

European Master for High Performance Computing

Pascal Bouvry
University of Luxembourg

EuroHPC Summit Week 2022



Paris, France | March 22 -24

Agenda

1. EUMaster4HPC project presentation - **Pascal Bouvry**
2. Short presentations of the EUMaster4HPC awarding universities
 - 2.1. Universitat Politècnica de Catalunya - **Maria-Ribera Sancho**
 - 2.2. Friedrich-Alexander-Universität Erlangen-Nürnberg - **Harald Köstler**
 - 2.3. Sorbonne Université - **Laura Grigori**
 - 2.4. Sofia University St. Kliment Ohridski - **Ana Proykova**
 - 2.5. Università della Svizzera Italiana - **Aryan Eftekhari**
 - 2.6. Kungliga Tekniska Högskolan - **Dirk Pleiter**
 - 2.7. University of Luxembourg - **Katerine Saleme Ruiz**



21 Participant Countries

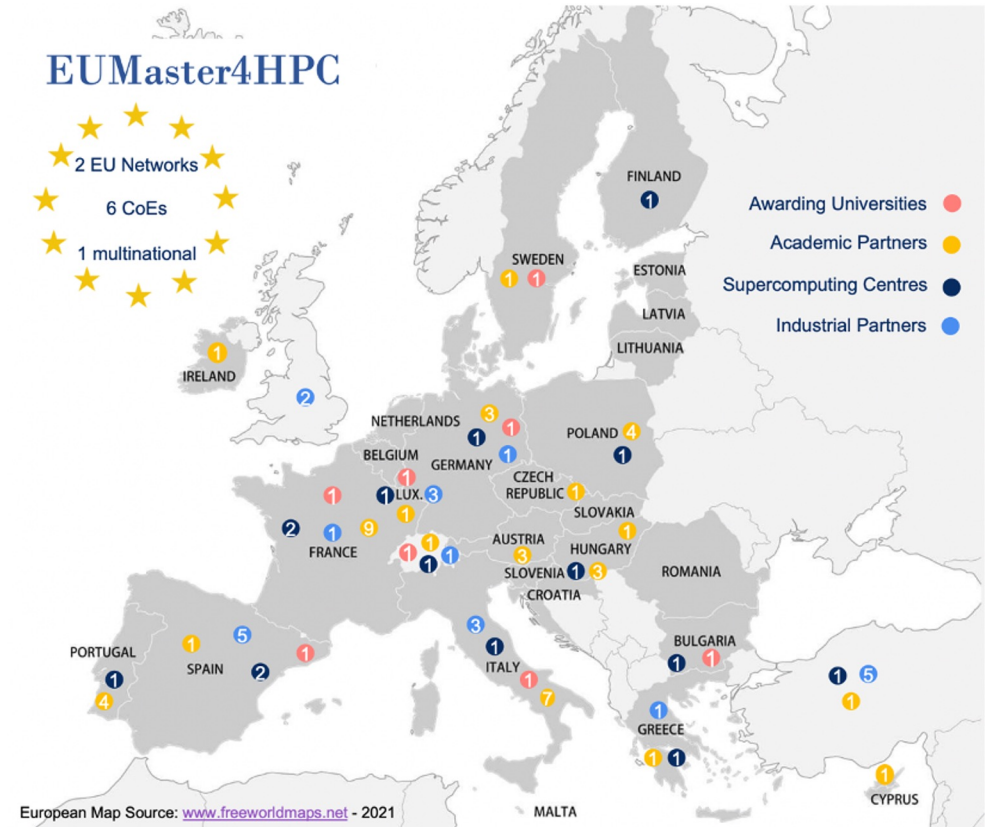
7 MEuros over 4 years

Start date : January 1st 2022

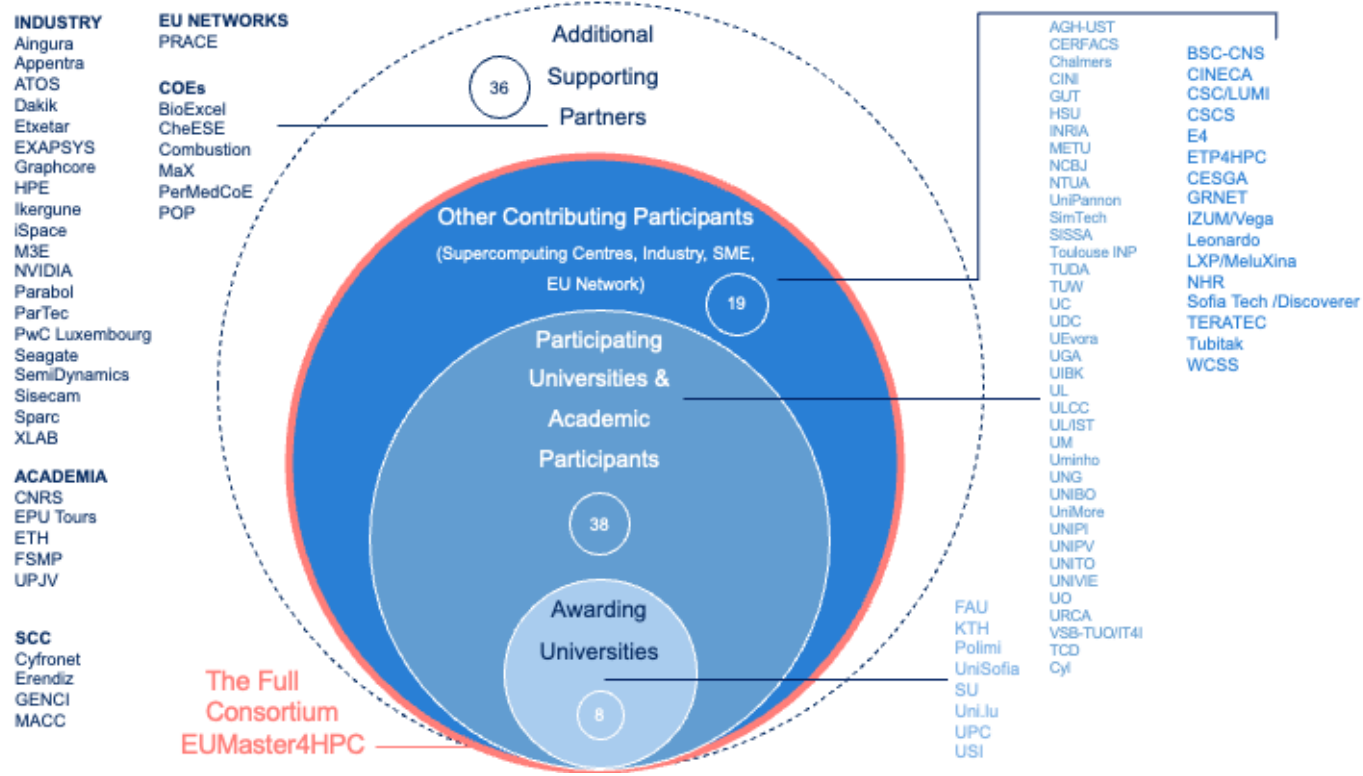
Start of the first cohorte: September 2022

Most of the funds go to students

Most of the efforts are in-kind



The Consortium and Partners



Target and Sizing

Main Objectives of the project:

120 ECTS Master (2 years) - Joint Curriculum across Europe

- Defining the body of knowledge, producing course content, bringing together the EU community
- Defining the country specific specialities: training 2 cohorts via a master pilot program
- First cohort of 50 students, second cohort of 100 students
- The first cohort will run on existing masters (Sep 2022), the second one on the to-be-defined curriculum (Sep 2023)

