ROOT

Data Analysis Framework

ROOT basics

FH Sustainable Computing Workshop

17th-18th January 2024

https://root.cern

https://root-forum.cern.ch

https://root.cern/primer/

https://root.cern/doc/master/group__Tutorials.html

https://github.com/root-project/training

What is ROOT?

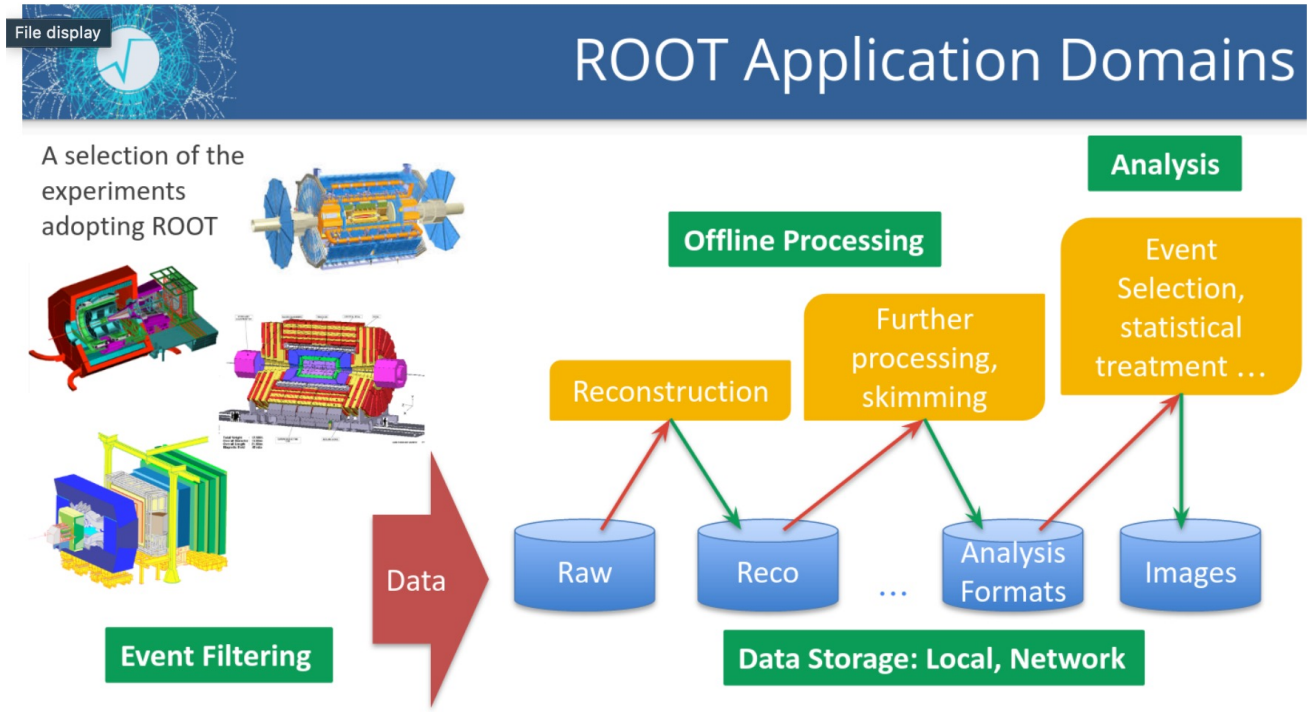
- A software framework that can be used for:
  - Data processing
  - Data analysis
  - Data visualisation
  - Data storage

- Mainly written in C++, with powerful Python bindings

- Adopted in HEP and other sciences (and also in industry)

Building blocks

- Histograms, graphs, trees → data analysis
- I/O → Row-wise, column-wise storage of C++ objects
- RooFit/RooStats → Modelling and statistical inference
- TMATH → Non-trivial functions, mathematical functions
- TMVA → Multivariate analysis



Today’s goals

- Begin to explore basic functionalities of ROOT
- Be able to use the C++ command line prompt
- Write and execute basic macros to perform basic functions, e.g. plotting and fitting

1) Investigating ROOT files

- Copy a pre-prepared ROOT file

```
cd root_workdir
cp /pnfs/desy.de/FH-Sustainability-Computing-Workshop/batch-exercise/DoubleMu_0.root .
```

- Open the file and navigate around the file structure
- How many events are there in the multiplicity histogram?
- How many bins? Lowest x-value? Highest x-value? Contents of a bin?

2) Drawing a histogram

- Plot the histogram with half the number of bins and change the colour of the line
- Add another histogram to the same plot in a different colour
- Extend the range of the y-axis

3) Investigate the TTree

- See what variables are contained in the tree
- Print out specific variables
- Look at the content of one branch

4) Use a TBrowser

- Use an interactive GUI, the TBrowser to investigate a file

5) Macros

- General structure of a macro name macroName.C

```
void macroName() {
    <
        ... lines of C++ code ...
    >
}
```

- Different possibilities to run the macro

```
root macroName.C
============
root
.x macroName.C
============
root
.L macroName.C
macroName()
```