POLITECNICO
MILANO 1863

PhD School - Politecnico di Milano

Regulations of the PhD program in:

Information Technology

Cycle XXXII

Location: Milano Leonardo

1. General Information

PhD School - Politecnico di Milano

PhD program: Information Technology

Location of the PhD program: Milano Leonardo

Subjects (SSD):
ING-INF/05: SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI - Information processing systems
ING-INF/04: AUTOMATICA - Systems and control engineering
ING-INF/03: TELECOMUNICAZIONI - Telecommunications
ING-INF/01: ELETTRONICA - Electronics
ING-INF/02: CAMPI ELETTROMAGNETICI - Electromagnetic fields
ING-IND/31: ELETTROTECNICA - Electrical engineering

PhD School Website: **http://www.polimi.it/phd**

PhD program Website: http://dottoratoit.deib.polimi.it/

Areas:
1) Computer Science and Engineering (ING-INF/05: Information processing systems)
2) Electronics (ING-INF/01: Electronics)
2) Systems and Control (ING-INF/04: Systems and control engineering)
4) Telecommunications (ING-INF/03: Telecommunications)

2. General presentation

The PhD Course in Information Technology is organized within the Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB) and is part of the PhD School as a significantly large program, including all research areas in Computer Science and Engineering, Electronics, Systems and Control, Telecommunications, with 18% of the total number of PhD students in the School.

Nowadays these fields of research are of great scientific and technical interest to both industry, governmental organizations, and to the society in general. The doctorate opens interesting possibilities of extended study and participation in high level research in information technologies that include hardware and software, automatic control, electronic components and systems, instruments, telecommunication networks, decision support systems. Scientific collaboration of DEIB with renowned research institutes in Europe, the United States and worldwide, facilitates the entrance into the world of international research through meetings with scientists and visits to laboratories abroad. Intense industrial collaboration of DEIB in applied research allows the doctoral student to become acquainted with the activities of technologically advanced companies, thus acquiring the elements needed to support a career choice in industrial research or in university.

DEIB's scientific activities in Information Technology (IT) are distributed along many areas , organized in four sections:

Computer Science and Engineering: the primary goal of research in Computer Science and Engineering is the application of Information Technology to innovative products and services in many applied fields. The research develops within these areas: information systems, database management, information design for the web, methods and applications for interactive multimedia, artificial intelligence, robotics, computer vision, advanced software architectures and methodologies, embedded systems design, dependable systems, computer performance, security and reliability.

Electronics: the research activities focus on new developments, such as applied nanoelectronics, sensors and diagnostic technologies, genetics and biomedicine, diagnostics of cultural heritage, and astrophysics applications. The research framework is naturally dynamical and evolves, continuously driven by prospects and new initiatives.

Systems and Control: the research activity covers various fields related to control system science, systems theory, ecology, operations research, and electrical and electronic measurements. Despite the rich variety of topics, both theoretical and application-oriented, a unifying system viewpoint is generally adopted, which enables the analysis, the management, and the design of complex systems (not only in the area of automation in a strict sense), through the powerful theoretical tools of mathematical modeling.

Telecommunications: given the interdisciplinary nature of the world of the telecommunications, in this section many competences coexist, among which: transmission systems and telecommunication networks, radio and optical wireless transmission, digital signal processing, electromagnetic methods, remote sensing methods and systems.

The four curricula correspond to a traditional subdivision of Information Technology, but do not preclude interdisciplinary research projects, according to the most recent trends. Information Technology is bringing about a deep reorganization of industrial structures, with merging and alliances between electronic, computer, and telecommunication companies; interesting opportunities towards public administrations and personal entrepreneurship are also open. A parallel trend is also seen in science and technology, where the interdisciplinary approach has become the most effective one.

3. Objectives

The DEIB Doctoral Program in IT enrolls, every year, an average of 60 students, mostly supported by scholarships from public institutions and private companies. After admission, each PhD student chooses a research advisor and a professor of the Doctoral Board as a tutor. Study activities consist of courses and individually guided study. Advanced courses (in English), reserved to doctoral students and senior graduate students, bring the attendants to the frontiers of knowledge in those sectors where DEIB's research is most active. Specific courses on relevant subjects are also organized by various national and international schools regularly accessed by our PhD students. The participation in local and external courses supplies the necessary knowledge to approach research problems in the

most serious and competitive way.

