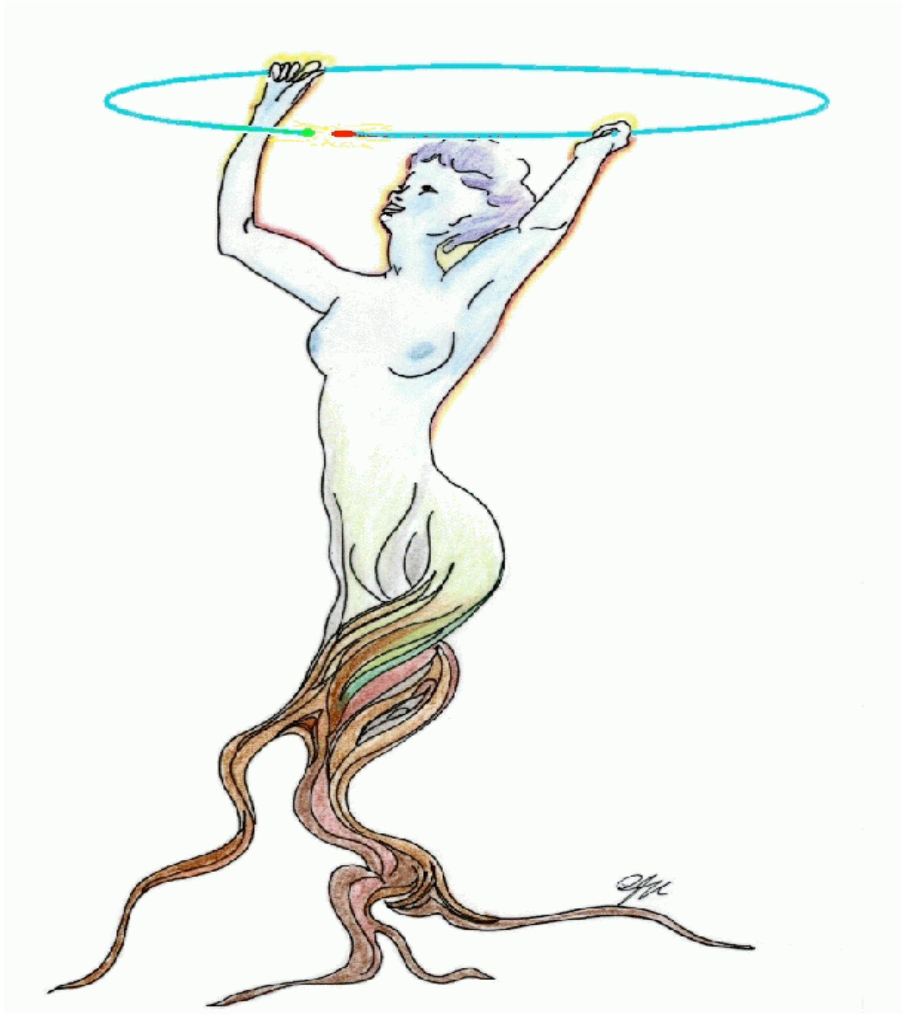
ROOT for beginners

Second Day

Programming



Writing scripts

- Today:

•Creation and destruction of objects
•Manipulating objects
•Finding the information - the user's guide to the user's guide
•Finding "lost" objects
•Writing functions
•Analysis scripts

Creation and destruction of objects

Commands "new" & "delete"

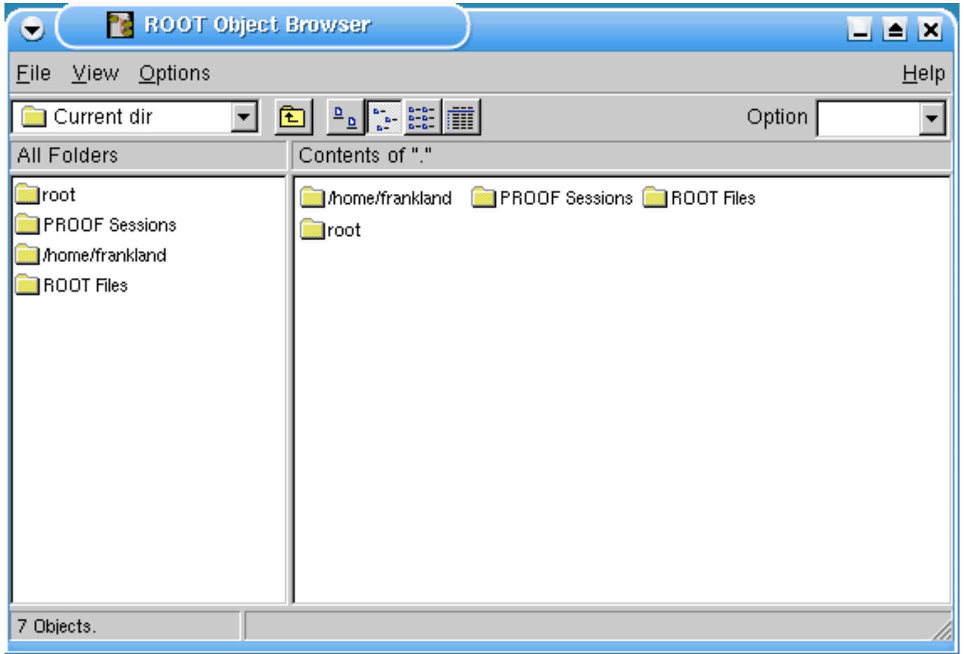
Object pointers

The "new" command

- Yesterday we began the day with:

```
new TBrowser
```

which made a "ROOT object browser" appear.



The "new" command

- Yesterday we began the day with:

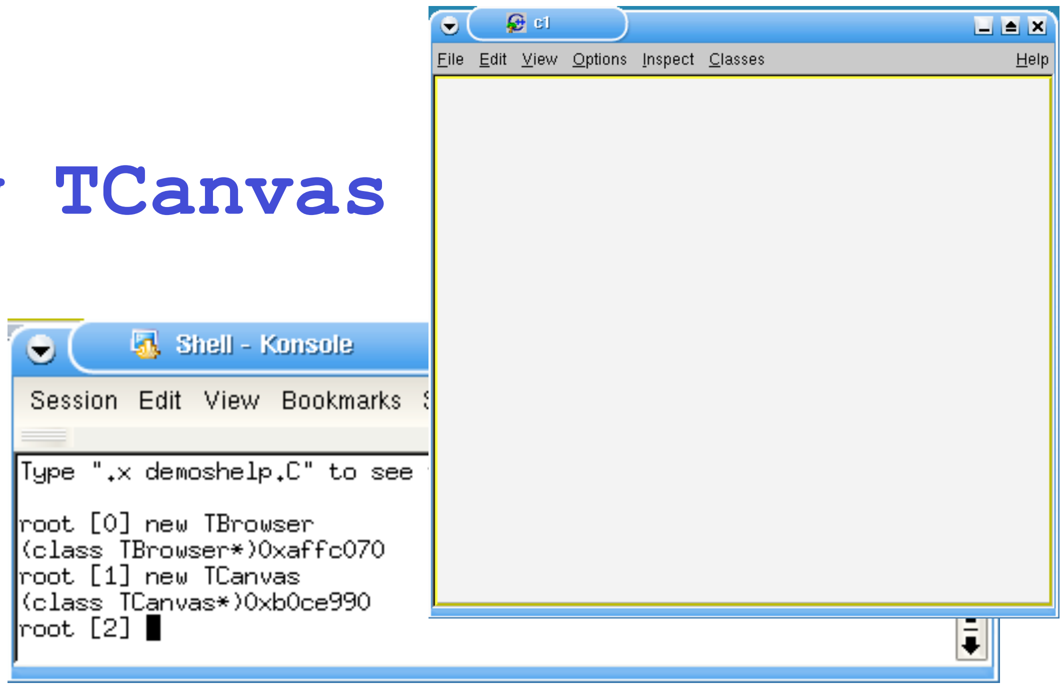
`new TBrowser`

which made a "ROOT object browser" appear.

- If you type

`new TCanvas`

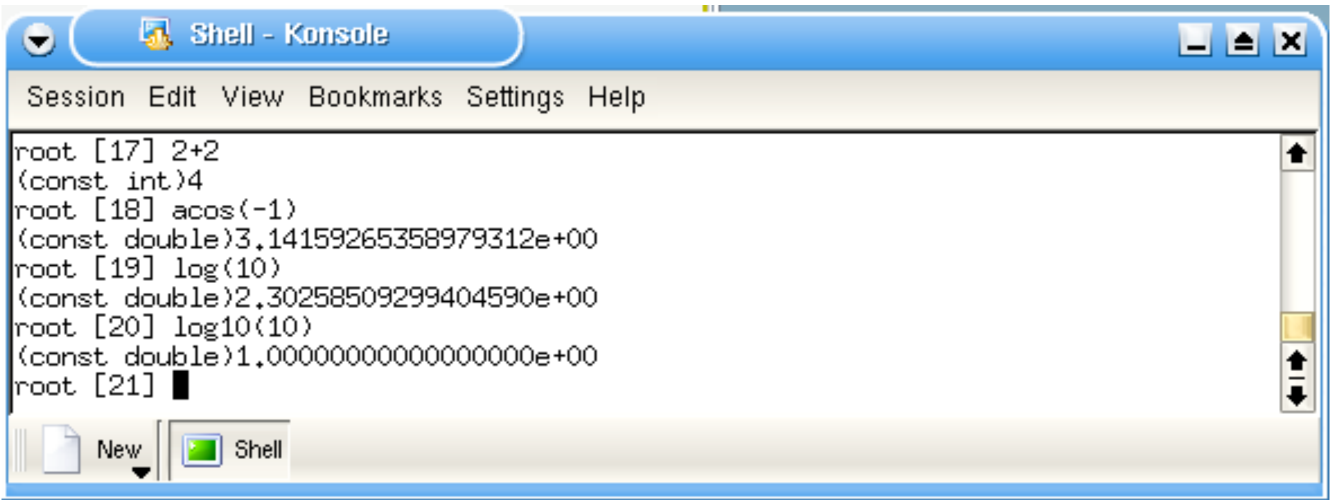
a canvas appears!



But what is going on in the command window ???

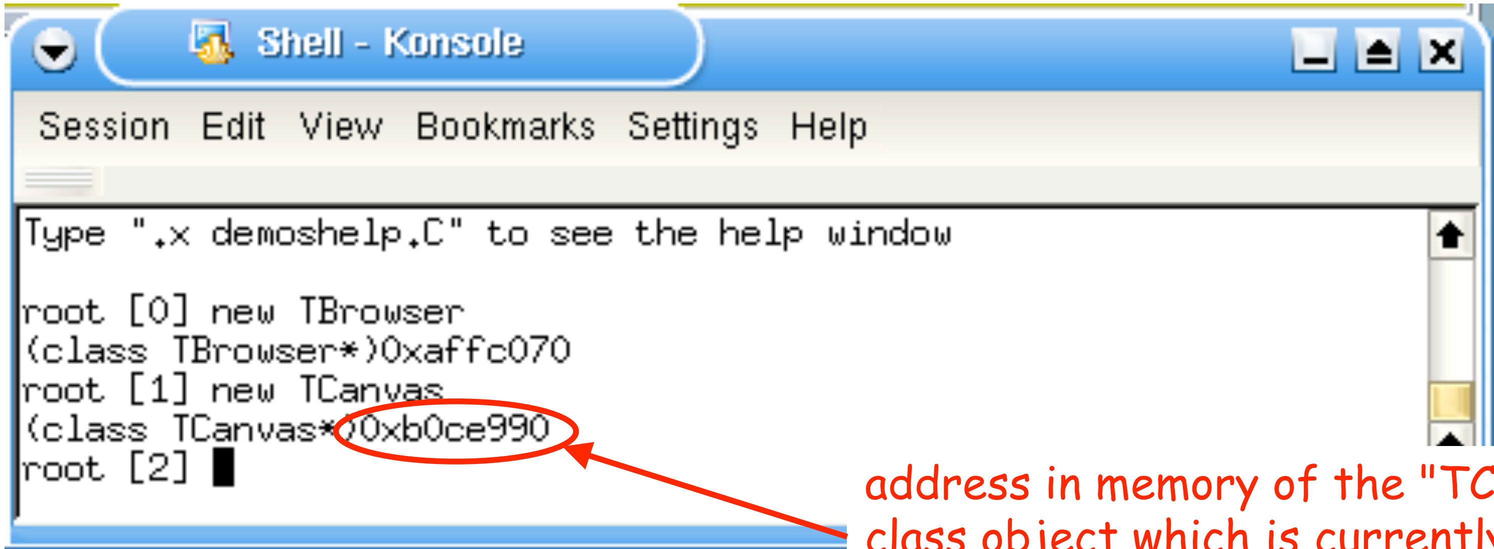
The command window

- The command window is a C++ interpreter!!
- It displays the value of each function, expression or command that you type - try e.g. 2+2…



The command window

- The values displayed after a **`new`** command are the type (*class*) & the address in memory of the created objects



address in memory of the "TCanvas" class object which is currently displayed on your screen

Object pointers

- To use the object, you have to put its address in to a special variable, an *object pointer* (or *pointer*)

Declaration of an (object) pointer :

```
ObjectType* toto;
```

Object pointers

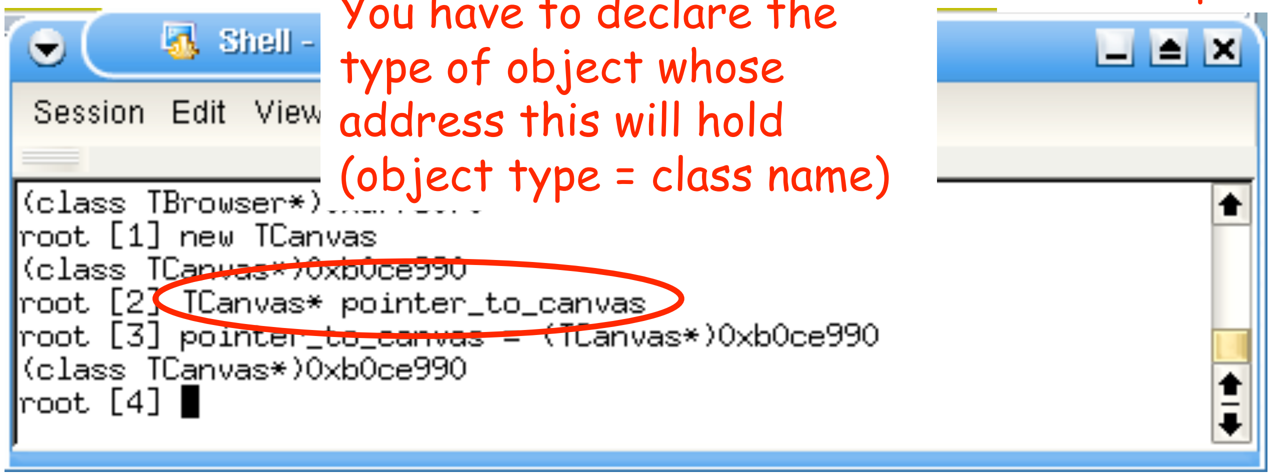
- To use the object, you have to put its address in to a special variable, an *object pointer* (or *pointer*)

Declaration of an (object) pointer :

`ObjectType*  toto;`

The '*' tells us this is a pointer

You have to declare the type of object whose address this will hold (object type = class name)



Object pointers

- The value held by the object pointer is the address of the object in memory

Initialisation of an object pointer :

```
toto = (ObjectType*)address ;
```

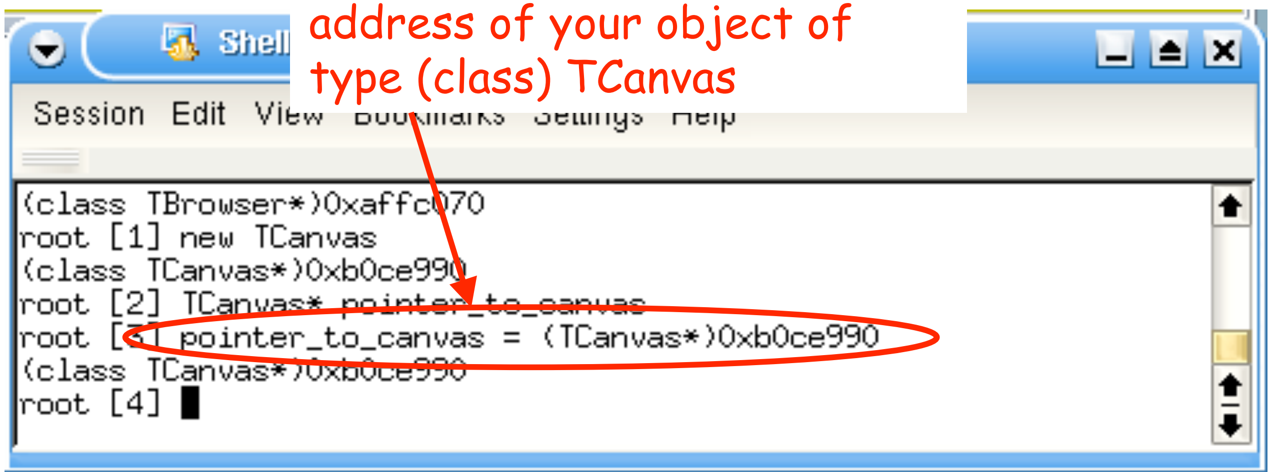
Object pointers

- The value held by the object pointer is the address of the object in memory

Initialisation of an object pointer :

toto = (ObjectType*)*address* ;

Initialise the pointer with the address of your object of type (class) TCanvas



Object destruction

- The *delete* command frees the memory space occupied by the objects
- <u>You must use it to destroy all the objects you don't need any more or you will fill the memory!</u>

Destroy an object:

```
delete toto;
```

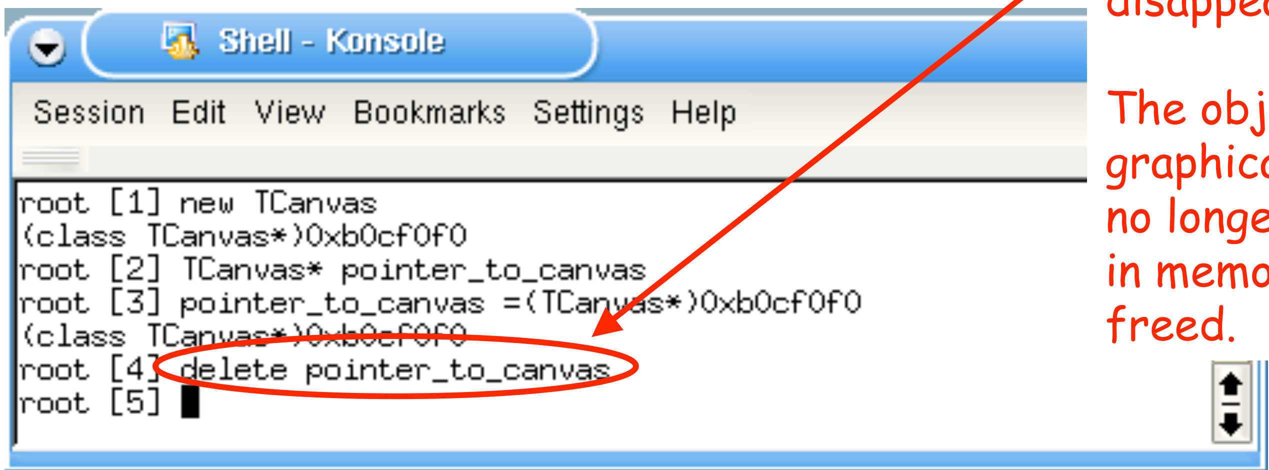
Object destruction

- The *delete* command frees the memory space occupied by the objects
- <u>You must use it to destroy all the objects you don't need any more or you will fill the memory!</u>

Destroy an object: `delete toto;`

Executing this command makes the canvas disappear!

The object (and its graphical representation) no longer exists, the space in memory it occupied is freed.



Constructors

- Most of the time we will declare a pointer, create an object, and initialise the pointer with the address of the object in one single line !!

