



# DØ Data Analysis with ROOT

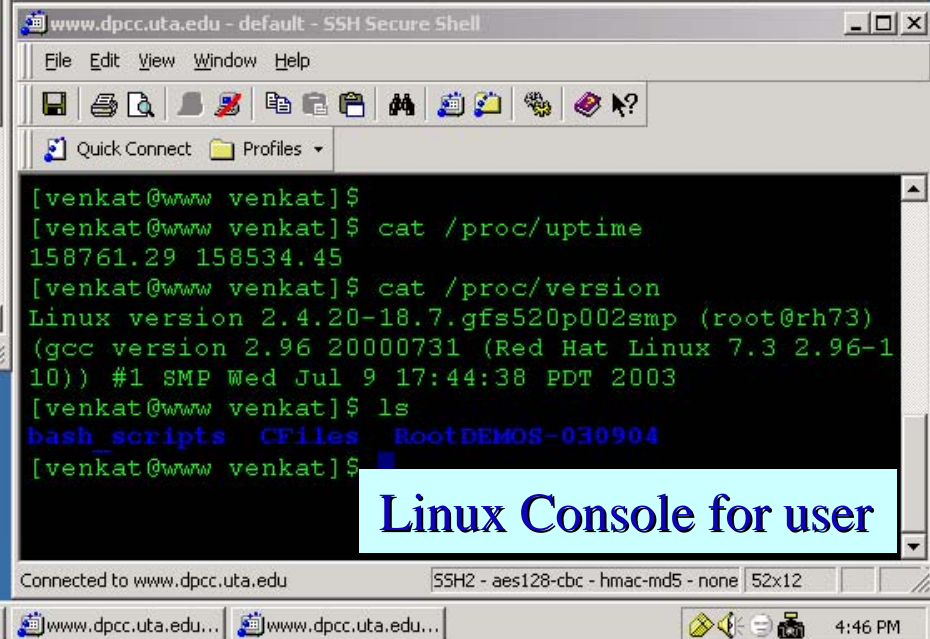
