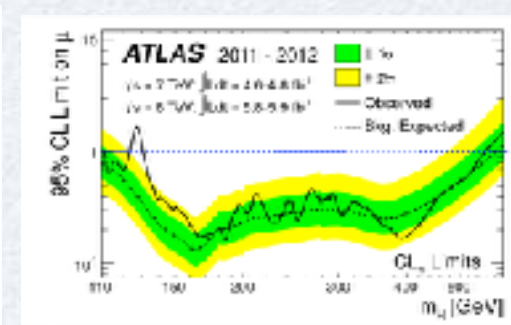
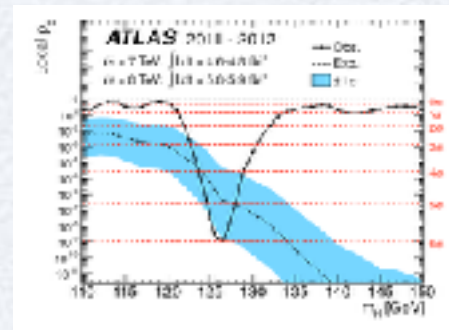
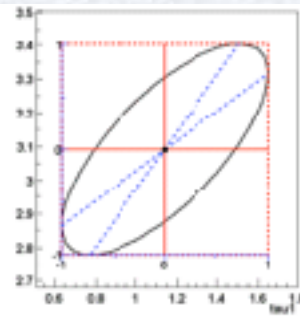
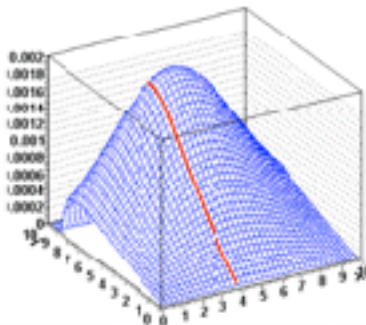
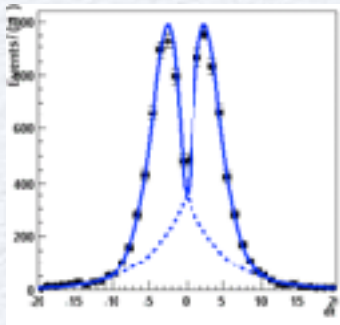


Statistics for Particle Physics Analyses: Introduction to Computing Examples

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CERN Academic Training November 2016



Computing Examples

- Work on computing examples based on ROOT including RooFit and RooStats
- Examples are interactive demos made of notebooks
- Running an a new CERN notebook service
 - **SWAN** (swan.cern.ch)
 - files will be stored in **cernbox**
- Log-in into SWAN using your cern credential
 - if you don't have **cernbox**, a link to create it is automatically provided
 - if you don't have a CERN computing account, some special accounts are provided for the course

SWAN

- swan.cern.ch



Starting SWAN

make sure to have selected
the default 86 version

SWAN Customisation

Specify the parameters that will be used to contextualise the container which is created for you. See [the online SWAN guide](#) for more details.

Software stack [more...](#)

86

Platform [more...](#)

x86_64-slc6-gcc49-opt

Environment script [more...](#)

e.g. `$CERNBOX_HOME/MySWAN/myscript.sh`

Number of cores [more...](#)

