un periodo di studi all'estero, gli esami sostenuti fuori sede e il conseguimento dei relativi crediti che lo studente intenda sostituire ad esami del proprio piano di studi.
Ai fini del riconoscimento di tali esami, lo studente all'atto della compilazione del piano delle attività formative che intende seguire nell'ateneo estero, dovrà produrre idonea documentazione comprovante l'equivalenza tra l'insegnamento impartito all'estero e l'insegnamento che intende sostituire, impartito nel Corso di Laurea Magistrale in Computer Engineering. L'equivalenza è valutata dal CCS. La conversione dei voti avverrà secondo criteri approvati dal CCS, congruenti con il sistema europeo ECTS.

Inoltre, come riportato nel successivo articolo 12 del presente regolamento, la certificazione dello svolgimento di attività formative svolte all'estero per un periodo non inferiore alle 100 ore, comporterà una migliore valutazione conclusiva attraverso un maggior incremento minimo assegnato al termine della prova finale.

Art. 12. Modalità della prova finale

La prova finale consiste nella discussione pubblica di un elaborato scritto, tendente ad accertare la preparazione tecnico-scientifica e professionale del candidato.

Per essere ammessi ad una determinata sessione d'esame finale, tutti gli esami di profitto delle attività formative devono essere superati dallo studente entro la data di scadenza fissata dallo Sportello dello Studente della Scuola Politecnica riportata nel 'Promemoria per gli studenti' presente pagine del sito web di Ateneo relative al CdS.

Ai fini del conseguimento della Laurea Magistrale, l'elaborato finale consiste nella redazione di una tesi (di carattere teorico, sperimentale o applicativo) elaborata dallo studente in modo originale sotto la guida di uno o più relatori, su argomenti definiti attinenti ad una disciplina di cui il candidato abbia superato l'esame; la tesi deve essere comunque coerente con gli argomenti sviluppati nel Corso di Laurea Magistrale. Tra i relatori deve essere presente almeno un docente della Scuola Politecnica e/o del Corso di Laurea Magistrale.
La tesi deve essere redatta in lingua inglese.
La tesi dovrà rivelare le capacità dello studente nell'affrontare tematiche di tipo applicativo e/o di ricerca. La tesi dovrà essere costituita da un progetto e/o dallo sviluppo di un'applicazione che proponga soluzioni innovative rispetto allo stato dell'arte e dovrà essere caricata sul sito Aulaweb (Upload tesi) del Corso di studio, almeno **20 giorni** prima della seduta di laurea, per la controrelazione.

La tesi dovrà altresì rivelare:

- ✓ adeguata preparazione nelle discipline caratterizzanti la Laurea Magistrale;
- ✓ adeguata preparazione ingegneristica;
- ✓ corretto uso delle fonti e della bibliografia;
- ✓ capacità sistematiche e argomentative;
- ✓ chiarezza nell'esposizione;
- ✓ capacità progettuale e sperimentale;
- ✓ capacità critica.

La Commissione di laurea è composta da almeno cinque componenti, la maggioranza dei quali deve essere costituita da professori di ruolo e ricercatori, ed è nominata dal Direttore del Dipartimento DIBRIS, o, su sua delega, dal Coordinatore del Corso di Studio. Le modalità di svolgimento della prova finale consistono nella presentazione orale della tesi di laurea da parte dello studente alla commissione per la prova finale, seguita da una discussione sulle questioni eventualmente poste dai componenti la commissione. La votazione finale di laurea sarà attribuita secondo i seguenti criteri:

1) La Commissione, nella valutazione conclusiva ai fini del conferimento del titolo di studi, attribuisce un incremento variabile da 0 ad un massimo di 6, stabilito dalla Scuola Politecnica di concerto con i Dipartimenti e riportato nel Manifesto degli Studi, alla media ponderata e normalizzata in centodecimi dei voti riportati nelle prove di verifica relative ad attività formative che prevedono una votazione finale, assumendo come peso il numero di crediti associati alla singola attività formativa.

2) Qualora lo studente abbia svolto attività formative all'estero (in relazione alla tesi o ad altre attività) per almeno l'equivalente di 100 ore di impegno (certificate dal/i responsabile/i di eventuale istituto straniero), il minimo incremento sarà aumentato a 2 punti.

