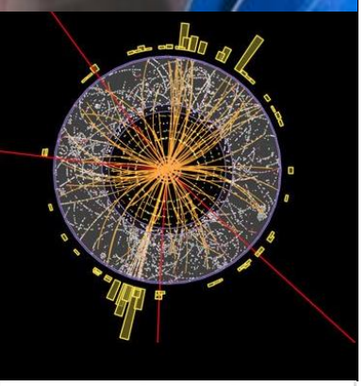
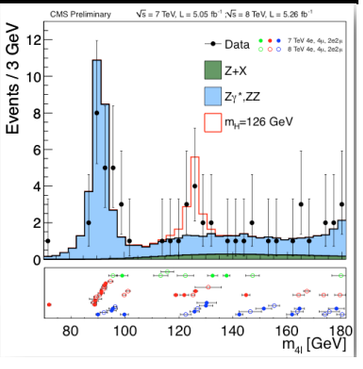
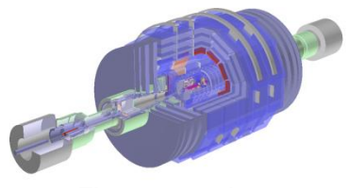






Firstname Lastname
CERN PH-SFT
CH-1211 Geneva 23
sftweb.cern.ch
root.cern.ch

PROOF Basics

ROOT Tutorials

2013

Open a PROOF-Lite session

- To start a PROOF-Lite session

```
$ root -l
root [0] TProof::Open("")
 +++ Starting PROOF-Lite with 2 workers +++
Opening connections to workers: OK (2 workers)
Setting up worker servers: OK (2 workers)
PROOF set to parallel mode (2 workers)
(class TProof*)0x8330140
root [1] gProof
(class TProof*)0x8330140
```

- Now we are ready to go
- gProof is a global instance of TProof
- … but what's TProof ?

TProof: the PROOF shell

- TProof is the interface class to interact with the PROOF session
- Everything in the session is done via TProof
  - Print(), gives information about the session
  - Process(), allows to run a TSelector
  - GetOutputList(), returns the list of output objects
  - DrawSelect(), draws distributions
  - …
- … and many others. Check:

http://root.cern.ch/root/html/TProof.html

TProof::Print()

- Gives information about the session

```
$ root [1] gProof->Print()
*** PROOF-Lite cluster (parallel mode, 2 workers):
Host name:                      macphsft12.local
User:                           ganis
ROOT version|rev|tag:           5.32/02|r43514
Architecture-Compiler:          macosx64-gcc421
Protocol version:               33
Working directory:              /Users/ganis/local/root/opt/root
Communication path:
/var/folders/uC/uC0RGjQUFlmzR689bg+JJU++0gQ/-Tmp-/plite-38583
Log level:                      0
Number of workers:              2
Number of active workers:   2
Number of unique workers:   1
Number of inactive workers: 0
Number of bad workers:          0
Total MB's processed:           0.00
Total real time used (s):   0.000
Total CPU time used (s):    0.000
```

Ordinal numbers and sandbox

Ordinal numbers

- Unique identifier
  - 0.n for workers (master is always 0)

- The sandbox
  - Location controlled by Proof.Sandbox

    Proof.Sandbox */my/special/sandbox*
  - Defaults
    - $HOME/.proof (standard PROOF)
    - $HOME/.proof/path-where-we-started (PROOF-Lite)