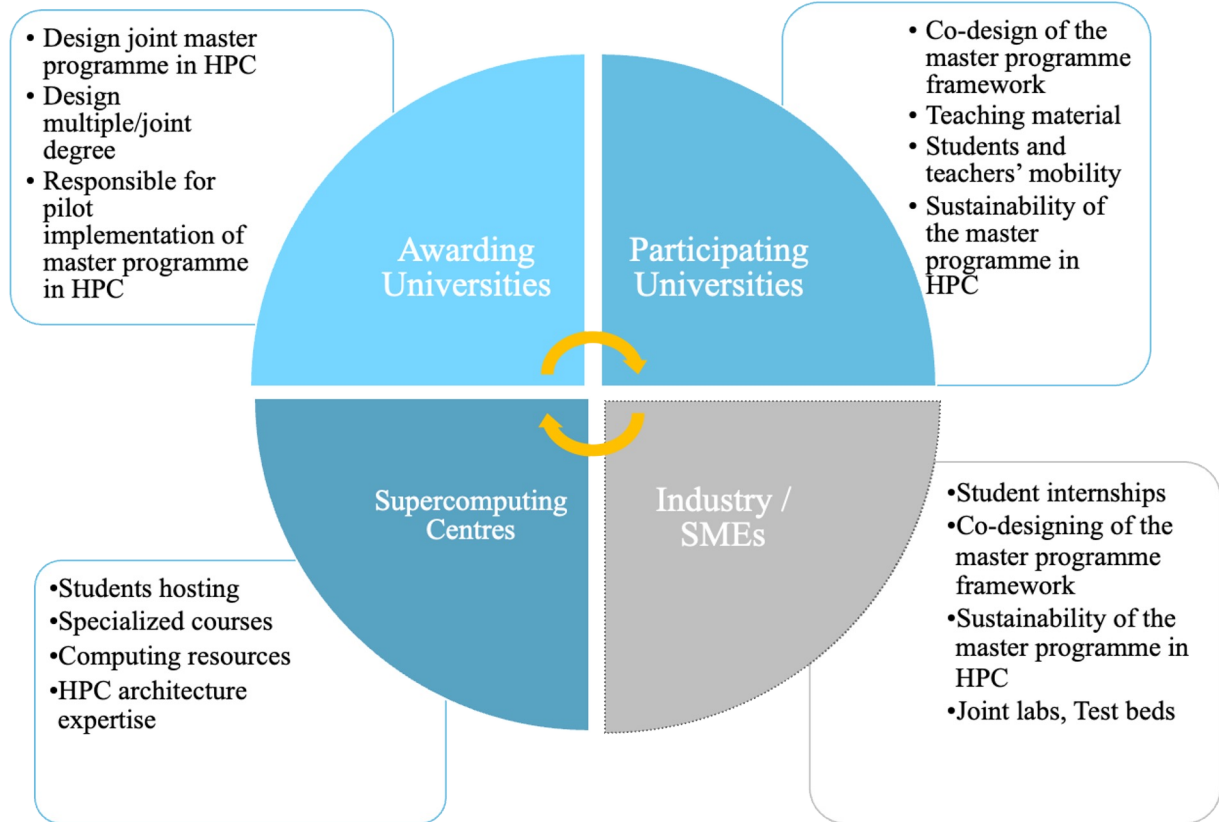


Project Objectives

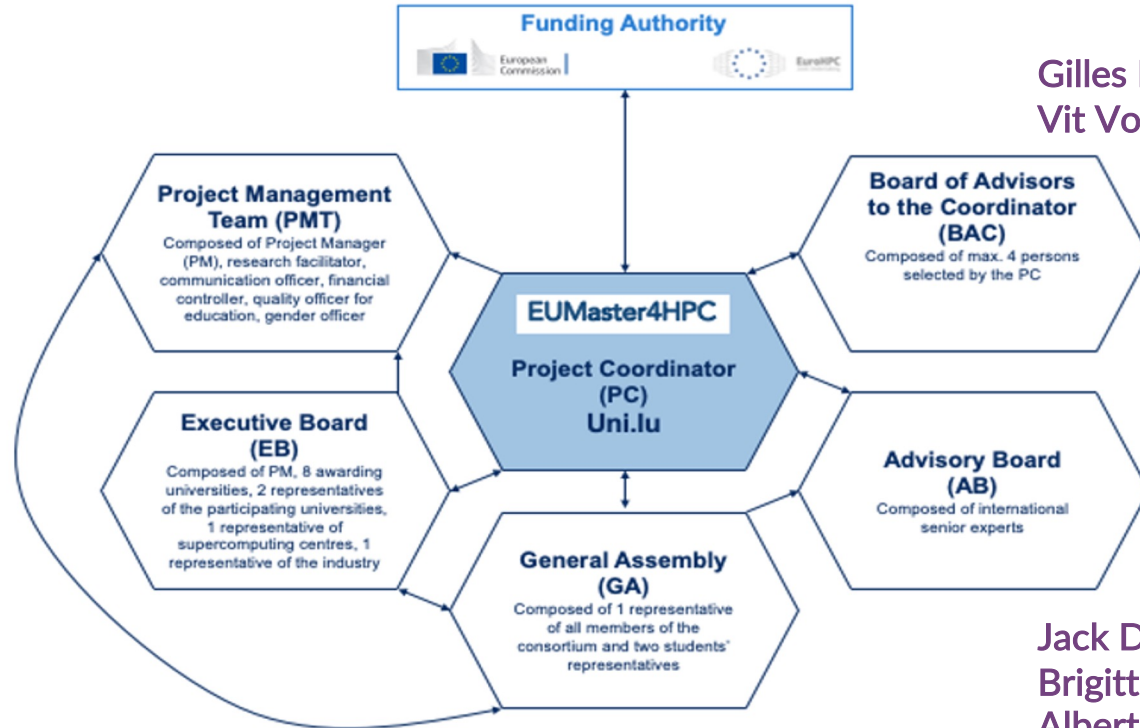
- O1: Design a common EU MSc curriculum in HPC
- O2: Implement a pilot program
- O3: Develop and share new educational content, materials and methodologies in HPC
- O4: Increase HPC-adoption by industry
- O5: Design and put specific collaboration mechanisms in place
- O6: Create a sustainable network of different stakeholders
- O7: Ensure sustainability of the master beyond the two cohorts and financial continuity