3) La Commissione, fermo il voto finale massimo attribuibile pari a centodieci, può concedere la lode allo studente che, sulla base degli incrementi di cui ai commi precedenti, abbia riportato un punteggio pari o superiore a centoundici, prima di ogni eventuale arrotondamento.

4) Inoltre, la “dignità di stampa” potrà essere conferita dalla commissione se votata all’unanimità e se il valore scientifico della tesi sia stato certificato da almeno una pubblicazione su rivista/conferenza internazionale che preveda la peer-review del full paper e accettata ufficialmente prima del momento della discussione.

Art. 13. Orientamento e tutorato

La Scuola Politecnica, di concerto con il Dipartimento DIBRIS, organizza e gestisce un servizio di tutorato per l'accoglienza e il sostegno degli studenti, al fine di prevenire la dispersione e il ritardo negli studi e di promuovere una proficua partecipazione attiva alla vita universitaria in tutte le sue forme.
Il CCS individua al suo interno un numero di tutor in proporzione al numero degli studenti iscritti. I nominativi dei tutor sono reperibili nelle pagine del sito web di Ateneo relative al CdS.

Art. 14. Verifica dell’obsolescenza dei crediti

I crediti acquisiti nell’ambito del Corso di Laurea Magistrale possono essere riconsiderati dopo 6 anni. Qualora il CCS riconosca l’obsolescenza anche di una sola parte dei relativi contenuti formativi, lo stesso CCS stabilisce le prove integrative che dovranno essere sostenute dallo studente, definendo gli argomenti delle stesse e le modalità di verifica.

Una volta superate le verifiche previste, il CCS convalida i crediti acquisiti con apposita delibera. Qualora la relativa attività formativa preveda una votazione, la stessa potrà essere variata rispetto a quella precedentemente ottenuta, su proposta della Commissione d’esame che ha proceduto alla verifica.

Art. 15. Manifesto degli Studi

Il Dipartimento DIBRIS, sentita la Scuola, pubblica annualmente il Manifesto degli Studi pagine del sito web di Ateneo relative al CdS. Nel Manifesto sono indicate le principali disposizioni dell’ordinamento didattico e del Regolamento Didattico del Corso di Laurea Magistrale, a cui eventualmente si aggiungono indicazioni integrative.

Il Manifesto degli studi del Corso di Laurea Magistrale contiene l'elenco degli insegnamenti attivati per l’anno accademico in questione. Le schede dei singoli insegnamenti sono pubblicate sulle pagine del sito web di Ateneo relative al CdS.

ALLEGATO A
CRITERI PER LA VALUTAZIONE DELLA DOCUMENTAZIONE PRESENTATA PER L'AMMISSIONE ALLA LAUREA MAGISTRALE IN COMPUTER ENGINEERING
Coorte 2023-25

I candidati, secondo l'Art. 2 del Regolamento didattico, dovranno presentare I seguenti documenti (gli studenti stranieri dovranno presentare la domanda tramite apposito portale online, pubblicizzato annualmente sui siti web istituzionali e sulle pagine del sito web di Ateneo relative al CdS):

PER TUTTI I CANDIDATI:

- certificati di laurea inclusivi del voto di laurea
- elenco degli esami sostenuti (Transcript of records)
- curriculum vitae (opzionale)

PER I SOLI CANDIDATI STRANIERI:

- breve descrizione dell'Università ove si è conseguito il titolo triennale o magistrale
- programma dei corsi della/e laurea/e ottenuta/e
- eventuale certificazione di conoscenza della lingua italiana pari a livello B1. (L'assenza del certificato di conoscenza della lingua italiana non impedirà l'iscrizione, ma comporterà la necessità di includere almeno un esame dedicato all'apprendimento della lingua italiana durante il corso.)

