ROOT's 2019 Plan of Work

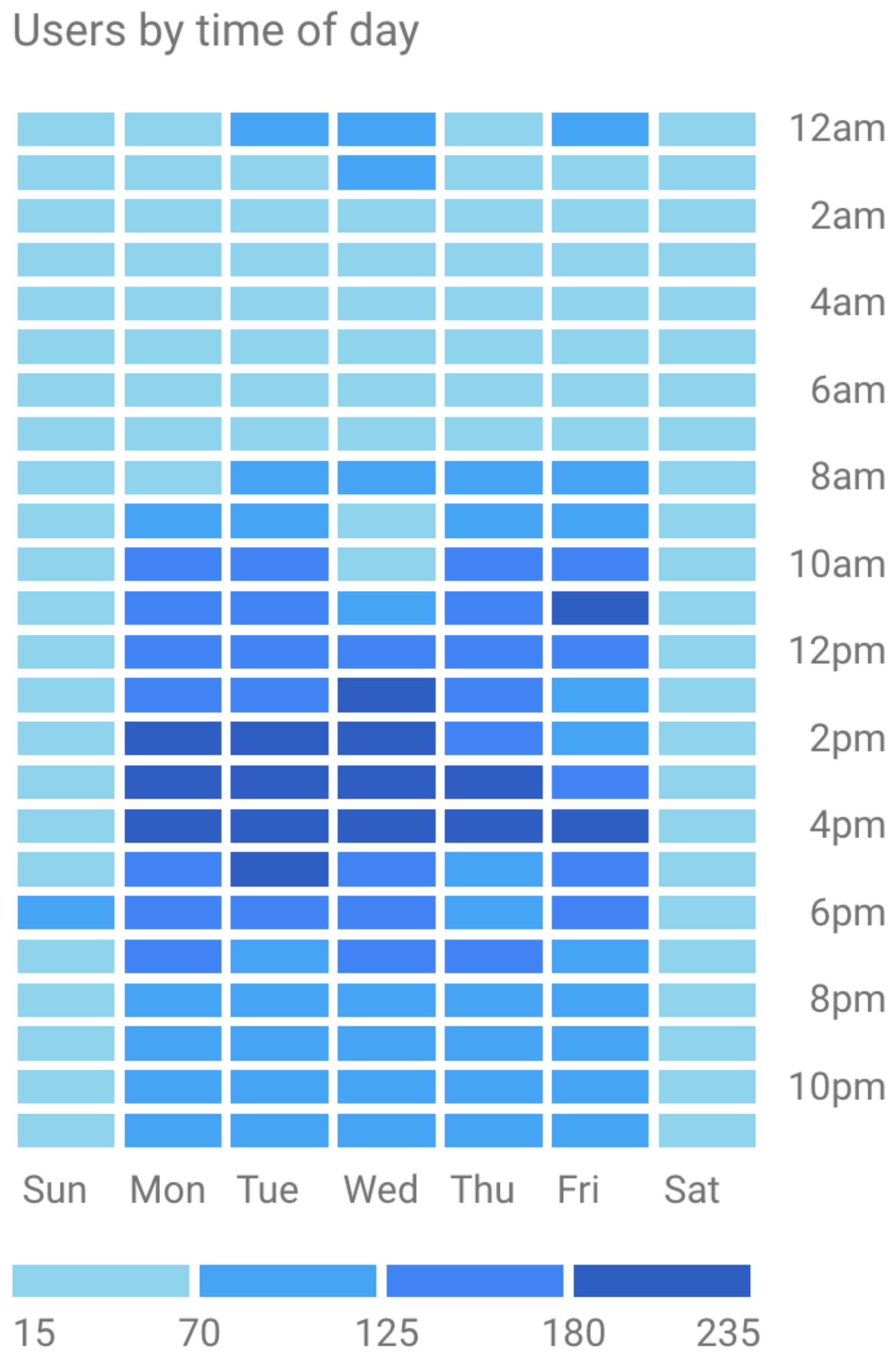
Axel Naumann for the ROOT team, SFT group meeting, 2019-02-11

Team: varying fractions of 20 people

- Kim Albertsson, CERN
- Guilherme Amadio, CERN
- Sitong An, CERN
- Bertrand Bellenot, CERN
- Iliana Betsou, CERN
- Philippe Canal, Fermilab
- Olivier Couet, CERN
- Enrico Guiraud, CERN
- Stephan Hageböck, CERN
- Sergey Linev, GSI
- Lorenzo Moneta, CERN
- Alja Mrak Tadel, UCSD
- Axel Naumann, CERN
- Danilo Piparo, CERN
- Oksana Shadura, Uni Nebraska Lincoln
- Matevz Tadel, UCSD
- Yuka Takahashi, CERN+Uni Cincinnati
- Enric Tejedor, CERN
- Stefan Wunsch, CERN

