# Table of Contents

LHCb Software Training

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHCb Starterkit</td>
<td>1</td>
</tr>
<tr>
<td>Hackathon and LHCb/software/computing week tutorials</td>
<td>1</td>
</tr>
<tr>
<td>Other hands on tutorials</td>
<td>2</td>
</tr>
<tr>
<td>Advanced tutorials</td>
<td>2</td>
</tr>
<tr>
<td>Older material</td>
<td>3</td>
</tr>
<tr>
<td>Third party tutorials and courses</td>
<td>3</td>
</tr>
<tr>
<td>CERN Technical Training Programme</td>
<td>3</td>
</tr>
<tr>
<td>Advanced C++ lectures</td>
<td>3</td>
</tr>
<tr>
<td>Public domain</td>
<td>3</td>
</tr>
</tbody>
</table>
LHCb Software Training

LHCb Starterkit

• StarterKit: First Steps in LHCb - LHCb data flow, DST exploration, LoKi Functors, DaVinci and Ganga introductions.
• ImpactKit: Second Analysis Steps in LHCb - Using git in LHCb, various analysis topics, HLT, more Ganga.
• NEW ImpactKit Student Talks 2020 - Talks given in lieu of an impactkit workshop in 2020.
• DevelopKit: Developing for the Upgrade in LHCb - Advanced git in LHCb, various development topics, Gaudi tutorials, upgrade topics, modern C++.

Hackathon and LHCb/software/computing week tutorials

• C++ course by Sebastien Ponce at the 5th LHCb software hackathon, January 2017
• Up to date version of the C++ course by Sebastien Ponce
• Introduction to Gaudi and the new LHCB framework by Gerhard Raven at the 5th LHCb software hackathon, January 2017
• LHCb new framework Tutorial by Sebastien Ponce, initially at the 5th LHCb software hackathon, January 2017
• How to structure efficient algorithms by Christopher Jones at the 6th LHCb software hackathon, March 2017
• the GIT tool and best practices by Sebastien Ponce at the 7th LHCb software hackathon, June 2017
• emacs and vim extensions for the new framework by Adam Davis at the 7th LHCb software hackathon, June 2017
• Sharing terminals with TMATE by Manuel Schiller at the 9th LHCb software hackathon, December 2017
• Hackathon software setup by Sebastien Ponce at the 9th LHCb software hackathon, December 2017
• Vectorization tools and examples by Florian Lemaitre at the 9th LHCb software hackathon, December 2017
• Monitoring software performance with PR2 by Maciej Pawel Szymanski at the 9th LHCb software hackathon, December 2017, updated June 2018 12th (Krakow) hackathon.
• Processor architectures by Omar Awile at the 9th LHCb software hackathon, December 2017
• Tools for measuring code performance by Monir Hadji at the 9th LHCb software hackathon, December 2017
• Optimisation of memory allocations by Sebastien Ponce at the 10th LHCb software hackathon, February 2018
• New counters in Gaudi by Sebastien Ponce, initially at the 11th LHCb software hackathon, April 2018
• C++ course at the 12th LHCb software hackathon in Krakow, June 2018.
• LHCb upgrade software framework at the 17th LHCb hackathon at CERN, October 2019.
• Efficiently exploit multicore architecture - the LHCb experience at the HSF Reconstruction and Software Triggers WG, June 5th 2019 and at 1st Real Time Analysis workshop, July 15th 2019
• SIMD and data structures for efficient reconstruction algorithms at the HSF Reconstruction and Software Triggers WG, June 5th 2019.
• Gaudi CMake modernization end of internship presentation, August 16th 2019.
• VTune tutorial at the 18th LHCb software hackathon, February 2020
• Geometry and condition related presentations at the 18th LHCb software hackathon, February 2020
  ♦ HEP detector description supporting the full experiment life cycle - Brief tutorial
  ♦ Detector Geometry Design
  ♦ Detector Condition Design
  ♦ Using conditions in functional framework
  ♦ DD4hep = LHCb integration
Other hands on tutorials

