

# Master Degree in Computer Science and Networking

The two-year Master Degree (Laurea Magistrale) in Computer Science and Networking is a jointly Program offered by the University of Pisa – Department of Computer Science and Department of Information Engineering, and Scuola Superiore Sant’Anna- Institute of Communication, Information and Perception Technologies (TeCIP).



## Objectives

The 2-year Master Program in Computer Science and Networking has been designed to meet the growing demand for an emerging kind of professionals with high-level expertise in both

- computer and information science and technologies
  - communication networking science and technologies,
- in a strongly integrated manner.

This expertise is needed in the design and implementation of both innovative software-hardware distributed infrastructures and service-based distributed applications in several areas of industry, e-business, research, social and citizen services, public administration.

## Courses and laboratories

Algorithm Engineering, Advanced Programming, Distributed Systems Paradigms and Models, Fundamentals of Signals, Systems and Networks, High Performance Computing, Network Configuration and Management, Software Service Engineering, Teletraffic Engineering, and specialized courses and laboratories in

- software technologies for platforms, systems, models, frameworks, tools, security, and applications in distributed contexts,
- communication technologies for optical and photonic infrastructures, and for network architectures, models, protocols and services,

- applied mathematics for architectures and applications modeling.

### **Admission requirements and selection**

- Bachelor degree in Computer Science, or Computer Engineering, or Telecommunication Engineering, or equivalent qualification degrees specified in the admission call.

- Good knowledge of English language, at least corresponding to an intermediate level (B1 Level in the European Framework for foreign languages).

The number of students is limited to 42 (30 EU, 10 non- EU citizens and 2 positions for honour students).

The medium of instruction is the English language.

Selection is set by titles and colloquium/interview.

### **Candidate's Profile: requested capabilities and background**

The courses of the Master Degree Programme in Computer Science and Networking assume the existence of a solid background knowledge at the methodological and technological level, that characterizes the Bachelor Programmes in Computer Science and in Computer Engineering of the University of Pisa.

The applicants are strongly recommended to verify their background level with respect to the topics and subjects indicated below, and to follow the suggestions about recommended readings. The first-year courses in Computer Science and Networking will assume that the student knows such Bachelor-level teaching material, or equivalent teaching material. The teachers of University of Pisa and Scuola Superiore Sant'Anna can be contacted for advising the applicants and the selected students.

It is required that the students in Computer Science and Networking possess good abilities of analysis and synthesis, as well as a scientific method of studying and problem solving capabilities.

The basic concepts and principles of *continuous and discrete Mathematics and Calculus* are necessary, in particular about real and complex numbers, series, limits, derivatives, integrals, logical-deductive reasonings, propositional logics and proof techniques, set, relations, functions, induction and recurrence, factorization, probability theory, and linear algebra.

All the basic disciplines in Computer Science and Engineering belong to the required background. In particular, a solid Bachelor-level knowledge is required in

- Programming Languages and Methodologies,
- Computer Architecture,
- Algorithms,
- Communication Networks,

both from a methodological viewpoint and from a design practice viewpoint.

The needed background in *Programming* includes programming paradigms (functional, imperative, object-oriented), basic concepts in semantics, programming language practice in (at least) C and Java, static and dynamic data structures, grammars, compilers and interpreters, program designing and verification, advanced programming abstractions, abstract machines and run-time supports. This required background is contained in the following recommended readings:

- Michael L. Scott, *Programming Language Pragmatics*, Third Edition, Morgan-Kaufmann, 2009
- B. Liskov (with J. Guttag), *Program Development in Java: Abstraction, Specification and Object-Oriented Design*, Addison-Wesley, 2001

The needed background in *Computer Architecture* includes basic concepts in system level structuring and modular design principles, logic circuits and technologies, firmware machine level, assembler machine level, processes and their run-time support, operating systems functionalities, input-output, memory hierarchies and caching, instruction level parallelism. In the University of Pisa such concepts and techniques are studied according to a Structured Computer Architecture approach and stressing the issues of performance evaluation, cost model and design techniques. This required background is contained in the following recommended readings:

- Marco Vanneschi, *Structured Computer Architecture*, Lecture Notes in preparation of Computer Science and Networking, <http://www.di.unipi.it/~vannesch/>, section Teaching – High Performance Computing. These Notes have been expressly written for Computer Science and Networking students, and are based on the Italian book “Architettura degli Elaboratori”, Pisa University Press.
- Other reference books are
  - D.A. Patterson, J.L. Hennessy, *Computer Organization & Design – The Hardware/Software Interface*. Morgan Kaufmann Publishers.;
  - A. Tanenbaum, “*Structured Computer Organization*”, Prentice-Hall.