Participant's Contributions



Governance

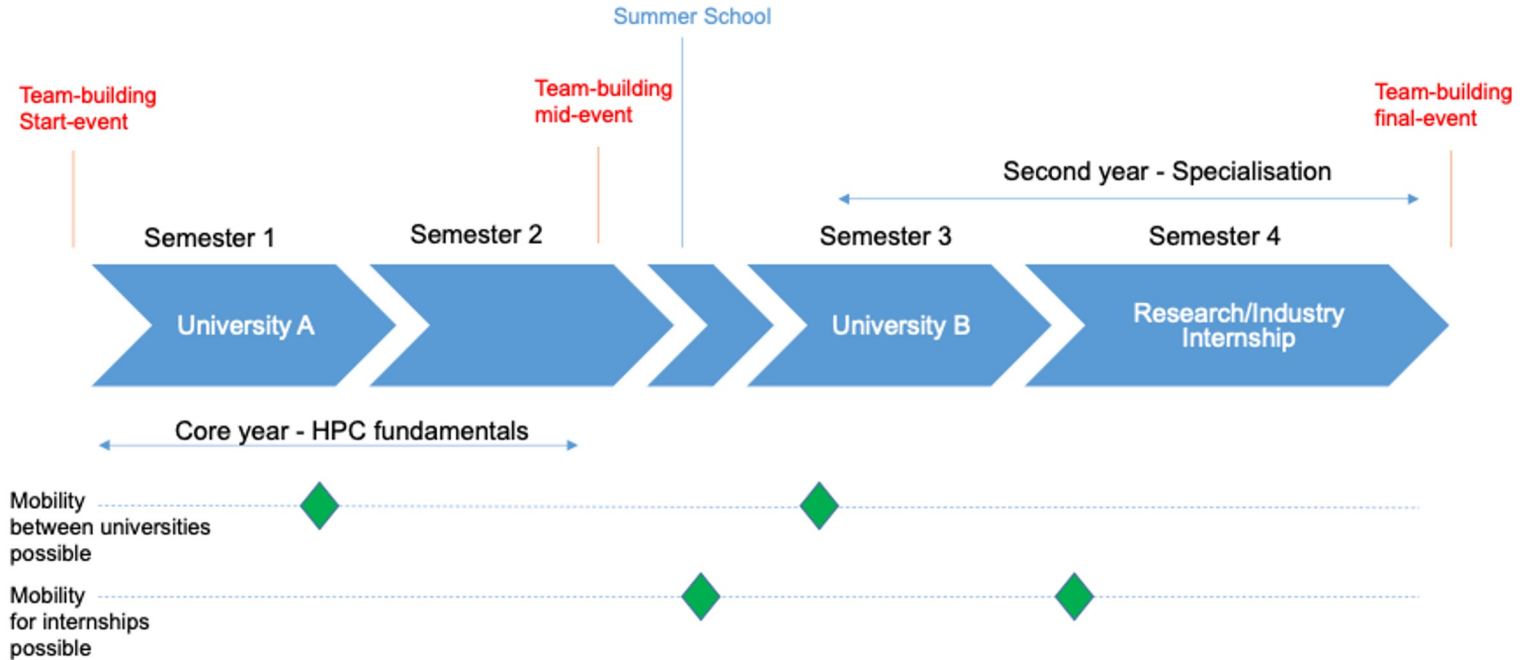


Gilles Fuchs
Vit Vondrak

Jack Dongarra
Brigitte Plateau
Albert Zomaya

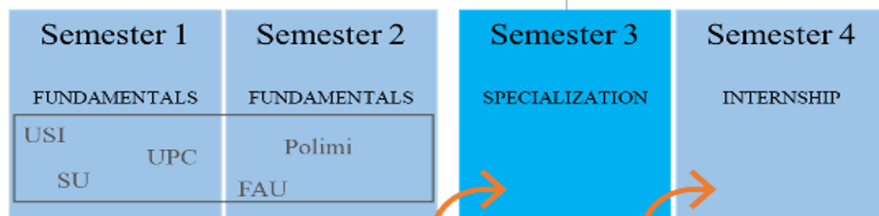
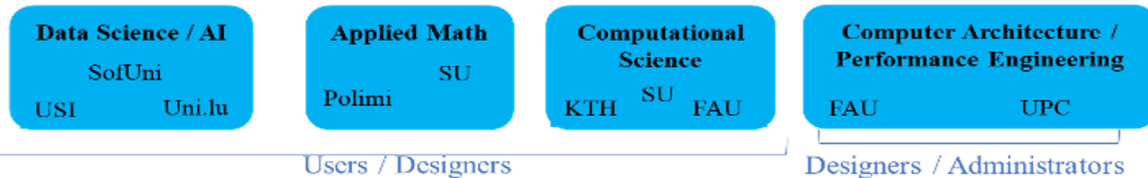


