SCtrain training week:
HPC in Engineering focus on FEM

Pavel Tomšič, University of Ljubljana, Slovenia

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- Why Sctrain?
  - Raising competences for the Science, Technology, Engineering, Mathematics (STEM) field .
  - HPC courses inclusion in Engineering and Data Science in HE.
  - Fostering the importance of HPC tools in modern society as a scientific, professional and development tool.
  - Providing more adaptive teaching and training.
  - Knowledge transfer for the HPC competences by HE educators.
  - Raising HPC usage and its inclusion to future business professionals.
  - Competence gap in HPC related knowledge towards USA, China and Japan.

- Outputs:
  - HPC in Engineering – FEM / June 2021
  - HPC in Data Science - Parallelization with MPI / February 2022
  - HPC in Engineering – CFD / October 2022
  - HPC in Data Science - IOT and Big Data / July 2023

More info at: http://sctrain.eu/

- Introducing project partners

  - UNIVERSITY OF LJUBLJANA (Slovenia)

    LECAD laboratory, as a part of Faculty for Mechanical Engineering at UL has access to a small Faculty Cluster (http://hpc.fs.uni-lj.si/) and is included in SLING - The Slovenian national supercomputing network aimed at offering HPC for researchers in universities, research institutions and industrial development. Through their work they are involved in several projects where HPC is an inevitable tool or where the main goal is the outreach of HPC related activities.

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  - TECHNISCHE UNIVERSITAET WIEN (Austria)

    The **Vienna Scientific Cluster (VSC)** is a consortium of several Austrian universities that have combined their resources to operate high-performance computing (HPC) cluster systems. The VSC Steering Committee appointed TU.it Solutions together with the VSC Research Center to operate the VSC systems. They provide resources such as compute time and file space on the HPC cluster systems of the VSC, help users in optimizing the workflows on the clusters, and provide training courses in HPC.

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- Introducing project partners

  - CINECA CONSORZIO INTERUNIVERSITARIO (Italy)

    CINECA is the largest Italian computing centre, one of the most important worldwide. With more than seven hundred employees, it operates in the technological transfer sector through high performance scientific computing, the management and development of networks and web based services, and the development of complex information systems for treating large amounts of data. Cineca is currently one of the Large Scale Facilities in Europe and it is a PRACE Tier-0 hosting site.

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  - VYSOKA SKOLA BANSKA - TECHNICKA UNIVERZITA OSTRAVA (Czech republic)

    IT4Innovations National Supercomputing Center at VSB – Technical University of Ostrava is a leading research, development, and innovation center active in the field of high-performance computing (HPC) and data analysis (HPDA). 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.

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VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

- Workshop:
  - Raising the level of knowledge and competences on the topic of HPC in Engineering, with a focus on FEM (Finite Element Method).
  - Introducing applications using HPC that enable addressing problems with higher complexity, and more detailed analysis of problems.
  - Introducing different approaches for solving complex problems.
  - Explaining the theoretical background for problem solving.
  - Introducing Commercial and Open Source Software.

- Expectations from the workshop
  - Be familiar with the workflow of using HPC.
  - Understand the theoretical background behind FEM analyses.
  - Understand the discretization of a problem in order to transfer from real-life case to a numerical one.
  - Understand the parallelization principles at using HPC to solve problems.
  - Be familiar with several different approaches for conducting numerical analyses.
  - Have an oversight of several different software packages for numerical analyses.

- Workshop presentation: Day 1
    - Introduction to HPCs
    - Introduction to FEM background
    - Access and usage of HPCFS cluster
    - Introduction to ANSYS workbench
    - FEM meshing explained
    - FEM theory for different kinds of engineering problems
    - FEM solver types

- Workshop presentation: Day 2
  - HPC parallelization methods with emphasis on MPI
  - Explaining linear and nonlinear problems with examples
  - Geometrical and material nonlinearities
  - FEM solvers for nonlinear problems explained
  - Contact nonlinearities and scalability

- Workshop presentation: Day 3
  - Employment of GPU on a HPC
  - GPU processing of FEM problems
  - Overview of Open source FEM software
  - Introduction to ELMER GUI
  - Simple cases in ELMER
  - Advanced nonlinear and thermo-mechanical analysis using ELMER

- Workshop presentation: Day 4
  - Explaining the Finite Volume Method
  - Introduction to OpenFOAM with examples
  - FVM for fluid-solid interaction
  - Analyses capabilities in Ansys workbench
  - Static, dynamic and modal analyses
  - Multiphysics FEM cases
  - FEM for fluid-solid interaction