User Support: https://root-forum.cern.ch, JIRA, emails

- Enormous time sink, but **KEY** feature of ROOT
- Weekly shifts covering forum, PRs, tests
- Stats for last 52 weeks:
  - 520 new bugs vs 500 fixed
  - forum: 14'000 posts! 1'300 new users (totaling 13'000), 30'000 page views / week! During weekdays, average first response <4h



Lively community

- Contribute Fedora, Arch, Gentoo, Conda packages
- 25 active authors last month; 350 commits to master
- ROOT's Mattermost channels have 199 members - lots of activity
- 1800 pull requests in 1 year! Using Jenkins to the max:
  PR checks, incrementals, nightlies, daily release snapshots

2019

The Themes

- **User support**
- **Robustness** (see e.g. new interfaces, testing, bug fixes)
- **Ease of use** (see e.g. RDF, TMVA)
- **Performance** (see e.g. RooFit, benchmarking)
- Whatever actually helps analyses!

TMVA

- Ease of use: interoperability (ROOT, numpy, current TMVA, sklearn, ...); support inference with externally trained models
  - Python-like C++ vector with shape info; Numpy arrays as input in Python
  - modularize Factory / Reader steps
- Performance: fast inference/application, high-throughput and low-latency, consistent across models / tools
- Focus on HEP-specific statistical compatibility checks (Kolmogorov–Smirnov), externalize / deprecate others (TMVA GUI)

RooFit

- Ease of use: improved python and collection interfaces
- Performance: less virtual calls, cache friendly, bulk data; parallelization of sub-tasks (e.g. PDF normalization)
- Robustness: test coverage, benchmarks
- More minimizers (GSL, scipy.optimize?)

Math

- Implement fitting for new histograms; collect usage feedback
- PRNG: VecMath-based, common for ROOT and Geant4/V; vectorized + MT-enabled; all standard algorithms; wrapped by ROOT
    - for ROOT, add RanLux++ and update RunLux implementation
- Investigate new minimizers, see scipy.optimize

WebGraphics, WebGUI, WebEve

- Provide "minimum viable product" for histogram graphics
- Decide on new default graphics style
- RFitPanel, RBrowser, file dialog; embedding in JupyterLab
- Eve7: a working prototype, coordinating with CMS Fireworks-Web development
- Testing

I/O

- Parallelism bottlenecks, TTreeReader performance fixes; parallel merger
- Consolidate tests and benchmarks
- RForest prototype and tutorials
- Explicit error handling for I/O
- Compression: rationalize compression setting, LZ4 (+Bitshuffle) default, CloudFlare zlib, investigate ZSTD
- std::shared_ptr, std::variant

Analysis tools: RDataFrame

- Nested loops, multi-dim (esp 2D) arrays for C++: RTensor
- Improved integration with Python, RHist, RForest
    - prototype CUDA RDaraFrame kernel "fed" from RForest!
- Bulk-I/O RDataFrame; dissolve event boundary
- Multi-dim category operations: pT-bins, sample, data/MC,...; including dedicated weights and systematic uncertainties

More modern and pythonic PyROOT

- Experimental pyroot (with current cppyy) to become default
- Improved pythonizations
    - extensible decoration mechanism; provide more + document + test
- Pythonic RooFit
- Multi-version PyROOT installs: multiple Python versions, multiple ROOT versions

Modules

- Serve as performance improvement for frameworks
- Complete features to enabled by default: all of ROOT, all platforms, incremental builds
- Optimize performance
- Help adoption by experiments' frameworks

Lazy builds, CMake, Platforms

- Ease of use, robustness: build / update parts of ROOT on top of existing build
- Robustness: re-define CMake interface for enabling / disabling parts
    - make fail-on-missing default, feature-based ("xmlio") not dependency-based ("libxml2")
- Ease of use: update packaging for deb (+ Ubuntu PPA?), rpm, MacOS
- Robustness: benchmark coverage + tracking, enable (+fix!) sanitizer builds
- Windows: finalize 32bit; prototype 64bit

Documentation + Training

- One day "train the trainer" event to spread the news + collect feedback
- `root [0] .help TTree`
- Rewrite crucial classes' documentation, rewrite old tutorials
- Prepare ROOT website generated from git (move away from Drupal)
    - focus on crucial, updated pages

Summary

- **User support**
- **Robustness** (see e.g. new interfaces, testing, bug fixes)
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- **Performance** (see e.g. RooFit, benchmarking)

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Plan

- Detailed work items at https://docs.google.com/spreadsheets/d/1u5R-YIOMDb-SXqVa4acUFOIcIn2U4thH-Aa0l0kG-ag/edit?usp=sharing
    - comments welcome!
- ROOT/Experiments meetings for significant updates
    - progress, change of focus
    - your requests
- I.e. as always!