Object creation with declaration and initialisation of pointer:

```
ObjectType* toto = new ObjetType;
```

Constructors

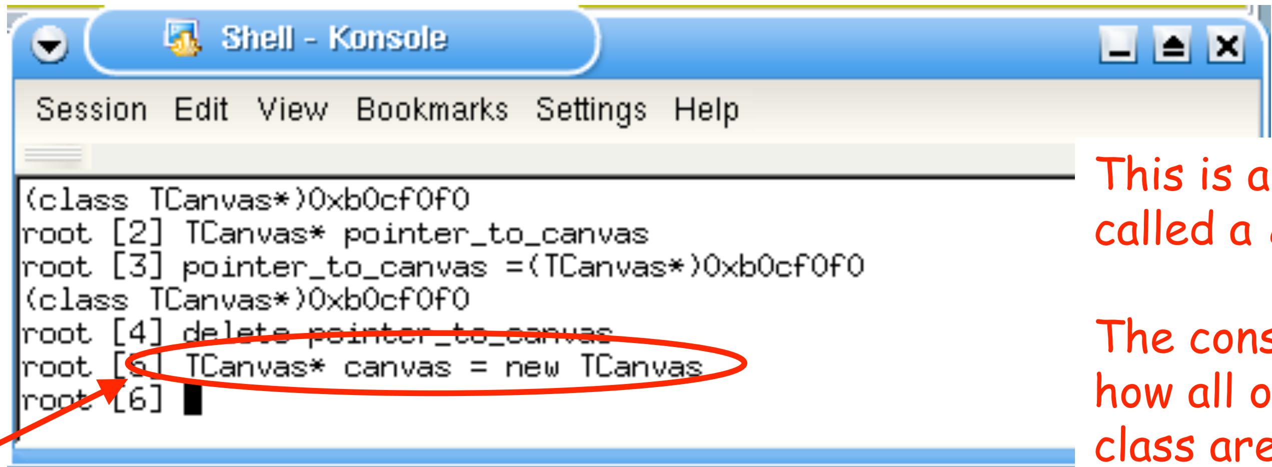
- Most of the time we will declare a pointer, create an object, and initialise the pointer with the address of the object in one single line !!

Object creation with declaration and initialisation of pointer:

ObjectType* toto = new ObjetType;

This is a special function called a *constructor*.

The constructor defines how all objects of a given class are made.



*a new canvas appears !

Constructors

- Generally, constructors have arguments

Object creation with declaration and initialisation of pointer:

```
ObjectType* toto = new
ObjectType(...);
```

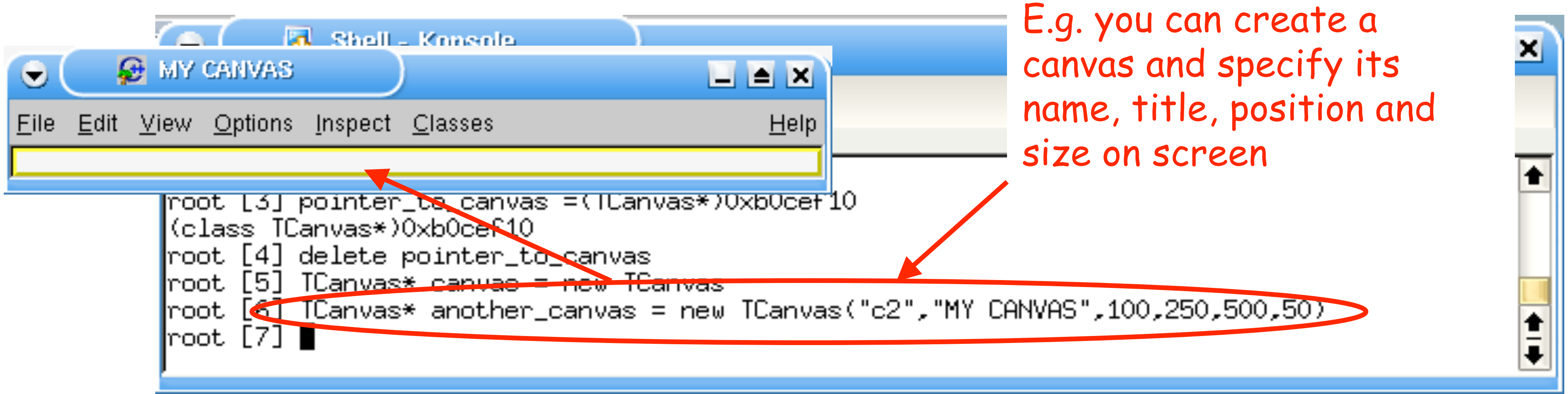
Constructors

- Generally, constructors have arguments

Object creation with declaration and initialisation of pointer:

ObjectType* toto = new ObjectType(...);

E.g. you can create a canvas and specify its name, title, position and size on screen



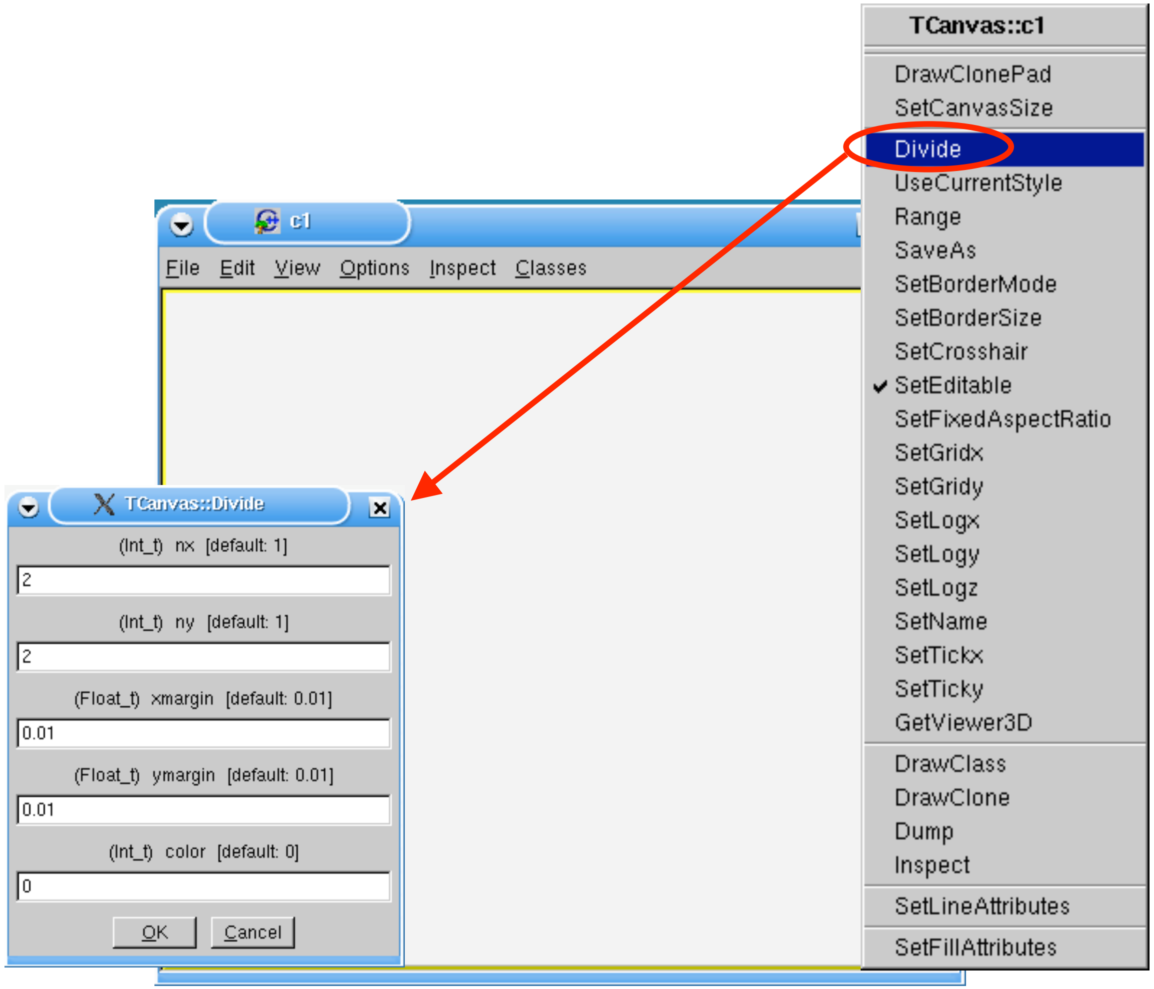
In the previous example, the canvas had default name "c1" and default title "c1"

Manipulating objects

Getting to grips with class methods

Interacting with objects

- Graphically, we can interact with an object using its context menu:



Example from yesterday, when we divided a canvas in 4

Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer:

`toto->Method(arguments);`

The object pointer with the '->' operator define which objet we interact with

Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer:

`toto->`*Method(arguments);*

One of the *methods* of the object's class. For example, one of the functions in the context menu.

All objects of the same *class* have the same *methods.*

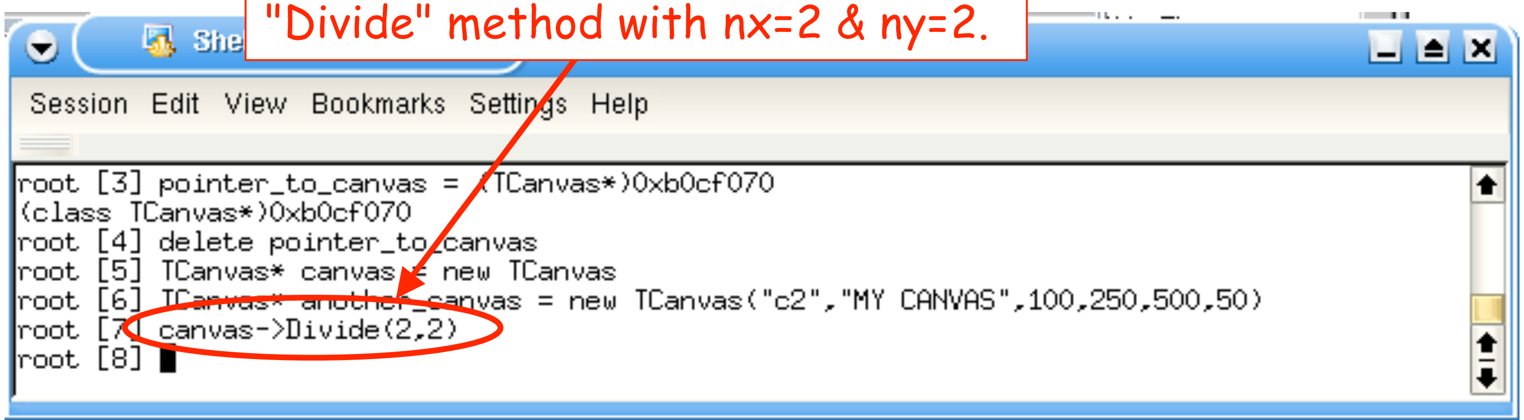
Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer:

canvas->Divide(2,2);

Interact with object "c1" using the pointer "canvas". We use its "Divide" method with nx=2 & ny=2.



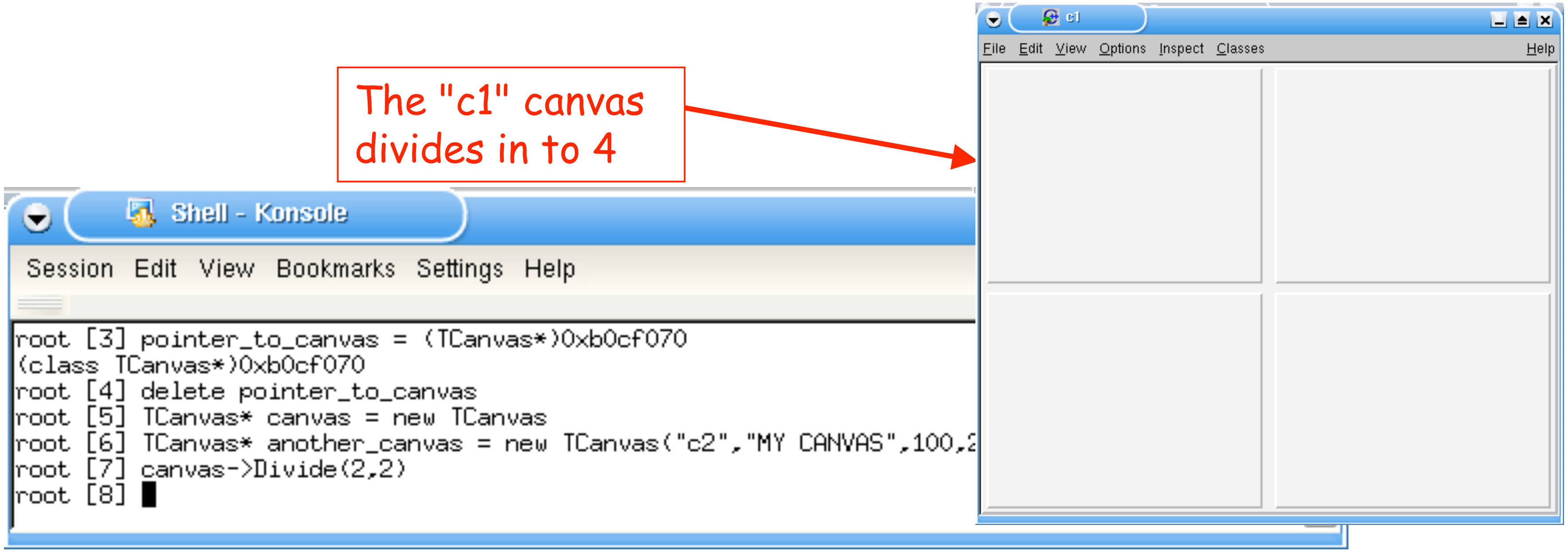
Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer:

canvas->Divide(2,2);

The "c1" canvas divides in to 4



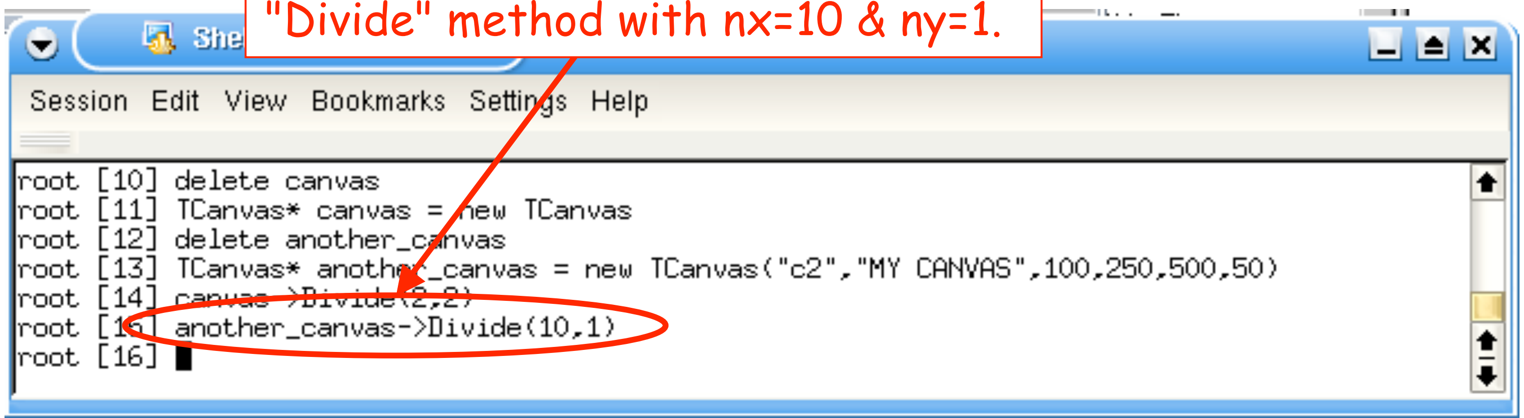
Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer:

another_canvas->Divide(10,1);

Interact with "c2" using pointer "another_canvas". We use c2's "Divide" method with nx=10 & ny=1.

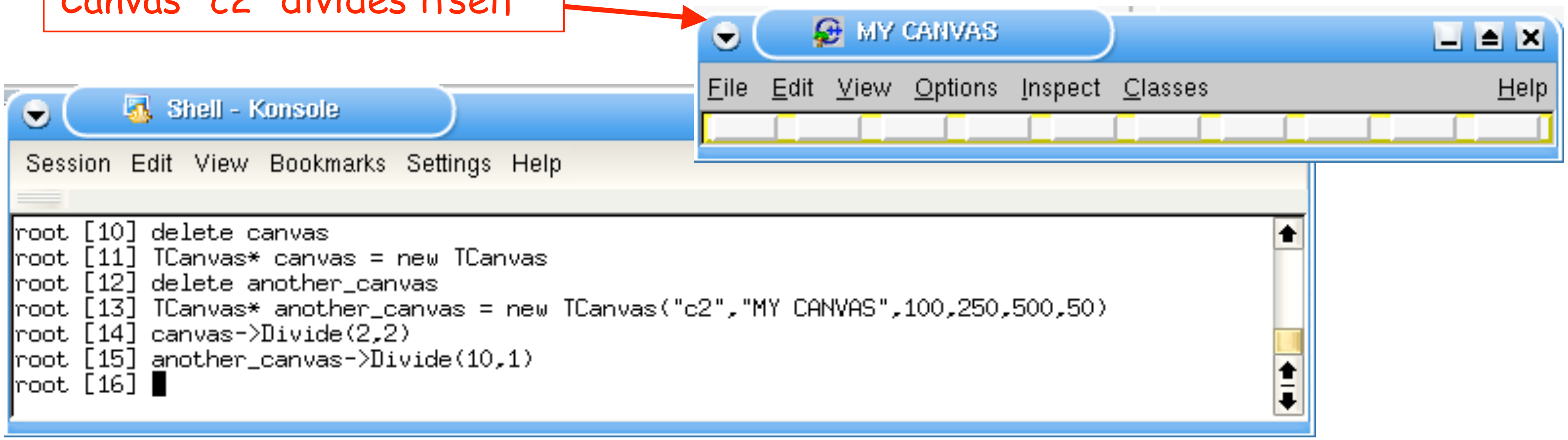


Interacting with objects

- With an object pointer, we can also interact with the object…

Interact with an object using a pointer: another_canvas->Divide(10,1);

Canvas 'c2' divides itself

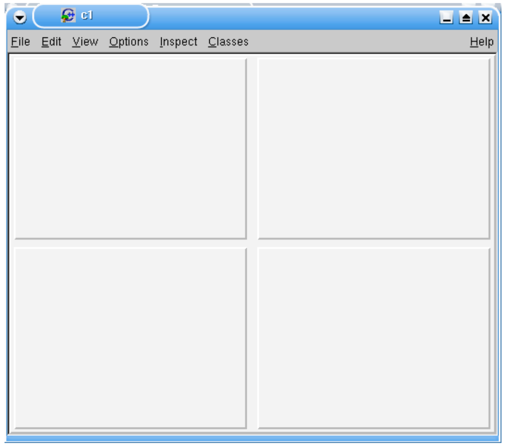


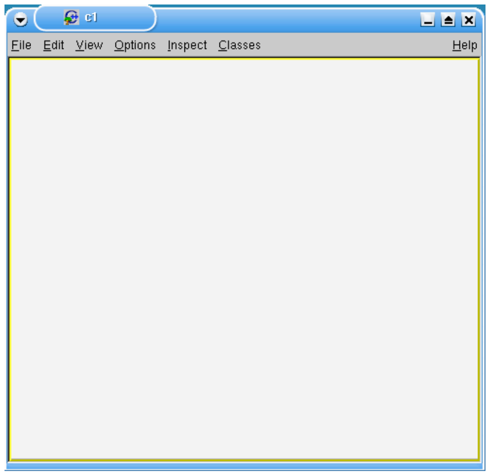
Interacting with objects

- Other operations on canvases:

`canvas->Clear();`

Clear the contents of the canvas, including any divisions





Make a canvas (or a pad) 'active', i.e. its border will become yellow and the next object to be drawn will appear on this canvas

`canvas->cd();`

Example with a histogram

- You can create a 1-D spectrum in much the same way as you create a canvas:

Creating a 1-D histogram

```
TH1F* histo = new TH1F("h1","My histo", 10, 0., 10.);
```

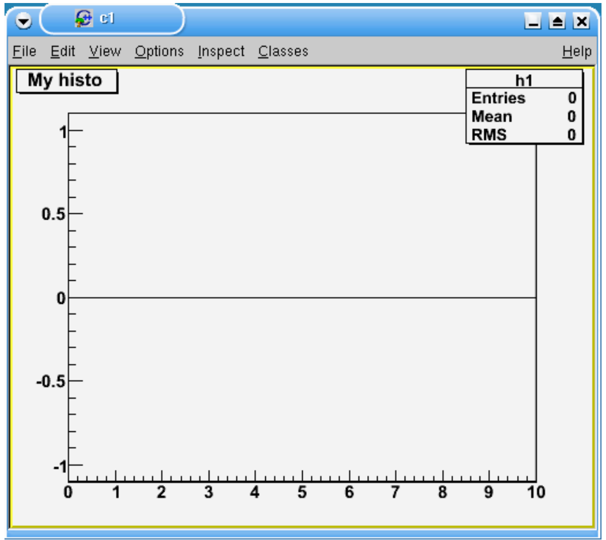
```
ObjectType* toto = new
ObjectType(...);
```

N.B. The histogram does not appear automatically on screen!

