



HPC for SMEs - Training Programme

Generic version

Developed by SME HPC consortium within Erasmus+ strategic project

smehpc.eu

Short description: generic version of training programme was developed with the aim of enhancing innovativeness in less developed regions by co-designing the High-Performance Computing Training Programme.



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Enabling SMEs to gain competitive advantage from the use of HPC (SME/HPC)

HPC for SMEs – Training Programme

Programme description: The aim of the HPC for SME Programme is to inform SMEs on the possibilities of using HPC technologies, their benefits & expected business impacts and to inform them about its technical aspects such as HPC infrastructure and programming.

The region-specific training outline will address also existing gaps in relation to HPC expertise and utilisation in pilot regions of Slovenia, Romania and Ireland.

Audience – SME managing staff: Managers and technical managers

Objectives

- To show and train SME staff about HPC advantages and usability

Learning outcomes - at the end of this programme the participant will:

- understand the purpose and use of HPC (introduction to need of HPC, good practice of HPC...)
- be able to understand HPC usage opportunities for SMEs
- be able to identify SMEs' opportunities for HPC usage
- be able to create service agreement between SMEs and HPC providers, and to adapt it to specific end-user needs if necessary
- get hands on experience by remote work on HPC infrastructures, get examples of problem solving...advanced exercises will provide more complex solutions to practical problems of HPC usage (parallel programming, OpenMP, MPI, use of some programming frames...)

List of topics

- Understanding High Performance Computing (HPC)
- Understanding HPC usage and identify opportunities for SMEs working with HPC
- SME/HPC provider relationship management.
- Exercises and solutions to practical problems by using HPC
- Advanced exercises and solutions to practical problems by using HPC

Prerequisites: none

Programme Duration – 2x7-hour blocks

Programme leader: self-study with optional mentoring & supervision of experts from the national HPC centre

Delivery method: online, face-2-face

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1	<p>Understanding High Performance Computing (HPC)</p> <p>Description – this topic focuses on the understanding of HPC & HPC process by examining the evolution of HPC, the motivation on why to use HPC, and the HPC Infrastructure with available software tools as well as covering basic understanding/usage of the system (logging in, transmitting files, submitting jobs, loading programmes, etc.).</p> <p>Objective</p> <ul style="list-style-type: none"> - To train SME staff to understand what HPC is (who operates it, what, why, how) <p>Learning outcomes – at the end of this topic participants will:</p> <ul style="list-style-type: none"> - understand the use and benefits of HPC for SMEs - understand how to use HPC and will be familiar with the Linux Command Line Interface - be competent to promote available HPC systems and services - be able to identify and access additional relevant HPC re/sources <p>Resources: PC with projector, theatre room, personal laptops/computer lab, access to HPC</p> <p>Course material (essential reading, video clips,...)</p>	<p>Duration: 3 hour block</p> <p>Learning Method: Lecture, group exercises</p>
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Outcome: HPC Training for enterprises

Understanding High Performance Computing (HPC)	
Topic 1	Introduction to High Performance Computing (HPC)
	What is High Performance Computing?
	How is HPC different from regular desktop computing?
	Why is HPC important?
	History of High-Performance Computing
	Some Application Areas for HPC
	European Exascale Projects
	Basic Linux commands



2	<p>Understand HPC usage and identify opportunities for SMEs working with HPC</p>	<p>Duration: 2x 1-hour block Learning Method: Lecture, group exercises</p>
<p>Description – with this topic all participants will learn about HPC usage opportunities. The goal is for SMEs staff to learn how to identify HPC opportunities for SMEs and why HPC is good for them. They will see some examples of SMEs success stories, for a better understanding of good-practice of HPC usage.</p> <p>Objective</p> <ul style="list-style-type: none"> - To provide SME staff knowledge to identify HPC opportunities and usability <p>Learning outcomes – at the end of this topic participants will:</p> <ul style="list-style-type: none"> - gain the understanding of HPC usability for SMEs - see some of the good practices of HPC usage - gain the knowledge to identify opportunities for SMEs <p>Resources: PC with projector, theatre room, personal laptops/computer lab</p> <p>Course material (essential reading, video clips,...)</p>		