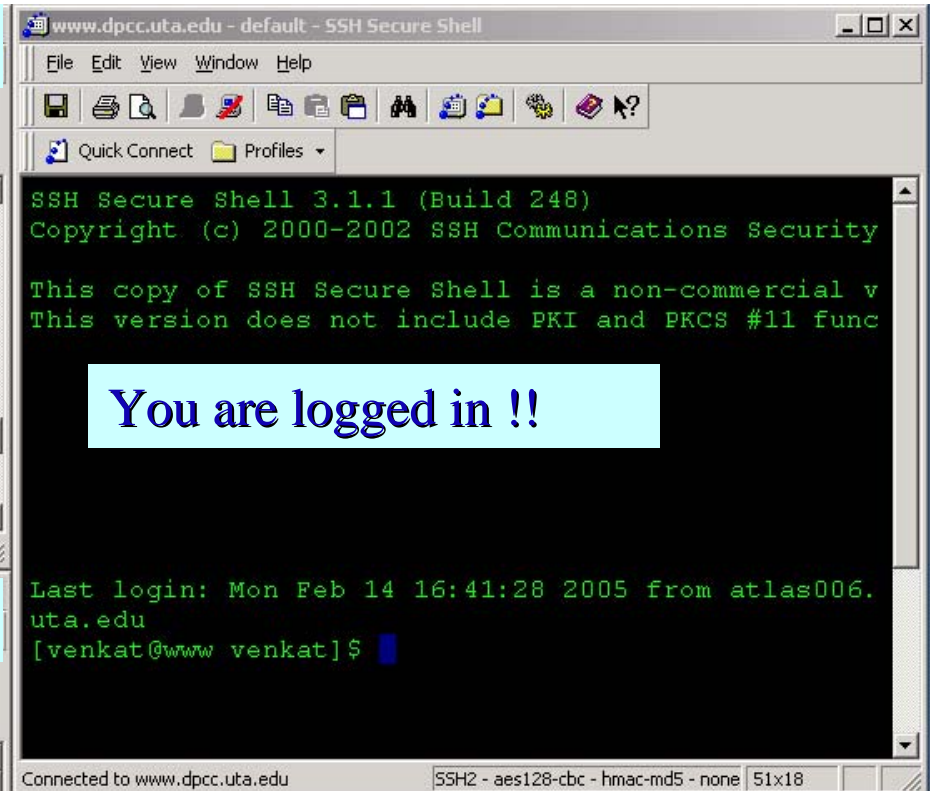
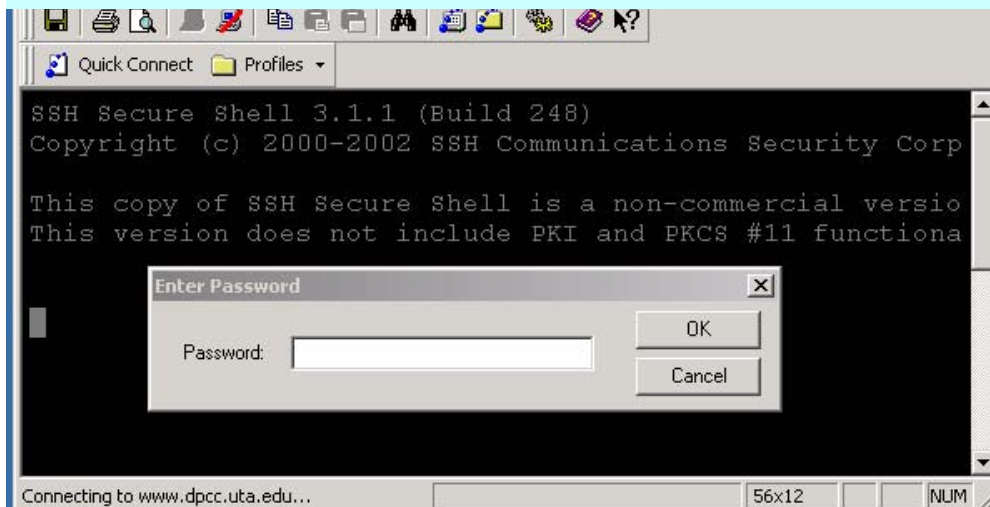
Venkat (for Dr. Yu)