Academic Journey



EU Master4HPC

SPECIALIZATION

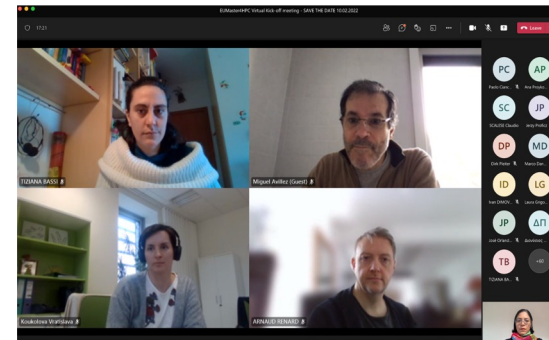
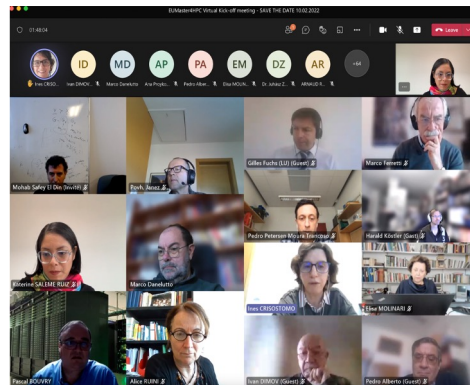
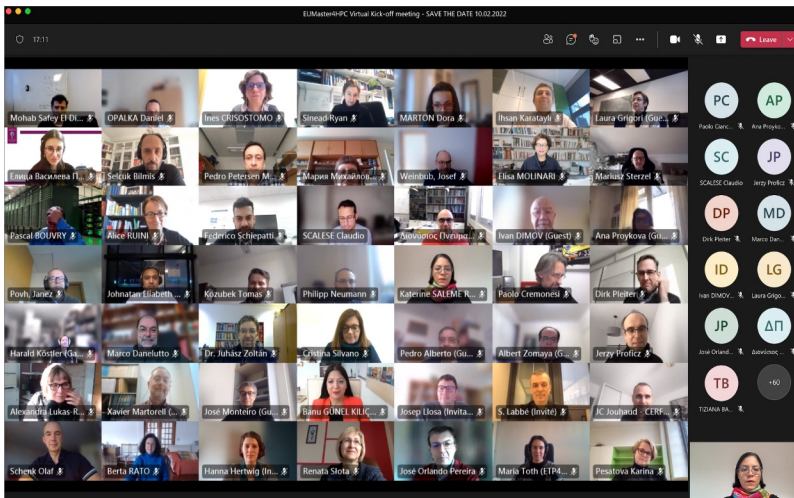


- First cohort
- Second cohort
- ➔ Students' mobility

Sept. 2022 Feb. 2023 Sept. 2023 Feb. 2024 Sept. 2024 Feb. 2025 Sept. 2025



Project Virtual Kick-off



This project has received funding from the European High-Performance Computing Joint Undertaking under grant agreement No 101051997

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<https://eumaster4hpc.uni.lu>

Universitat Politècnica de
Catalunya

Maria-Ribera Sancho

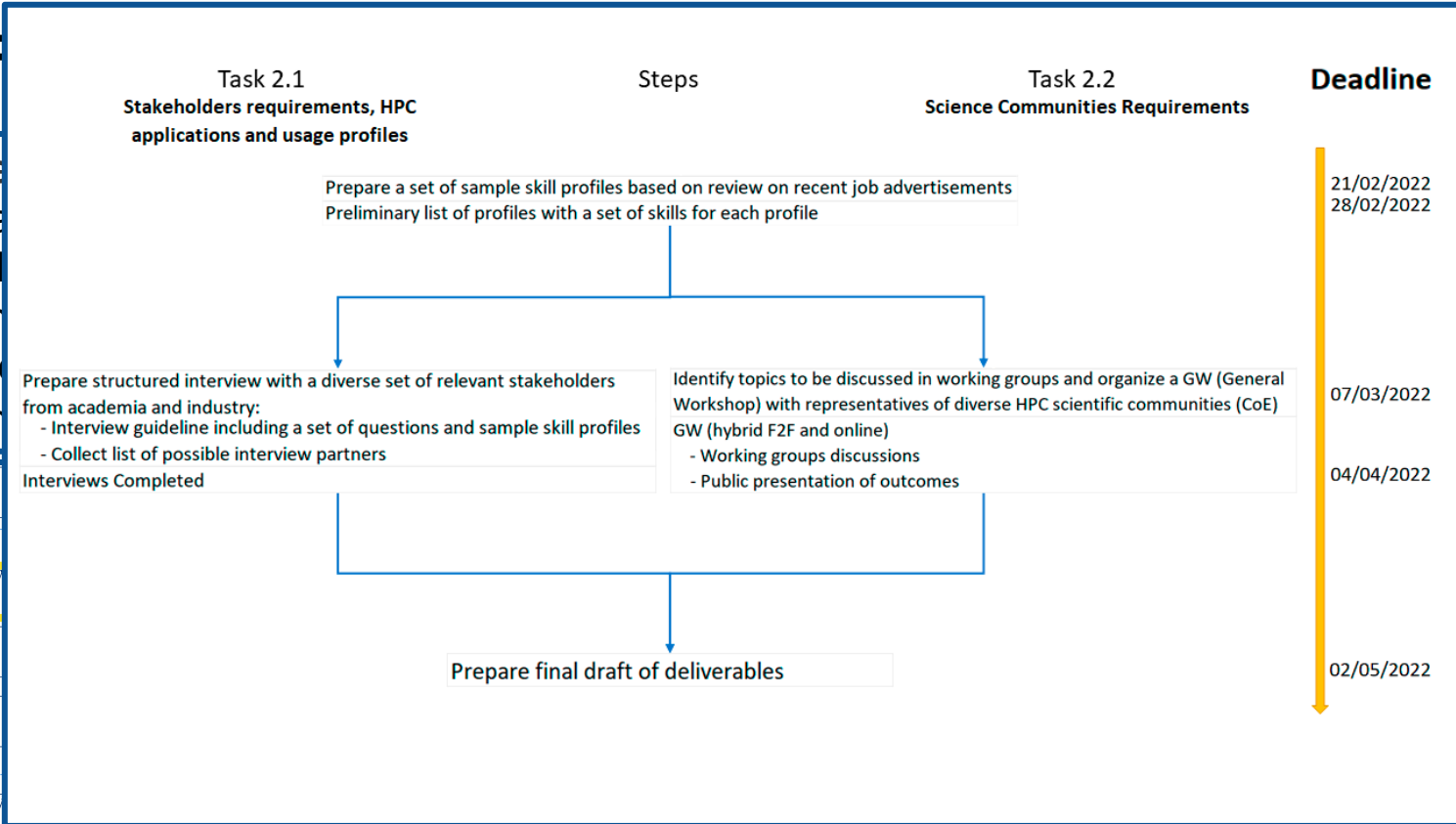
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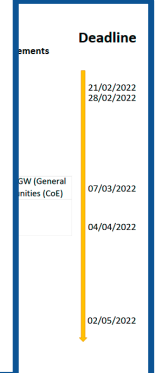
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Master in Innovation and Research in Informatics - HPC