Understand HPC usage and identify opportunities for SMEs working with HPC	
Topic 1	Aspects and benefits of using HPC technology
	Economic reasons
	Innovative reasons
	Marketing reasons
	Competitive advantage reasons
Topic 2	Use cases
	Biomedicine
	Manufacturing and Materials
	Virtual Prototyping
Topic 3	Success stories
	Cloud-based optimisation of water turbines for power generation
	HPC Cloud-based simulation of flange tightening
	Cloud-based HPC optimisation of manufacturing processes
	Cloud-based optimisation of a multi-body wave energy device

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	Cloud-based multiphysics simulation for MEMS micro speaker design and development	
	Optimisation of steel structure manufacturing	
	Improving fire safety of buildings by simulation in the cloud	
Topic 4	Roadmap for improving SME uptake of HPC	
	Introduction	
	Are SMEs ready to use HPC services?	
	Are HPC Centres ready for SMEs?	

3	SME/HPC provider relationship management	Duration: 2-hour block Learning Method: Lecture, group exercises
	<p>Description – this topic focuses on understanding the legal and operative engagement process between SMEs and HPC providers, including service quality, legal documentation (service level agreements, contracts, NDA, etc.) and additional value add services (knowledge of further educational environment, etc.).</p> <p>Objective</p> <ul style="list-style-type: none"> - To train SME staff to understand the operational aspects of engaging with HPC providers <p>Learning outcomes – at the end of this topic participants will:</p> <ul style="list-style-type: none"> - understand the administrative process of SME engagement with HPC providers - be able to formalise engagement with HPC providers <p>Resources: PC with projector, theatre room, personal laptops/computer lab</p> <p>Course material (essential reading, video clips,...)</p>	

SME/HPC provider relationship management	
Topic 1	HPC Global Market Landscape
	Key drivers for HPC market growth
	HPC Market Segments
	Key Players in HPC Market



	How could HPC solutions benefit SMEs?	
Topic 2	Initiatives on HPC Adoption by SMEs: Regional and International Perspectives	
	HPC Adoption Initiatives for SMEs: EU Countries	
	Adoption Initiatives for SMEs: USA	
Topic 3	Implementation of new types of SLAs	
	SLA/SLIs templates	
	Reference SLA/SLIs for SMEs	

4	Exercises and solutions to practical problems by using HPC	Duration: 3-hour block Learning Method: Lecture, group exercises
	<p>Description – this topic all participants will be provided hands on experience by working remotely on the HPCs infrastructures: examples on problem solving, tutorials for domain specific use cases, HPC and software...</p> <p>Objective</p> <ul style="list-style-type: none"> - To provide SME staff experience with real HPC problems and remote hands on work on HPC <p>Learning outcomes – at the end of this topic participants will:</p> <ul style="list-style-type: none"> - gain the understanding of HPC infrastructure - get hands on experience by remotely working on the HPC - see specific use cases for domain environment <p>Resources: PC with projector, theatre room, personal laptops/computer lab Course material (essential reading, video clips,...)</p>	

Exercises and solutions to practical problems by using HPC		
Topic 1	HPC Terms and technologies	
	Clusters	
	Supercomputers	
	Shared memory	

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	Distributed memory	
	Hybrid Systems	
	Parallel Programming	
	Usage example	
Topic 2	HPC intro – Exercises	
	Connecting to the HPC system	
	Arctur-2 system overview	
	SLURM Basics	
	Job management	
	Transferring files	
	Accessing software	
	Using resources effectively	
	Using shared resources responsibly	

5	Complex (advanced) exercises and solutions to practical problems by using HPC	Duration: 3-hour block Learning Method: Lecture, group exercises
	<p>Description – The advance courses will provide more complex (advanced) exercises and solutions to practical problems by using HPC</p> <p>Objective</p> <ul style="list-style-type: none"> - To train HEI staff to understand the operational aspects of engaging with SMEs <p>Learning outcomes – at the end of this topic participants will:</p> <ul style="list-style-type: none"> - get experience with parallel programming, OpenMP, MPI, use of some programming frames - be able to see some advanced data management and data formats used on HPC - Get basic knowledge of GPU programming with CUDA <p>Resources: PC with projector, theatre room, personal laptops/computer lab</p> <p>Course material (essential reading, video clips,...)</p>	



Complex exercise and solution to practical problems by using HPC		
Topic 1	Introduction to complex exercises	
	Basics	
	Serial and parallel applications	
	Types of parallelism	
	Message passing interface	
	CUDA	