All research is conducted under the guidance of a scientific supervisor. The student will, throughout the three-year period, publicly illustrate both his/her studies and research results to DEIB professors and colleagues, and to audiences of international scientific conferences. In doing this, the student will develop a capacity for public speaking as well as improving his/her ability of oral and written communication.

The PhD program is held within a large international framework which includes also joint programs established with foreign institutions, aimed at training young researchers and PhD students.

4. Professional opportunities and job market

The PhD degree in Information Technology gives access to the highest levels of scientific research in the ICT and related areas. Depending on their interests, their personal inclinations and circumstances, students who have reached the PhD degree may head for a career in university or in industry, both in Italy or worldwide.
Each year Politecnico di Milano and neighboring universities award post-doctorate positions oriented towards research and teaching. In recent years the number of offered positions in our disciplines has fulfilled the expectations of the best PhD graduates. As a result of the experience gained with their PhD studies, in seminary courses, conferences and other education activities, the research graduate is also qualified to undertake teaching activities.
The habit of communicating and working in English, as well as the knowledge of the academic world, acquired during visits and stays abroad, qualifies the PhD graduate for positions offered by the best worldwide universities.
As evidence of the interest shown by companies for this PhD track, many scholarships for graduate students at DEIB have been funded by major industrial firms, to promote research in their respective fields of interest.
Those aiming for a research career in industry must be aware that the globalization of the economy has led to industrial research centers often being localized in other countries, and organized into intercontinental research structures that impose great mobility on the researchers themselves.
Openings are also available in sectors that are not tied to industry, but to services (e.g., transport planning, natural and human resource management, web services), in important engineering firms, in technical services of government and EU bodies, in international institutions.
Finally, the competence developed in brilliant PhD activities may led, as it happened in the past, to the establishment of innovative and creative companies, where it is possible to combine personal interests and entrepreneurship attitudes.

5. Enrolment

5.1 Admission requirements

Italian and International citizens can apply. They are requested to have graduated in accordance with the pre-existing laws D.M. 3.11.1999 n. 509, or to have a Master of Science degree in accordance with

D.M. 3.11.1999 n. 509, or a Master of Science in accordance with D.M. 22.10.2004 n. 270, or similar academic title obtained abroad, equivalent for duration and content to the Italian title, with an overall duration of university studies of at least five years.
The certified knowledge of the English language is a requirement for admission. Please refer to the PhD. School website for details.
The admission to the programs will be established according to the evaluation of the candidates' curricula, motivation letters, and an illustrative report about the development of a possible PhD research, which candidates will send contextually with their application to the admission announcement.

5.2 Admission deadlines and number of vacancies

The number of positions is indicated in the announcement for the admission to the 32nd cycle of PhD program: http://www.polimi.it/phd.
Scholarships both on general and on specific themes are available, in accordance with what is specified in the call. Scholarships may be granted from the University and Research Ministry, from Politecnico, from companies or from the Department, based on research project funds.

6. Contents

6.1 Requirements for the PhD title achievement

The achievement of the PhD title in Information Technology requires a study and research activity of at least three years equivalent of full time study, research and development of PhD thesis.
The PhD in Information Technology requires a minimum of 30 credits from PhD level courses, to be earned as described in paragraph 6.3 below.
Among the 30 credits, at least 15 credits have to be obtained through PhD courses characterizing the PhD program in Information Technology (held by DEIB Professors or foreign Professors visiting DEIB), at least 5 credits from PhD School Courses and 10 or less credits may be taken from external PhD courses, e.g., from other PhD programs, or from Summer Schools. All the mentioned courses have to foresee an evaluation for the PhD student to let her/him obtain the corresponding credits.
Other activities like attendance to seminars, PhD courses without evaluation, workshops, conferences, and similar, contribute to create the curriculum of the PhD student. They have to be agreed with the Tutor (see below) in advance. A Minor Research is also possible, and belongs to this category of activities. It consists basically of a research activity with a limited time extension, in a research topic different from the one of the Major Research that will lead to the PhD Thesis. It does not contribute to the acquisition of credits.
Courses from the Master Degree may be inserted in the curriculum of the student, in agreement with the Supervisor (see below) and the Tutor, but do not contribute to the acquisition of the credits.