ASPETTI DELLA CARRIERA VALUTATI PER L'AMMISSIONE AL CORSO - SOGLIA DI AMMISSIONE: 85/110 PUNTI:

1. adeguata conoscenza lingua inglese (ammesso/non ammesso)
2. potenziale accademico (media dei voti, class rank, GPA…: valutazione max 50)
3. rilevanza del titolo di studio di I livello (valutazione max 30)
4. qualità dell'Università che ha erogato il titolo di I livello (valutazione max 20 e solo per Università straniere)
5. altri aspetti del Curriculum Vitae (altri titoli di studio, esperienza lavorativa, qualificazioni professionali, ecc.) (valutazione max 10)

Per l'ammissione al Corso di Studi verranno prima valutati i titoli secondo i criteri successivamente specificati. L'ammissibilità si raggiunge con un punteggio minimo di 85 (considerando che alle Università Italiane eroganti titoli di I livello verrà attribuita la massima valutazione di 20 punti, come da punto 4).

Nella valutazione della documentazione presentata dai candidati saranno applicate le seguenti regole:

1. CONOSCENZA LINGUA INGLESE (AMMESSO/NON AMMESSO)

i. Uno studente che ha una certificazione della lingua almeno pari a B2 sarà valutato idoneo e ammesso.

ii. Uno studente che ha frequentato una scuola secondario di secondo grado italiana e che ha ottenuto un titolo di primo livello in cui fosse presente un esame di inglese, sarà valutato idoneo e ammesso.

iii. Uno studente, che ha completato il primo ciclo di studi accademici con tutti i corsi erogati in inglese, sarà valutato idoneo e ammesso.

iv. Uno studente che non è in possesso delle certificazioni sopra menzionate ma supera con successo il test B2 erogato dal Settore Sviluppo Competenze linguistiche (di Ateneo) sarà valutato idoneo e ammesso.

2. POTENZIALE ACCADEMICO (MAX. 50):

Il punteggio per il potenziale accademico verrà attribuito secondo la seguente tabella

Voto di laurea in 110°				
	> 106	97-106	87-96	66-86

Punteggio accademico	50/50	45/50	40/50	35/50

Il punteggio di laurea degli studenti stranieri sarà ricalcolato in 110° come segue:

$$\mathbf{Voto_{110} = max\ (arrotonda\ (110*\ voto/max\_voto),66)}$$

Dove *voto* è il voto ottenuto nel paese straniero e *max_voto* è il voto massimo ottenibile in quel paese (*arrotonda* è la solita operazione di arrotondamento e *max(a,b)* prende il valore massimo tra a e b). Solo gli studenti con almeno 6 semestri di studi saranno valutati.

3 - Rilevanza del titolo di studio (max. 30):

Punteggio	Tipo di Laurea
30	Lauree italiane di primo livello appartenenti alle classi L8 o L31 o altri titoli (anche esteri) che prevedono almeno 45% CFU in contenuti di informatica, automatica, matematica, fisica
20	Titoli (anche esteri) che prevedono dal 40% al 44% di CFU in contenuti di informatica, automatica, matematica, fisica
15	Altri titoli (anche esteri) che prevedono dal 30% al 39% di CFU in contenuti informatica, automatica, matematica, fisica

4. RANKING DELL'UNIVERSITÀ OVE SI È CONSEGUITO IL TITOLO DI I LIVELLO (MAX. 20):

Giacché in Italia è previsto il valore legale del titolo il punteggio delle università italiane sarà fissato a 20. Per le università non italiane, il punteggio sarà valutato in base alle classifiche internazionali fornite dal sito http://www.webometrics.info/en. In particolare:

20 se l'istituto è tra i primi 500 del ranking internazionale,
18 se l'istituto è tra 501 e 1000,
15 se l'istituto è tra 1001 e 1500,
11 se l'istituto è tra 1501 e 2000
6 se l'istituto è tra 2001 e 2500
0 oltre il 2500 o se assente dal ranking del sito precedente.

5. ALTRI ASPETTI DEL CURRICULUM VITAE (altri titoli di studio, esperienza lavorativa, qualificazioni professionali, lettera di motivazione, lettera di presentazione, ecc.) (MAX.10):

Il curriculum vitae del candidato sarà valutato con riferimento a esperienze professionali/accademiche particolari, ad esempio competenze linguistiche, titoli di studio ulteriori, qualifiche professionali certificate ecc.

