

Advanced computing technologies (Grid, Cloud, HPC). Practical usage of EMI, OpenNebula middleware and key parallel programming technologies.

Laboratory of Information Technologies (LIT)

Introduction

Nowadays it's impossible to imagine a scientific research without computer assistance. In many fields scientists have a need to simulate complex processes as well as to store, manage, process and analyze huge amount of data. Grid, Cloud and HPC technologies let solve such tasks.

JINR actively participates in different international projects which are relied on advanced computing technologies. JINR has Tier-1 and Tier-2 grid sites what are parts of Worldwide LHC computing grid (<http://wlcg.web.cern.ch>) infrastructure. Along with these production grid sites there is a training grid infrastructure aimed for learning, development and research activities. It is deployed on facilities of JINR cloud service (<http://cloud.jinr.ru>) which is also used for a wide range of tasks including trainings in cloud technologies. "HybriLIT" heterogeneous cluster is a computation component of a multifunctional center for data storage, processing and analysis of the LIT JINR (<http://hybrilit.jinr.ru>). It is intended for performing computations with the use of parallel programming technologies. Heterogeneous structure of computational nodes allows developing parallel applications for the solution of a wide range of mathematical resource-intensive tasks using the whole capacity of multicore component and computation accelerators.

Project aims

1. Basic grid and cloud concepts, use cases and benefits of both technologies for science.
2. Theoretical knowledge on grid and cloud infrastructures, middlewares' architectures and services (mostly focusing on EMI and OpenNebula).
3. Practical skills to start unassisted work with EMI and OpenNebula, ones of the most widespread grid and cloud middlewares in the world:
 - security infrastructure (requesting a digital certificate, making a temporary proxy certificate, different manipulations with digital certificates);
 - job management (job preparation, requirements description, running it in the Grid, controlling, obtaining results);
 - data management (copying data to and from grid, other common operations);
 - operations with metadata catalogs (making file's replicas (exact copies), registration data in special file catalogs, assigning additional access rights and metadata descriptions);
 - basic skills on clouds (creating virtual machine image, making VM templates, VM creation and deployment, accessing VM, cloud testbed deployment).
4. The development of effective applications for carrying out computations on heterogeneous computation systems consisting of multi-core CPU, GPU and Intel Xeon Phi coprocessors is discussed.
 - OpenMP, MPI, CUDA, OpenCL parallel programming technologies;
 - Hybrid OpenMP and CUDA parallel programming on multiple GPU computation systems;
 - OpenMP Programming on Intel Xeon Phi coprocessors;
 - Comparative analysis of the efficiency of the GPU, multi-core CPU, and Intel Xeon Phi coprocessor approaches
 - Work with GitLab - version control system for mutual development of applications.

Practical trainings are held on Multifunctional Information and Computing Complex JINR.

Entry requirements

Good knowledge in Linux user-level skills (including command line operations) as well as administration and programming (including text editors and shell scripting) are expected from applicants.