TH1F ? Histogram in 1 dimension of Floating-point values

Example with a histogram

- Display and fill the histogram:



Display a histogram:

```
histo->Draw();
```

Fill a histogram:

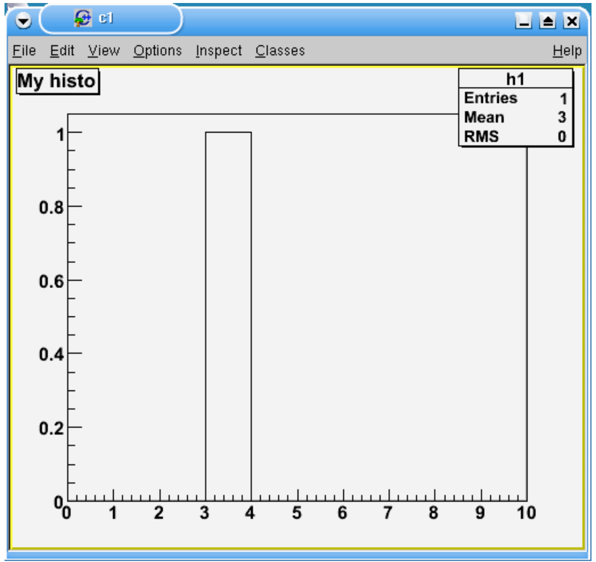
```
histo->Fill(3);
```

The "3" corresponds to a X-axis value

Nothing seems to happen ?

Example with a histogram

- Refresh the canvas:



Tell the canvas that an object it is displaying has changed:

```
canvas->Modified();
```

When using the command window, this automatically causes the canvas to refresh.

However, in a script/programme you also have to ask for the canvas to redraw its objects!

Force the canvas to refresh:

```
canvas->Update();
```

Example with a histogram

- Starting to get bored ?

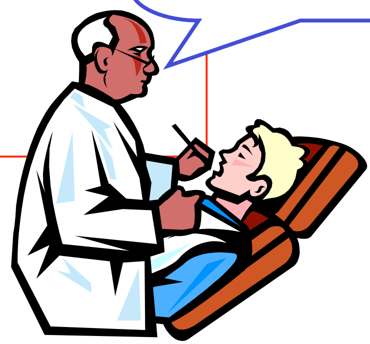
We could carry on like this until we finish filling our histogram…

```
histo->Fill(1.43);
histo->Fill(6.9);
    …
histo->Fill(9, 2);
canvas->Modified();
```

Fill with a weight, i.e. the value '9' has occurred twice

But we'd be happier if we wrote a loop…
…in a function…
…programmed in C++
……!!!

Don't look at me like that…



Creating objects without "new"

There is another way…

'Temporary' vs. 'Permanent' objects

The other way…

- There is another way to create and manipulate objects…

Creating an object without "new"

```
ObjectType toto(...);
```

The other way…

- There is another way to create and manipulate objects…

Creating an object without "new"

```
ObjectType toto(...);
```

If the constructor has arguments, put them here

Creating an object with "new"

```
ObjectType* toto_ptr = new ObjectType(...);
```

The other way…

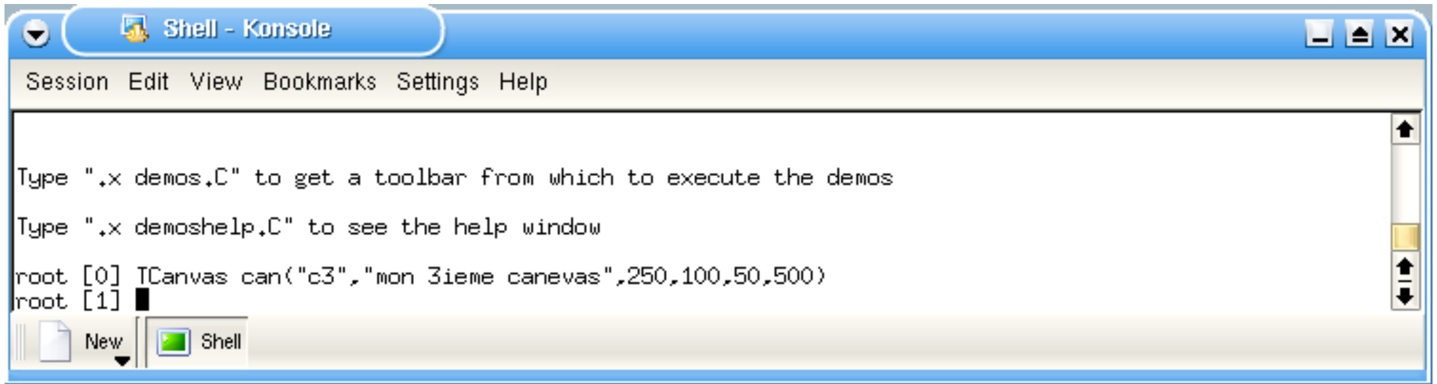
- There is another way to create and manipulate objects…

Creating an object without "new"

```
TCanvas can("c3","title",250,100,50,500);
```

Creating an object with "new"

```
TCanvas* can_ptr = new TCanvas("c3","title", …);
```

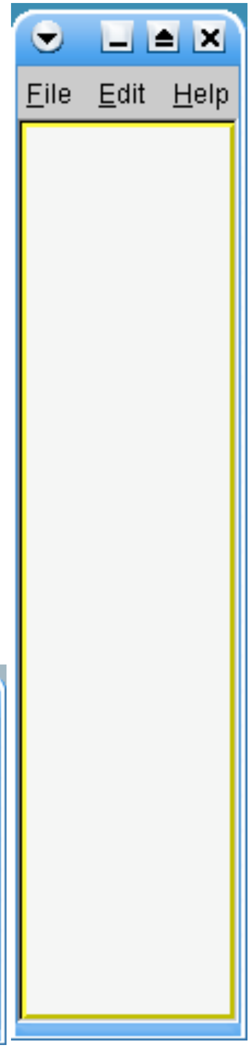


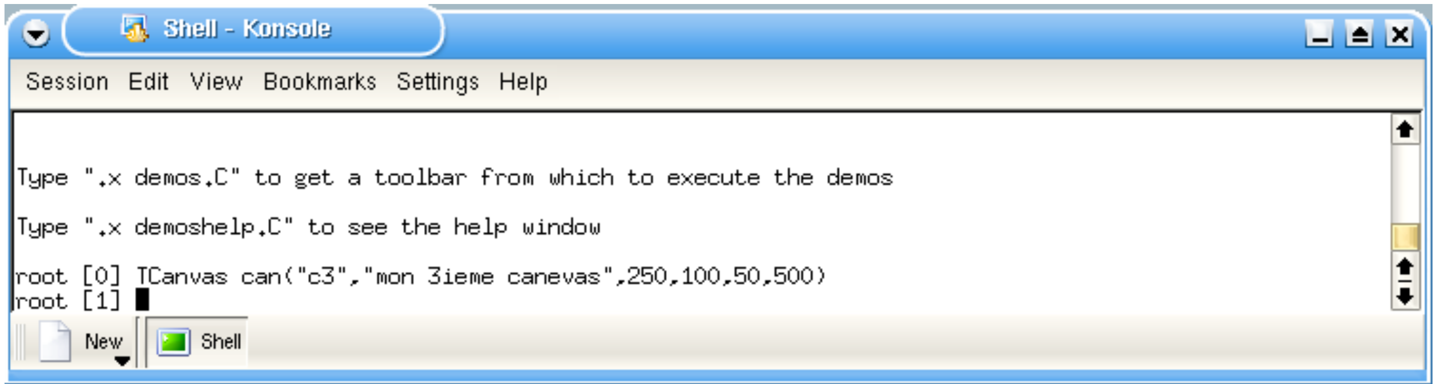
The other way…

- The way we interact with the object isn't quite the same as before…

Interact with an object created without "new"

toto. *Methode(arguments);*





The other way…

- The way we interact with the object isn't quite the same as before…

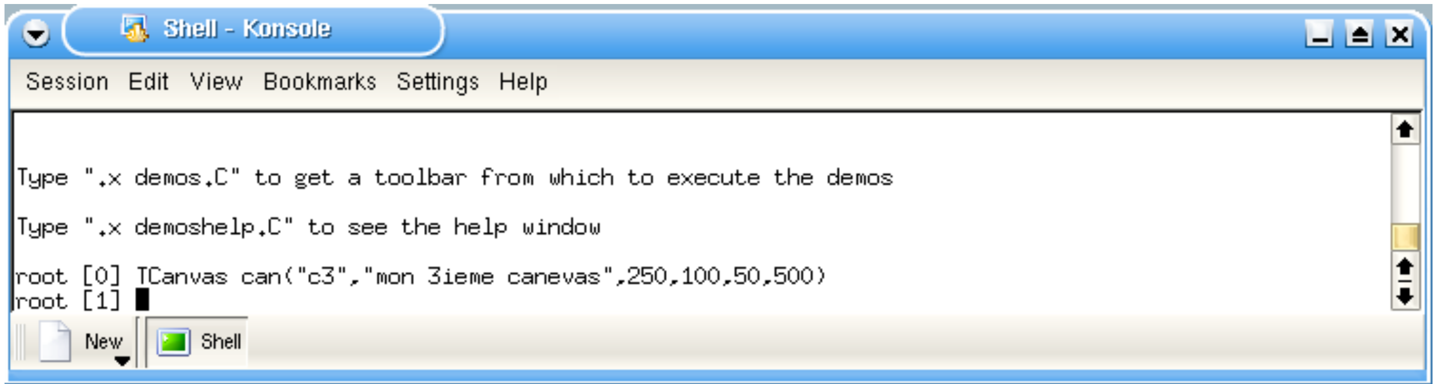
Interact with an object created without "new"

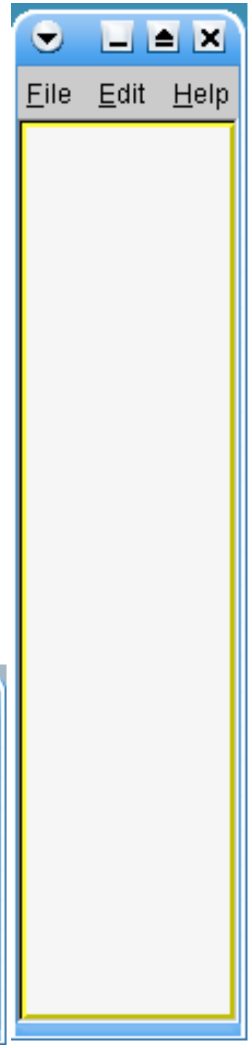
`toto.Methode(arguments);`

In one case we use the '.' operator, in the other '->'

Interact with an object using a pointer:

`toto_ptr->Methode(arguments);`





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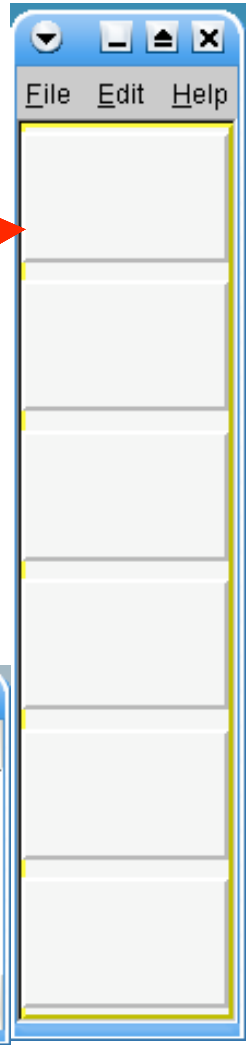
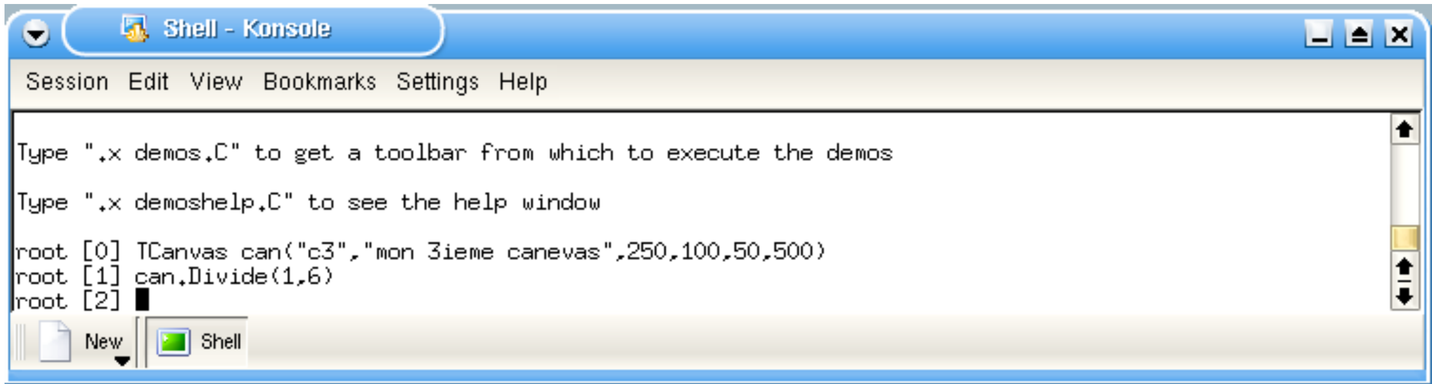


Interact with an object created without "new"

`can.Divide(1,6);`

Interact with an object using a pointer:

`can_ptr->Divide(1,6);`



The other way…

- We can also obtain the address in memory of an object created in this way, and then use a *pointer*

Initialise a pointer with the address of an existing object

```
ObjectType* toto_ptr = &toto;
```

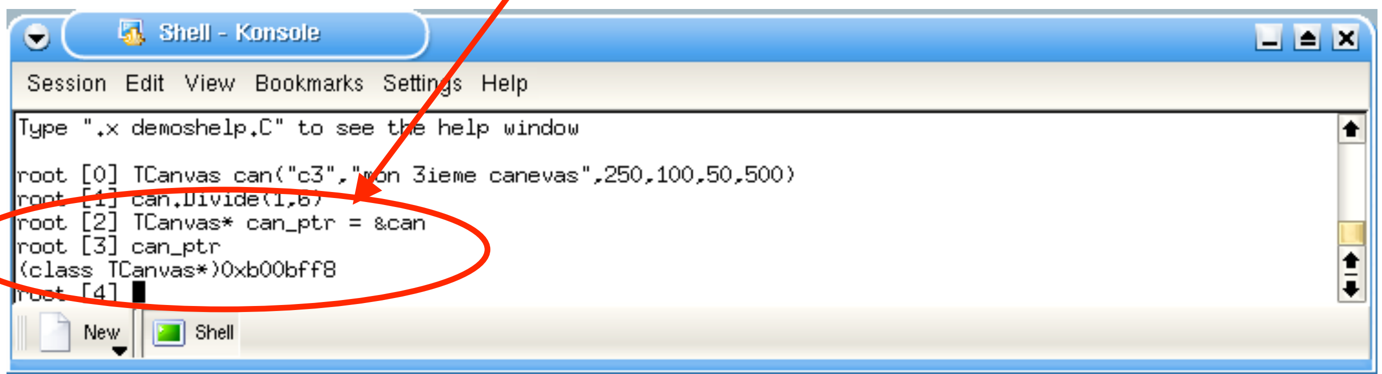
The other way…

- We can also obtain the address in memory of an object created in this way, and then use a *pointer*

Initialise a pointer with the address of an existing object

```
ObjectType* toto_ptr = &toto;
```

Operator returning the address of the object 'toto'

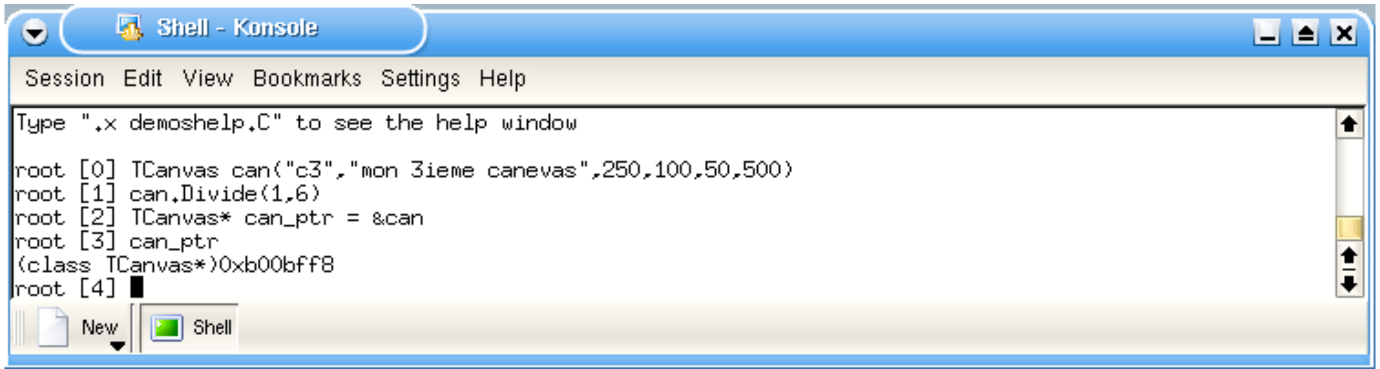


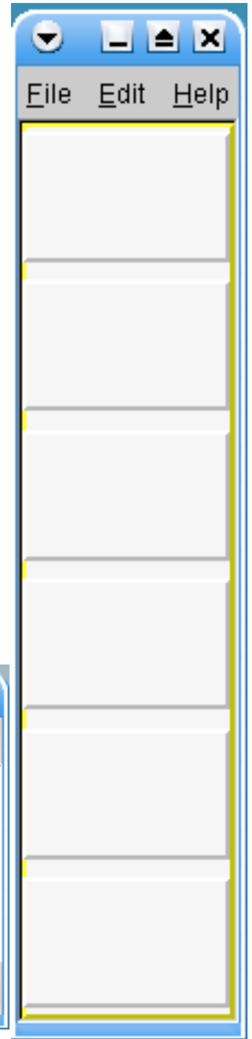
The other way…

- The use of a pointer to interact with the object is identical to the previous cases…

Interact with an object using a pointer

toto_ptr ->Methode(*arguments*);



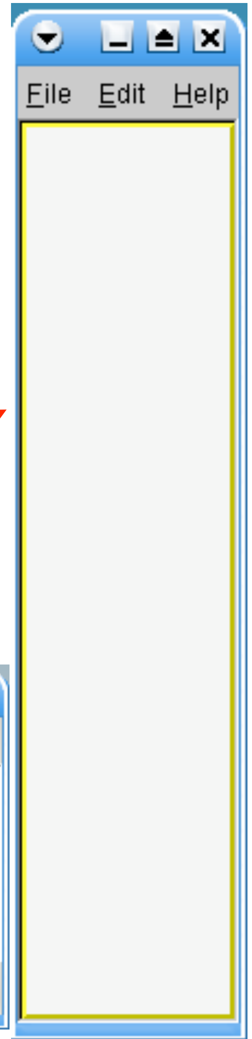


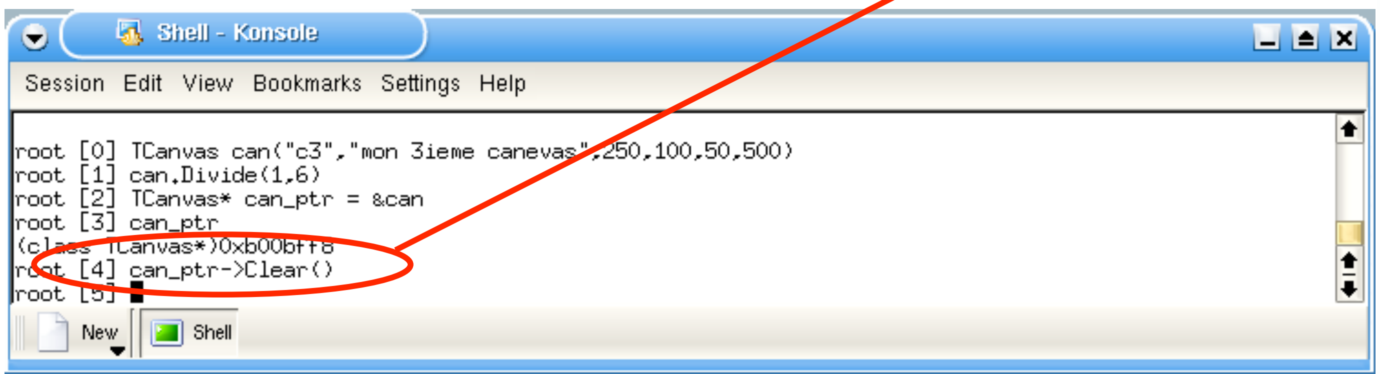
The other way…

- The use of a pointer to interact with the object is identical to the previous cases…