02-16-05

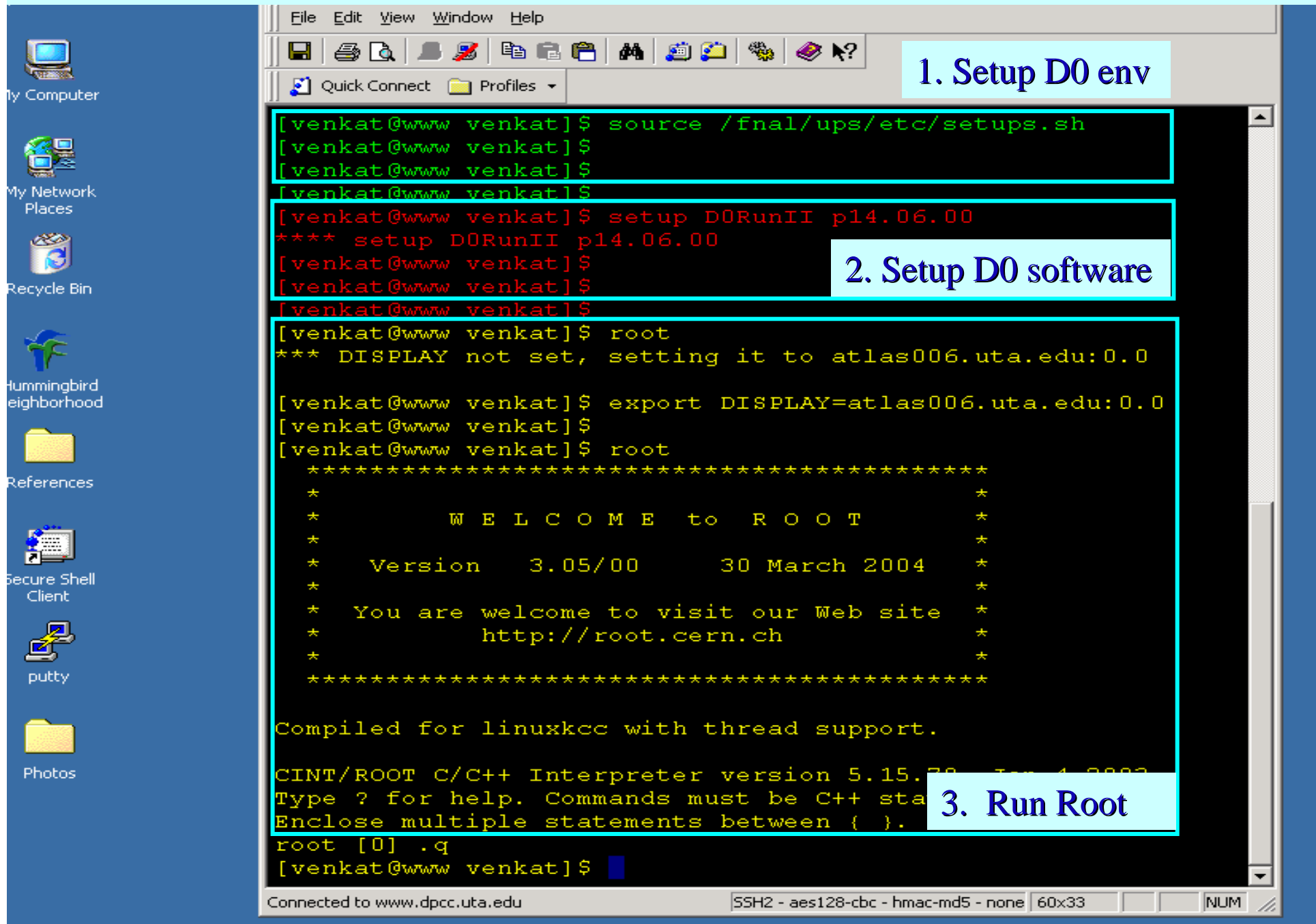
## Enter hostname username and click Connect



## Enter password, Click OK



IP Address for your machine is given on the top left hand corner of your monitor



The screenshot shows a Windows desktop with a terminal window open. The desktop has icons for 'My Computer', 'My Network Places', 'Recycle Bin', 'Hummingbird neighborhood', 'References', 'Secure Shell Client', 'putty', and 'Photos'. The terminal window has a menu bar (File, Edit, View, Window, Help) and a toolbar. The terminal output shows the following commands and their results:

```
[venkat@www venkat]$ source /fnal/ups/etc/setups.sh
[venkat@www venkat]$
[venkat@www venkat]$
[venkat@www venkat]$
[venkat@www venkat]$ setup D0RunII p14.06.00
**** setup D0RunII p14.06.00
[venkat@www venkat]$
[venkat@www venkat]$
[venkat@www venkat]$ root
*** DISPLAY not set, setting it to atlas006.uta.edu:0.0

[venkat@www venkat]$ export DISPLAY=atlas006.uta.edu:0.0
[venkat@www venkat]$
[venkat@www venkat]$ root
*****
*                                     *
*           W E L C O M E   t o   R O O T           *
*                                     *
*   Version   3.05/00       30 March 2004           *
*                                     *
*   You are welcome to visit our Web site           *
*           http://root.cern.ch                     *
*                                     *
*****

Compiled for linuxkcc with thread support.

CINT/ROOT C/C++ Interpreter version 5.15.72 - Jan 4 2002
Type ? for help. Commands must be C++ statements.
Enclose multiple statements between { }.

root [0] .q
[venkat@www venkat]$
```

