

RESEARCH AT IT4INNOVATIONS

Our supercomputers support
European science, industry, and society



IT4Innovations National Supercomputing Center at VSB – Technical University of Ostrava is a leading research, development, and innovation centre active in the fields of High-Performance Computing (HPC), Data Analysis (HPDA), and Artificial Intelligence (AI) and their application to other scientific fields, industry, and society. IT4Innovations operates the most powerful supercomputing systems in the Czech Republic, which are provided to Czech and foreign research teams from both academia and industry. Together with the CESNET and CERIT-SC institutions, IT4Innovations constitutes e-INFRA CZ, a strategic research infrastructure of the Czech Republic.

IT4Innovations currently operates three supercomputers — Barбора, NVIDIA DGX-2, a specialized system for AI calculations, and a petascale system called Karolina with a theoretical peak performance of about 15.7 PFlop/s.

The key research areas of IT4Innovations include big data processing and analysis, machine learning, development of parallel scalable algorithms, solution of computationally demanding engineering problems, advanced visualization, virtual reality, modelling for nanotechnologies, and material design.

RESEARCH LABS



1. The Advanced Data Analysis and Simulations Lab specializes in advanced data analysis, research and development in the field of HPC co-design, data and cloud technologies to enhance industry and society, programming models for HPDA, artificial intelligence, modelling, simulation, and application of dynamical systems.

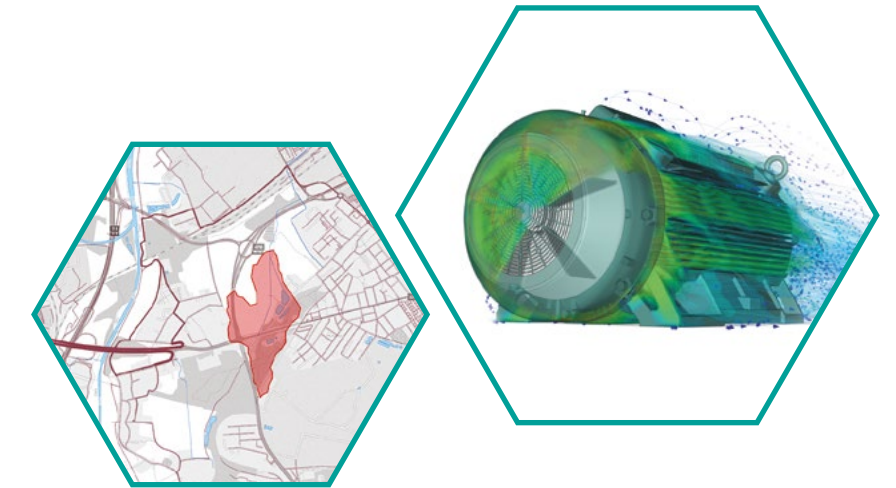
2. The Infrastructure Research Lab specialises in acceleration of parallel applications, code analysis, performance and scalability optimisation as well as application energy-efficiency optimisation, development of services provided to infrastructure users, image processing, scientific data visualisation, and virtual reality.

3. The Parallel Algorithms Research Lab focuses on high-quality basic and applied research in the field of development of scalable algorithms and HPC libraries, numerical modelling, engineering simulations, and high-performance molecular simulations.

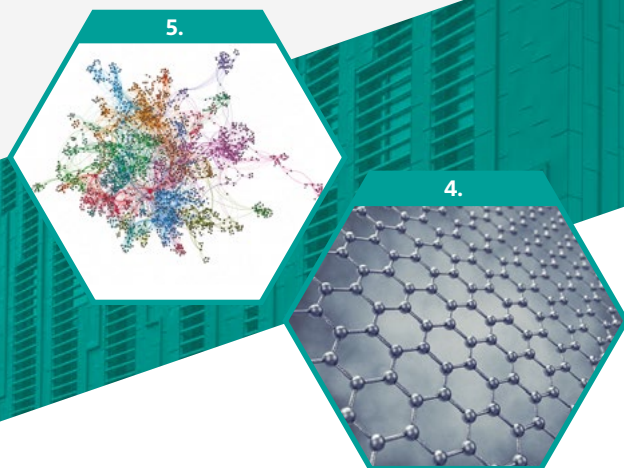
4. The Big Data Analysis Lab focuses on network security, the Internet of Things, big data analytics, speech processing, and applications of artificial intelligence in complex systems.

5. The Modelling for Nanotechnologies Lab focuses on optical diagnostics, material design, development of special surfaces for nano-optics, and modelling and design of nanocomposites.