Interact with an object using a pointer

```
can_ptr ->Clear();
```



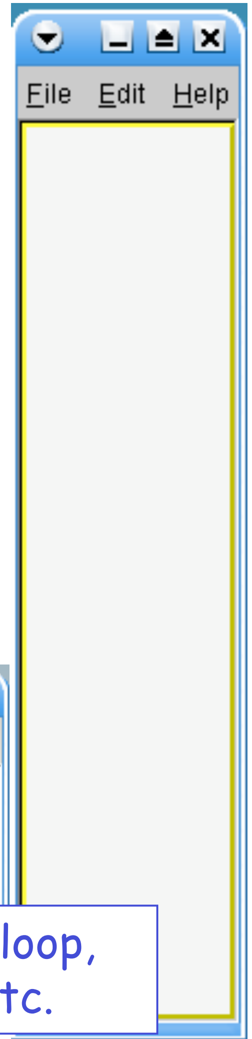


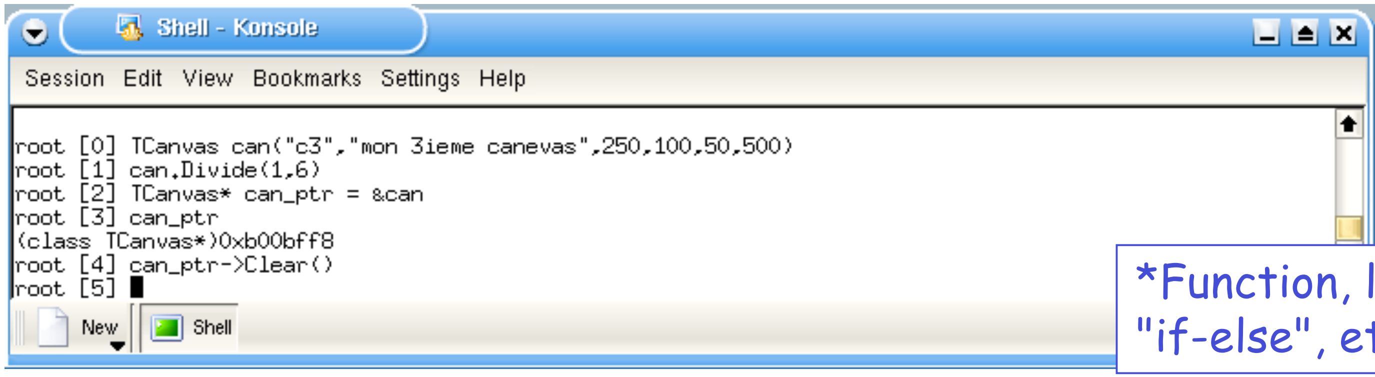
The other way...

- What's the difference ? We don't need to *delete* the object when we've finished with it…

Objects created this way are automatically destroyed at the end of the *code block** in which they are created.

Objects created with "new" are only destroyed by the user, with "delete".





*Function, loop, "if-else", etc.

The other way...

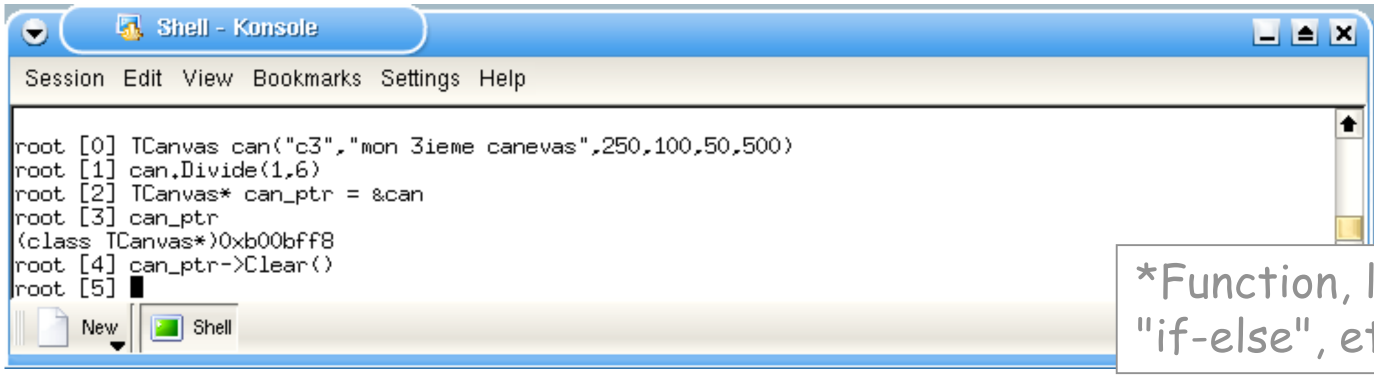
- What's the difference ? We don't need to *delete* the object when we've finished with it…

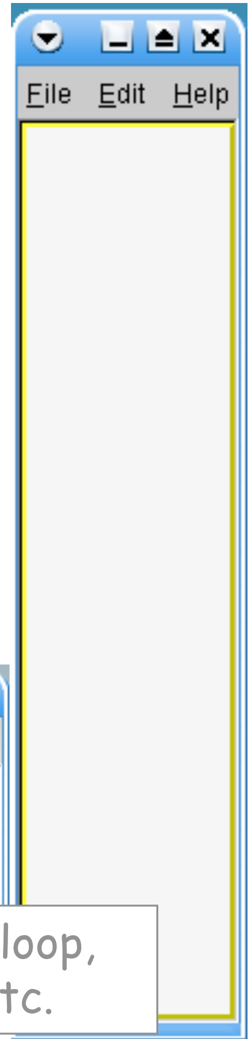
Temporary objects

Objects created this way are automatically destroyed at the end of the *code block** in which they are created.

Permanent objects

Objects created with "new" are only destroyed by the user, with "delete".





*Function, loop, "if-else", etc.

Getting information on classes

Where's the manual ?

Where's the manual for the manual ?

Do I have to learn it all by heart ?*

*NO!!!!

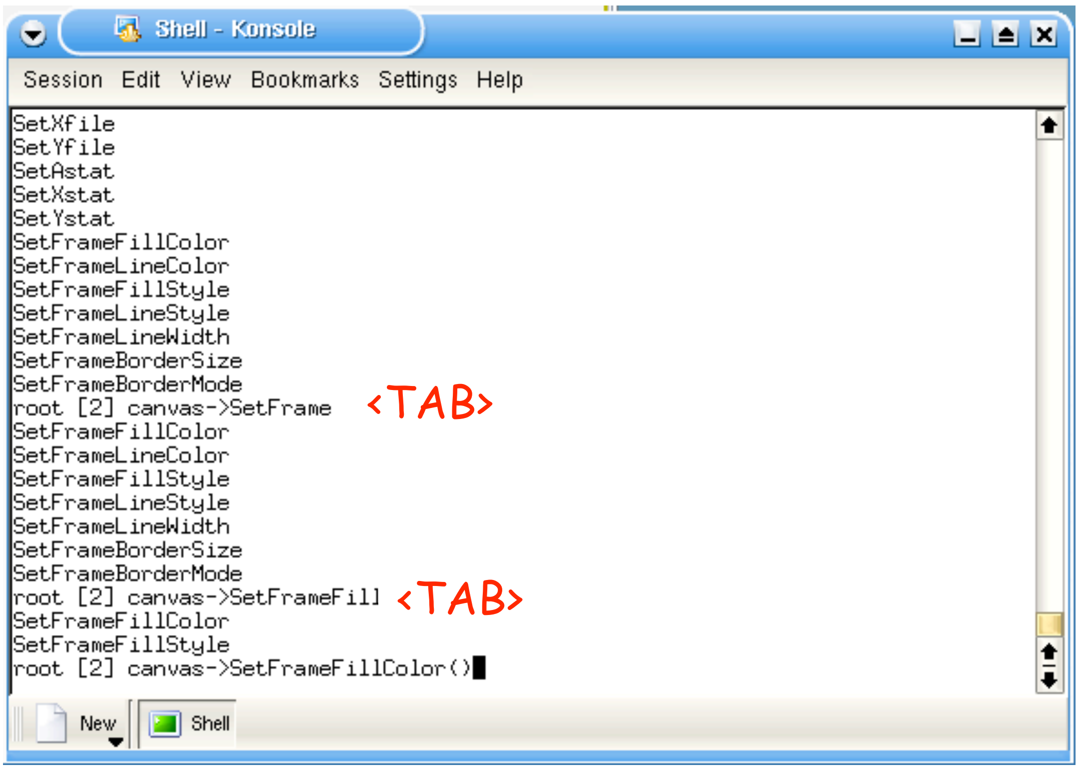
Getting to know your way around

- How can I find out all the possible ways to interact with an object ?
- How do I find out all the methods of a class ?

1. command line completion with <TAB>

Very efficient, reduces to bare minimum the amount you have to type (and so reduces typing errors…)

TIP 1:
most methods which change an object begin "Set…"
TIP 2:
most methods which give an information about an object begin "Get…"

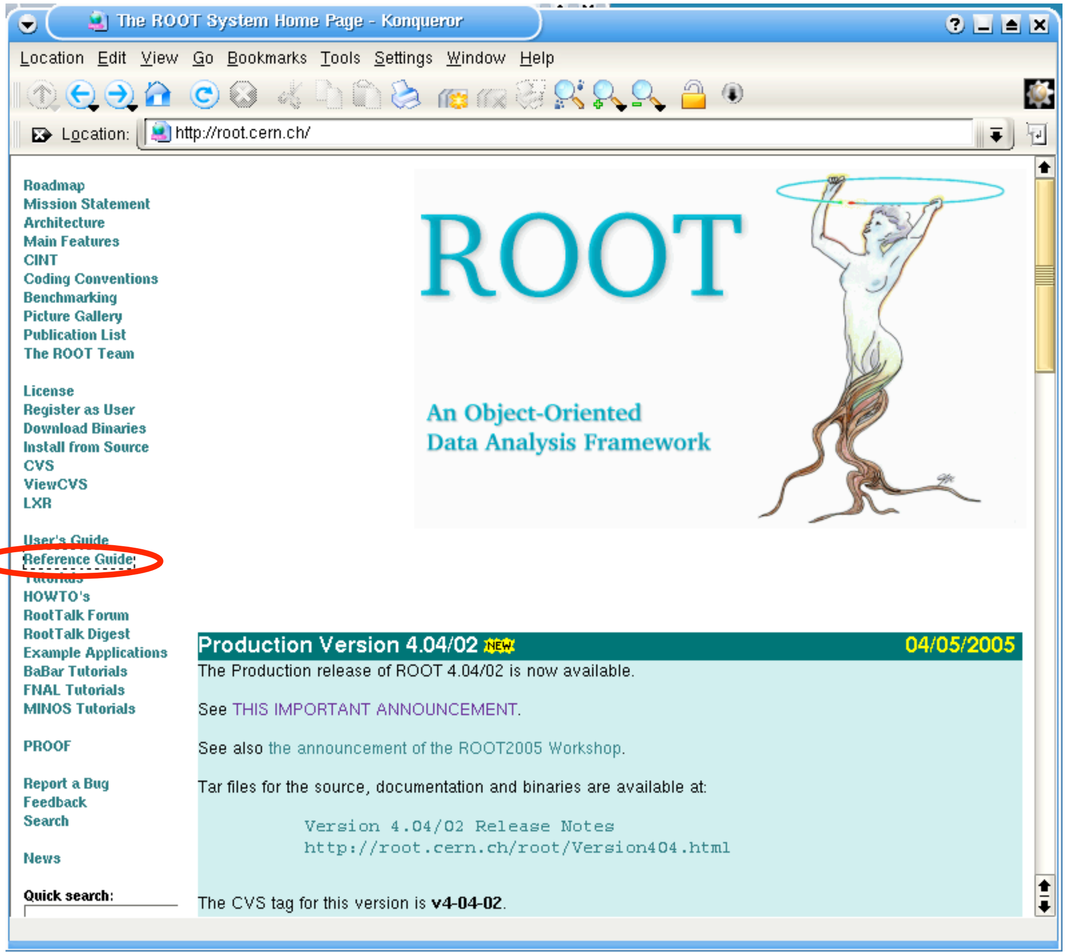


Getting to know your way around

- The best method: http://root.cern.ch

2. Look at the ROOT web site

1. click on "Reference Guide"



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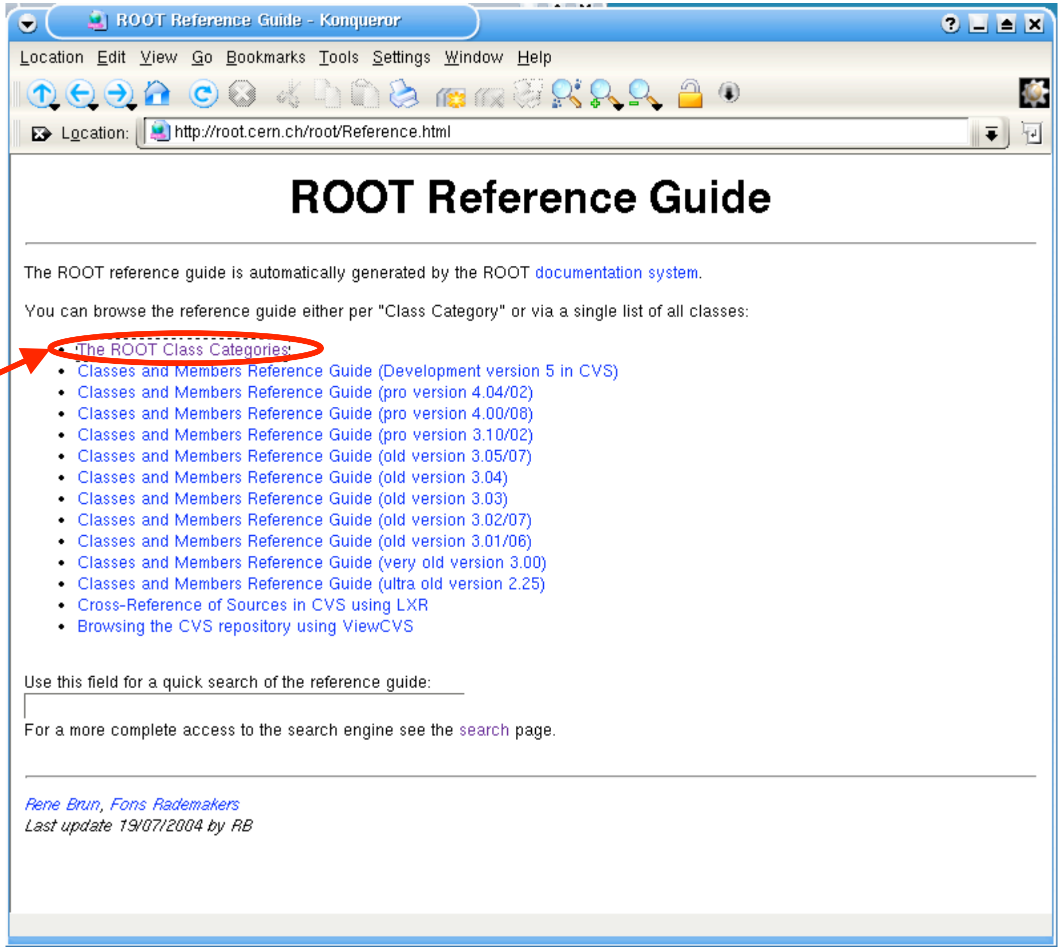
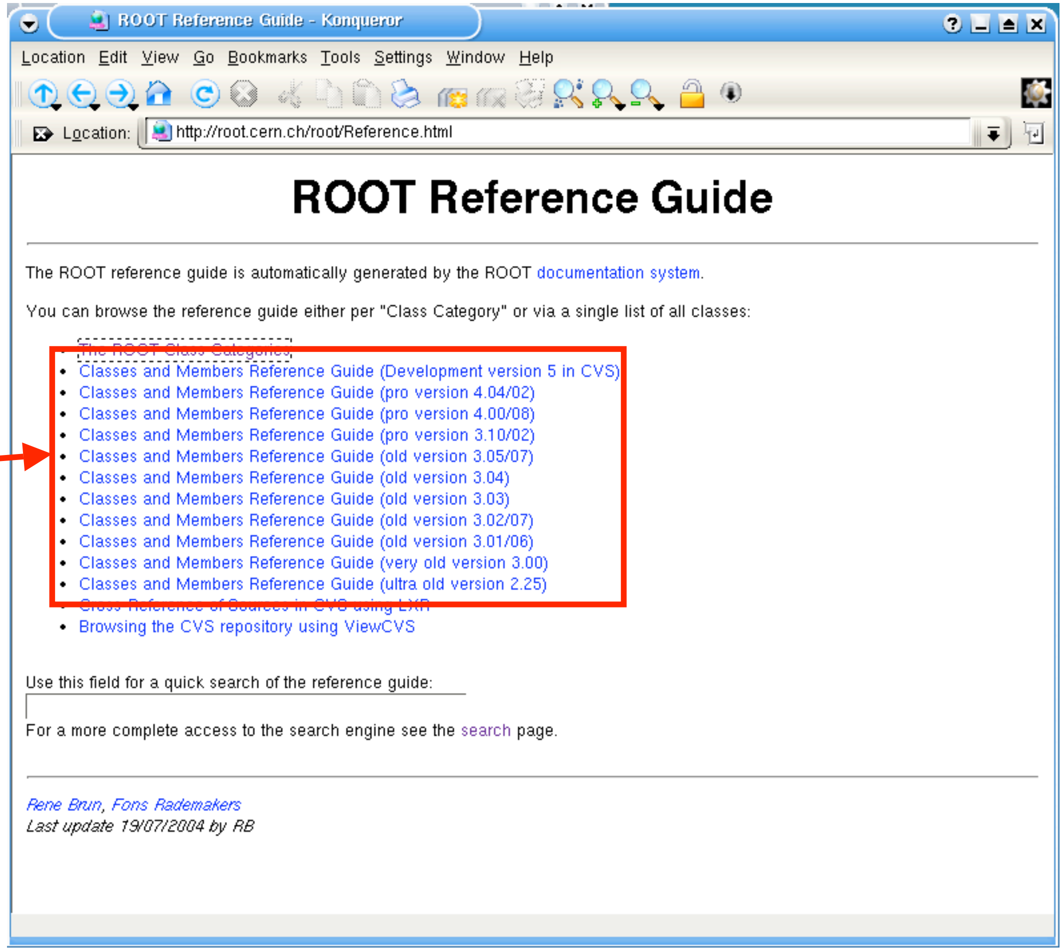


2. list of classes by category (histos, matrices, 3D geometry, etc.)