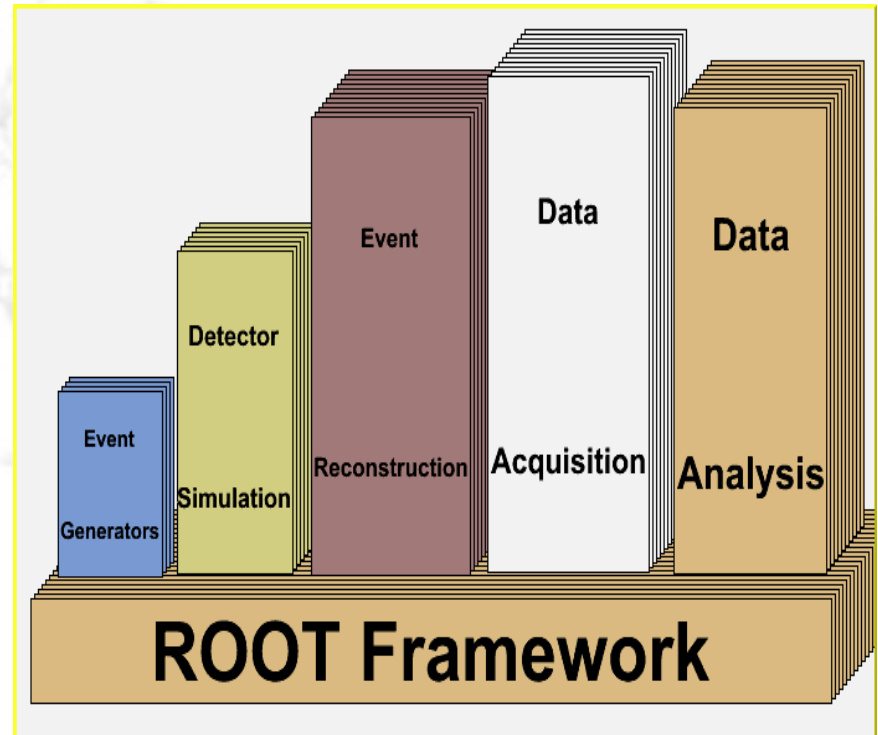
Three callout boxes are present:

- 1. Setup D0 env** (top right)
- 2. Setup D0 software** (middle right)
- 3. Run Root** (bottom right)

The terminal window status bar at the bottom shows: 'Connected to www.dpcc.uta.edu', 'SSH2 - aes128-cbc - hmac-md5 - none', '60x33', and 'NUM'.

# ROOT- Architecture

- The ROOT system provides a set of OO framework
- Histogramming methods in 1, 2 and 3 dimensions
- Curve Fitting, Minimization, Graphics Class libraries
- CINT C++ command line interpreter
- Mainly “useful for data analysis” tools