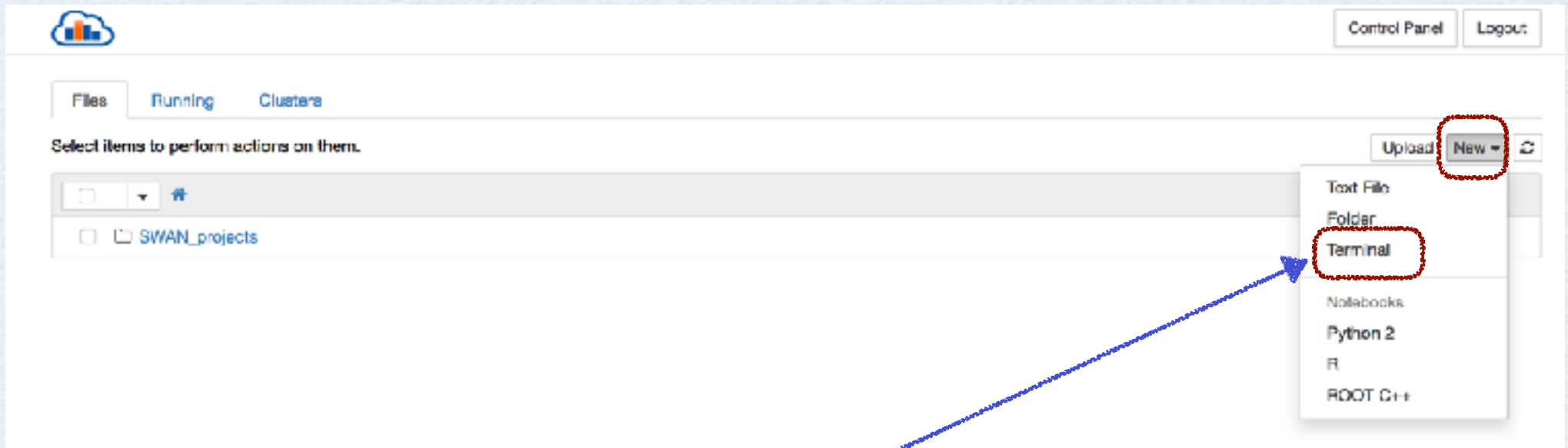
1

Start my Session

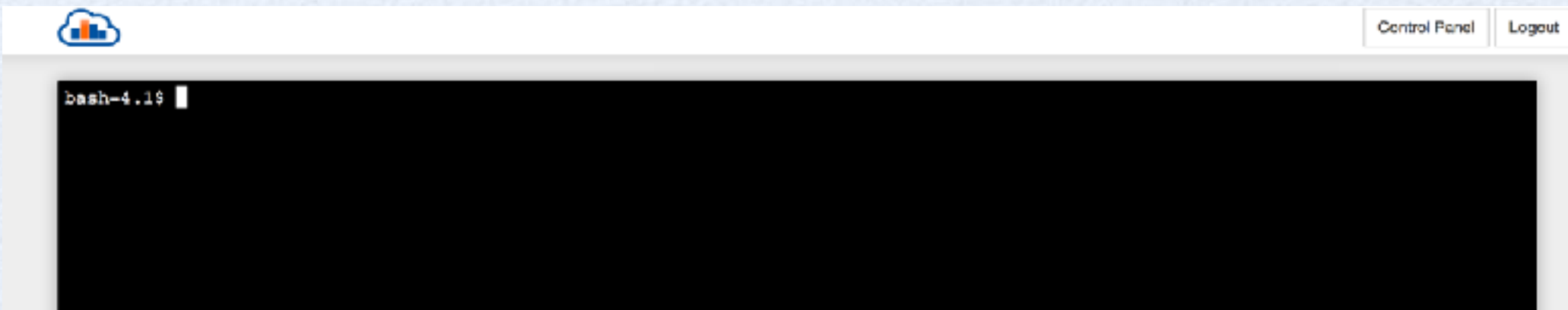
click here to start

Starting a Terminal in SWAN

After login cernbox home directory will be visible



Start a terminal window



Downloading the Notebooks

- After starting the terminal, download the notebooks for today's session.
- Download from my Web page using *wget*:

```
wget http://www.cern.ch/moneta/swan/Day1.tar.gz
```

