ROOT Plan of Work 2020

Axel for the ROOT team, EP-SFT 2020-01-27
Plan of Work?

• List of items we want to accomplish

• See https://root.cern/program-work for previous ones

• 2019 detailed items here: https://docs.google.com/spreadsheets/d/1u5R-YIOMDb-SXqVa4acUFQIcIn2U4thH-Aa0l0kG-ag/edit?usp=sharing

• To solicit feedback!
What do you do as a ROOT developer?
• Main load is support:
• Reply to posts:
  >14'000 in 2019, again!
Support

• Main load is support:
  • Reply to posts
  • Fix bugs:
    > 400 in 2019, again!
Support

• Main load is support:
  • Reply to posts
  • Fix bugs
  • Training

• Train-the-trainer
• Experiments' tutorials
• Summer students
• CERN School of Computing
Train-The-Trainer

• First event of its kind
• Goal: grow ROOT ambassadors to help with
  • Broadcasting news
  • Collect feedback
  • Curate material
Outreach

CERN EP Software Seminar

Elisabetta Manca (INFN Pisa / CMS),
Enrico Guiraud (ROOT)

On RDataFrame

https://indico.cern.ch/event/849610/
Outreach

• CHEP!

• 13 contributions

• https://indico.cern.ch/event/773049/contributions/, search for "ROOT"
The Team @ CERN, Summer 2019!
The Team @ CERN, Begin 2019
The Team @ CERN

• Large fluctuation of key contributors since begin 2019
  • Lost Danilo, Guilherme, Javier, Enrico, Xavi
  • Plus Massimiliano
ROOT Team @ CERN?

• ROOT development largely de-centralized:
  • I/O, Web graphics + GUI, Time Series, RHist, C++ modules, RooFit
  • All rely crucially on team members not located at CERN
• Big thanks to all contributors!
The Teamwork

• From team's anonymized feedback:
  • "Everyone in the group can speak their mind and even newcomers' opinions are listened to"
  • "People always available for help, everyone is friendly and helpful"
  • "Constant feedback about our work among the members of the team"
  • Energetic, creative, open-minded set of people
2019 Main Development Lines

- PyROOT
- WebGUI + graphics, Eve7
- I/O: RNTuple, Compression
- C++ runtime modules for dictionary
- Math: RooFit acceleration, TMVA interface, CuDNN
2019's Changes

• > 4000 commits
2019's Authors

- > 100 authors
ROOT Project in 2020
Driving Factors

The best ROOT, as quickly as possible

Limited by available people and expertise
The Limits

• A question of

• Compromises?
The Limits

• A question of
• Compromises?
• Optimization!
Optimization

• We can decide on priority and relevance
• We need convincing arguments
  • To *not do* something
  • But even more to *do* something
Cost

• Whenever we invest we need to know why

• Cost considerations:
  
  • Bugs that silently give the wrong result are a disaster

  • Each new line / feature introduced will incur 30 years of integrated maintenance

• Features are not valuable by and for themselves
Raison d'être (1)

• LHC and CERN as a whole is a physics production machine
• ROOT is a major engine in that clockwork
• ROOT's impact
  • Experiments' data, 1Exabyte and counting
  • High energy physics' central standard library, from framework to analysis, from histogramming to graphics
Raison d'être (2)

• Experiments' frameworks benefit from ROOT

• ROOT's most relevant impact is with approx 30'000 physicists

• Improves physics results: uncertainties, parametrizations, convincing peers of the best analysis approach

• Makes physicists more productive: less coding or debugging, more thinking and trying approaches

• CERN Senior Staff ("The Nine"): "proliferation of different software tools and frameworks for scientific and non-scientific workflows"
ROOT Project in 2020: Feedback from Team
Strengths

Project-level Tasks

- Need more developers.
Project-level Tasks

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- Need more developers.
- Need more developers.

2020: Enrico (fellow) + three students...
Plan of Work 2020
Work Items

- [https://docs.google.com/spreadsheets/d/1h_6t8cTCACNApQQgCoLI8GjrlhmckDT46nceVCTE1Zg/edit?usp=sharing](https://docs.google.com/spreadsheets/d/1h_6t8cTCACNApQQgCoLI8GjrlhmckDT46nceVCTE1Zg/edit?usp=sharing)

- Please comment!
Main Development Lines

• Make new PyROOT default

• RDataFrame: **bulk** processing, **RNTuple** interplay

• Eve7: **fireworksWeb** for LHC Run3; ILC prototype

• C++ runtime modules for dictionary: MacOS, Windows, optimizations
I/O

- RNTuple: TTree -> RNTuple, hadd, efficient RDF integration
- Compression
- std::variant, std::optional, limited std::shared_ptr
Math

- TMVA inference
- RooFit speed-up, e.g. through architecture-specific code
- New minimizers, PRNGs
- RHist news: ILC contributions plus technical student!
Graphics, GUI

- Finalize crucial features: legend, palette, ...
- Make them "teachable"
- Basis for getting feedback
Graphics, GUI

void ntpl004_dimuon() {
    Convert();
    // Enable multi-threading only after the conversion because we use RDF’s Range() in it,
    // which currently does not support multi-threading
    ROOT::EnableImplicitMT();
    auto df = ROOT::Experimental::MakeNTupleDataFrame("Events", kNTupleFileName);
    // As of this point, the tutorial is identical to df102_NanoAODDimuonAnalysis except the
    // use of InvariantMassStdVector instead of InvariantMass
    // For simplicity, select only events with exactly two muons and require opposite charge
    auto df_2mu = df.Filter("nMuon == 2", "Events with exactly two muons");
    auto df_os = df_2mu.Filter("Muon_charge[0] != Muon_charge[1]", "Muons with opposite charge");
    // Compute invariant mass of the dimuon system
    auto df_mass = df_os.Define("Dimuon_mass", InvariantMassStdVector<float>, ["Muon_pt",
        "Muon_eta", "Muon_phi", "Muon_mass"]);
    auto df_mass = df_os.Define("eta_size", "Muon_mass.size()");
    // Make histogram of dimuon mass spectrum
    auto h = df_mass.Histo1D("Dimuon_mass", "Dimuon_mass", 36000, 0.25, 300, "Dimuon_mass");
    // Request cutflow report
    auto report = df_mass.Report();
}
Conclusion
ROOT in 2020

- Lots of work ahead of us:
  - Several major, multi-year development lines
  - Gradual release into production-grade ROOT, e.g. new PyROOT
  - Many ideas with lots of relevance for physicists - but not enough time!
- ROOT needs more hands:
  - Actively scouting, offering productive and welcoming environment
Thank you!

• Thank you for helping us by
  • Using ROOT!
  • Providing feedback!
  • Reporting bugs!
  • Handing in patches!
• We are working on ROOT for you:
  • Please continue pinging us if we don't get things right!
ROOT Workshop 2020

- At Fermilab!
- June 9-11, 2020
- https://cern.ch/root2020
Summary

• Appreciate excellent cooperation with experiments, including ROOT+experiments' meetings

• Expect several major developments in 2020:

  • Release new PyROOT, show-case RHist and graphics, exciting measurements + features for RNTuple!