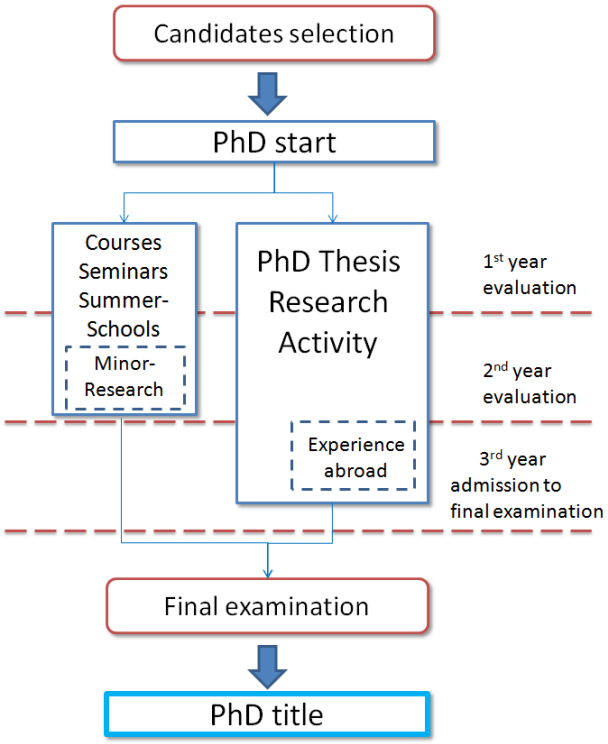
6.2 Research development

The main aim of all PhD programs at Politecnico di Milano is the development in the candidates of a research-oriented mind-set, with expertise and skills in a specific research topic. To this end, candidates develop a problem-solving capability in complex contexts, including the capacity of performing deep problem analysis, identifying original solutions, and evaluating their applicability in

practical contexts.
These skills provide the PhD candidates with major opportunities of development in their research both in the academic field, and in public and private organizations.
PhD candidates are requested to develop an original research contribution. The PhD thesis must thus contribute to increase the knowledge in the candidate's research field. Besides, it has to be coherent with the research topics developed in the Department where the PhD program is carried out.
The original research results are collected in the PhD thesis, where the candidate's contribution is put in perspective with respect to the research state of the art in the specific research field.
The PhD research is developed under the guidance of a supervisor, who supports the candidate in the setting-out and in the everyday activities related to the thesis development. The supervisor is not necessarily a member of the Board of Professors, and may also belong to an institution different from Politecnico di Milano. The supervisor can be supported by one or more co-supervisors.
To develop the capability of carrying out research activities, candidates must earn a minimum of 30 credits from courses coherent with their PhD program. To each candidate admitted to the program, a Tutor, belonging to the Board of Professors, is appointed. The Supervisor and the Tutor cannot be the same person.
The Tutors supervise and support the candidates over all their training path. They assist the candidates in the choice of courses to be included in a study plan, which must finally be approved by the Coordinator of the PhD program.
Further activities intended to develop the candidate's personal skills and research expertise are encouraged during the PhD path.
Candidates must acquire the capability to present and discuss their work in their research community. Consequently, both the participation to international conferences and the publication of the research results in peer-reviewed journals are encouraged.
The PhD program favors the candidates' research interactions with other groups in their research field, preferably abroad. Research visits of at least three months are strongly encouraged, as through them the candidates may acquire further skills to develop their research work and thesis.
The duration of the program is normally three years.

6.3 Objectives and general framework of the teaching activities

The PhD programs and the PhD School activate teaching forms of different kind and credit value, including courses, seminars, project workshops, laboratories. Teaching activities both cover the basic research issues (problems, theories, methods), which represent the founding element of the PhD program and identify clearly its cultural position, and deepening in a specialist way some research issues connected with the problems developed in the theses.
Lessons are usually held in English, except when indicated otherwise. The PhD program includes at least one complete path delivered in English language.
Structured teaching activities allow to earn ECTS credits. Other activities, typically specialised and for which it is difficult to evaluate the learning and its quantification, fall within the scientific activities of which the Board of Professors takes into account in the overall evaluation, but they do not allow to earn ECTS.
A summary of the activities of the PhD student can be summarized in the following graph:



All activities related to courses (attendance/evaluation) have to be completed within the second year of the program. Programs of the courses organized by the PhD in Information Technology are available on the web site of the PhD program reported above. In the same web site, other information like the schedule of the courses is available.

