CERN School of Computing 2023

Sunday, August 20, 2023 - Saturday, September 2, 2023

Delta Centre - University of Tartu

Academic Programme

The complete programme will offer over 50 hours of lectures and hands-on exercises. The programme is organized over three distinct tracks: Physics Computing, Software Engineering, and Data Technologies. In addition, guest lectures, student presentations and special evening talks will be organised.

(Please note that this programme may be subject to minor changes.)

Physics Computing

Introduction to Physics Computing
by Arnulf Quadt (University of Göttingen)
2h lectures
foundations of particle physics
introduction to the Standard Model
event filtering
calibration and alignment
event reconstruction
event simulation
physics analysis
data flow and computing resources

Data Science and Interactive Data Exploration
by Pere Mato (CERN)
2h lectures + 2h exercises
introduction, data science tools
using data from different sources
non-numeric data

Data Analysis
by Toni Šćulac (University of Split)
4h lectures + 3h exercises
introduction to data analysis
probability density functions and Monte Carlo methods
parameter estimation and confidence intervals
hypothesis testing and p-value

Introduction to Machine Learning
Lukas Alexander Heinrich (Technische Universitat Munchen)
3h lectures + 3h exercises
what is machine learning
learning algorithm, loss function, optimisation
overfitting and underfitting
machine learning in HEP

Software Engineering

Tools and Techniques
by Pere Mato (CERN)
2h lectures + 3h exercises

introduction to software engineering
test frameworks, memory checkers
collaborating on complex software

Software Design in the Many-Cores Era
by Andrei Gheata (CERN) and Stephan Hageboeck (CERN)
4h lectures + 3h exercises
Amdahl's and Gustafson's laws, data and task parallelism
parallel programming in C++, concurrency and synchronisation
performance and correctness - profiling and debugging multithreaded applications
patterns for parallel software development

Creating Secure Software
by Sebastian Lopienski (CERN)
3h lectures + 3h exercises
introduction to computer security
security in different phases of software development
web application security

Data Technologies

Data Management
by Alberto Pace (CERN)
5h lectures
data workflow, storage models and technologies
reliability and error correction
practical cryptography: hash functions, symmetric and asymmetric encryption, digital signatures
authentication, authorization and accounting: PKI, certificates, Kerberos, OpenID, OAuth etc.
distributed hash tables, block storage, data replication, caching

Data and Storage Technologies
by Andreas J. Peters (CERN)
1h lecture + 3h exercises
storage technologies: present and future
data formats and access patterns
optimizations in IO systems
redundancy, cloud storage

Data Visualization
by Eamonn Maguire (Proton, Switzerland)
2h lectures + 2h exercises
data visualization: theory and practical applications
multi-dimensional data visualization

Additional lectures

Student lightning talks session