# Example 1 (Simple)

- Open a root file
- Save a root file
- Use browser to view a root file

## Example 2 (Programming)

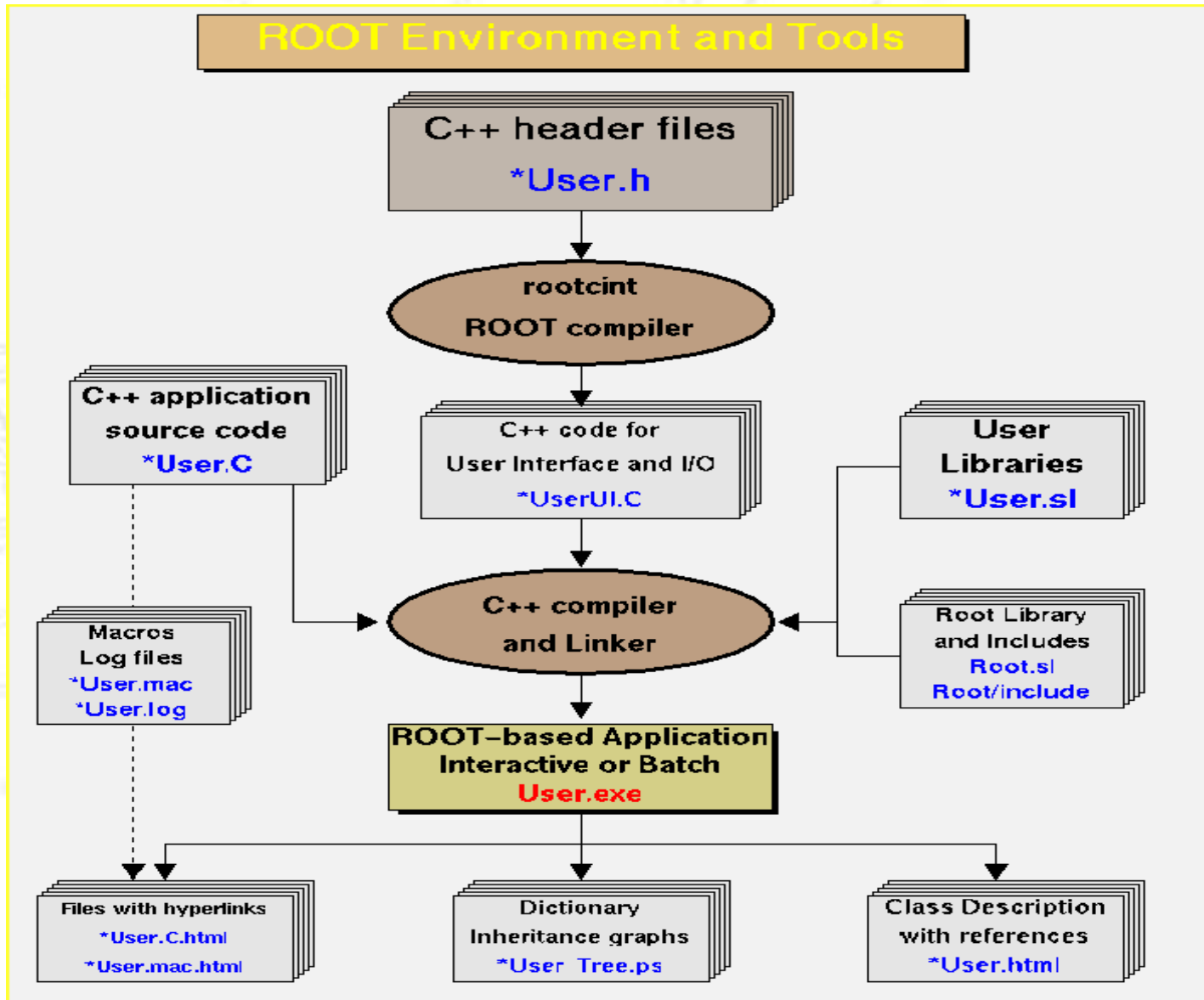
- Histogram filling, fitting with Gaussian
- Drawing a legend and some other options
- Save the histogram as .gif file / .root file



## Example 3 (Complex)

- Adding your own class with a shared library
- TObject
- rootcint (C++ interpreter and how to use it)

# Root CINT: Overview





# Step 1: MyVector.h

```
#include <iostream.h>
#include "TObject.h"

class MyVector: public TObject {
private:
    Float_t fX;// X position
    Float_t fY;// Y position
    Int_t fTempValue; //!temporary state value
public:
    MyVector(){ fX = -1; fY = -1; }// Default Constructor
    void Print() const;
    void SetX(float x){ fX = x; }
    void SetY(float y){ fY = y; }

ClassDef (MyVector, 1)
};
```

## Step 2: MyVector.cxx

```
#include "MyVector.h"
ClassImp (MyVector);

void MyVector::Print() const {
    cout << fX << "i + " << fY << "j " << endl;
}
```

## Step 3: MyVector\_LinkDef.h

```
#ifdef __CINT__
#pragma link off all globals;
#pragma link off all classes;
#pragma link off all functions;
#pragma link C++ class MyVector;
#endif
```