At the end of each year, an evaluation of the PhD candidate is foreseen to continue the program. At the conclusion of the PhD studies, the Board of Professors evaluates the candidates. Candidates who receive a positive evaluation submit their theses to two external reviewers for refereeing. If the evaluation provided by the reviewers is positive (o after the revisions required by the external reviewers), the candidates defend their thesis in a final exam, in front of a Committee composed of three members (at least two of which must be external experts).

The tables below summarize the candidate's path (as regards coursework activities). At the same time, the program foresees that the candidates are devoted to research activity in a continuous way, following the lead of their supervisors, and of the Board of Professors.

First/Second Year

Individual study related to the Major Research topic
Courses, selected according to the table reported here below.

Courses	*Possible details or reference to following tables*	*Number of credits (min-max)*	*Note*
PhD School Courses	*See table*	*5- min*	

Courses characterising the PhD program	*See table and website*	*15- min*	
Other PhD courses	*External courses with evaluation*	*10- max*	
Other activities	*Seminars, courses without evaluation, Minor Research, ..*	*No credits*	*To be agreed in advance with the Tutor*

Third year

In the third year the candidate should be devoted entirely to the research and to the development of the PhD thesis.

PhD Course List

A) The PhD Program in Information Technology organises the **Characterising Courses** listed in table A. For the admission to the final exam, the acquisition of at least 15 credits in this list is **mandatory**.

B) The PhD School organises every year general and Inter-doctoral courses. The acquisition of **at least 5 credits** is **mandatory** among these courses. The list of PhD courses organized by the PhD School is available at the website http://www.dottorato.polimi.it/en/during-your-phd/phd-school-courses

C) Other PhD courses
A maximum of 10 credits can be obtained by choosing among courses provided by other PhD programs at Politecnico di Milano and/or external Institutions (in this case prior authorization from the tutor and the coordinator has to be obtained).

PREPARATORY COURSES
If the supervisor and the tutor find it useful or necessary that the candidate attends preparatory courses (chosen among the activated courses at the Politecnico di Milano) the Board of Professors of the PhD program may assign some extra-credits to be acquired to complete the training path. The credits acquired in this way will be considered as additional, in relation to the mandatory credits to be acquired with the PhD courses.

SPECIALISTIC COURSES, LONG-TRAINING SEMINARS
The attendance of Specialistic Courses, Workshops, Schools, Seminars cycles is strongly encouraged and (if these seminars, workshops are certified and evaluated) may be awarded by credits of type C), according the modalities established by the Board of Professors and previous approval of the study plan submitted by the candidate. These courses and workshops can be inserted in the study plan, even if they are not evaluated (and therefore not qualified as credits), as optional “additional teaching”.

The scheduled course planning for the academic year 2016-2017 follows. Other courses may be activated during the year. In this case the candidates will be promptly informed, and will be allowed to

insert these new courses in their study plan.

Table A: PHD COURSES CHARACTERISING THE PHD program

SSD	Name of the Course	Professor	A.A./Semester	Language	Credits
ING-INF/05	Advanced Topic on Reconfigurable FPGA-based Systems Design	Marco Santambrogio	November 2016	English	5
ING-INF/05	Advanced Topics in Computer Security	Stefano Zanero	June 2017	English	5
ING-INF/05	Big data technologies	Stefano Ceri	March- April 2017	English	5
ING-INF/05	Data and Information Quality	Cinzia Cappiello	May-June 2017	English	5
ING-INF/05	Genomic Computing	Marco Masseroli	Spring 2017	English	5
ING-INF 05	Intelligence for Embedded Systems	Marco Roveri	January/February 2017	English	5
ING-INF/05	Internet Economics	Nicola Gatti	Feb 2017	English	5
ING-INF/05	Learning Sparse Representations for Image and Signal Modeling	Giacomo Boracchi	March – April 2017	English	5
ING-INF/05	Parallel computing using MPI and OpenMP	Luca Breveglieri	Jan-July 2017	English	5
ING-INF/05	Professional Communication	Nicoletta Di Blas	January-February 2017	English	5
ING-INF/05	Stream and Complex Event Processing	Emanuele Della Valle	Second semester	English	5
ING INF 05	Volunteer and Crowd-based Approaches in Computing	Marco Brambilla	from December 2016 to February 2017	English	5
ING-INF/05	Intelligent Multiagent Systems	Francesco Amigoni	Spring 2017	English	5
ING/INF01	Communications Circuits	Carlo Samori	March-April 2017	English	5
ING-INF/01	Digital Circuits and Systems for DSP and FPGA-based Processing	Angelo Geraci	June 2017	English	5