Getting to know your way around

- The best method: http://root.cern.ch

2. complete list of all classes for each version of ROOT



Getting to know your way around

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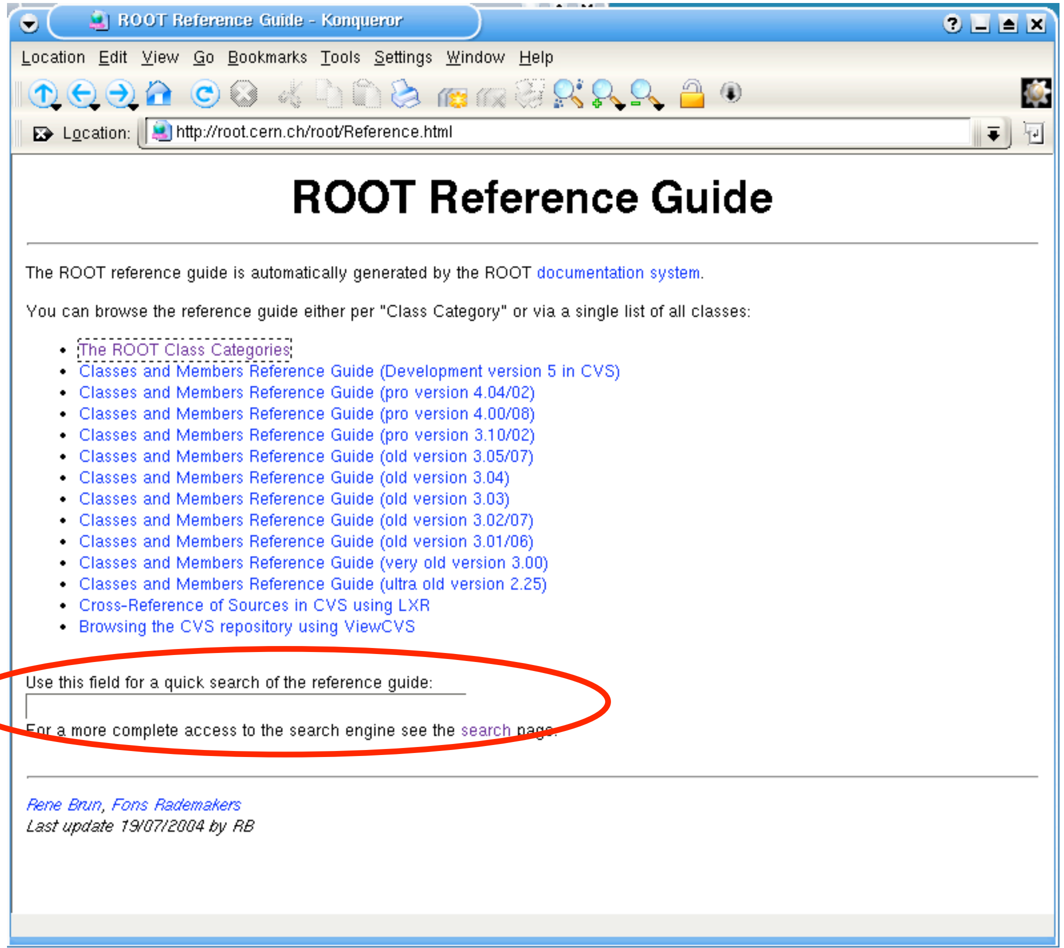
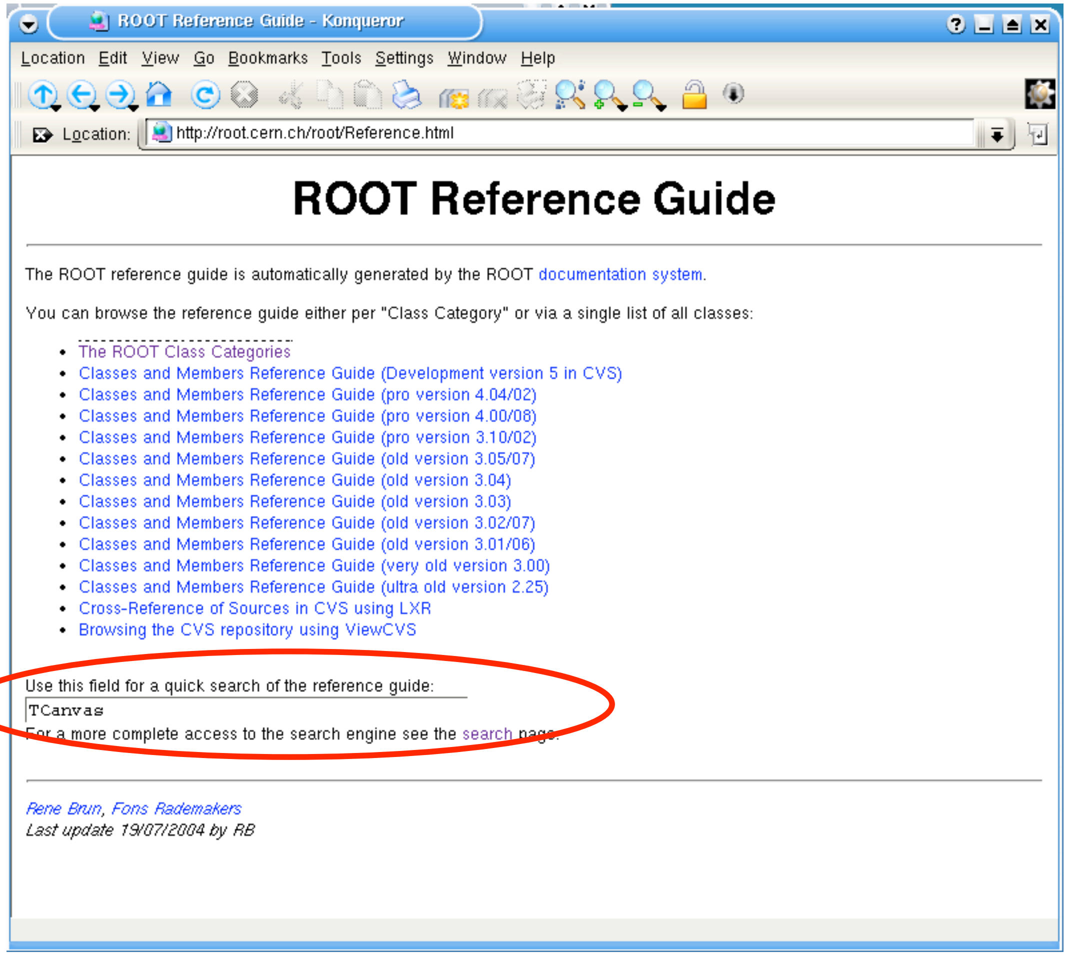
2. keyword search



Getting to know your way around

- The best method: http://root.cern.ch

type "TCanvas" then <ENTER>/ <RETURN>

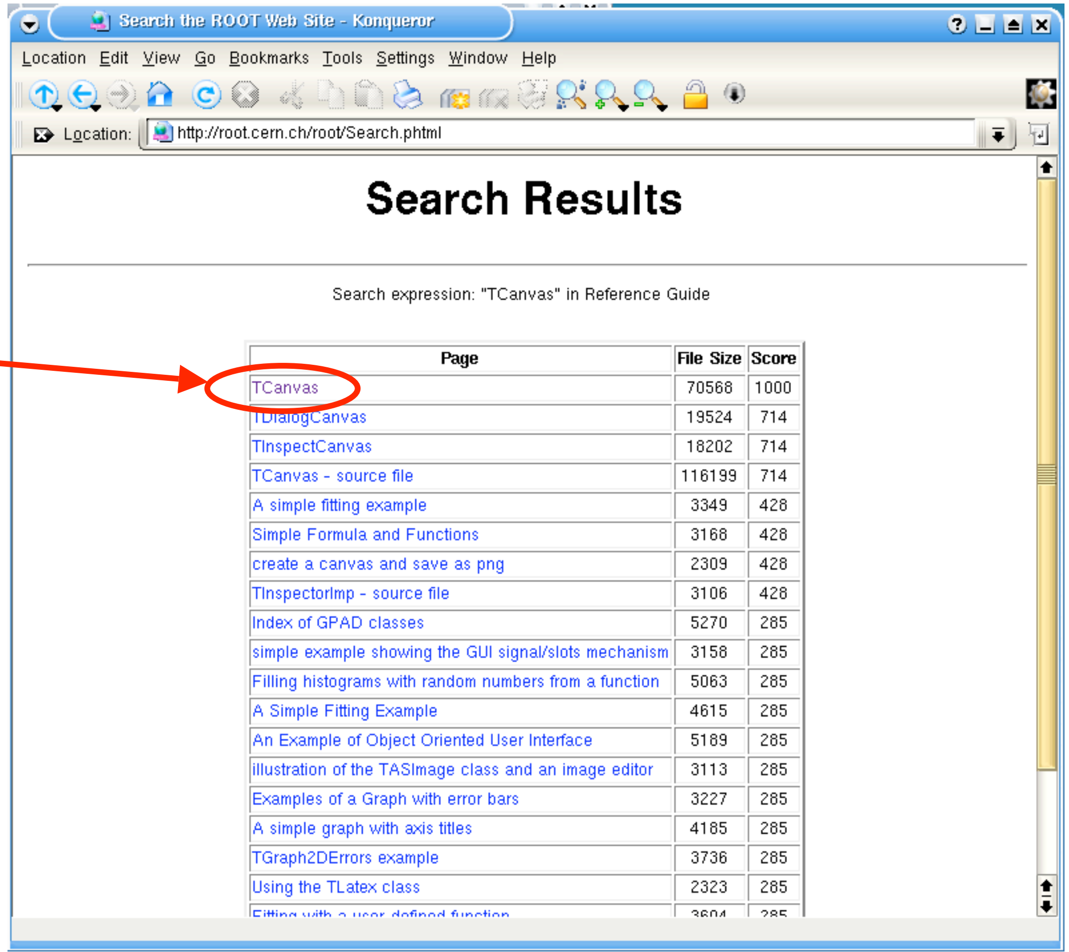


Getting to know your way around

- The best method: http://root.cern.ch

searching using the name of a class works best…

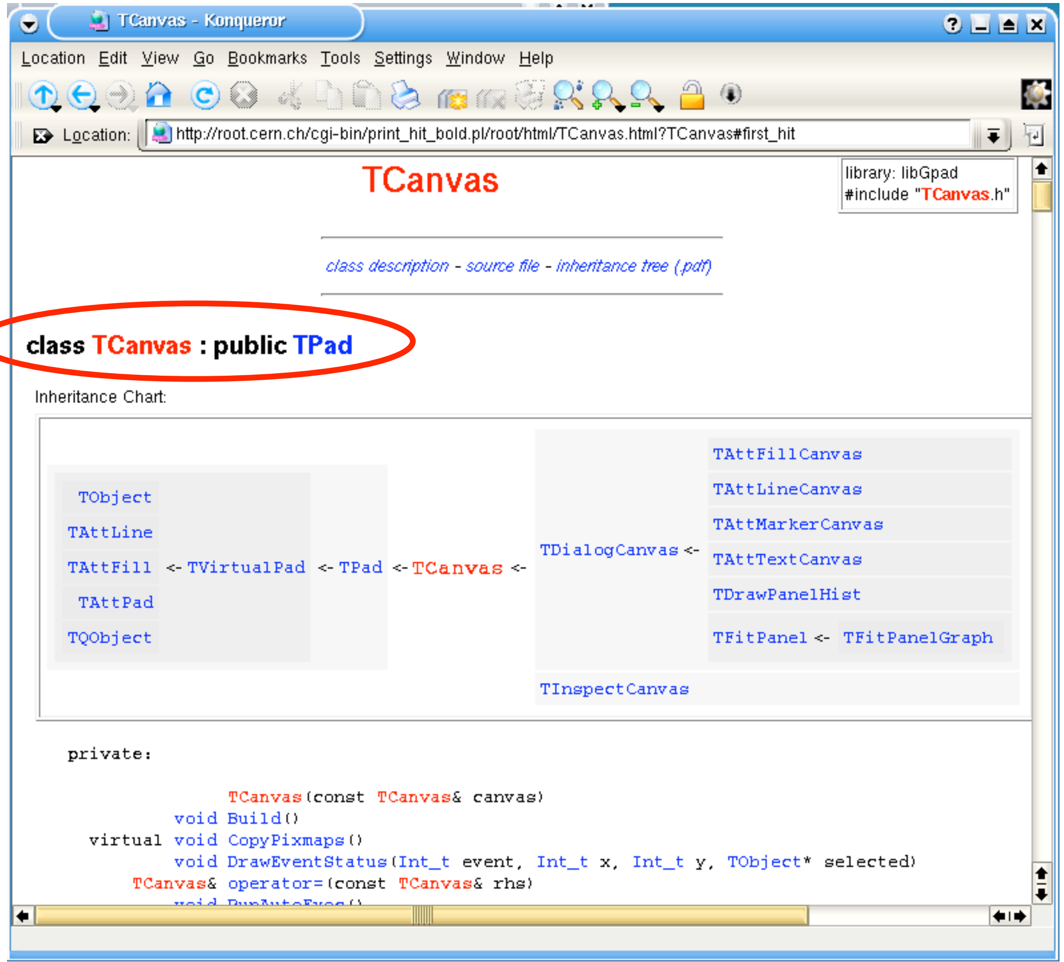
…but don't neglect the other responses which can be very interesting!!



Presentation of a page documenting a class

- All necessary information is here… as long as you know where to look

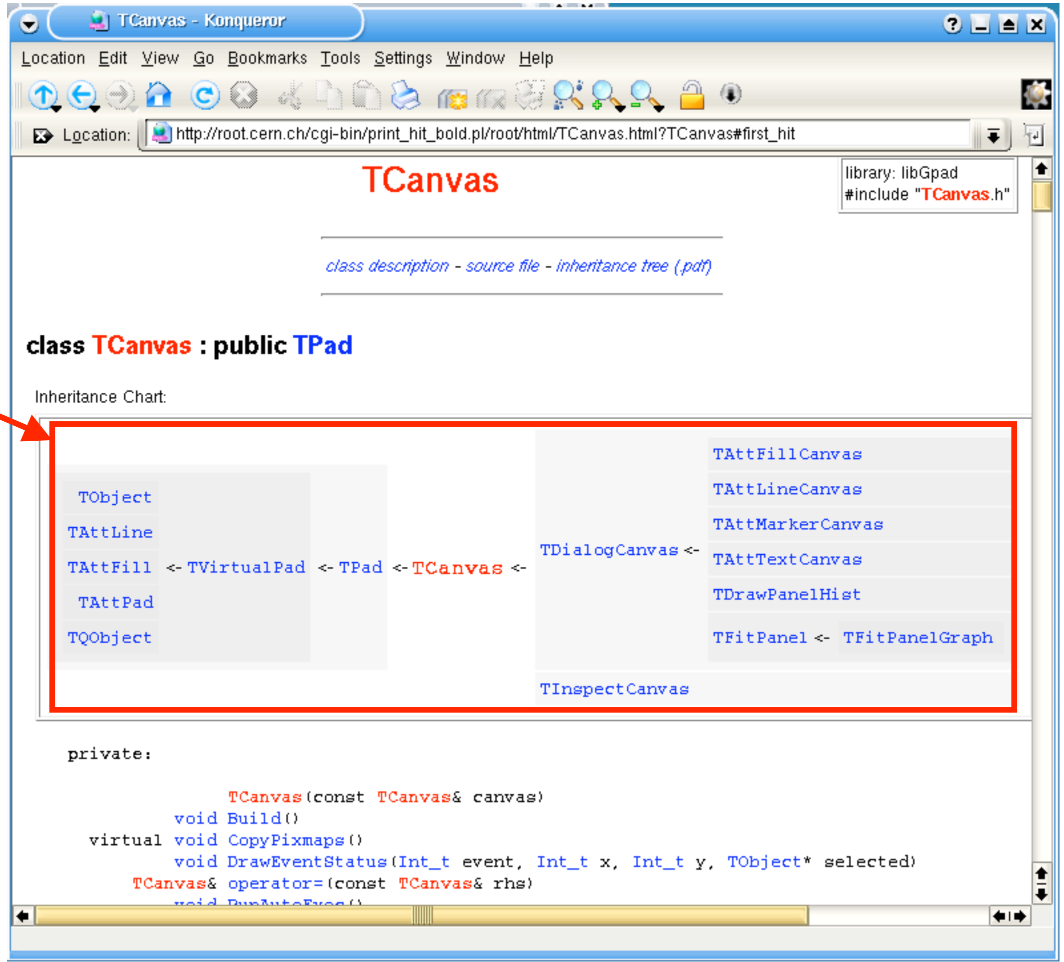
Class name and name of its closest family relation (parent class)



Presentation of a page documenting a class

- All necessary information is here… as long as you know where to look

Complete family tree for the class



Presentation of a page documenting a class

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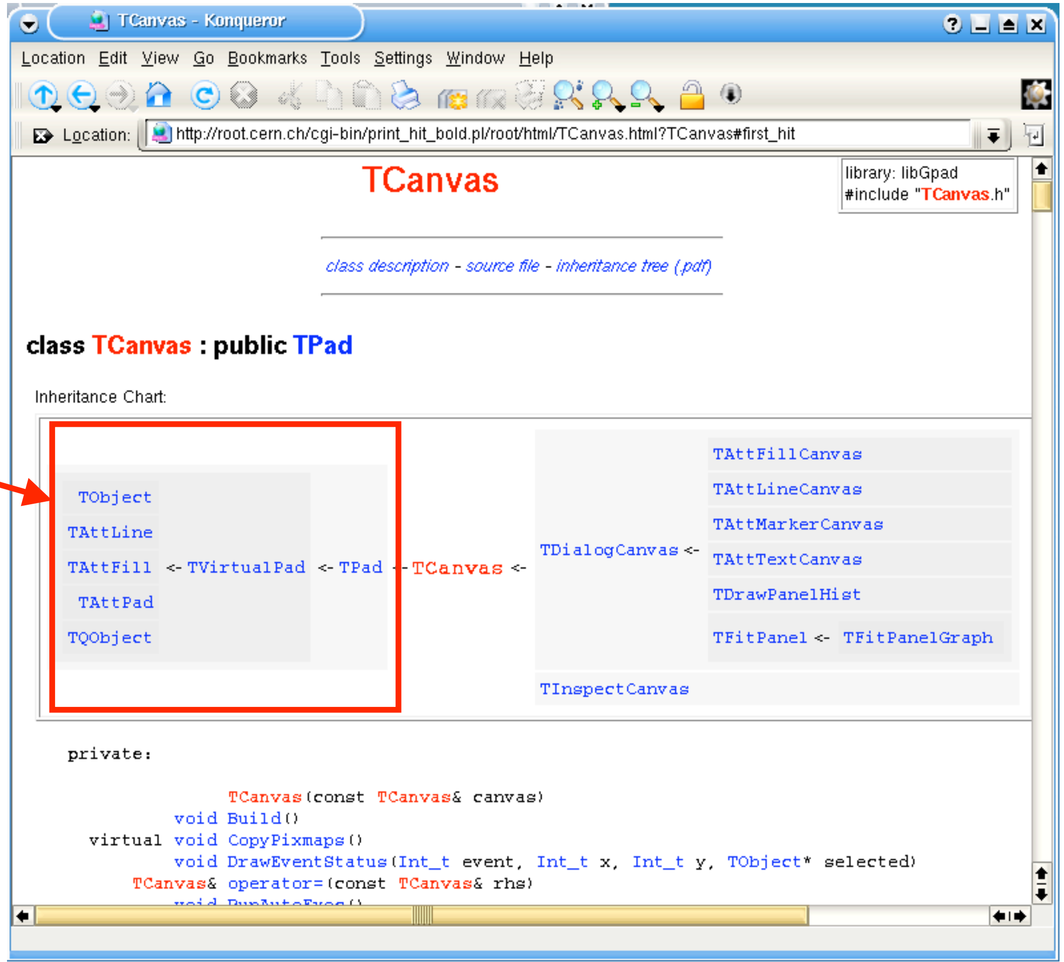
Complete family tree of the class

parents and grand-parents to the left



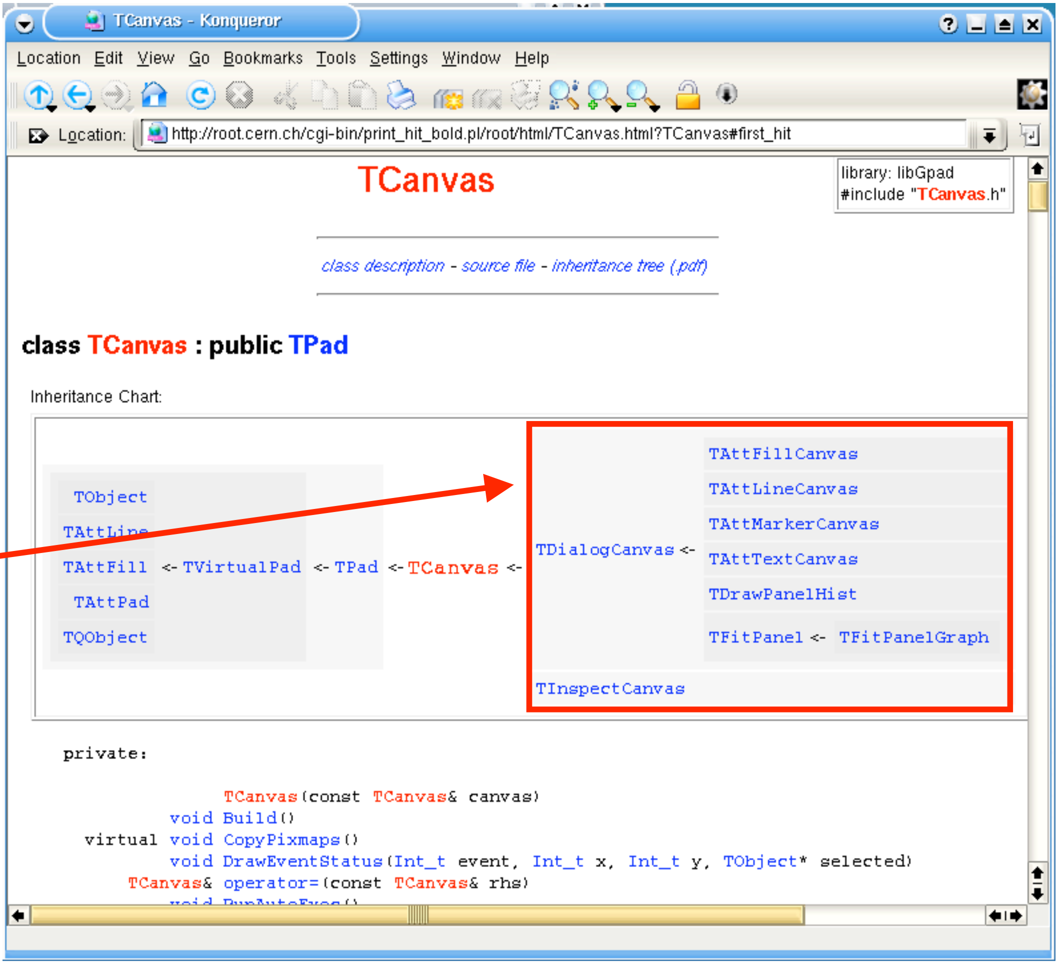
Presentation of a page documenting a class