Compulsory (30 ECTS)	HPC Specialization Compulsory (18 ECTS)	HPC Specialization Optional (42 ECTS)	Master Thesis (30 ECTS)
Algorithmic Methods for Mathematical Models	Processor Architecture	Advanced Processor Architecture	
Statistical Modeling and Design of Experiments	Multiprocessors Architecture	Nanoelectronic Circuit Design	
Techniques and Methodology of Innovation and Research in Informatics	Operating Systems	Processor Design	
Concurrence, Parallelism and Distributed Systems		Compilers for High-Perf. Comp.	
Seminars – can also be an external subject		Parallel Progr. Tools and Models	
		Supercomp. for Challenging Applications	
		Supercomputers Architecture	



UPC complementarity at the EUMaster4HPC

Disciplines	Uni.Lu	Sofia	Polimi	FAU	Sorbonne	KTH	USI	UPC
Applied Math			√	√	√	√	√	
Applications			√	√	√	√	√	
Parallel/Het. Prog.	√	√	√	√		√		√
Distributed/Cloud	√	√	√	√		√	√	√
DevOps		√						
Big Data/HPDA	√	√			√		√	√
AI	√	√	√		√	√	√	√
Comp. Architecture								√
Transversal skills	√							√

Friedrich-Alexander-Universität
Erlangen-Nürnberg

Harald Köstler

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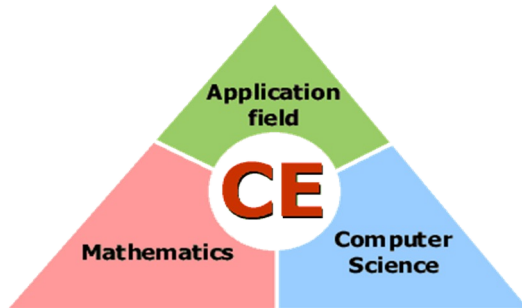


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- FAU was founded in 1743
- currently more than 40.000 students
- 5 faculties, technical faculty has 6 departments
- Bachelor/Master program in Computational Engineering (CE)
- CE is interdisciplinary and located within Computer Science



Friedrich-Alexander-Universität
Technische Fakultät



HPC@FAU

- Erlangen National High Performance Computing Center (NHR@FAU)
- Several HPC-related research groups and courses in
 - performance engineering and performance modeling
 - scalable numerical algorithms
 - HPC software design
 - Novel computer architectures
 - HPC applications like molecular dynamics, CFD, physics, medical engineering, material science
- International collaborations e.g. within EuroHPC

Implementation of a prototype for the European Master in HPC

- Application for first cohort already open (<https://www.eumaster4hpc.tf.fau.eu/>)
- Selection process will involve academia, industry and HPC centers
- First cohort of students will start in winter term 22/23

Sorbonne Université

Laura Grigori

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- One of the oldest and one of the youngest european universities
Formed in 2018 by merging Paris-Sorbonne in arts and humanities with
Pierre and Marie Curie in sciences, engineering and medicine
- 52.000 students of which 10.200 are international
- Three faculties: Humanities, Medicine and Science&Engineering
- Faculty of Science and Engineering: 18.500 students, 87 laboratories, 1 Engineering School, 4 marine stations, etc.
- Located in the heart of Paris. (10min walk away from Notre Dame Cathedrale)