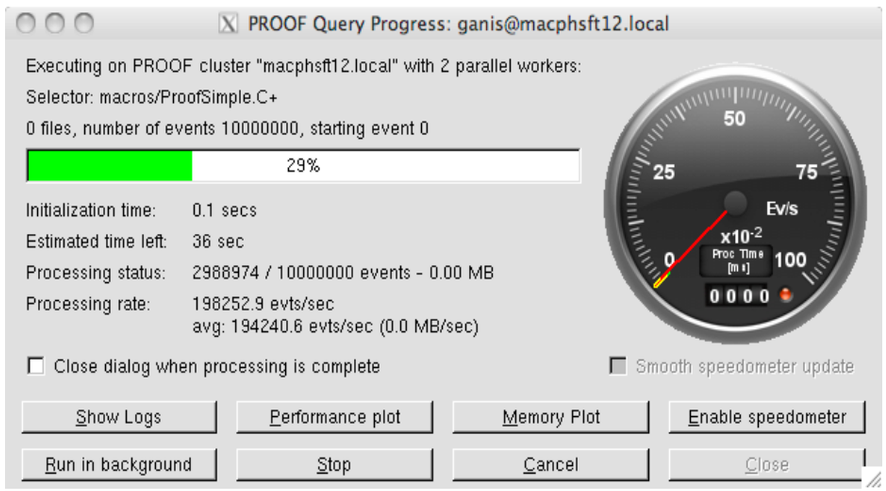
Sandbox content

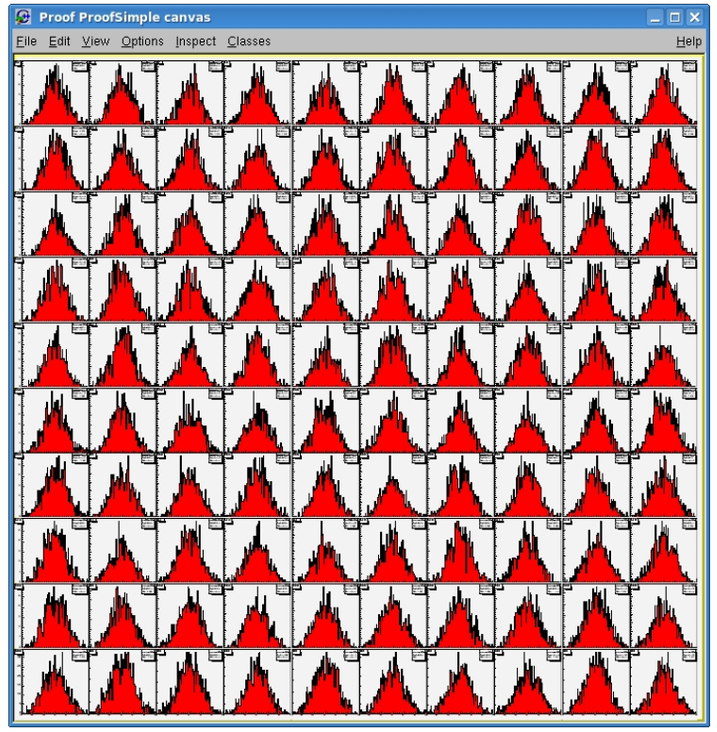
- cache
  - for package tarballs, code, binaries
- packages
  - where packages are actually build
- queries (master or PROOF-Lite only)
  - where the results from queries are stored
- datasets (master or PROOF-Lite only)
  - where information about datasets is stored
- session-*SessionUniqueID*
  - Working area (logs, …) for session *SessionUniqueID*

First processing (first exercise)

- The file ProofSimple.C,.h define a TSelector which fills 100 histograms with gaussion random numbers

```
root[] gProof->SetParameter("ProofSimple_Nhist", (Long_t)100)
root[] gProof->Process("ProofSimple.C+",10000)
```

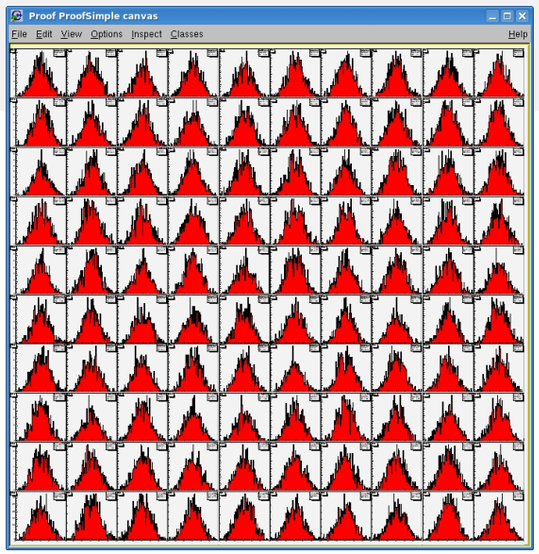




The same without PROOF

- Repeat on the local session

```
root[] TProofPlayerLocal *p = new TProofPlayerLocal()
root[] p->AddInput( \
          new TParameter<Long_t>("ProofSimple_Nhist", 100)
root[] p->Process("ProofSimple.C+",10000)
```