- All necessary information is here… as long as you know where to look

Complete family tree of the class

parents and grand-parents to the left

children and grand-children to the right



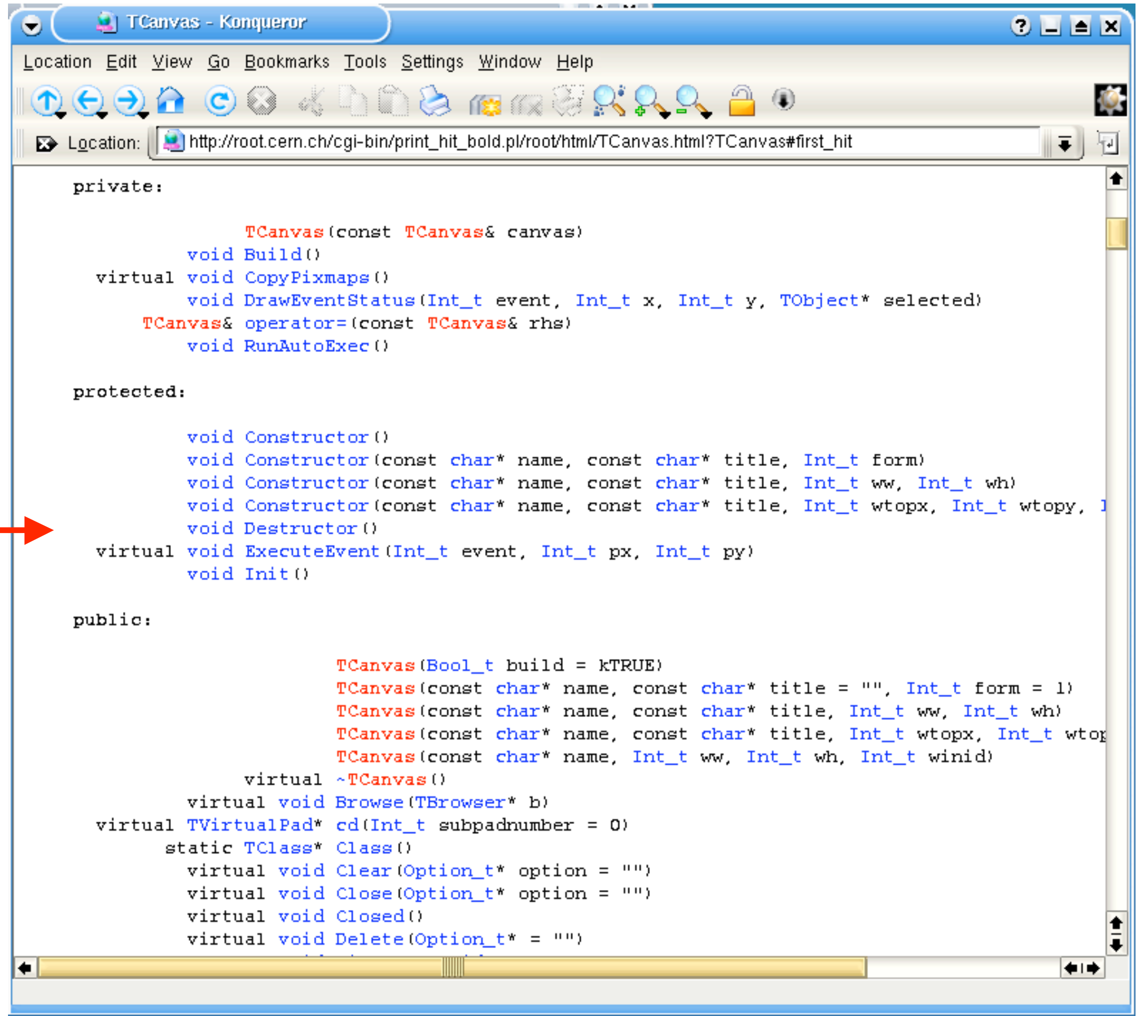
Presentation of a page documenting a class

- All necessary information is here… as long as you know where to look

(a bit further down)

complete list of class methods

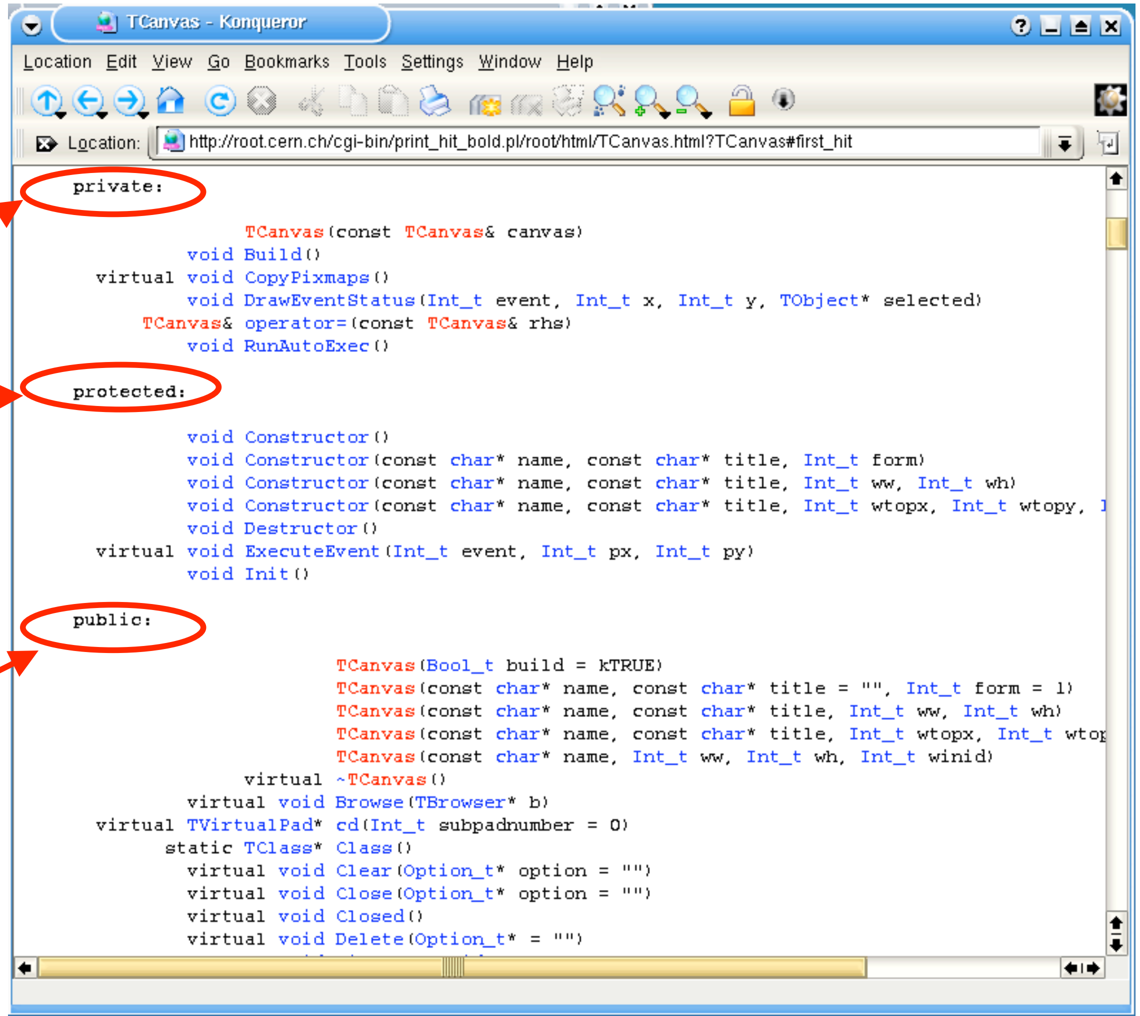
each method name is a link to an explanation of the method



The class methods list

- There are three types of method: "private", "protected", and "public"

you cannot use the "private" or "protected" methods...

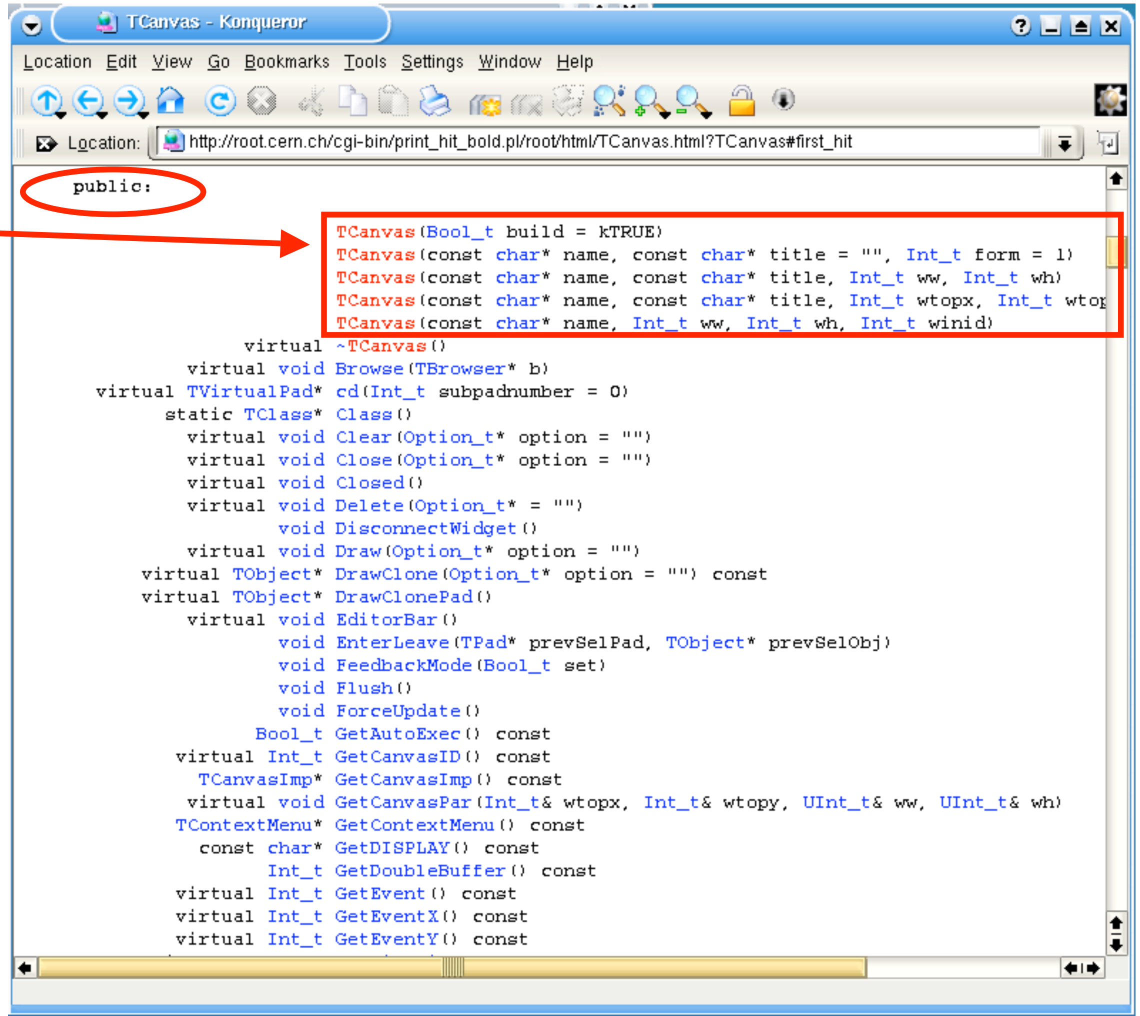


... so we'll only look at the "public" ones

The class methods list

- The "public" methods list is always organised in the same way:

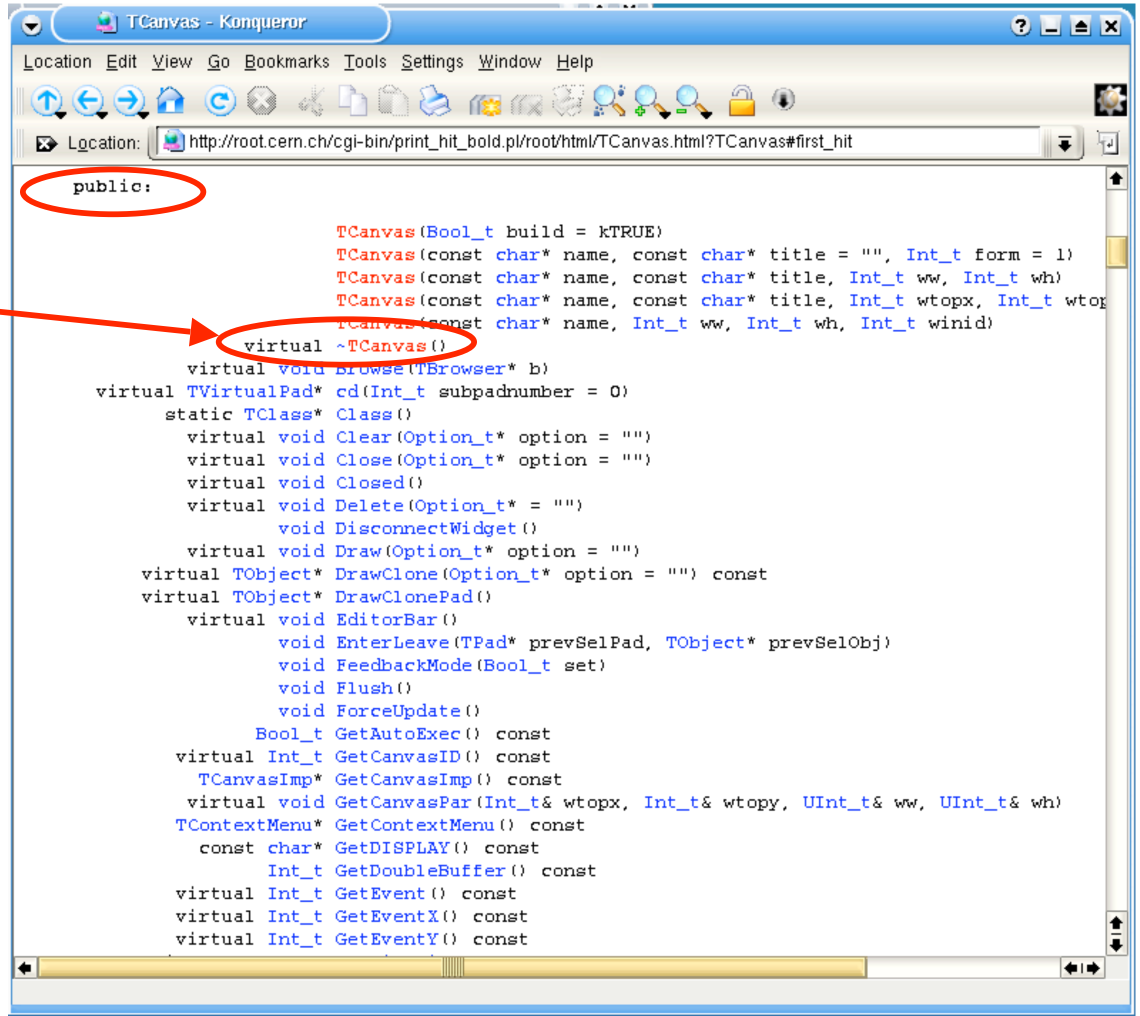
First the *constructors* of the class (methods with the same name as the class)



The class methods list

- The "public" methods list is always organised in the same way:

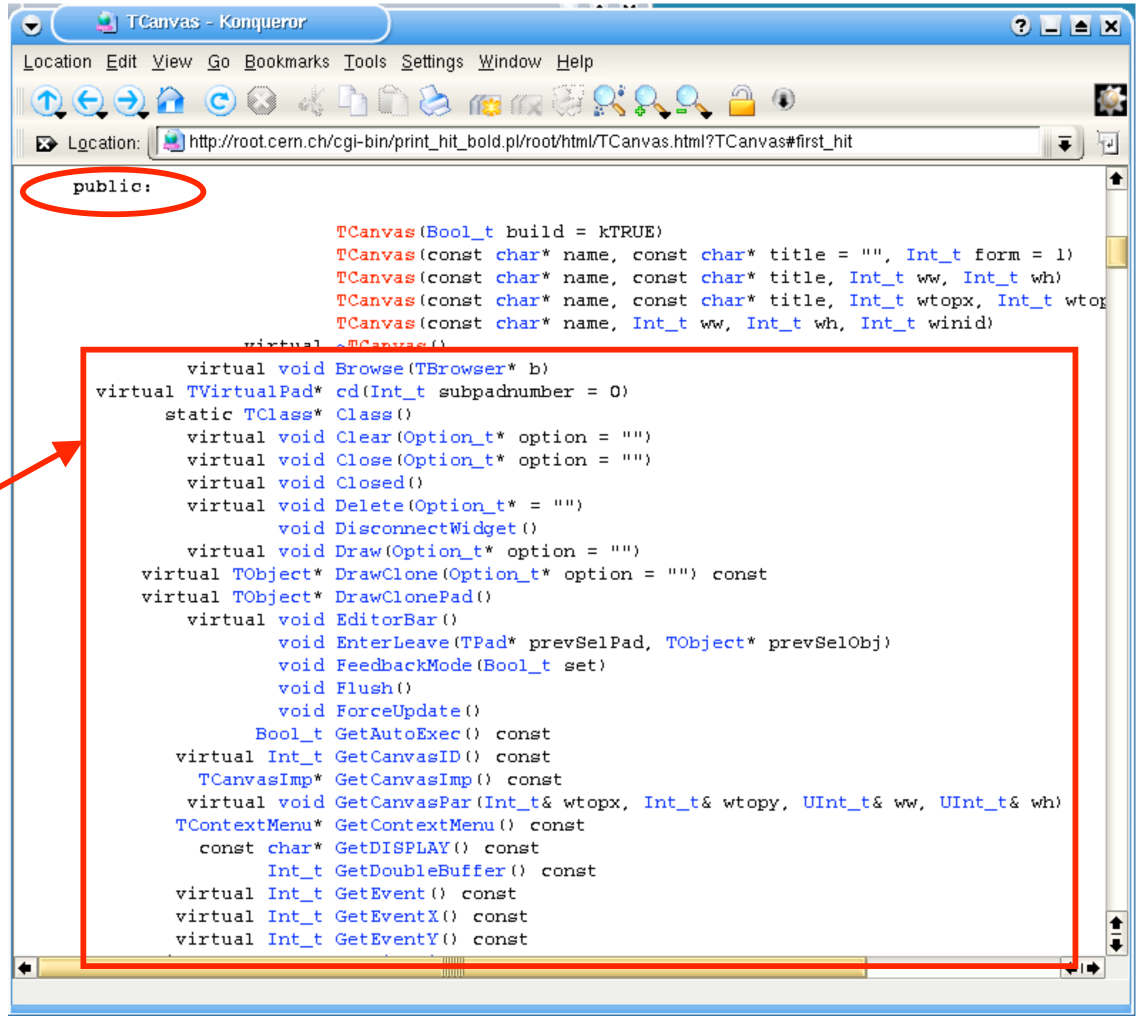
A destructor "~ClassName()" called when the object is destroyed, e.g. by delete*



*the destructor cannot be called directly i.e.
toto->~ClassName();
does not work. we use:
delete toto;

The class methods list

- The "public" methods list is always organised in the same way:



An alphabetical list of *all* of the methods of the class...?