- In Mathematics :
ranked third in the world by Shanghai for 2021
- EUMaster4HPC:
Master in Computer Science and Master in Mathematics



HPC@SU: Imbrication CS-applied math + engineering applications

- Master1 balanced between math and CS
 - applied mathematics and numerical simulations
 - parallel computing, algorithms and architectures
- Master2 integrates multi-disciplinary courses towards traditional HPC applications (chemistry, mechanics, physics, geosciences, etc.), and more recent ones (data analysis, quantum simulations)
- Possible to obtain Master in Computer Science and Master in Mathematics
- Interaction with 5 french universities (EPU Tours, Toulouse INP, UO, UGA, UPJV, URCA)

SU role: Promote mobility of students and teachers

- Summer schools in 2023 and 2024
- Each student participates to 2 workshops organized locally: discovery of HPC professions, HPC research specificities
- Each student participates to a challenge in M2 (groups of 5): topic given by a center/industry with participation of an academic partner
- Internship in supercomputing centers/industry/academic institutions



Sofia University St. Kliment
Ohridski

Ana Proykova

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- Sofia University was founded in 1888
- Over 24 000 students in STEM & humanities
- Faculty of Mathematics and Informatics & Faculty of Physics - over 3800 bachelor and master students
- Masters in Computer Science (specialization in Artificial Intelligence, Distributed Systems and Mobile Technologies, Information Retrieval)
- Masters in Quantum Informatics

SOFIA UNIVERSITY
ST. KLIMENT OHRIDSKI



1. Sofia University is the host of

- * the first big data Centre of Excellence in Eastern Europe-GATE
- * the Institute for Scientific Research in Computer Science and Artificial Intelligence, the Centre of Excellence Universities for Science, Informatics and Technologies in e-Society (UNITe) – UNITe

2. Role at the EUMaster4HPC project

*Leads the work package **Develop recommendations and roadmap of a pan-European education programme in HPC: propose adjusted curriculum***

Identify inter-program synergies; develop an action plan to connect HPC courses to the pilot programme



Università della Svizzera Italiana

Aryan Eftekhari

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USI at a glance

- Over 10,000 Graduates in 2021.
- Faculty of Informatics:
 - 5 research institutes and 40 faculty professors.
 - Highly successful in competitive research funding (SNF, EU, and industry).
- Master in Computational Science (MCS):
 - Supported by the Institute of Computing.
 - CSCS/ETH cutting-edge resources.
 - Multiple double degree programs.
 - Course topics include: *HPC, High-Dimensional Data Analysis, Optimization, and Statistical Computing.*



CSCS

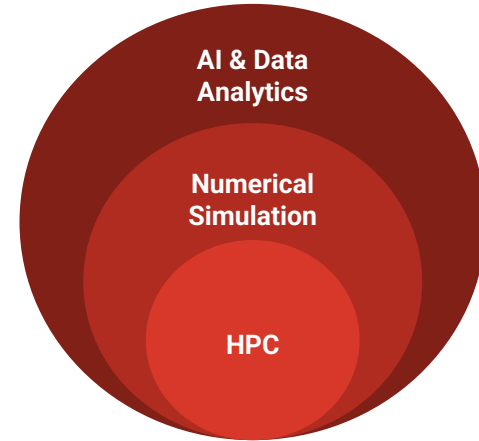
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre



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<https://eumaster4hpc.uni.lu>

Master in Computational Science at USI — **Interdisciplinary** and **Specialized**



1st Semester Communal

Introduction to CS, data science, PDEs, alongside fundamentals in ODEs, ML, and HPC.

2nd Semester Communal

Advanced discretization, stochastic, and optimization methods, as well as applied courses on simulations and supercomputing.

3rd Semester Specialization

Elective courses such as bioinformatics, quantum computing, particle filtering, and thesis preparation.

4th Semester Thesis Project

Master's thesis project with a dedicated professor.



Double Degrees & Shared Courses

Academic



Friedrich-Alexander-Universität
Erlangen-Nürnberg



AI + HPC

Università
della
Svizzera
italiana

**Institute of
Computing
CI**

Università
della
Svizzera
italiana

**Systems
Institute
SYS**



CSCS

Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

Research

Research Institutes & Cutting-Edge Resources



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Kungliga Tekniska Hoegskolan

Dirk Pleiter

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KTH at a glance

- Sweden's leading technical university
 - Ranked 89 in the 2022 QS World University Rankings
- About 13.5 thousand students