# Step 4: MainVector.cxx

```
#include "stdlib.h"

#include "Riostream.h"
#include "TROOT.h"
#include "MyVector.h"

int main(int argc, char **argv) {
    double numx, numy;
    MyVector *vector = new MyVector();
    vector->SetX(atof(argv[1]));
    vector->SetY(atof(argv[2]));
    vector->Print();
    cout << " Bye " << endl;
    return 0;
}
```

# Useful Links

## UTA

[http://www-hep.uta.edu/~venkat/talks/Analysis\\_phys5326.ppt](http://www-hep.uta.edu/~venkat/talks/Analysis_phys5326.ppt) (W to mu nu)

[http://www-hep.uta.edu/hep\\_notes/d0.html](http://www-hep.uta.edu/hep_notes/d0.html) (Intro to Data Analysis and W/Z analyses)

## DØ

[http://www-d0.fnal.gov/phys\\_id/emid/d0\\_private/EM\\_Particle\\_Documentation\\_EMID.html](http://www-d0.fnal.gov/phys_id/emid/d0_private/EM_Particle_Documentation_EMID.html) (EM Particle Documentation)

[http://www-d0.fnal.gov/phys\\_id/muon\\_id/d0\\_private/certif/p14/index.html](http://www-d0.fnal.gov/phys_id/muon_id/d0_private/certif/p14/index.html) (Muon ID/Certification document)

[http://www-d0.fnal.gov/computing/algorithms/calgo/jet\\_met/certification.html](http://www-d0.fnal.gov/computing/algorithms/calgo/jet_met/certification.html) (Missing Transverse Energy ( $E_T$ ) page)

<http://quarknet.fnal.gov/run2/hdecay.shtml> (Getting to Higgs .. Very Very Very useful)

## ROOT / TMBTree

<http://root.cern.ch/> (ROOT System Homepage)

<http://root.cern.ch/root/Tutorials.html> (ROOT Tutorials and numerous examples)

<http://root.cern.ch/root/HowTo.html> (ROOT How To and Gotcha !!)

[http://www-d0.fnal.gov/~serban/tmb\\_tree/TMBTreeIntro.html](http://www-d0.fnal.gov/~serban/tmb_tree/TMBTreeIntro.html) (How to use TMBTrees)

[http://www-d0.fnal.gov/nikhof/?doc/tmb\\_tree.html](http://www-d0.fnal.gov/nikhof/?doc/tmb_tree.html) (TMBTree class definitions and their description)

## C++ , Scripting, Linux etc..

<http://root.cern.ch/root/Cint.html> (ROOT C++ Interpreter)

<http://linux.ctyme.com/> (Linux MAN pages)

<http://www.tldp.org/LDP/abs/html/> (Bash Scripting Guide)