ING-INF/01	Electrical Characterization of Nanoscale samples & bio-chemical Interfaces : methods and electronic instrumentation	Marco Sampietro and Giorgio Ferrari	November 2016	English	5
ING-INF/01	New Materials and Devices for post-Si Computers	Daniele Ielmini	February 2017	English	5
ING-INf/01	Nuclear microelectronics	Carlo Fiorini	November-December 2016	English	5
ING/INF 04	Analysis of Complex Networks: Theory and Applications	Carlo Piccardi	September-October 2017	English	5
ING-INF/04	Data-driven control system design	Simone Formentin	May 2017	English	5
ING-INF/04	Hybrid systems	Maria Prandini	February/March 2017	English	5
ING-INF-04	Switching control of dynamical systems: Theory and applications	Patrizio Colaneri	June 2017	English	5
ING-INF03	Numerical Methods for Electromagnetics	Gian Guido Gentili	November-December 2016	English	5
ING-INF/03	Photons and Bits: at the root of the information age	Mario Martinelli	2nd semester	English	5
ING-INF/03	Synthesis and Design Techniques for RF filters	Giuseppe Macchiarella	Spring 2017	English	5

6.4 Presentation of the study plan

PhD candidates must submit a study plan, which may be revised periodically (approximately every three months), in order to adequate them to possible changes in the course list, or to needs motivated by the development of their PhD career. The study plans must be approved by the PhD program Coordinator, according to the modalities established by the Board of Professors of the PhD program itself.

6.5 Yearly evaluations

Candidates present their work to the Board of Professors at least once a year. In particular, the candidates must pass an annual evaluation in order to be admitted to the following PhD year.

The third year evaluation establishes the candidate's admission to the final PhD defense. As a results of each successful annual evaluation, the candidates receive an evaluation (A/B/C/D). Candidates who do not pass the exam will be qualified as “Repeating candidate”(Er) or “not able to carry on with the PhD (Ei)”.
After the final year, candidates who have achieved sufficient results but need more time to draw up their theses may obtain a prorogation of up to 12 months, which has to be deliberated by the Board of Professors.

6.6 PhD thesis preparation

The main objective of the PhD career is the development of an original research contribute. The PhD thesis is expected to contribute to the advance of the knowledge in the candidate's research field.
The PhD study and research work is carried out, full time, during the three years of the PhD course. Stages or study periods in (Italian or International) companies or external Institutions may complete the candidate's preparation.
The resulting theses need to be coherent with the research issues developed in the Department where the PhD program is developed.
The candidate must present an original thesis, discuss its contribution to the state of the art in the research field in the research community.
The PhD research is developed following the lead of a supervisor, who supports the candidate in the setting out and in the everyday activities regarding the thesis development.
At the conclusion of the studies, admission of the candidate to send the final thesis to two external reviewers will be evaluated by the Board of Professors. Upon the decision of the reviewers the candidate may be admitted to the final exam or requested to revise the thesis for a maximum of six months. In the final exam, the research activity carried out and the thesis will be evaluated by an examination Committee composed by three members, of which at least two external evaluation members.

7. Laboratories, PhD Secretary Services

The Department hosts 30 laboratories for Computer Science and Engineering, Systems and Control, Electronics, Telecommunications and advanced interdisciplinary studies. Professional technicians continuously update the laboratory infrastructures and assist researchers and students.