- Workshop presentation: Day 5
  - Presentation of more demanding cases
  - Presentation of EuroHPC, PRACE and EuroCC projects
  - How to access HPC clusters at partners institutions
  - Discussion of presented training week

- Zoom
  - All lectures and hand-on sessions will take place via Zoom
  - During the breaks there will be breakout rooms in order to get familiar with participants and to have an opportunity to ask the lecturer additional questions
  - All sessions will be recorded but only lectures will be saved for further dissemination
  - No participant questions or open debates will be displayed after the video editing
  - Zoom link:

https://zoom.us/j/93539178169?pwd=Q1lOLzRsWFFHQjB0dE5zeHB1TTg0UT09

Meeting ID: 935 3917 8169
Passcode: 372591

- Web page   http://sctrain.eu/

- E-classroom Moodle

SCtrain | SUPERCOMPUTING KNOWLEDGE PARTNERSHIP

Co-funded by the Erasmus+ Programme of the European Union

Complementing the gaps in current HE courses and taking up high performance computing (HPC) knowledge for future science, technology, engineering and mathematics (STEM) professionals.

We aim to establish international cooperation and exchange of knowledge between acknowledged professionals in the field of High-performance computing (HPC). Usage of HPC, presenting nowadays the prospective field of business professionals, is one of the main accelerators of modern science and has certainly the ability to expand future-driven EU potential. A great deal of the most popular software tools that res... the tremendous possibilities of HPC. Therefore, researchers must often start h...
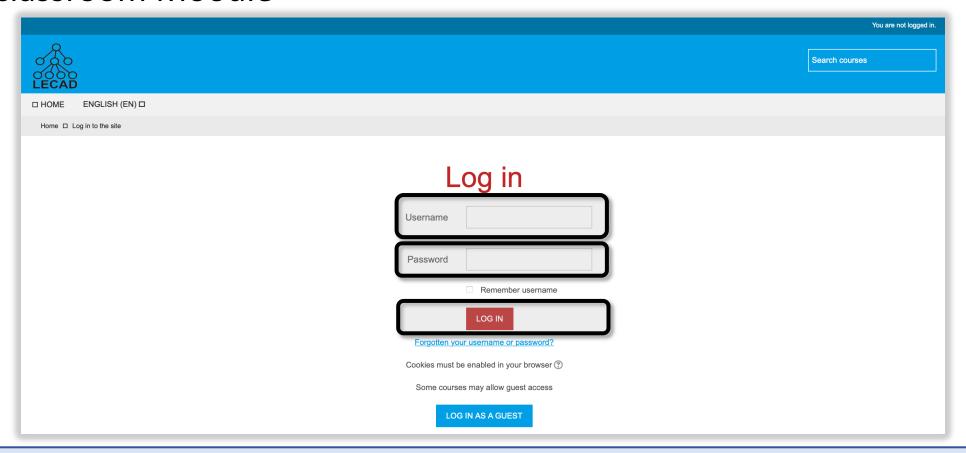
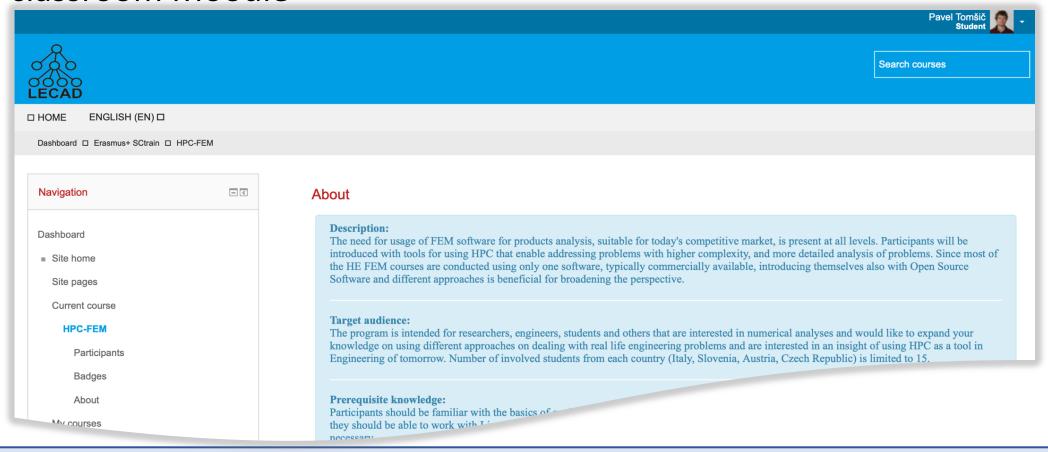**HPC in Engineering focus on FEM (Finite Element Method)**