REGOLAMENTO DIDATTICO – Parte Speciale

Curriculum	Anno di corso	Codice	Nome	CFU	SSD	Tipologia	Ambito	Lingua	Obiettivi formativi	Ore riservate attività didattica	Ore riservate allo studio personale
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	61884	ADVANCED DATA MANAGEMENT	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	Students will be provided with a sound grounding on theoretical, methodological, and technological fundamentals concerning data management for advanced data processing architectures, with a specific reference to large-scale distributed environments. Students will learn key elements of NoSQL and stream-based systems as well as basic issues in parallel and distributed query processing, multi-query processing, and high-throughput transactional systems. Students will be involved in project activities.	56	94

ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	80156	COMPUTER SECURITY	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in transit, in implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access control in information systems and most relevant access control models and mechanisms.	72	153

ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	80158	HUMAN COMPUTER INTERACTION	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course provides the student with the methodology, the theory, and the techniques for the design of interactive products to support the way people communicate and interact in their everyday and working lives. This relies on the mastery of the development process for the understanding of the capabilities and desires of people and on the kinds of technology available to interaction designers, together with a knowledge of how to identify requirements and develop them into a suitable design. The course will cover standard techniques as well as an introduction to advanced topics, including sound and music computing (as a complementary component of visual and haptic interfaces), and emotional and social interfaces. A coursework devoted to the realization of the development process of a concrete interaction	48	102

									design project of an interactive product will be implemented during the whole semester, in a simulated working environment typical of Startups. Further, students will learn to design and manage motion capture sessions using the Qualisys industry standard motion capture system available at Casa Paganini-InfoMus. Finally, students will learn techniques to present their results, including elevator pitches and reporting to stakeholders.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	90530	NETWORK ANALYSIS	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	Learning algorithms and techniques for large scale graph analytics, including centrality measures, connected components, graph clustering, graph properties for random, small-world, and scale free graphs, graph metrics for robustness and resiliency, and graph algorithms for reference problems.	48	102

ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	11 10 95	INDUSTRIAL AUTOMATION	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95 international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-	1	86 79 8	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Students will be provided with advanced skills related to machine learning and data analysis.	72	78

CENTERED COMPUTING									Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	11 10 97	OPERATIONS RESEARCH	6	MAT/09	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and modelling a decision process in terms of an optimization problem by defining the decision variables, the cost	48	102

									function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	11 11 00	SOFTWARE ENGINEERING LAB	3	ING-INF/05	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese		24	51
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	11 11 02	SOFTWARE ENGINEERING	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Software Engineering is a discipline that rules every aspect of the software development process. In other word is the application of Engineering to the Software. It is concerned with requirement	48	102

									specification, design, models, writing documentation and also writing unit tests, not just coding. Moreover it also provide metrics to quantify the quality of the product, i.e. the software developed. Software Development Templates, Requirement Analysis, UML Modeling Systems, Design Patterns, Verification and Validation, Time Template Specification Languages, Temporary Property Verification Algorithms, Modeling and Case Resolution using Model Checkers "		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	11 11 03	ARTIFICIAL INTELLIGENCE	9	IN G-IN F/ 05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the “deductive” side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action	72	78

									effects will be added on top of the basic capabilities for representation and reasoning.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	1	111104	MOBILE SECURITY	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese	The course aims to introduce the main security mechanisms of mobile operating systems and applications and present the core techniques, methodologies and tools for the vulnerability assessment and penetration testing of Android and iOS applications. The course involves both lectures and practical sessions for students.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	801644	MULTIMODAL SYSTEMS	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	This course provides students with foundational conceptual knowledge, methodologies, and tools for designing, implementing, and evaluating computer systems that can capture, represent, and automatically analyze the behavior of their users (e.g., in terms of gesture, movement, facial expressions, speech) and interact with them by generating	48	102

									multisensory feedback (e.g., images, sounds, control of actuators) in real-time.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	80394	MASTER THESIS	27		PROVA FINALE	Per la Prova Finale	Inglese		0	675
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	80459	AUGMENTED AND VIRTUAL REALITY	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	In this course, you will learn the fundamentals of Semantic Web technologies. You will learn how to collect information form linked data and metadata to represent knowledge an build knowledge bases, and how to access and benefit from semantic web technologies applied to smart applications in a H2020 perspective.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51

ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	90535	HIGH PERFORMANCE COMPUTING	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	Learning the main aspects of modern high-performance computing systems (pipeline/superscalar processors,shared-memory/message-passing multiprocessors, vector processors, GPUs) and basic programming skills for high-performance computing (cache optimization, OpenMP, MPI, OpenCL).	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	90538	DATA PROTECTION & PRIVACY	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese	Students will learn key elements in data protection and privacy: data privacy and anonymity, metrics and techniques; macro and microdata protection; data protection in outsourcing scenarios; privacy on the web; advanced access control. Students will be involved in project activities.	48	102
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	94977	ENGLISH LANGUAGE B2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: -	30	45

									understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers effortlessly for both parties; - produce a clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.		
ARTIFICIAL INTELLIGENCE AND HUMAN-CENTERED COMPUTING	2	10 86 06	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning	48	102

									algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition, spam filtering, and malware detection		
COMPLEX SYSTEMS ENGINEERING	1	80156	COMPUTER SECURITY	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in	72	153

									transit, in implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access control in information systems and most relevant access control models and mechanisms.		
COMPLEX SYSTEMS ENGINEERING	1	80158	HUMAN COMPUTER INTERACTION	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese	The course provides the student with the methodology, the theory, and the techniques for the design of interactive products to support the way people communicate and interact in their everyday and working lives. This relies on the mastery of the development process for the understanding of the capabilities and desires of people and on the kinds of technology available to interaction designers,	48	102

									together with a knowledge of how to identify requirements and develop them into a suitable design. The course will cover standard techniques as well as an introduction to advanced topics, including sound and music computing (as a complementary component of visual and haptic interfaces), and emotional and social interfaces. A coursework devoted to the realization of the development process of a concrete interaction design project of an interactive product will be implemented during the whole semester, in a simulated working environment typical of Startups. Further, students will learn to design and manage motion capture sessions using the Qualisys industry standard motion capture system available at Casa Paganini-InfoMus. Finally, students will learn techniques to present their results, including elevator		

									pitches and reporting to stakeholders.		
COMPLEX SYSTEMS ENGINEERING	1	80190	EMBEDDED SYSTEMS	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	This course presents the fundamentals of embedded systems. After a brief review of the most relevant architectures, the course focuses on microcontroller programming for control applications, with a particular attention on peripheral configuration, real time and event-based programming techniques.	48	102
COMPLEX SYSTEMS ENGINEERING	1	90530	NETWORK ANALYSIS	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	Learning algorithms and techniques for large scale graph analytics, including centrality measures, connected components, graph clustering, graph properties for random, small-world, and scale free graphs, graph metrics for robustness and resiliency, and	48	102

									graph algorithms for reference problems.		
COMPLEX SYSTEMS ENGINEERING	1	90545	MULTIAGENTS SYSTEMS	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	Getting acquainted with the concept of an agent and multiagent system, and learning how to design intelligent autonomous agents and how to deal with the main implementation issues.	48	102
COMPLEX SYSTEMS ENGINEERING	1	111095	INDUSTRIAL AUTOMATION	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95 international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an	72	78

									industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.		
COMPLEX SYSTEMS ENGINEERING	1	8679 8	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Students will be provided with advanced skills related to machine learning and data analysis. Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.	72	78
COMPLEX SYSTEMS ENGINEERING	1	1110 97	OPERATIONS RESEARCH	6	MAT/09	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems	48	102

									by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and modelling a decision process in terms of an optimization problem by defining the decision variables, the cost function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.		
COMPLEX SYSTEMS ENGINEERING	1	11 10 98	SYSTEM ENGINEERING LAB	3	ING-INF/04	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del	Inglese	A systems engineering laboratory is a course that teaches students how to apply systems engineering principles to the design, development, and management of complex systems. The laboratory typically	24	51

							Lavoro		covers topics such as system requirements analysis, system architecture design, system integration and testing, system optimization and performance analysis, and system risk management.		
COMPLEX SYSTEMS ENGINEERING	1	11 11 05	SYSTEM IDENTIFICATION AND OPTIMAL CONTROL	9		CARATTERIZZANTI	Ingegneria Informatica	Inglese		0	0
COMPLEX SYSTEMS ENGINEERING	1	11 11 06	SYSTEM IDENTIFICATION	5	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The goal of the course is to provide methodologies and tools for designing systems' models to be used for control, estimation, diagnosis, prediction, etc. Different identification methods are considered, both in a "black box" context (where the structure of the system is unknown), as well as in a "grey box" (uncertainty on parameters) one. Methods are provided for choosing the complexity of the models, for determining the values of their parameters, and to validate them.	40	85

