



ROOT – A C++ framework for petabyte data storage, statistical analysis and visualization ☆

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ABSTRACT

A new stable version (“production version”) v5.28.00 of ROOT [1] has been published [2]. It features several major improvements in many areas, most noteworthy data storage performance as well as statistics and graphics features. Some of these improvements have already been predicted in the original publication Antcheva et al. (2009) [3]. This version will be maintained for at least 6 months; new minor revisions (“patch releases”) will be published [4] to solve problems reported with this version.

New version program summary

Program title: ROOT

Catalogue identifier: AEFA_v2_0

Program summary URL: http://cpc.cs.qub.ac.uk/summaries/AEFA_v2_0.html

Program obtainable from: CPC Program Library, Queen’s University, Belfast, N. Ireland

Licensing provisions: GNU Lesser Public License v2.1

No. of lines in distributed program, including test data, etc.: 2 934 693

No. of bytes in distributed program, including test data, etc.: 1009

Distribution format: tar.gz

Programming language: C++

Computer: Intel i386, Intel x86-64, Motorola PPC, Sun Sparc, HP PA-RISC

Operating system: GNU/Linux, Windows XP/Vista/7, Mac OS X, FreeBSD, OpenBSD, Solaris, HP-UX, AIX

Has the code been vectorized or parallelized?: Yes

RAM: > 55 Mbytes

Classification: 4, 9, 11.9, 14

Catalogue identifier of previous version: AEFA_v1_0

Journal reference of previous version: Comput. Phys. Commun. 180 (2009) 2499

Does the new version supersede the previous version?: Yes

Nature of problem: Storage, analysis and visualization of scientific data

Solution method: Object store, wide range of analysis algorithms and visualization methods

Reasons for new version: Added features and corrections of deficiencies

Summary of revisions: The release notes at <http://root.cern.ch/root/v528/Version528.news.html> give a module-oriented overview of the changes in v5.28.00. Highlights include

- **File format** Reading of TTrees has been improved dramatically with respect to CPU time (30%) and notably with respect to disk space.

☆ This paper and its associated computer program are available via the Computer Physics Communications homepage on ScienceDirect (<http://www.sciencedirect.com/science/journal/00104655>).

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- **Histograms** A new TEfficiency class has been provided to handle the calculation of efficiencies and their uncertainties, TH2Poly for polygon-shaped bins (e.g. maps), TKDE for kernel density estimation, and TSVDUnfold for singular value decomposition.
- **Graphics** Kerning is now supported in TLatex, PostScript and PDF; a table of contents can be added to PDF files. A new font provides italic symbols. A TPad containing GL can be stored in a binary (i.e. non-vector) image file; add support for full-scene anti-aliasing. Usability enhancements to EVE.
- **Math** New interfaces for generating random number according to a given distribution, goodness of fit tests of unbinned data, binning multidimensional data, and several advanced statistical functions were added.
- **RootFit** Introduction of HistFactory; major additions to RooStats.
- **TMVA** Updated to version 4.1.0, adding e.g. the support for simultaneous classification of multiple output classes for several multivariate methods.
- **PROOF** Many new features, adding to PROOF's usability, plus improvements and fixes.
- **PyROOT** Support of Python 3 has been added.
- **Tutorials** Several new tutorials were provided for above new features (notably RooStats).

A detailed list of all the changes is available at <http://root.cern.ch/root/html/doc/examples/V5>.

Additional comments: For an up-to-date author list see: <http://root.cern.ch/drupal/content/root-development-team> and <http://root.cern.ch/drupal/content/former-root-developers>.

The distribution file for this program is over 30 Mbytes and therefore is not delivered directly when download or E-mail is requested. Instead a html file giving details of how the program can be obtained is sent.

Running time: Depending on the data size and complexity of analysis algorithms.

References:

[1] <http://root.cern.ch>.

[2] <http://root.cern.ch/drupal/content/production-version-528>.

[3] I. Antcheva, M. Ballintijn, B. Bellenot, M. Biskup, R. Brun, N. Buncic, Ph. Canal, D. Casadei, O. Couet, V. Fine, L. Franco, G. Ganis, A. Gheata, D. Gonzalez Maline, M. Goto, J. Iwaszkiewicz, A. Kreshuk, D. Marcos Segura, R. Maunder, L. Moneta, A. Naumann, E. Offermann, V. Onuchin, S. Panacek, F. Rademakers, P. Russo, M. Tadel, ROOT – A C++ framework for petabyte data storage, statistical analysis and visualization, *Comput. Phys. Commun.* 180 (2009) 2499.

[4] <http://root.cern.ch/drupal/content/root-version-v5-28-00-patch-release-notes>.

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