SUPERCOMPUTERS



	Karolina	Barбора	NVIDIA DGX-2
Put into operation	Summer 2021	Autumn 2019	Spring 2019
Theoretical peak performance	15 690 TFlop/s	849 TFlop/s	130 TFlop/s / 2 PFlop/s in AI FP16
Compute nodes	831	201	1
CPU	1 692 cores in total	2x Intel Cascade Lake, 18 cores, 2.6 GHz, 7 235 cores in total	2x Intel Xeon Platinum, 24 cores 48 cores in total
GPU accelerators	576x NVIDIA A100	32x NVIDIA Tesla V100	16x NVIDIA Tesla V100 32GB HBM2



DIGITAL INNOVATION HUB OSTRAVA

- Registered at the European Commission level
- Member of DIHnet EU, the European network of digital innovation hubs

CERTIFICATION

- ISO 9001 Quality Management System
- ISO 27001 Information Security Management System

EDUCATION AND TRAINING ACTIVITIES

- PRACE Training Center
- Doctoral School for Education in Mathematical Methods and Tools in HPC
- Operation of an HPC oriented doctoral study program “Computational Sciences”
- Innovative Training Network project EXPERTISE for PhD students within Horizon 2020
- NVIDIA Deep Learning Institute

THE IT4INNOVATIONS FLAGSHIPS

The IT4I flagships are key research activities that represent IT4I's scientific excellence from the medium to long term perspective:

- ESPRESO, a highly parallel solver library for engineering applications
- Materials design – closer to reality using exascale computing
- HPC platforms for scientific workflow execution

IT4INNOVATIONS IS A PROUD MEMBER OF:

- BDVA (Big Data Value Association)
- EUDAT (EU Collaborative Data Infrastructure)
- EuroHPC Joint Undertaking
- ETP4HPC (European Technology Platform in the area of High-Performance Computing)
- PRACE (Partnership for Research and Advanced Computing in Europe)
- EOSC (European Open Science Cloud)

IT4I
is a proud
member of



SELECTED PROJECTS

ACROSS (HPC big dAta artifiCial intelligence cross stack platfoRm tOwardS exaScale, www.acrossproject.eu

The ACROSS project will co-design and develop an HPC, BD, and Artificial Intelligence (AI) convergent platform, supporting applications in the Aeronautics, Climate and Weather, and Energy domains. To this end, ACROSS will leverage on next generation of pre-exascale infrastructures, still being ready for exascale systems, and on effective mechanisms to easily describe and manage complex workflows in mentioned three domains. ACROSS will combine traditional HPC techniques with AI (specifically machine learning/deep learning) and BD analytic techniques to enhance the application test case outcomes.

DICE (Data Infrastructure Capacity for EOSC), www.dice-eosc.eu

The DICE consortium brings together a network of computing and data centres, research infrastructures, and data repositories for the purpose to enable a European storage and data management infrastructure for EOSC, providing generic services and building blocks to store, find, access and process data in a consistent and persistent way.

EuroCC, www.eurocc-project.eu

The EuroCC project will bring together the expertise to create a European network of national competence centers for HPC in 31 European states to provide a service portfolio for industry, academia, and public administrations. It aims to increase the competences and capabilities of High Performance Computing, High Performance Data Analytics and Artificial Intelligence and to close existing gaps to increase usability of these technologies in the different states.

EVEREST, www.everest-h2020.eu

The project is developing a holistic approach for co-designing computation and communication in the high-tech and especially secure system for HPDA. This will be achieved by simplifying the programmability of heterogeneous and distributed architectures through a “data-driven” design approach, the use of hardware-accelerated AI, and through an efficient monitoring of the execution with a unified hardware-software paradigm.

IO-SEA (IO Software for Exascale Architecture), www.iosea-project.eu

IO-SEA aims to provide a novel data management and storage platform for exascale computing based on hierarchical storage management (HSM) and on-demand provisioning of storage services. The platform will efficiently make use of storage tiers spanning NVMe and NVRAM at the top all the way down to tape-based technologies. Advanced IO instrumentation and monitoring features will

be developed in the IO-SEA project leveraging the latest advancements in AI and machine learning to systematically analyze the telemetry records to make smart decisions on data placement.

LEXIS (Large-scale EXecution for Industry & Society), www.lexis-project.eu

The target of the project is to build an advanced engineering platform leveraging modern technologies from High Performance Computing, Big Data and Cloud Computing. The benefits of the LEXIS project will be demonstrated in the context of three industrial large-scale pilots; aeronautics, weather and climate, and earthquake and tsunami.

LIGATE (Ligand Generator and portable drug discovery platform AT Exascale), www.ligateproject.eu

The project aims to integrate and co-design best in class European open-source components together with proprietary IPs to keep worldwide leadership on Computer-Aided Drug Design (CADD) solutions exploiting today high-end supercomputer and tomorrow Exascale resources, fostering the European competitiveness in this field.

POP2 (Performance Optimisation and Productivity 2), www.pop-coe.eu

The project is primarily focused on providing assistance with analysis of parallel applications, identification of bugs in codes, and recommendation of optimisation methods, leading to higher performance and better scalability for a given application.

PRACE (Partnership for Advanced Computing in Europe), www.prace-ri.eu

PRACE is a Research Infrastructure that supports different HPC activities and allows researchers from across Europe to apply for time on high-performance computers from a series of hosting nations via a central peer review process.

SCALABLE (SCAlable LAttice Boltzmann Leaps to Exascale), www.scalable-hpc.eu

In the project eminent industrials and academic partners team up to improve the performance, scalability, and energy efficiency of an industrial Lattice Boltzmann methods-based computational fluid dynamics (CFD) software. Lattice Boltzmann methods (LBM) have already evolved to become trustworthy alternatives to conventional CFD. LBM is especially well suited to exploit advanced supercomputer architectures through vectorization, accelerators, and massive parallelization. The project will directly benefit the European industry, while contributing to fundamental research.