									Moreover, state estimation problems are addressed and their connections with control and identification are considered.		
COMPLEX SYSTEMS ENGINEERING	1	11 11 07	OPTIMAL CONTROL	4	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course on Optimal Control is a core course in the curriculum of a Master's degree in Computer Engineering. The course is designed to provide students with a comprehensive understanding of the theory and techniques of optimal control, which is a fundamental concept in the design of control systems. The course covers various topics related to the analysis, design, and implementation of optimal control systems, including mathematical modeling, control theory, optimization techniques, and practical applications.	32	68
COMPLEX SYSTEMS ENGINEERING	2	80 16 7	PRODUCTION SYSTEMS	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Under the title 'Production Systems' one can place very many different problems. This course is related with the decomposition of a planning and control	48	102

									problem of a production systems in different subproblems. For any of the subproblems after a analysis process, a set of solving technques will be considered. Such solving techniques have to be integrated in possible solution of the 'main' production problem.		
COMPLEX SYSTEMS ENGINEERING	2	80171	TECHNOLOGIES FOR WIRELESS NETWORKS	6	ING-INF/03	A SCELTA	A Scelta dello Studente	Inglese	The course aims to provide a framework for all major network technologies that use wireless (wireless) transmissions, considering application areas and architectures both from a structural and protocollary point of view. More specifically, the main objective is to provide knowledge and insight on the following topics: i) Introduction to architectures with the classification of wireless networks in mobile cellular systems, technologies for wireless local area networks (LAN) and Personal-Sensor-Body Area Networks (PAN, SAN, and BAN).	48	102

									ii) The cellular mobile radio networks from the second generation (2G-GSM) and evolutions (GPRS and EDGE), to the third generation (3G-UMTS) and the fourth (4G, LTE) for ending with the current 5G technology. iii) The standard for IEEE802.11 (Wi-Fi) WLAN networks, described in all its evolutions starting from version 11b up to version 11ax. iv) Personal communications through the Bluetooth standard, including the latest variants like Bluetooth low-power. The result of learning is to give the student, oriented to a specific field of Engineering, the ability to understand the different technologies of wireless networks and make effective design choices for their effective use.		
COMPLEX SYSTEMS ENGINEERING	2	80172	METHODS AND MODELS FOR DECISION SUPPORT	6	MAT/09	A SCELTA	A Scelta dello Studente	Inglese	The course aims at introducing the modelization and solution tools for complex decision problems: methods based on integer	48	102

									programming models, heuristics and metaheuristics for combinatorial optimization problems, the PERT method for Project Management are studied. Finally fundamental concepts for solving multi-criteria decision problems are introduced. Applications to manufacturing planning and scheduling and logistics (network flow, location and vehicle routing) will be considered.		
COMPLEX SYSTEMS ENGINEERING	2	8026 8	LOGISTIC SYSTEMS PLANNING AND CONTROL	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims to provide methodologies and tools for optimizing and controlling logistic systems (intermodal networks, container terminals, logistic centers). Referring to the planning and organization of logistic systems, the student will learn how to: - identify the decision problem type - define the most appropriate mathematical model - define the most adequate solution methodology - choose a software	48	102

									solution for the problem - discuss the problem relevance/effects		
COMPLEX SYSTEMS ENGINEERING	2	80394	MASTER THESIS	27		PROVA FINALE	Per la Prova Finale	Inglese		0	675
COMPLEX SYSTEMS ENGINEERING	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51
COMPLEX SYSTEMS ENGINEERING	2	94977	ENGLISH LANGUAGE B2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: - understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers effortlessly for both parties; - produce a	30	45

									clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.		
COMPLEX SYSTEMS ENGINEERING	2	98458	ADVANCED CONTROL SYSTEMS	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims at providing modeling and methodological approaches to sensing, actuation, and control in order to describe and analyze a system, and make decisions based on the available data in a distributed, predictive and/or adaptive manner, thereby performing “smart actions”. The student will approach such smart systems by studying proper models and methods in different applicative contexts, such as smart power grids, connected autonomous vehicles and platooning, energy efficient buildings, distributed logistics, and environmental monitoring.	48	102