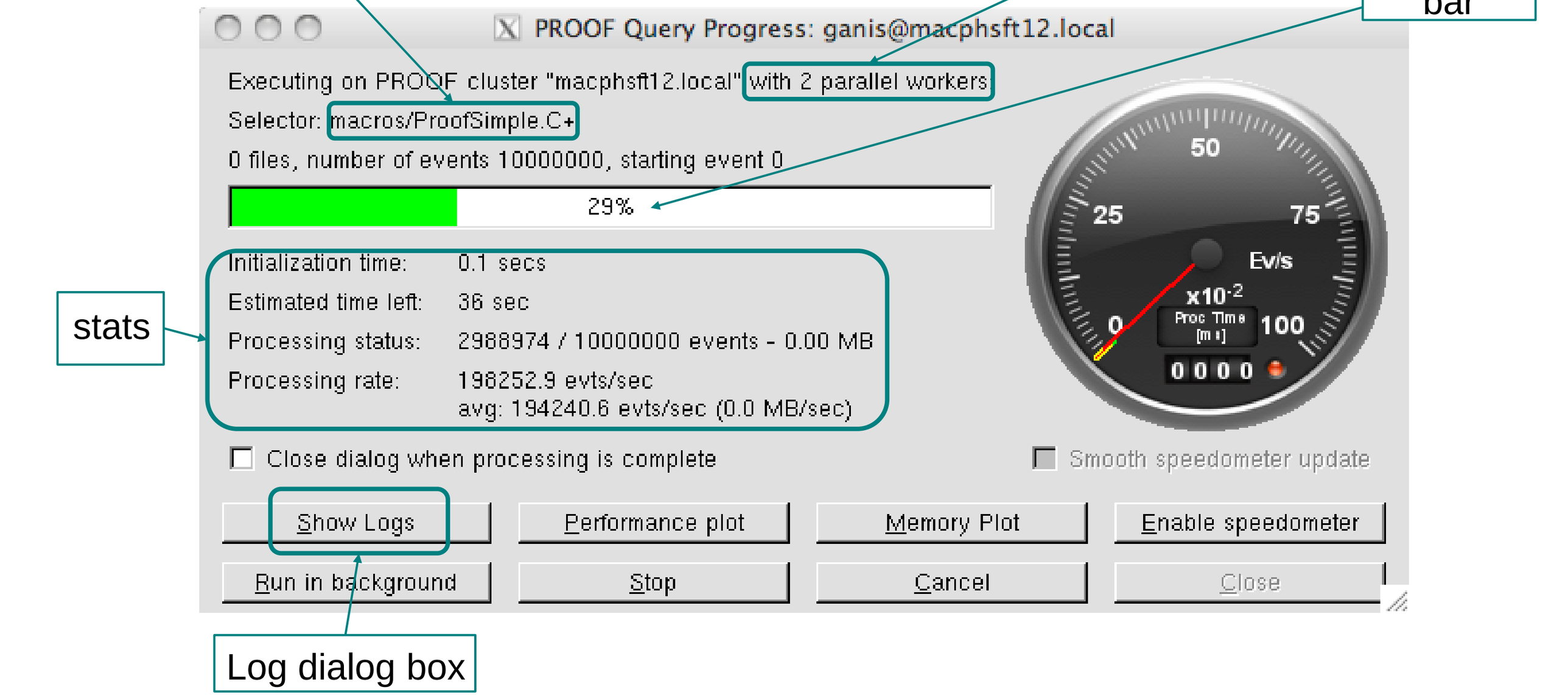


- Try to measure the time with gROOT->Time()
  - What do you find?

