



High Level Education in High Performance Computing: MHPC.

Application Call 2019 - 2020

SISSA and ICTP, in collaboration with CNR/IOM promote a 12 months education program in High Performance computing.

The program spans the academic year 2019-2020, starting from **September 9, 2019**.

Short description

The Master in High Performance Computing (MHPC) hosted and organized by SISSA (International School for Advanced Studies) and ICTP (Abdus Salam International center for theoretical physics), in collaboration with CNR/IOM (Istituto Officina dei Materiali of the Italian National Research Council), is an innovative degree program devoted to training students in the booming field of HPC. SISSA, ICTP and CNR/IOM are well known first rank institutions in applied and theoretical mathematics and physics.

MHPC is an innovative educational program, that trains scientists and professionals to modern computational technologies. MHPC trains students in taking the right decision with the right tools for each computational problem. Students that complete the Master have a solid background in scientific computing approaches, algorithms, and modeling.

The program combines lectures with hands-on tutorials. Tutorial sessions are strongly application-oriented, and a final thesis defense completes the program.

Courses

Courses are organized in full day programs which include active lectures during the morning and practice hands-on tutorials during the afternoon. They are held by internationally renowned scientists. Tutorial sessions are strongly application-oriented and will be used to assess the learning process.

PART I, HPC Concepts and Programming: ~5 months

Advanced and parallel programming, software design and management, numerical analysis, data management, computer hardware and administration.

- **1.1 Scientific programming environment**
- **1.2 Introduction to Computer Architectures for HPC**
- **1.3 Introduction to Parallel Programming**
- **1.4 Advanced Programming**
- **1.5 Introduction to Numerical Analysis**
- **1.6 High Performance Computing Technology**
- **1.7 Scientific data management**
- **1.8 Advanced Linear Algebra Libraries and Accelerators**
- **1.9 Best Practices in Scientific Computing**

PART II, HPC Algorithms for Science and Technology: ~1 months

The second part of the master is devoted to implement HPC strategies in non standard scientific and industrial applications. This part is composed by one mandatory course and other optional courses for at least 16 CFU (for a total duration of at least one month of courses. 4 CFU correspond approximately to a one week course). Optional courses will be activated only if a sufficient number of students will be attending. The second part is spread from February to June included. As an example of the course list of the second part, we report some of the courses of the previous editions:

- **Data Structures & Sorting and Searching (mandatory)**
- **Electronic structure: from blackboard to source code (2 CFU)**
- **Advanced Computer Architectures & Optimizations (4 CFU)**
- **The Finite Element Method Using deal.II (4 CFU)**
- **Reduced Basis Methods (4 CFU)**
- **Fast Fourier Transforms in Parallel and Multiple Dimensions (2 CFU)**
- **Cluster Analysis (2 CFU)**
- **Monte Carlo methods (4 CFU)**
- **Supervised Machine Learning (2 CFU)**
- **Unsupervised Machine Learning (2 CFU)**
- **Supervised Machine Learning applied to text analytics (2 CFU)**
- **Reinforced Learning (2 CFU)**
- **Deep Learning (2 CFU)**
- **Approximation and interpolation of simple and complex functions (2 CFU)**
- **Spatial locality algorithms (2 CFU)**
- **Big Data Processing with MapReduce (4 CFU)**
- **Lattice Boltzmann (2 CFU)**
- **Molecular dynamics (2 CFU)**

PART III, HPC Thesis development: 6 months

During the last period of the master, students will develop a technically and scientifically challenging project in collaboration with an on-going research team and/or an industrial partner. In their projects, students apply the skills developed in the previous sections of the program. Project proposals must be submitted to and accepted by a committee and must be overseen by a qualified adviser. The project should not last more than nine months and should then be reported in a written thesis. The thesis development may overlap with the second part of the courses. During the thesis project, students may be supported by fellowships from sponsoring institutions or industrial partners. A thesis defense completes the program.

Fees

The MHPC fee is € 7.000,00. Non-EU applicants who require a VISA may need to provide proof of financial coverage for the master fee and for the living expenses during the entire duration of the master course. **MHPC does not provide any financial coverage.** Any agreement with external financial institutions or sponsoring company must be undertaken by the candidates themselves before the deadline of the MHPC applications (see www.mhpc.it for available scholarships or sponsorships).

External support for students from developing countries

ICTP offers every year a variable number of scholarships for applicants from developing countries, covering the MHPC fees as well as the cost of living expenses. The deadline for the applications for these scholarships is typically at the end of march (much earlier than the deadline for the application to MHPC itself), due to time restrictions in the VISA request procedures. Please consult the website www.mhpc.it for the exact deadlines for these scholarships. The scholarships are provided by ICTP (not by MHPC), and *winners are automatically admitted to MHPC.*

External scholarships

Other research institutes (including SISSA, OGS, CNR/IOM, and others) as well as private companies and industries may offer scholarships to cover the fee of the master and/or partial/full living expenses. All these scholarships will be advertised on the website www.mhpc.it, and will have their own deadlines and conditions. These are independent with respect to the MHPC application and deadline, and application/admission to these scholarships **will not** imply application/admission to MHPC, which must be actuated separately. The only exception to this rule is given by winners of ICTP scholarships for developing countries, who are granted admission to MHPC.

Prerequisites

MHPC is accessible by Italian students graduated with “laurea magistrale (D.M. 270/2004)” and “laurea Vecchio Ordinamento (L. 341/1990)”. International applicants with a Bachelor, Master, or Doctoral degree are welcome to apply.

Application Procedure

The application procedure is available online at www.mhpc.it. The deadline for the applications is set to **July 5th, 2019 at 11:59 am**.

Evaluation Procedure

The online applications will be evaluated mostly on the applicant curriculum. A short phone or online interview may be required. Admitted applicants from non-EU countries must be able to complete any required VISA procedures before the start of the courses **(September 9th, 2019)**.

MASTER IN HIGH PERFORMANCE COMPUTING

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Italian privacy disclaimer:

Ai fini del D.Lgs. 196/2003, si informa che la Scuola Internazionale Superiore di Studi Avanzati si impegna a rispettare il carattere riservato delle informazioni fornite dai candidati: tutti i dati notificati saranno trattati solo per le finalità connesse e strumentali all'ammissione, nel rispetto delle disposizioni vigenti.

Trieste, February 2019

MHPC Director
Luca Heltai