HPC-Related Master Training at KTH

- Leverage existing program: MSc in CS with its Scientific Computing track
- Specialisations:
 - High-Performance Computing
 - Includes mandatory courses in parallel computing and GPU programming
 - Optional courses, e.g., in advanced algorithms, AI
 - Computational Science
 - Mandatory courses focus on methods in scientific computing, e.g.
 - Numerical methods and algorithms used in parallel and distributed computing (for particle models, solving ODEs and PDEs)





Activities beyond education: Stakeholder requirements assessment

- Goal: Base work on common MSc for HPC curriculum on evaluation of stakeholders requirements
 - Stakeholders includes commercial organisations
- Approach: Identify a set of job descriptions and corresponding skill profiles
- Implementation:
 - Evaluate open advertisements as of early 2022
 - Collect feedback using
 - Surveys (see: <https://forms.gle/nSE3jsd1ctPTzJBv5>)
 - Structured interviews

JOB PROFILE #3: HPC System Software Developer / HPC Software Engineer

How relevant is this JOB PROFILE #3?

- Very important
- Somewhat important
- Neutral
- Somewhat unimportant
- Rather unimportant

JOB PROFILE #3 / SKILL #1: Software engineering skills and technologies (source code management, CI)

- Very important
- Somewhat important
- Neutral
- Somewhat unimportant
- Rather unimportant

JOB PROFILE #3 / SKILL #2: Knowledge of fundamental networking or distributed computing concepts

- Very important
- Somewhat important
- Neutral
-



University of Luxembourg

Katerine Saleme Ruiz

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FNR



- Founded in 2003
- Research-oriented, interdisciplinary, international and multilingual university
- 1,420 academic staff (including doctoral candidates, postdoctoral researchers, research associates and others) supporting 268 professors, assistant professors and lecturers in their teaching
- Close to European institutions, financial institutions and leading industry players
- Three faculties, three campuses, three interdisciplinary centres

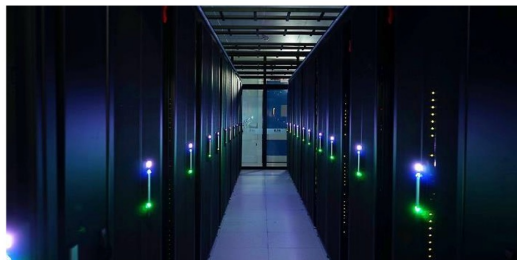




UNIVERSITY OF LUXEMBOURG
Department of Computer Science

AREAS

- Intelligent and Adaptive Systems
- Information Security
- Communicative Systems
- Software and Systems



PEOPLE

- 20 professors
- 51 post-docs and 47 doctoral candidates
- 12 technical and administrative staff



Master in Information and Computer Sciences



Duration: 2 years full-time
programme / 4 semesters
(120ECTS)

https://www.en.uni.lu/studies/fstm/master_in_information_and_computer_sciences

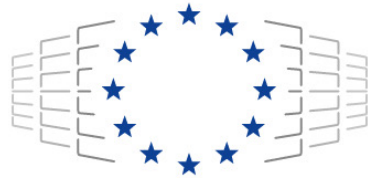


Role of uni.lu at the EUMaster4HPC project



- Awarding University
- Contribute to the definition of the body of knowledge
- Contribute to the development and share new educational content, materials and methodologies
- Support the implementation of the pilot programme
- Promote mobility of students and teachers to allow sharing expertise and resources among the consortium
- Contribute to create joint/multiple degrees

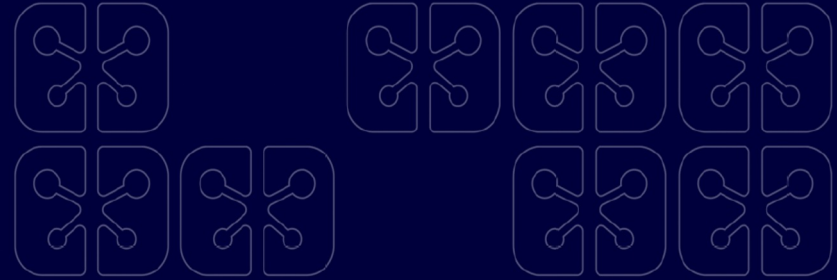
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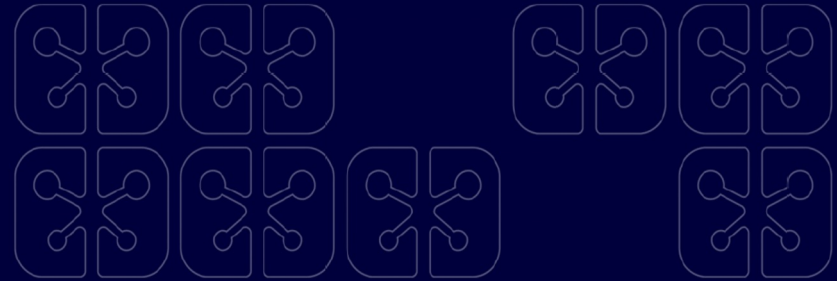
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