TProofBench: another exercise

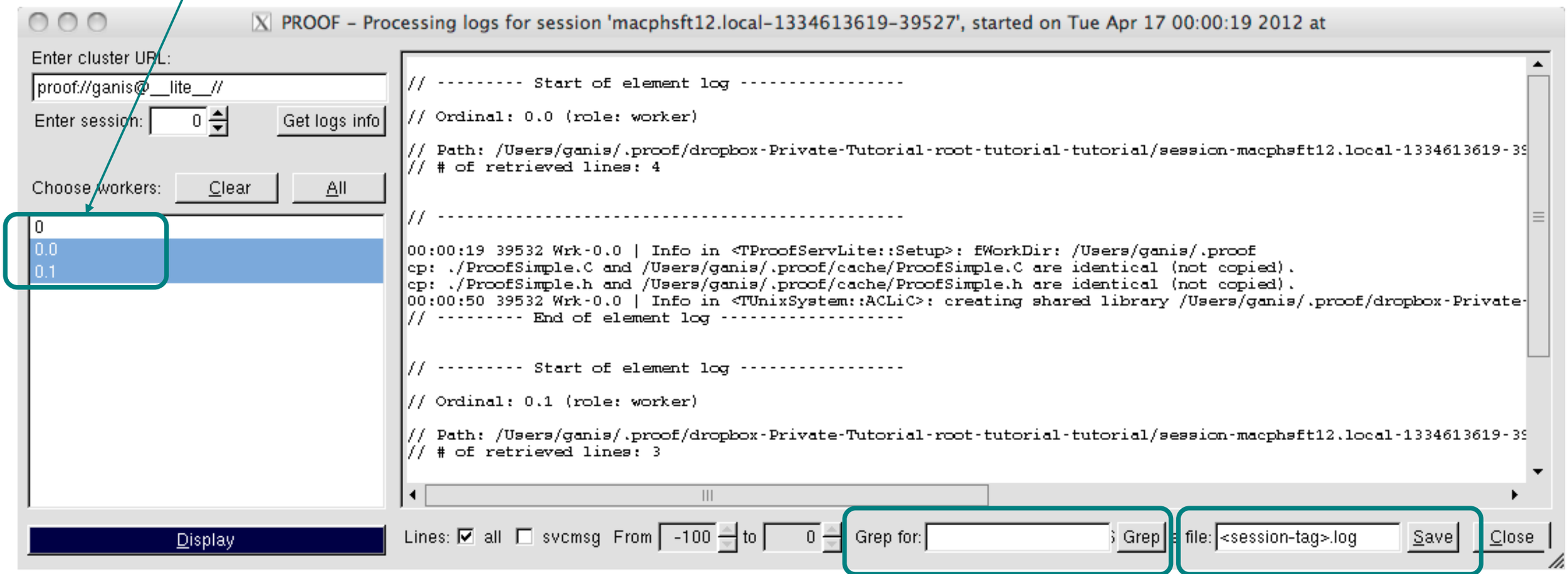
- TProofBench is a tool to benchmark a PROOF cluster (lite or full installation)
- Framework for CPU-intensive and I/O-intensive scalability tests
- Default benchmarks
  - CPU-intensive
    - Random number generation
  - I/O-intensive
    - Readout TTrees based on $ROOTSYS/test/Event.C,.h
- Exercise 14b

The dialog box



The log dialog box

Select logs to display



Can be started also with TProof::fLogViewer

Grep functionality

Save to a file

Where are the results?

- In the output list

```
root [] gProof->GetOutputList()
(class Tlist*)0x89eae58
root [] gProof->GetOutputList()->ls()
OBJ: TStatus    PROOF_Status      : 0 at: 0x8a264a8
OBJ: TH1F       h0       h0 : 0 at: 0x89d5b48
OBJ: TH1F       h1       h1 : 0 at: 0x8a22de0
OBJ: TH1F       h2       h2 : 0 at: 0x8a21f88
OBJ: TH1F       h3       h3 : 0 at: 0x8a215f8
OBJ: TH1F       h4       h4 : 0 at: 0x8a24100
OBJ: TH1F       h5       h5 : 0 at: 0x8a288b8
OBJ: TH1F       h6       h6 : 0 at: 0x8a31c20
...
OBJ: TH1F       h96      h96 : 0 at: 0x89e9b38
OBJ: TH1F       h97      h97 : 0 at: 0x89ea000
OBJ: TH1F       h98      h98 : 0 at: 0x89ea4c8
OBJ: TH1F       h99      h99 : 0 at: 0x89ea990
root []
```