- CMake Configuration for CMT users - (DEPRECATED) Basic instructions on the CMake configuration of projects for developers used to CMT.
- CMake for Gaudi-based projects - CMake configuration of Gaudi based on CMake 3.15
- DaVinci Tutorials - Getting started with DaVinci. Requires all of the above!
- Grid and Grid Data Tutorial - Getting the most out of the grid, and saving your time. Requires all of the above! -- (assumes you use Ganga).
- ROOT vs. POOL Tutorial - Using ROOT or POOL persistency, the differences and the how-to
- Python Configurables - Getting started with Configurables (last updated 2008-12-09). Also:
  - Job configuration using Python (last updated 2008-03-18)
  - Brunel and Reconstruction Configurables (last updated 2009-03-17)
  - DaVinci Configurable (last updated 2009-03-17) and Wiki
  - Gauss Configurable
  - TupleToolsAndConfigurables, understanding the differences between configurables and their C++ classes.
- Introduction to Panoramix - Getting started with Panoramix
- GaudiPython tutorial
- NEW Introduction to Ostap - New GitHub-based Ostap tutorials
- Ostap (formely known as PyPaw) - set of useful extensions for PyROOT
- Introduction to LoKi - Getting started with LoKi
- NEW Getting started with Bender - New GitHub-based Bender & BenderScript tutorials
- Introduction to Bender - Getting started with Bender
- Introduction to BenderScript - Getting started with BenderScript
- MicroDST tutorial
- Tutorial on Hlt2 - last updated 2010-03-12
- Simulation, Digitization and Reconstruction - An example of simulating, digitizing and reconstructing a specific signal event file
- Book-keeping tutorial (last presented 2009-06-15). See also the presentation given on 2008-12-10 (from slide 6).
- Tutorial for MC Production contacts - last updated 2010-12-15
  - Guidelines on running Gauss at Generator level
  - Writing decfiles and analysing the results
  - Filling production requests and necessary checks
  - Obtaining the generator statistics
- Analysis preservation and reproducibility - tutorials, examples and tools

Advanced tutorials

- Simulation Advanced Tutorial: how to simulate detectors: two days tutorial covering Gauss, Boole, geometry, event model and much more
- Conditions Database Usage (pdf)
- Event model and GaudiObjDesc tutorial (pdf)
- The agendas and contents of tutorial sessions both at CERN and elsewhere are listed here.
- Running LHCb software in the CernVM virtual machine.
- EclipseTutorial
- SwimmingTutorial
- RooStats Tutorial
- GPU programming: Introduction to CUDA and GooFit
Older material

These are mostly obsolete but contain useful background material

- Introduction to LHCb software - part 1 - Software organisation, environment setup and CMT (Eclipse Version)
- Introduction to LHCb software - part 2 - Algorithms, Printing, Job Options (Eclipse Version)

Third party tutorials and courses

CERN Technical Training Programme

The full catalog is available here (CERN authentication required). In particular the following courses are recommended:

- Python: Hands-On Introduction
- Python: Advanced Hands-On

- Course ID 3935 C++ Part 1 - Hands-On Introduction
- Course ID 3936 C++ Part 2: Object-Oriented
- Course ID 4308 C++ Part 3: Hands-On Generic Programming in C++ and the STL
- Course ID 4883 C++ Part 4: Hands-On Large Scale in C++
- Course ID 4718 Hands-On Modern C++: Making the most of the 11/14 standards

- CERN openlab / Intel Parallelism, Compiler and Performance Workshop
- CERN openlab / Intel Workshop on Numerical Computing (07-07 February 2012 session)
  - Understand floating-point arithmetic (Jeff Arnold) slides
  - Floating-point control in the Intel C/C++ compiler and relevant libraries (Martyn Corden) slides

Advanced C++ lectures

Slides from the advanced C++ lectures given by Walter Brown at CERN in July 2009

Public domain

- Python tutorial from python.org (version specific)
- Online Python tutor

-- MarcoCattaneo - 16-Dec-2010