The list of laboratories is provided below:

Systems and Control
Automatic Control Laboratory
Computer Laboratory for Environmental Systems - LITA
LOOMS Laboratory
Optical and Electronic Measurements Laboratory
ORLAB
Electronics
Analog integrated circuit design
Circuits and systems: theory and applications

Digital electronic systems
Electron devices
Radiation detectors and low-noise electronics
Single-photon detectors and applications
Computer Science and Engineering
ARCSLAB (Adaptable, Relational and Cognitive Software Environments) Laboratory
Artificial intelligence and robotics laboratory
Bioinformatics and Web Engineering Lab
Embedded system laboratory (Como Campus)
HOC - Hypermedia Open Center Laboratory
Linux Laboratory
NECST Lab - Novel, Emerging Computing System Technologies
Software engineering lab
Telecommunications
ANTLab - Research and experimental laboratory of wireless network and networked embedded systems
BONSAI (Broadband Optical Networks, Security, and Advanced Internet)
Electromagnetic compatibility laboratory "C.E.S.A.R.E."
Geophysical and Radar Sounding (GEOSAR) laboratory
Image and Sound Processing Lab (ISPLab)
PoliCom
Sound and Music Computing Lab
Spino d'Adda satellite station
Wireless system laboratory (WISYLAB)

Information Technology PhD Secretariat:

In this Office candidates receive information about the teaching; in particular, they are informed about deadlines to be respected, how to enter the study plans, training, etc. The Office provides information about the possibility of joining a double doctorate courses in agreement with foreign universities.
Foreign students are also supported by the specific services that offer support to cope with bureaucratic issues (visa, residence permits, documents, ...), to access Italian language courses, and housing.

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Information Technology PhD head of administration:
Fabio Conti – Tel. 02/23993431
E-mail address: fabio.conti@polimi.it

8. Internationalization and other activities

Carrying out study and research activities at external laboratories is strongly recommended. Long stays are possible (up to 18 months). Scholarships are increased by 50% for a maximum of 6 months abroad.

The stay require a formal approval by the Board of Professors. Additional funds for long travel/stays abroad may be available from various PhD fundings. Other money may come from the advisor's funds and from teaching.
Politecnico di Milano supports joint PhD paths with International Institutions, as well as Joint and Double PhD programs. Further information are available on the PhD School website and on the PhD program website.
During the PhD program, a limited teaching activity by the candidate ($\leq$ 40 hours/year) is also possible.

Attachment A1 – PhD Board of Professors

Description of the composition of the Board of Professors

Name	Affiliation	SSD / Title of SSD
Bonarini Andrea	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Alippi Cesare	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Amigoni Francesco	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Baresi Luciano	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Bascetta Luca	DEIB	ING-INF/04 - Automatica
Bertuccio Giuseppe	DEIB	ING-INF/01 - Elettronica
Bolchini Cristiana	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Bolzern Paolo	DEIB	ING-INF/04 - Automatica
Castelletti Andrea Francesco	DEIB	ING-INF/04 - Automatica
Ceri Stefano	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Cesana Matteo	DEIB	ING-INF/03 - Telecomunicazioni
Ferrigno Giancarlo	DEIB	ING-INF/06 - Bioingegneria Elettronica e Informatica
Fiorini Carlo Ettore	DEIB	ING-INF/01 - Elettronica
Garatti Simone	DEIB	ING-INF/04 - Automatica
Gentili Gian Guido	DEIB	ING-INF/02 - Campi Elettromagnetici
Geraci Angelo	DEIB	ING-INF/01 - Elettronica
Ghezzi Carlo	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Giacomazzi Paolo	DEIB	ING-INF/03 - Telecomunicazioni
Lanzi Pier Luca	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Magarini Maurizio	DEIB	ING-INF/03 - Telecomunicazioni

Name	Affiliation	SSD / Title of SSD
Malucelli Federico	DEIB	MAT/09 - Ricerca Operativa
Monti Guarnieri Andrea Virgilio	DEIB	ING-INF/03 - Telecomunicazioni
Pernici Barbara	DEIB	ING-INF/05 - Sistemi di Elaborazione delle Informazioni
Rech Ivan	DEIB	ING-INF/01 - Elettronica
Sottocornola Spinelli Alessandro	DEIB	ING-INF/01 - Elettronica

Attachment A2 – PhD Advisory Board

The PhD Advisor Board consists of people that play leadership roles in important national and international companies:

Name	Affiliation
Baldi Livio	Micron Semiconductors Italia
Bartolini Claudio	HP Labs (USA)
De Gaudenzi Riccardo	European Space Agency
Fogliazza Giuseppe	MCM S.p.A.
Marchi Renato	Gruppo PAM
Renzi Fabrizio	IBM Italia S.p.A.
Signani Stefano	Unicredit S.p.A.
Valla Massimo	Telecom
Verzura Stefano	Huawei