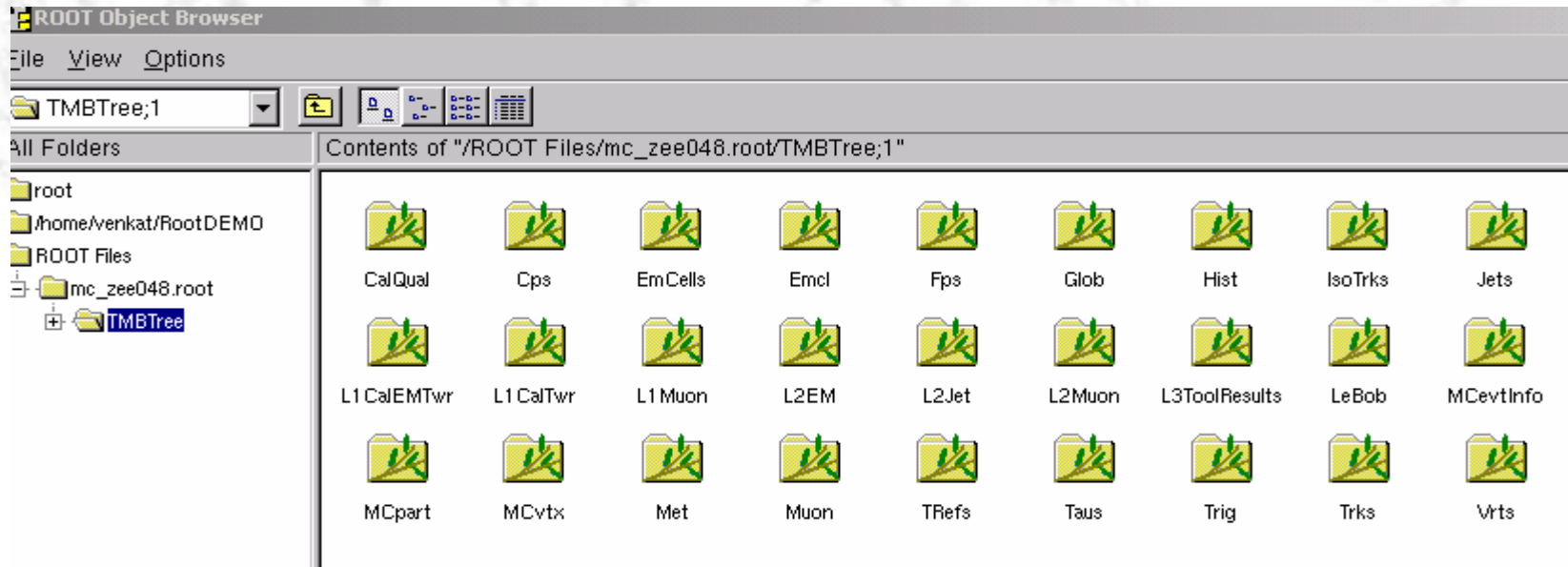
<http://amath.colorado.edu/documentation/LaTeX/basics/> (How to use LaTeX)

# Assignment 1

- Copy the Input file containing the W mass data to your home area. It can be found at `/home/venkat/RootDEMO/WTransDEMO/Input.data`
- Look at the contents of the file. You will see 3 columns. The first one denotes the Run number, the second Event number and the third column is the calculated W Transverse mass.
- Write a macro to
  - read in the values from the input file
  - plot the data as a 1D histogram. (Select suitable bin size and range for your histogram)
  - Save the output as a “.root” file for later use.
  - Save the same file as “.gif” for your presentation.
- Refer to the macro in `/home/venkat/RootDEMO/HistogramDEMO/Hist1D.C` for more help on creating root macros.

# Assignment 2

- Open a root session. Issue the command
- `root [0] TBrowser br` (Its case sensitive!!) You will see a browser pop up on your screen. Open the “.root” file given below.
- `/home/venkat/RootDEMO/mc_zee048.root`
- Double click on the root-file and you will see a subfolder containing TMBTree. Click on TMBTree and you will see a subfolder that looks like this -



# Assignment 2 (contd..)

- Select the following and view their contents
  - EMCL object
  - Muon object
  - MET object
- View/Save the following histograms
  - Emcl.\_calE, Emcl.\_calPhi, Emcl.\_calEta, Emcl.\_emfrac, Emcl.\_HMx7, Emcl.\_iso, Emcl.\_id, Emcl.\_pT
  - Muon.\_pT, Muon.\_calPhi, Muon.\_calEta, Muon.\_isTight, Muon.\_charge, Muon.\_E
  - \_MEy, \_MEx, ScalarET\_weta, \_MET



# Phase I of the Project

- You will be working with the Data samples similar to the one in assignment 2, and writing macros/c++ code to filter the data according to the signal you are looking for.
- The data samples are divided into four categories

$$W \longrightarrow e + \nu$$

$$Z \longrightarrow \mu + \mu$$

$$W \longrightarrow \mu + \nu$$

$$Z \longrightarrow e + e$$

- Look at the reference for TMBTrees and get acquainted with what the variables mean.
- Learn more about your physics process and how to use the selection criteria for your specific physics process.