COMPLEX SYSTEMS ENGINEERING	2	1086606	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition,	48	102

									spam filtering, and malware detection		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	80156	COMPUTER SECURITY	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Upon completion of the course, students will be able to: explain the concepts of confidentiality, availability, and integrity (CIA) as well as the concepts of threat, vulnerability, exploit and (cyber-)risk and (cyber-)risk mitigation; explain the strengths and weaknesses of cryptographic techniques as well as their role in protecting data at rest and in transit, in implementing the concept of digital signature and in supporting the design of security protocols; explain the security model of web browsers and identify the most relevant vulnerabilities of web applications; explain the causes and effects of buffer overflows in executable programs; explain the key principles of access	72	153

									control in information systems and most relevant access control models and mechanisms.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	90538	DATA PROTECTION & PRIVACY	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Students will learn key elements in data protection and privacy: data privacy and anonymity, metrics and techniques; macro and microdata protection; data protection in outsourcing scenarios; privacy on the web; advanced access control. Students will be involved in project activities.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	98460	SOFTWARE PLATFORMS	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Software Platforms is a fundamental module in the software development path. The development of complex software systems does not only require proficency in programming but also the knowledge of advanced models, paradigms and tools. Software Platforms describes the models, the paradigms and the tools which support Web Applications, Web Services and Microservices, and introduces the evolution	60	88

									toward serverless computing.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	10 18 12	DIGITAL FORENSICS	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	Learning how to conduct digital investigations, following the standard process involving identification, acquisition, storage, and analysis of digital evidence.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	1	11 10 95	INDUSTRIAL AUTOMATION	6	ING-INF/04	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims at providing the modeling and methodological tools for the formalization and resolution of some important decision-making and management problems in the context of industrial systems. During the course, planning, scheduling and control problems will be formalized and solved according to the framework proposed by the ANSI/ISA-95 international standard. Special focus will be devoted to the primary and support functions given by the Manufacturing Execution System (MES). At the end of the course, the student will be able to position an	48	102

									industrial automation problem in the context of ANSI/ISA-95 and to formalize and to solve decision-making problems, using proper methods and tools.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	86798	MACHINE LEARNING AND DATA ANALYSIS	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Students will be provided with advanced skills related to machine learning and data analysis. Students will learn insights on machine learning and data analysis methodologies and a series of real world applications.	72	78
SOFTWARE PLATFORMS AND CYBERSECURITY	1	111097	OPERATIONS RESEARCH	6	MAT/09	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The Course introduces to optimization models and methods for the solution of decision problems. It is structured in the main topics of problem modelling, computational tractability, and solution by means of algorithms that can be implemented on a computer. Several applications are considered and various case studies are detailed. The target of the Course consists in making the students acquire the expertise to face decision problems	48	102

									by means of models and methods that can operate in the presence of limited resources. The students will be taught to: understanding and modelling a decision process in terms of an optimization problem by defining the decision variables, the cost function to be minimized (or the figure of merit to be maximized), and the constraints; framing the obtained problem within the range of the reference optimization problems (linear/nonlinear, discrete/continuous, deterministic/stochastic, static/dynamic, etc); achieving the matching between the corresponding solving algorithm and a suitable software.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	11 11 00	SOFTWARE ENGINEERING LAB	3	ING-INF/05	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del	Inglese	A software engineering laboratory is a hands-on course that teaches students how to apply software engineering principles to real-world software development projects. The laboratory typically focuses on software development	24	51

							Lavoro		methodologies, software design and architecture, software testing and debugging, and project management.		
SOFTWARE PLATFORMS AND CYBERSECURITY	1	11 11 02	SOFTWARE ENGINEERING	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	Software Engineering is a discipline that rules every aspect of the software development process. In other word is the application of Engineering to the Software. It is concerned with requirement specification, design, models, writing documentation and also writing unit tests, not just coding. Moreover it also provide metrics to quantify the quality of the product, i.e. the software developed. Software Development Templates, Requirement Analysis, UML Modeling Systems, Design Patterns, Verification and Validation, Time Template Specification Languages, Temporary Property Verification Algorithms, Modeling and Case Resolution using Model Checkers	48	102