The needed background in *Algorithms* includes basic concepts in computational problems, tractability and undecidability, computational complexity, divide-et-impera, searching and ordering, dynamic programming, generation of combinations and permutations, greedy computations, trees, dictionaries, tables, randomized data and algorithms, data structures and algorithms for graphs. This required background is contained in the MIT lectures available at:

- <http://didawiki.cli.di.unipi.it/doku.php/magistraleinformaticanetworking/ae/ae2012/start>.

and in the book:

- T. Cormen, C. Leiserson, R. Rivest, C. Stein. *Introduction to Algorithms*. MIT Press, third edition, 2009, chapters 2, 3, 4, 6, 7, 8, 10, 11 (no perfect hash), 12 (no randomly built), 15 (no optimal BST), 18, 22 (no strongly connected components).

The needed background in *Communication Networks* includes basic concepts and techniques in technologies for packet switching networks, protocol layers with specific examples of existing products and frameworks, application layer, transport layer, network layer, link layer, wireless LAN, introduction to security issues. This required background is contained in

- A. Leon-Garcia, I. Widjaja, *Communication Networks*, Mc Graw Hill, chapters 1, 2, 3
- J.F. Kurose & K.W. Ross. *Computer Network and Internet*. Pearson, chapter 1
- A. Tanenbaum, *Computer Networks*, Prentice Hall, chapter 1, 2

In addition it is encouraged to get familiar with some elements in physics of electromagnetism (electricity phenomena and basics of geometric optics), that can be found in any physics textbook.

## Supports for students

*Welcome Package for non-EU students*

The University of Pisa may decide to offer to non-EU students a temporary welcome accommodation consisting in a three-month free lodging (in a shared room), and an Italian Language Course for foreigners. The course lasts 40 hours and it will be given at the "Centro Linguistico" (CLI) of the University of Pisa.

Further information at

<http://www.unipi.it/index.php/students/item/2274-extraordinary-contributions>

*Scholarship for non-EU student - Department of Computer Science and Department of Information Engineering, University of Pisa*

Further information on the call for admission <http://mcsn.sssup.it/admission/call/> .

#### *DSU contributions*

Students may apply for the contributions provided by the the “Azienda della Regione Toscana per il Diritto allo Studio Universitario” (DSU - Student’s Support Office). The annual call for contributions is published in the month of July at <http://www.dsu.toscana.it> (see a summary in English language of the previous call for application at: [http://www.dsu.toscana.it/export/sites/default/it/documenti/doc/interventimonetari/bandi/ARD\\_SU\\_1\\_ING\\_RAT\\_bando\\_borsa\\_alloggio\\_14-15\\_-testo\\_definitivo.pdf](http://www.dsu.toscana.it/export/sites/default/it/documenti/doc/interventimonetari/bandi/ARD_SU_1_ING_RAT_bando_borsa_alloggio_14-15_-testo_definitivo.pdf)).

DSU aids consist in scholarships (up to 1,600.00 Euros per year), lodging grants, free meals at the University canteen, tuition waivers.

#### *Merit awards - TeCIP Institute, Scuola Superiore Sant'Anna*

Further information on the call for admission <http://mcsn.sssup.it/admission/call/> .

#### **Industrial contacts**

Several collaborations are established with prestigious national and international enterprises, in order to favour the professional training, to offer economical supports to students, and to provide job opportunities during and after the Program.

We mention the stage and employment programmes at Telecom and Amazon labs, internships at Google and Yahoo, as well as other on-going initiatives.

#### **Further information**

Official website: <http://www.di.unipi.it/it/didattica/wtw-lm>

Application website: <http://mcsn.sssup.it/howtoapply.htm>

#### **Contacts**

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