COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Computing Technologies*

General information	
Year of the course	1st
Academic calendar (starting and ending date)	2nd semester: March - May 2024
Credits (CFU/ECTS):	6
SSD	FIS/01
Language	English
Mode of attendance	Recommended, not compulsory

Professor/ Lecturer	
Name and Surname	Giacinto Donvito
E-mail	donvito@infn.it
Telephone	3935403592
Department and address	Dipartimento di Fisica / Palazzina ReCaS
Virtual room	https://infn-it.zoom.us/j/3329168917
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Lunedì mattina

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
150	40	15	95
CFU/ECTS			
6	5	1	

Learning Objectives	Basic elements of computing theory and scientific computing, principles of Grid computing, computing for the LHC experiments and other applications of the Grid, Cloud computing, Big Data processing/handling.
Course prerequisites	Basics of the computing theory, including concepts connected to the common usage of the computing machines.

Teaching strategies	Frontal and interactive lessons. Laboratory session with the aim of using the main computing topics on a real scientific problem.
Expected learning outcomes in terms of	
Knowledge and understanding on:	o Understand the scientific method, the nature, and the methods of research in Physics o Knowledge of advanced computational techniques o Knowledge of advanced computer tools commonly used in basic and applied research o Knowledge of high-performance computing o Knowledge of the basic aspects of the scientific computing, in particular those connected to some specific applications in physics and the most widely used models (Grid and Cloud computing, Big Data handling)

Applying knowledge and understanding on:	o Ability to use analogy to apply known solutions to new problems (problem solving) o Ability to use analytical and numerical mathematical computation tools o Ability to use electronic and computer technologies and their application to experimental data acquisition o Ability to perform raw estimates of the computing power needs for some specific applications in the scientific computing o Ability to use the right computing and storage technology to solve a scientific problem
Soft skills	● **Making informed judgments and choices** o Ability to work with increasing levels of autonomy, including taking responsibility in project planning and managing facilities o Ability to perform evaluations and rating of different solutions and models with respect to their capability to solve specific problems of scientific computing in physics o During the Laboratory works the students has to find the best technology to implement and fulfil the scientific requirement of the use-case ● **Communicating knowledge and understanding** o Competence in communication in Italian and English in advanced fields of Physics o Specific ability in the presentation and dissemination of knowledge with appropriate scientific language o General ability to work in a group, and to be inserted quickly and effectively in the workplace o Communication skills based on the specific terminology used in the field of scientific computing, ● **Capacities to continue learning** o Acquisition of basic knowledge tools for continuous learning and knowledge updates o Self-documentation on the topics necessary for implementation during the laboratory phase
Syllabus	
Content knowledge	1. The computer (memory, Von Neumann model, Flynn taxonomy, etc) 2. Principles of distributed computing and application fields 3. Cluster Beowulf and examples of real batch systems (HTCondor) 4. Difference between HTC e HPC 5. Concepts of security and cryptography 6. Principles of Grid computing (middleware, WLCG infrastructure, etc) 7. Examples of computing models in bioinformatics communities 8. Principles of Cloud Computing (virtualization, IaaS, PaaS, SaaS paradigms, cloud storage, etc) 9. Framework for distributed computing for Big Data (Apache Spark, Apache Hadoop, MapReduce) 10. Multidisciplinary data centers for scientific computing: the ReCaS Bari case
Texts and readings	Papers and specific material provided by the lecturer
Notes, additional materials	Bibliography to further explore the subjects treated in the lectures
Repository	Teams and sharepoint

Assessment	
Assessment methods	Oral exam consisting in a discussion about the contents treated during the course.
Assessment criteria	o Knowledge of the basic concepts and principles of scientific calculation, with particular reference to applications in physics. o Knowledge of the fundamental and peculiar characteristics of distributed and parallel computing (HTC and HPC), Grid calculation, Cloud paradigm, Big Data processing and handling.

	o Knowledge and capability to evaluate the specificity of some intensive computational applications in the scientific field in order to justify in detail the choice of the calculation paradigm that must be used in the given context and the reasons that lead to the exclusion of different solutions
Final exam and grading criteria	Oral exam (100%)
Further information	
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