The course focuses on using HPCs for solving complex PDE-based engineering problems, using the Finite Element and Finite Volume Methods. An introduction to HPC usage will be presented, as well as the employment of different software, such as Ansys, Elmer FEM, and OpenFOAM. Background on problem parallelization and benefits of using GPUs will be explained. The course will take place between June 28 and July 2 2021 and is free of charge.
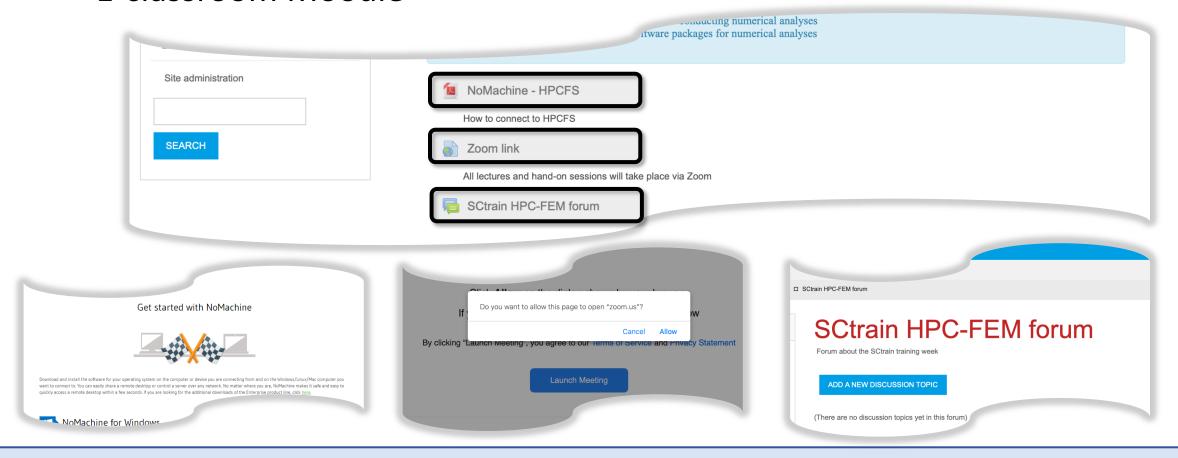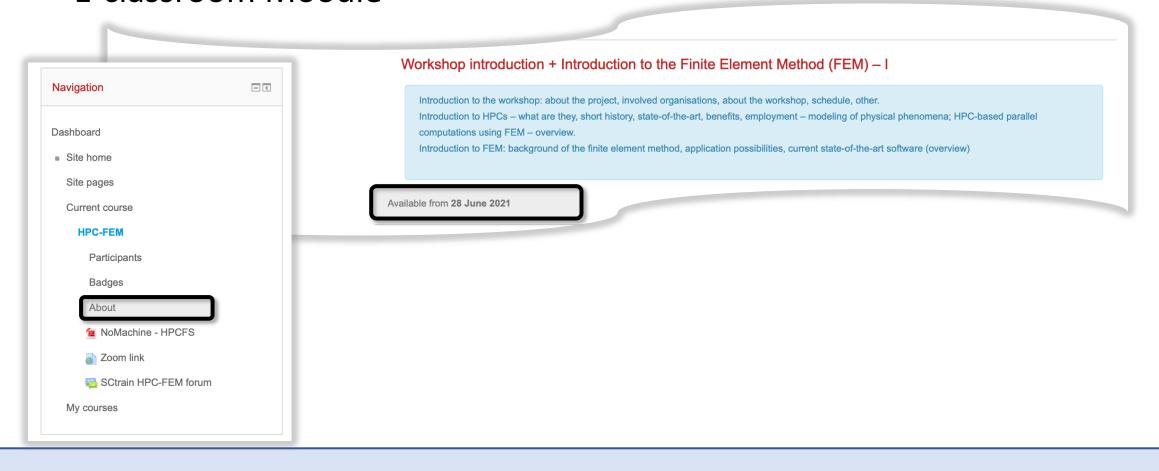
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- Outreach

Friends & Family
Students like you
General Public

HPC Community
Academia
Policy Makers

Inform
Engage
Inspire

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Thank you for your attention!

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