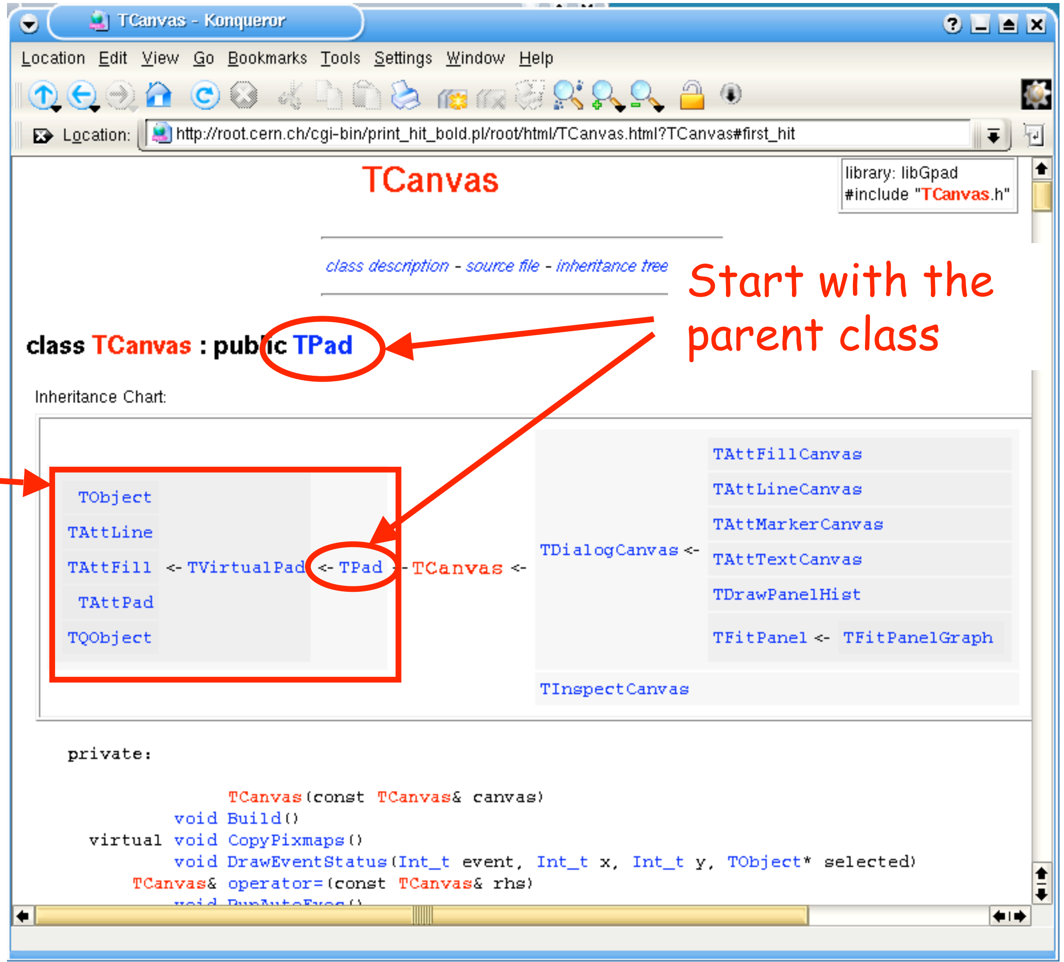
Where is "Divide" ?

Finding ALL the methods of a class

- If a method seems to be missing from a class, it might be defined by its (grand-)parents…

The objects of a class *inherit* all the characteristics & know-how of their ancestors…

…whilst adding a few particularites of their own.

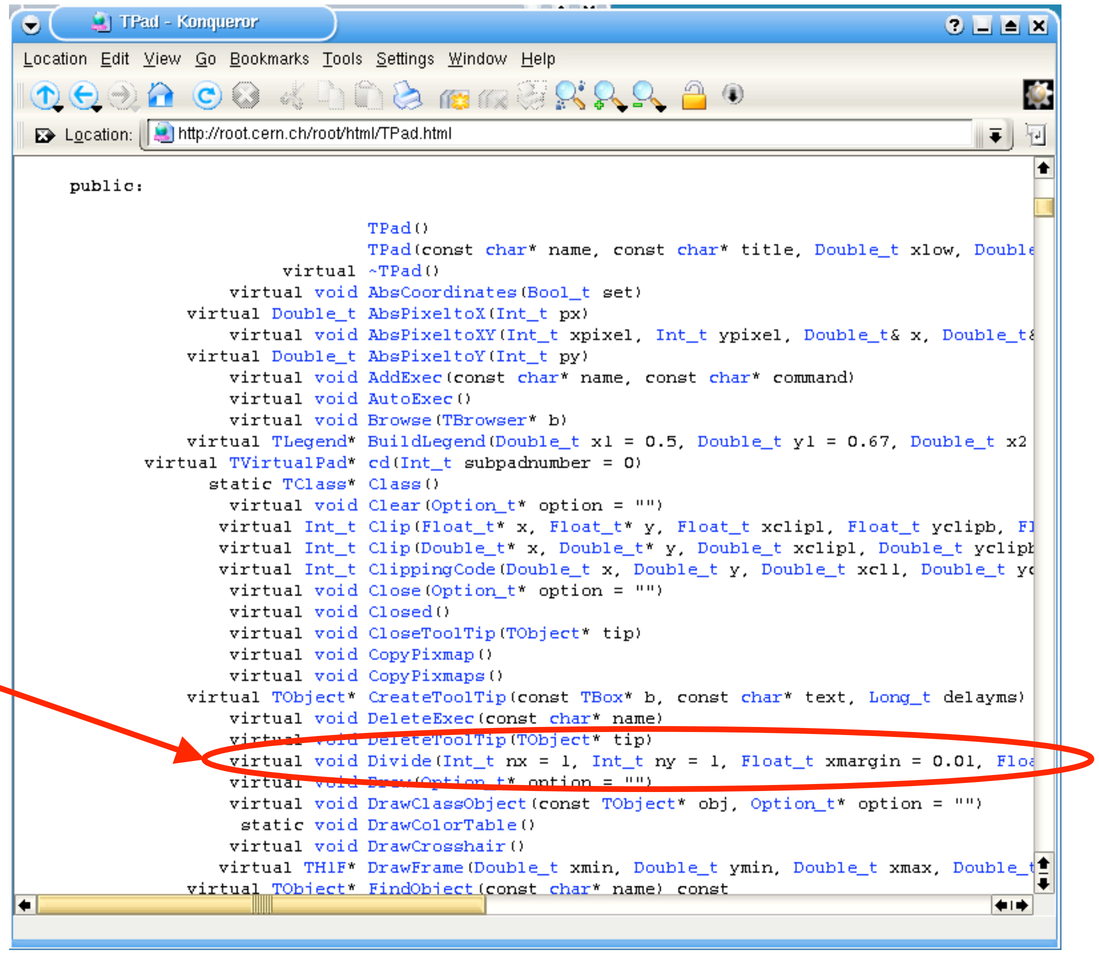


Finding ALL the methods of a class

- If a method seems to be missing from a class, it might be defined by its (grand-)parents…

Found it!
Let's look at the explanation…*

*…we'll explain the function declaration (variable types, default arguments etc.) later

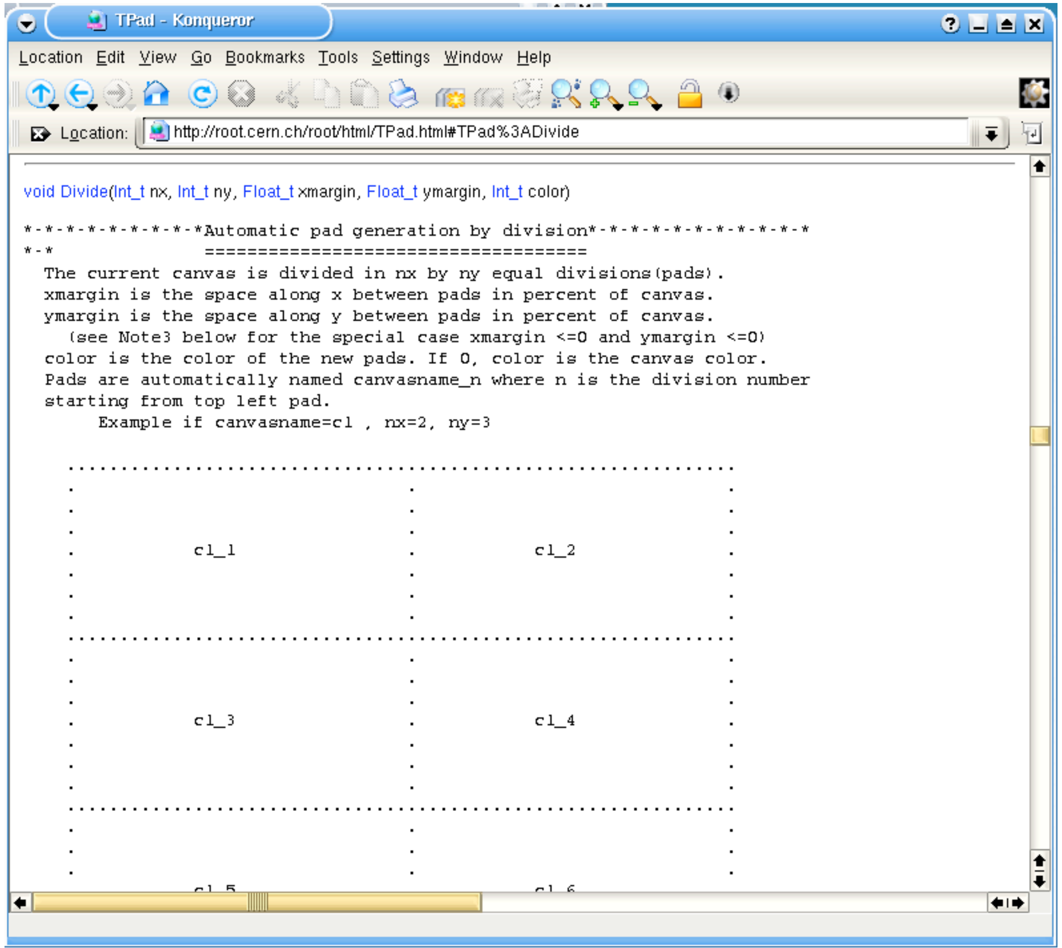


Finding ALL the methods of a class

- If a method seems to be missing from a class, it might be defined by its (grand-)parents…

Here is the on-line HTML documentation for method "Divide" of class "TPad", the parent class of "TCanvas".

As TCanvas does not define another 'Divide' method, this is the one used by objects of class TCanvas.



Lost & found

Retrieving lost objects

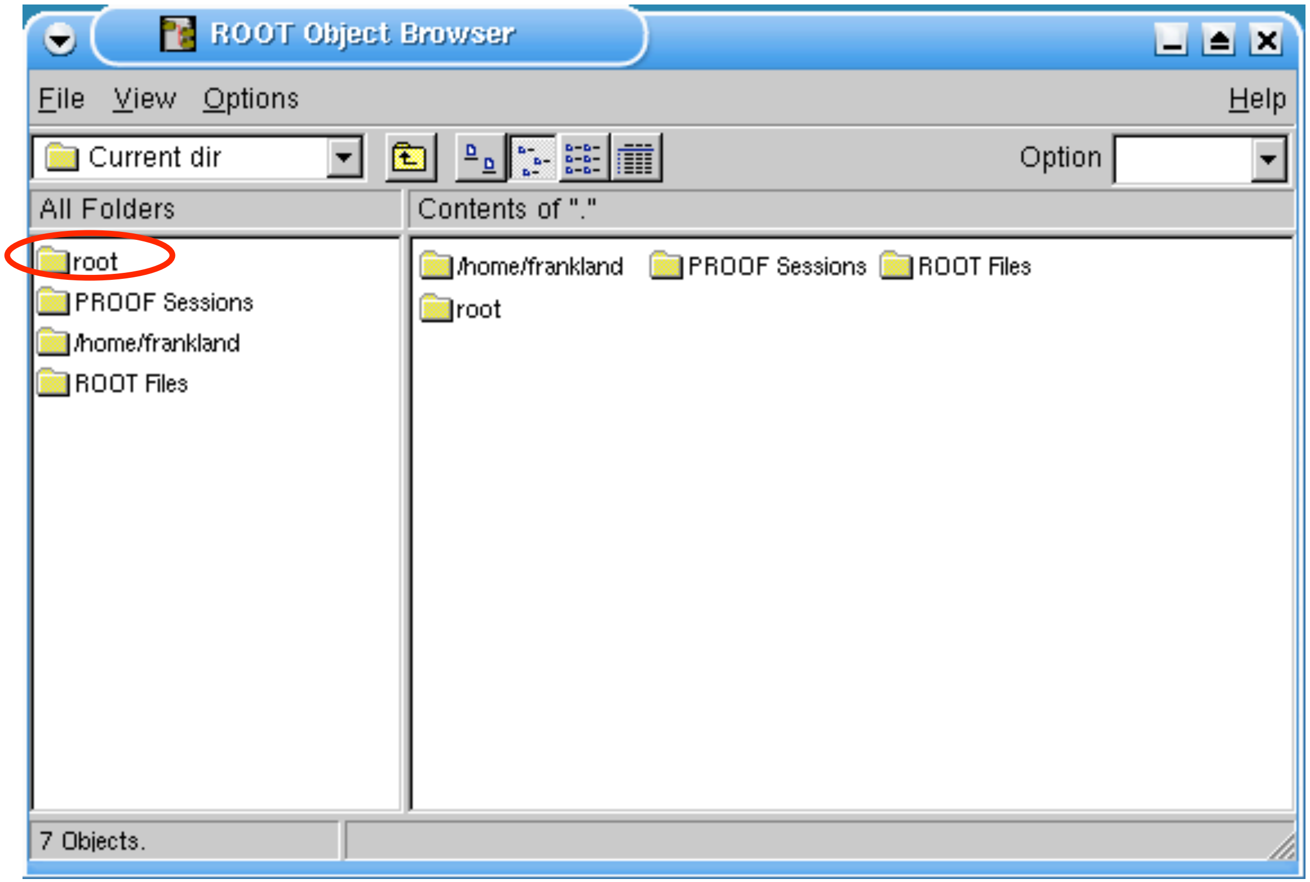
Or:

Why (most) objects have a name

Finding 'lost' objects

- ROOT keeps lists of objects, allowing to find them easily

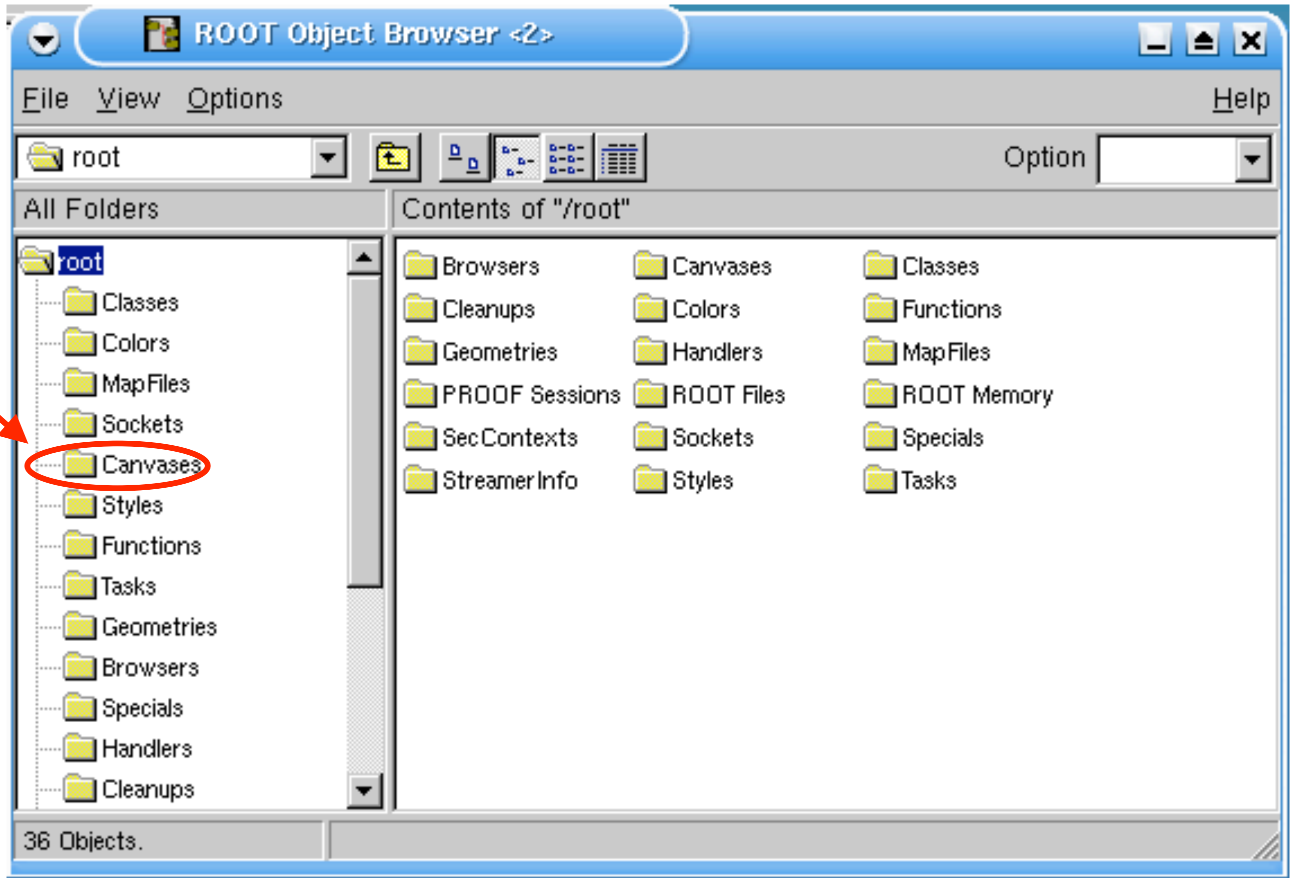
Double-click 'root'



