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NOVEMBRO

encontro de computação avançada 2024

UBI, Universidade
da Beira Interior

UBI Experience with HPC

Rohollah Garmanjani

NOVA FCT, NOVA Math

4th Advanced Computing Meeting
University of Beira Interior (UBI)
November 5-6, 2024

UIDB/00297/2020 and UIDP/00297/2020

NOVAMATH
CENTRO PARA MATEMÁTICAS
E APLICADAS



Apoios:



EuroHPC
Joint Undertaking



Outline

- 1 3CA.UBI (Centro de Competências em Computação Avançada da Universidade da Beira Interior)
- 2 HPC-driven Research Projects at UBI
- 3 Training
- 4 Future Research

3CA.UBI's Team Members and Areas of Expertise



Pedro R. M. Inácio

Associate Professor
Coordinator of 3CA.UBI
prmi@ubi.pt

Areas: Security and Privacy of Data, Computer-based Simulation



Paulo Gomes

Dir. of Informatic Service
pgomes@ubi.pt

Areas: System Administration, Networks and Cybersecurity



Mário M. Freire

Full Professor
Co-coordinator of 3CA.UBI
mariof@ubi.pt

Areas: Organization of Systems, Computation on Cloud



G. (Until Oct. 6, 2024)

Postdoctoral Researcher
r.garmanjani@ubi.pt

Areas: Comput. Math., Optimizatoin, ML&DS

3CA.UBI's Objectives

- **Facilitate Knowledge Sharing:** Provide expertise and access to advanced computing and visualization resources.
- **Enable Access to RNCA:** Support UBI researchers in connecting with RNCA.
- **Support HPC-driven Research:** Leverage and expand UBI research projects requiring advanced computing, fostering HPC skills and research growth.
- **Drive Scientific Innovation:** Act as a catalyst in the development and support of cutting-edge scientific projects.
- **Promote Opportunities and Collaboration:** Serve as a central hub for sharing project calls, funding sources, and collaborative opportunities.

HPC-driven Research Projects at UBI

- HPC Simulations for Flame Control with Plasma Actuators
- Explainable AI for ECG-Based Cardiac Diagnosis
- Simulations of Taylor Cone Jet for Electrospray Optimization
- Modeling Ribbing and Misting in Roll Coating
- LLMs in Mental Health Support Systems
- Benchmarking CNNs for Neural Architecture Optimization
- Object Recognition Aid for the Visually Impaired
- Large Eddy Simulation of Supercritical Rocket Propulsion

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- **Short Trainings:** Typically 1-hour sessions.
 - **Target Audience:** Mainly people with computational backgrounds.
 - **Objectives:**
 - Familiarize researchers with HPC usage.
 - Cover essential tasks: remote access, job submission, and job management.
- **Long-term Trainings:** Multi-session courses lasting from a few weeks to several weeks.
 - **Target Audience:** Participants from diverse fields with limited computational experience.
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 - Build foundational skills in Machine Learning and Data Science (ML&DS).
 - Generate demand for HPC resources by introducing ML workflows.

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Long-term Trainings: Introduction to ML&DS with Python

- Part I: Python, Data Processing, and Data Visualization (12 hrs)
 - Python basics and Linux command lines
 - Data manipulation and processing with NumPy and Pandas
 - Data visualization techniques with Matplotlib, Seaborn, and Plotly
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 - Supervised learning algorithms: Linear regression, Logistic regression, SVMs, decision trees
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Student Projects from the Course

- Predicting Hotel Cancellation Using Real-World Dataset
 - Applied machine learning to analyze factors contributing to hotel booking cancellations.
- CNN Reconstruction with Optimal Sparse Sensor Placement in a Flow Field
 - Explored sensor placement techniques for accurate flow reconstruction using Convolutional Neural Networks (CNNs).
- Predicting Position for Football Players
 - Used machine learning models to predict player positions based on match data.

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Impact, Learning Outcomes, and Future Plans

● Impact and Engagement:

- High attendance (30+ students: PhD, MSc, BSc) from diverse fields (e.g., Computer Science, Engineering, Bioinformatics, Sport Science).
- Increased interest in advanced ML applications.
- Boosted confidence in Python-based data analysis and ML model building.
- Gained foundational understanding of ML techniques across disciplines.

● Future Plans:

- Launch of a new course, “Hands-on Supercomputing in ML,” focusing on HPC-driven ML workflows for advanced applications.

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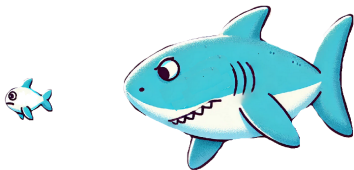
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Future Research: Motivation and HPC Solutions for SME Competitiveness

- **Motivation:** SMEs face challenges such as:
 - Concerns about using private cloud services due to competitive disadvantages
 - Small datasets
 - Data privacy issues
 - Limited computational resources



Future Research: Goal and Challenges

- **Goal:**

- Develop a federated learning system leveraging government-supported HPC infrastructure to support SMEs.

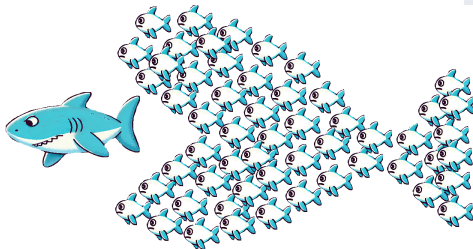
- **Challenges:**

- **Optimization:** Developing efficient optimization algorithms tailored for federated machine learning.
- **Data Quality and Privacy:** Ensuring secure, high-quality data integration across sources.

Future Research: Impact for SMEs

- **Broader Impact:**

- Helping SMEs utilize HPC and AI resources leads to better decision-making and a competitive edge against larger enterprises.



Thank You!