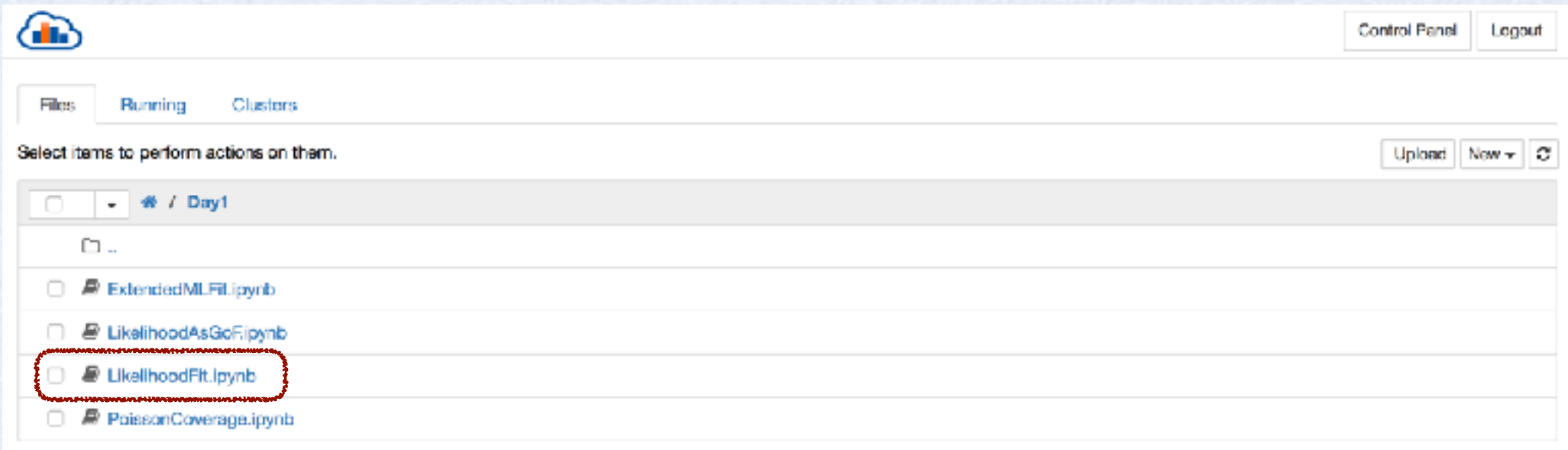
```
bash-4.1$ wget -nv http://www.cern.ch/moneta/swan/Day1.tar.gz
2016-11-27 12:30:53 URL:http://moneta.web.cern.ch/moneta/swan/Day1.tar.gz [200496/200496] -> "Day1.tar.gz" [1]
bash-4.1$ ls
Day1.tar.gz  SWAN_projects
bash-4.1$ tar -zxvf Day1.tar.gz
Day1/
Day1/ExtendedMLFit.ipynb
Day1/LikelihoodAsGoF.ipynb
Day1/LikelihoodFit.ipynb
Day1/PoissonCoverage.ipynb
bash-4.1$
```

- untar the downloaded archive file

```
tar -zxvf Day1.tar.gz
```

Starting a Notebook

- After downloaded and extracted the notebooks, go back to SWAN home page and select the desired notebook



The screenshot shows the SWAN interface. At the top left is a logo with a cloud and a bar chart. At the top right are buttons for 'Control Panel' and 'Logout'. Below the logo are tabs for 'Files', 'Running', and 'Clusters'. A message says 'Select items to perform actions on them.' with buttons for 'Upload', 'New', and a refresh icon. The main area shows a file browser for 'Day1' with a list of notebooks: 'ExtendedMLFit.ipynb', 'LikelihoodAsGoF.ipynb', 'LikelihoodFit.ipynb' (highlighted with a red dashed box), and 'PoissonCoverage.ipynb'.

Starting a Notebook

LikelihoodFit (autosaved) Control Panel Logout

File Edit View Insert Cell Kernel Help Connecting to kernel ROOT C++ \$3

CellToolbar

Likelihood fit to exponential data

This notebook shows how to perform a likelihood fit to a data sample distributed according to an exponential distribution. The data sample consists of n events (e.g. $n=20$) generated randomly using the ROOT exponential random number generator. A negative log-likelihood function is constructed using the given data set. The log-likelihood function is a function of the fit parameter τ , which is the slope of the exponential distribution and the minimum of the function is found using simple tools provided by ROOT.

The example shows also how to estimate the error of the parameter using both the second derivative of the log-likelihood function or the $\Delta\ln L=0.5$ rule. By increasing the number of generated events one can see how the likelihood shape approaches a parabola and the errors estimated in the two methods become equal.

1. Event generation

First we generate n events using an exponential distribution with mean life $\tau=2$

```
In [1]: int n = 20;
double tau = 2;
std::vector<double> x(n);
TRandom3 r(0);
for (int i = 0; i < n; ++i)
    x[i] = r.Exp(tau)
```

```
In [2]: // comment this line for avoiding printing the random generated values
x
```

```
{std::vector<double> &} { 0.736121, 0.257743, 0.211415, 2.53096, 0.656154, 0.237043, 2.76202, 0.672238, 1.22943, 0.15
9545, 8.65069, 0.146272, 2.50028, 3.00072, 0.492201, 0.766004, 2.56399, 1.05053, 0.126264, 0.492685 }
```

References

- Presentation about Jupiter notebooks and SWAN
 - <https://cernbox.cern.ch/index.php/s/cpqdIOaNIwrlzJu>
- Basics of ROOT for fitting
 - <https://cernbox.cern.ch/index.php/s/SjJnYSkJrY9Kv8y>
- RooFit tutorial slides
 - <https://cernbox.cern.ch/index.php/s/kzGv4406IrpFpVM>
- RooStats tutorial slides
 - <https://cernbox.cern.ch/index.php/s/9DWJCObingTWB3r>