Processing data: EventData example

- Generate a few files, for example 10

```
root [] .L CreateEventTree.C
root [] Int_t i = 0;
root [] for(;i<10;++i){\
          CreateEventTree(Form("data/evtree_%d",i));}
```

- Create a chain

```
root [] TChain c("tree")
root [] for(i=0;i<10;++i){\
 c.AddFile(Form("file:///home/user/data/evtree_%d",i));}
```

- Process the chain inside PROOF

```
root [] c.SetProof()
root [] c.Process("EventDataSelector.C+")
```

Processing data: EventData example

- Use gROOT->Time() to measure speed-up
  - No PROOF

```
root [] c.SetProof(0)
root [] gROOT->Time();
root [] c.Process("EventDataSelector.C+")
```

  - PROOF

```
root [] c.SetProof()
root [] gROOT->Time();
root [] c.Process("EventDataSelector.C+")
```

TFileCollection: the dataset

- The concept of dataset is very useful in HEP: it refers to a set of files containing homogeneous data
  - e.g. all the data taken during Summer 2009 under uniform detector conditions.
- Is useful to refer to a dataset by name

- TFileCollection: named list of TFileInfo
- TFileInfo: most generic way of describing a file
  - Multiple URLs, meta-information

- A TFileCollection is the typically the result of a query to a catalog

Datasets in PROOF

- TProof has a set of methods to perform basic operations on datasets
  - RegisterDataSet(const char *name, TFileCollection *)
  - VerifyDataSet(const char *name)
  - ShowDataSets()
  - TFileCollection *GetDataSet(const char *name)
  - ...
- The name is in the form /group/user/*datasetname*
  - 'group' is an advanced PROOF concept: by default anybody is in group 'default'

Register / verify a dataset

- Second part of Exercise 14c
- Create a dataset for the files we used in the previous example
- Register and Verify it
- Process the dataset ‘by name’

Loading additional code

- When the selector needs additional code - for example a new class defined in the files MyClass.C and MyClass.h – PROOF provides two ways to make it available
  - gProof->Load("MyClass.C")
    - Equivalent of .L on the ROOT shell
    - Convenient for simple things
  - Package ARchives (PAR)
    - Structured archives with build and setup facilities
    - Convenient for more complex and stable things, e.g. the experiment analysis suite

PARs

- Zipped tarballs identified by a name and the .par extension, e.g. *pack*.par
- The tarball contains a structure like this

```
./pack
./pack/PROOF-INF
./pack/PROOF-INF/BUILD.sh
./pack/PROOF-INF/SETUP.C
```

- The code (.C, .h, makefiles, ...) should be put in the top level directory
- BUILD.sh: script to build the package, e.g. runs 'make'
- SETUP.C: is a macro running the final setup

Pythia8 example

- This is en example of running a real Monte Carlo simulation in PROOF
  - Pythia8 is the first usable C++ version of a famous HEP generator
- It needs a PAR file to setup the environment
- To run the example we need to link to pythia8
  - Available under /cvmfs/sft.cern.ch/lcg/dev

pythia8.par

```
$ tar tzvf par/pythia8.par
drwxr-xr-x mslawins/sf       0 2008-07-03 19:45 pythia8/
-rw-r--r-- mslawins/sf    1521 2008-07-03 19:45 pythia8/main03.cmnd
drwxr-xr-x mslawins/sf       0 2008-07-03 19:46 pythia8/PROOF-INF/
-rw-r--r-- mslawins/sf     233 2008-07-03 19:46 pythia8/PROOF-INF/SETUP.C
```

```
void SETUP()
{
   // Load the libraries

   gSystem->Load("$PYTHIA8/lib/libpythia8.so");
   gSystem->Load("libEG");
   gSystem->Load("libEGPythia8");

   // Set the include paths
   gROOT->ProcessLine(".include $PYTHIA8/include");
}
```

Pythia8 exercise

- Exercise 14d
- Download the pythia8.par and the related selectors
- Run the code to produce the following plot

Summary

- We have seen the basic concepts of PROOF
  - How to run a selector for a CPU intensive job
  - How to process a TChain
  - How to do the same from a named dataset
  - How to use a PAR file