SOFTWARE PLATFORMS AND CYBERSECURITY	1	11 11 03	ARTIFICIAL INTELLIGENCE	9	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the “deductive” side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.	72	78
SOFTWARE PLATFORMS AND CYBERSECURITY	1	11 11 04	MOBILE SECURITY	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese	The course aims to introduce the main security mechanisms of mobile operating systems and applications and present the core techniques, methodologies and tools for the vulnerability assessment and penetration testing of Android and iOS applications. The course involves both	48	102

									lectures and practical sessions for students.		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	80394	MASTER THESIS	27		PROVA FINALE	Per la Prova Finale	Inglese		0	675
SOFTWARE PLATFORMS AND CYBERSECURITY	2	86746	ITALIAN LANGUAGE (FOR FOREIGN STUDENTS) - BRIEF	3	L-FIL-LET/12	ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course allows the student to achieve a sufficient oral and written comprehension of the local language, as well as an introduction to country culture.	24	51
SOFTWARE PLATFORMS AND CYBERSECURITY	2	86799	DISTRIBUTED SYSTEMS	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and design; and how they meet the demands of contemporary distributed applications. 1. Distributed systems characterization 2. Coordination of distributed systems Physical and logical clock synchronization Distributed mutual exclusion Election algorithms and protocols 3. Consistency of	48	102

									distributed systems Data centric systemsClient centric systems Consistency protocols 4. Resilience of distributed systems Distributed process pooling and resilience Reliable distributed communication services Distributed operation commit Recovery of faulty systems 5. Case studies Hyperledger permissioned blockchains Google distributed storage and computation In memory Distributed Data Store Office online collaboration platforms		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	8680 0	VIRTUALIZATION AND CLOUD COMPUTING	6	ING-INF/05	CARATTERIZZANTI	Ingegneria Informatica	Inglese	The course provides the foundations of the main virtualization technologies at the state of the art. In detail, the course focuses on several types of virtualization, like Storage-level, OS-level, Application-level, and Enterprise-level virtualization. The course is mostly practical, with the aim to teach the student how to deal with current virtualization technologies to build	48	102

									actual virtualized architectures.		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	90535	HIGH PERFORMANCE COMPUTING	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	Learning the main aspects of modern high-performance computing systems (pipeline/superscalar processors,shared-memory/message-passing multiprocessors, vector processors, GPUs) and basic programming skills for high-performance computing (cache optimization, OpenMP, MPI, OpenCL).	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	2	94977	ENGLISH LANGUAGE B2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Provide a level of knowledge and understanding of the English language equivalent to the B2.1 level of the European framework. At the end of the course the student will be able to: - understand the key topics of a complex text on both concrete and abstract topics, including technical discussions; - express themselves with a certain fluency and spontaneity, interacting with native speakers	24	51

									effortlessly for both parties; - produce a clear and detailed text on a wide range of topics and express an opinion on a topical issue, indicating the advantages and disadvantages of the different options.		
SOFTWARE PLATFORMS AND CYBERSECURITY	2	10 18 11	BINARY ANALYSIS AND SECURE CODING	6	INF/ 01	AFFINI O INTEGRATIVE	Attività Formative Affinio Integrative	Inglese	Being able to write secure code, analyze the behavior and assess security properties of source and binary programs, pinpointing and fix their vulnerabilities or apply corrective counter-measures.	48	102
SOFTWARE PLATFORMS AND CYBERSECURITY	2	10 86 06	TRUSTWORTHY ARTIFICIAL INTELLIGENCE	6	ING-INF/ 05	A SCELTA	A Scelta dello Studente	Inglese	The aim of this course is to provide graduate students with fundamental and advanced concepts on the security of machine learning and trustworthy artificial intelligence. Part 1 of the course introduces the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some practical techniques to assess the vulnerability of machine-learning	48	102

									algorithms and to protect them from adversarial attacks. Part 2 introduces the international regulations behind the so called “trustworthy AI”, and the main techniques to design robust machine-learning algorithms which are fair, privacy preserving and whose operation can be explained at some extent to the final users. The course uses application examples including object recognition in images, biometric recognition, spam filtering, and malware detection		