Finding 'lost' objects

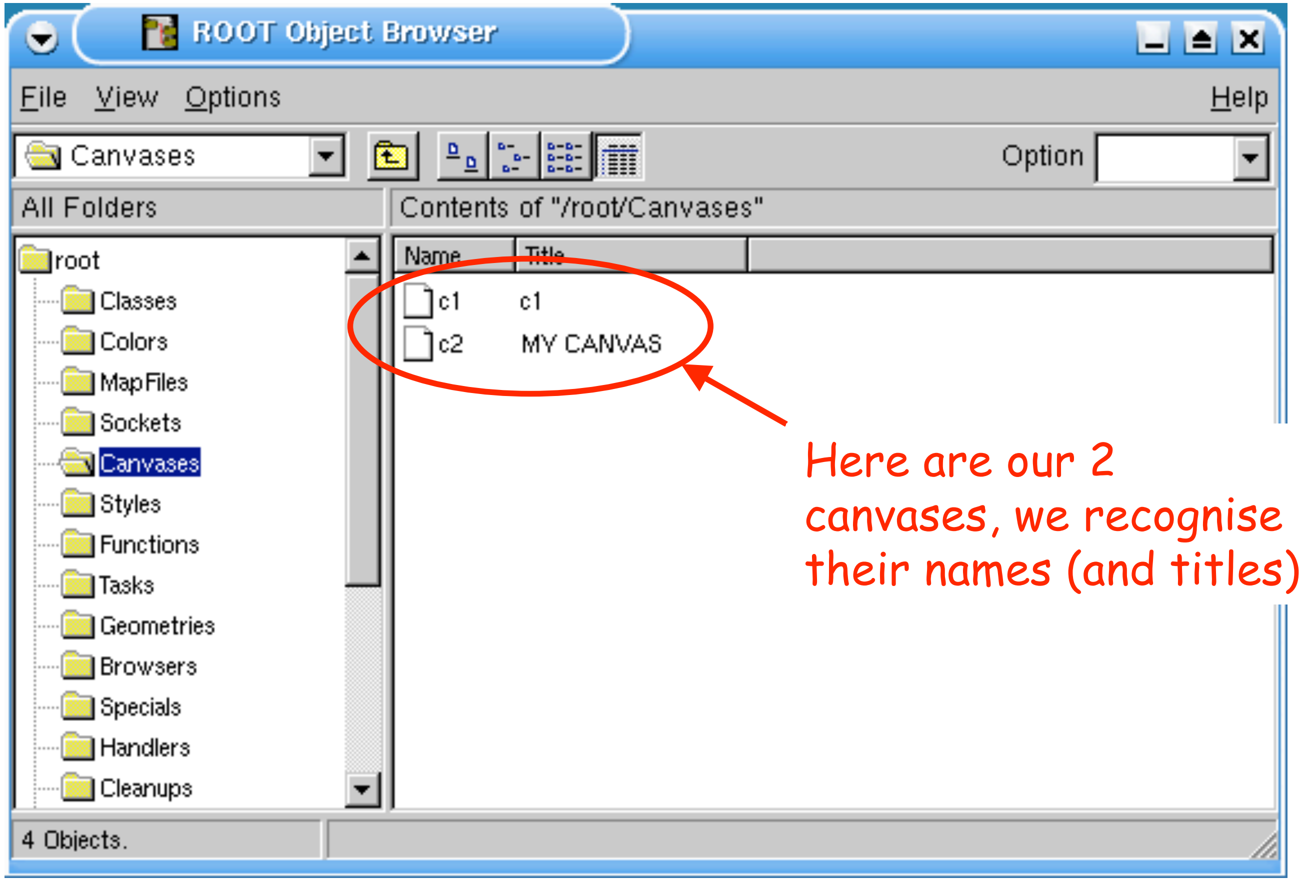
- You can browse these lists using the TBrowser

Click on 'Canvases'



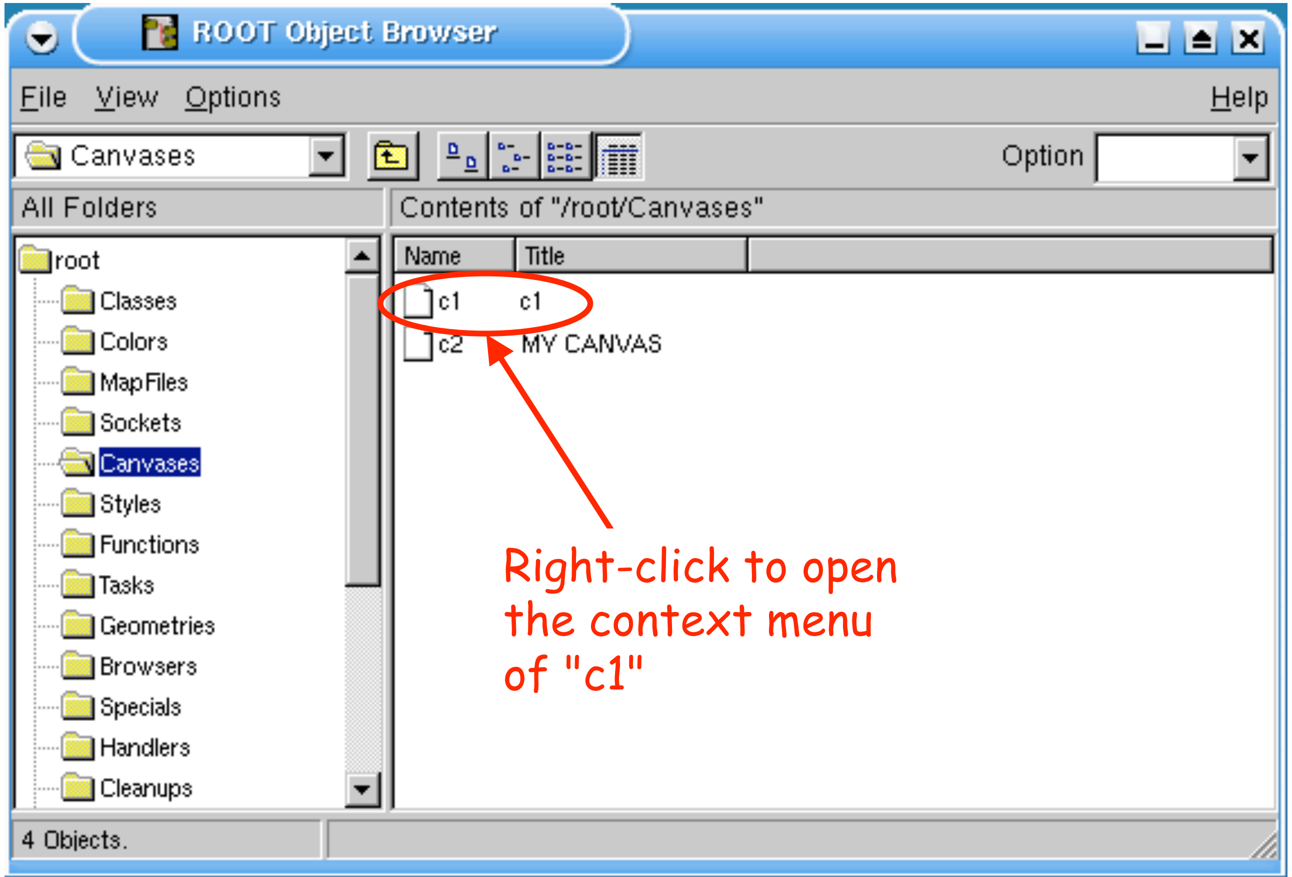
Finding 'lost' objects

- Each object has to have an unique name for us to find it.



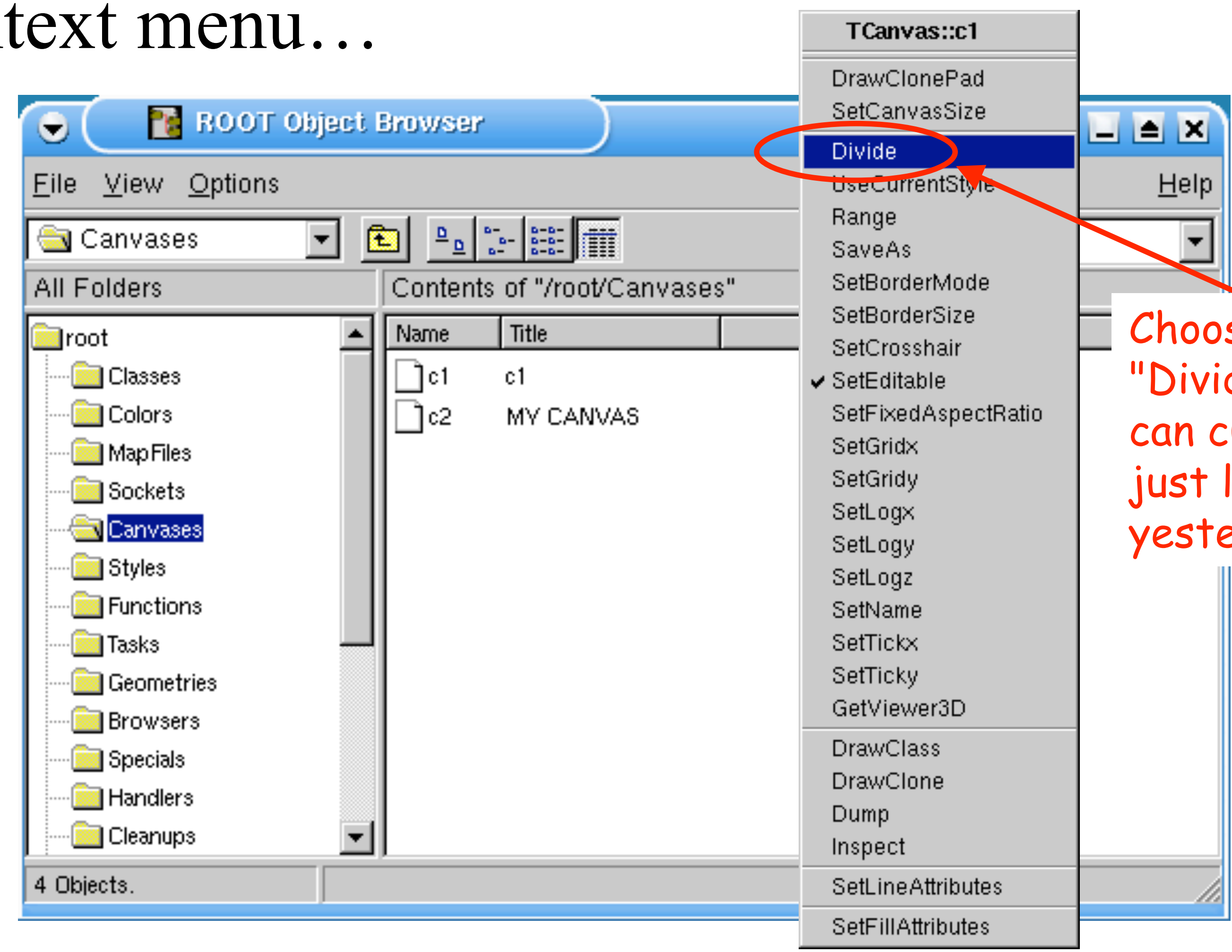
Finding 'lost' objects

- You can interact with the objects using their context menu…



Finding 'lost' objects

- You can interact with the objects using their context menu…



Choose e.g. "Divide", and you can cut "c1" in 4, just like yesterday…

Finding 'lost' objects

- …or if you knew the address of the object, you could use a pointer:

```
gROOT->GetListOfCanvases()->FindObject("c1");
```

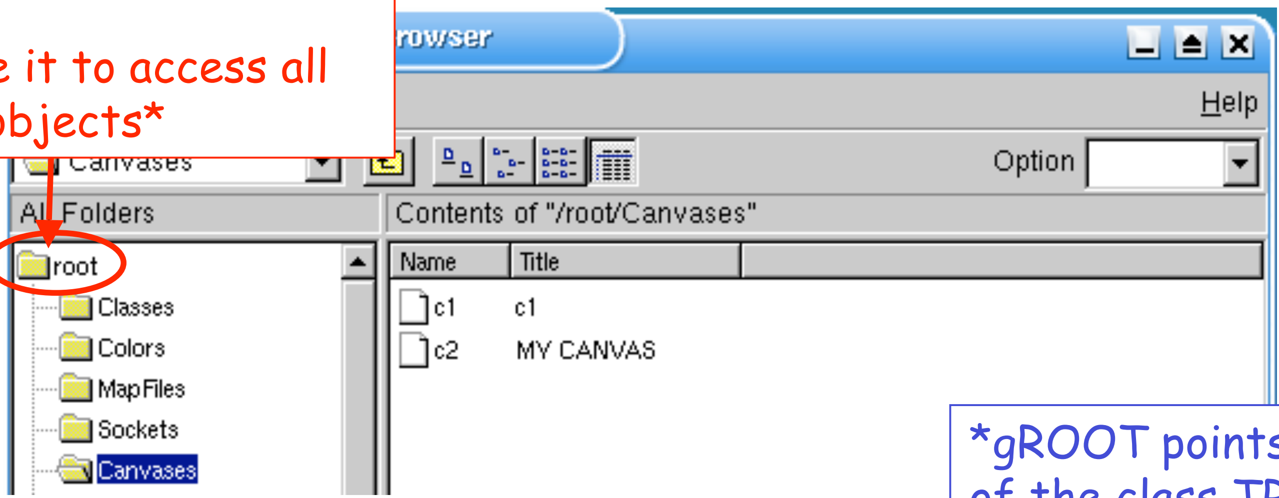
Finding 'lost' objects

- …or if you knew the address of the object, you could use a pointer:

```
gROOT->GetListOfCanvases()->FindObject("c1");
```

This global pointer contains the address of the 'root' folder of the folder tree.

You can use it to access all the other objects*

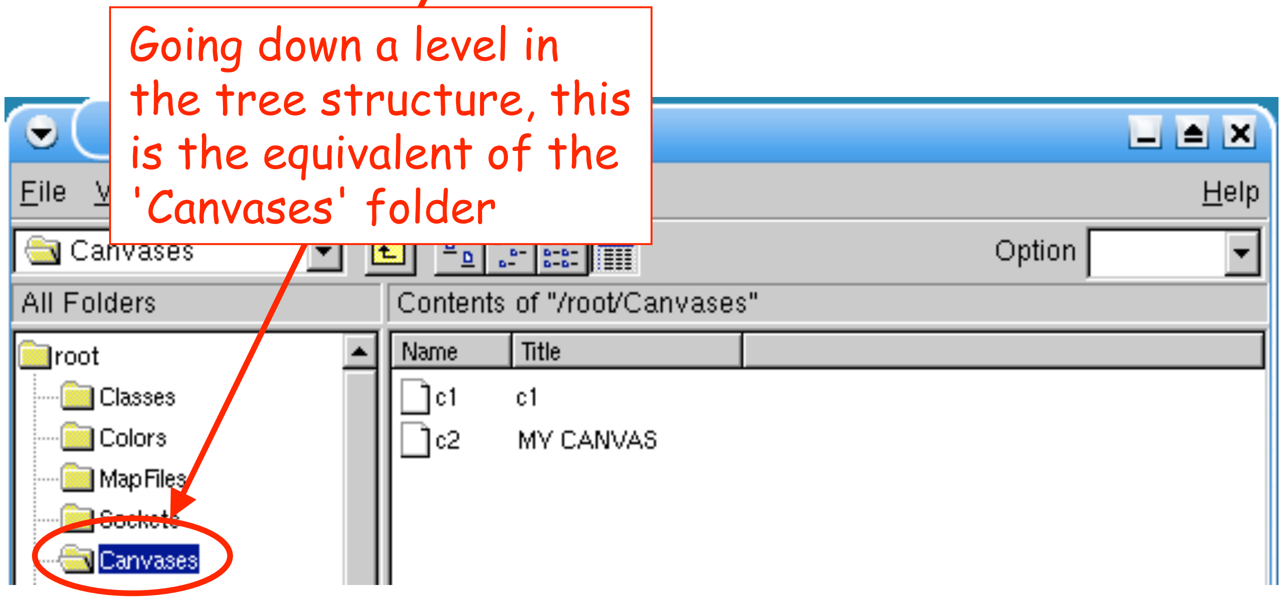


*gROOT points to an object of the class TROOT.

Finding 'lost' objects

- …or if you knew the address of the object, you could use a pointer:

```
gROOT->GetListOfCanvases()->FindObject("c1");
```

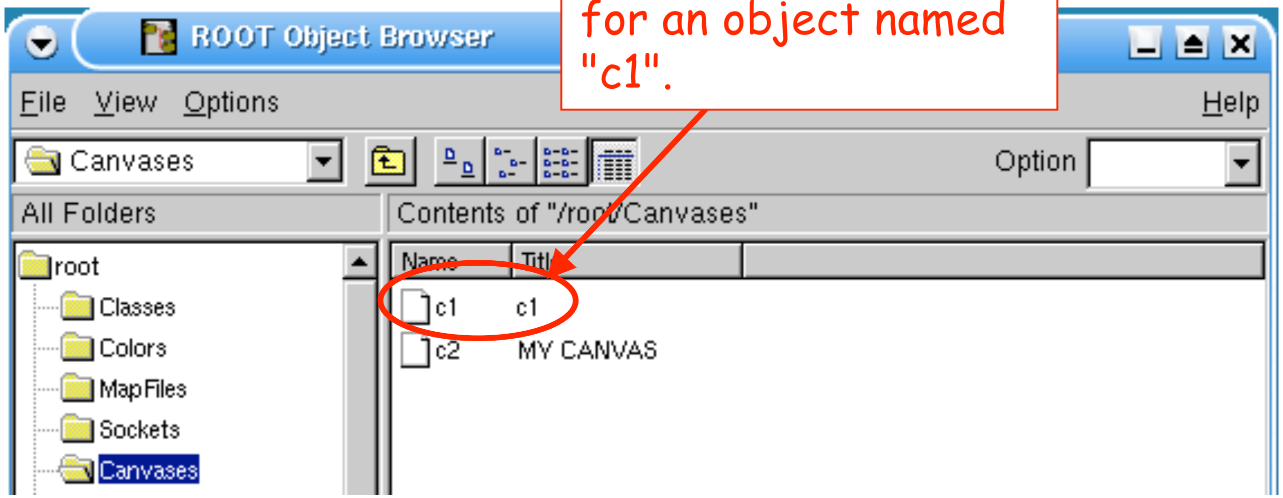


Finding 'lost' objects

- …or if you knew the address of the object, you could use a pointer:

```
gROOT->GetListOfCanvases()->FindObject("c1");
```

In the list/folder of all Canvases, we look for an object named "c1".



Finding 'lost' objects

- If you aren't sure which folder to look in, you can recursively search through all the folders:

```
gROOT->GetListOfCanvases()->FindObject("c1");
```

```
gROOT->FindObject("name");
```

This is the MAGIC FORMULA which allows to find (nearly) any object anywhere anytime.

You'll use it all the time!!

Finding 'lost' objects

- All you have to do now is put the address in the appropriate pointer and use it:

```
ClassName* toto = (ClassName*) gROOT->FindObject("nom");
```

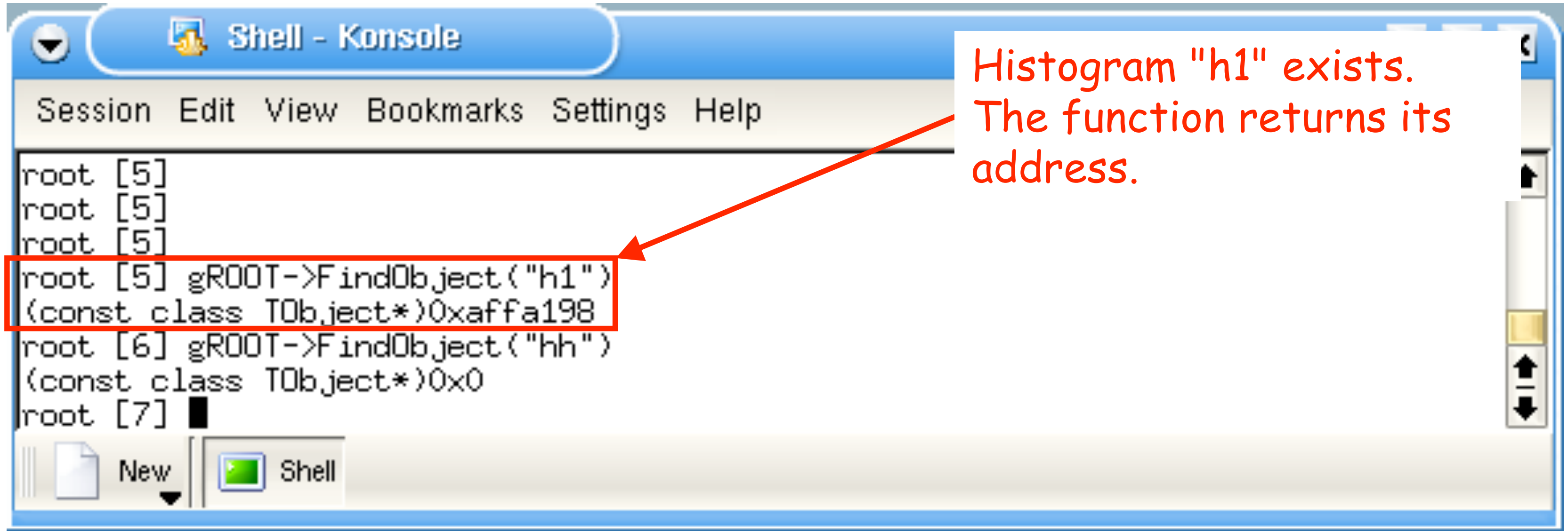
We have to re-specify the class of the object we hope to find here

Example: we look for canvas "c1" and wipe it clean:

```
TCanvas* c1_ptr = (TCanvas*) gROOT->FindObject("c1");
c1_ptr->Clear();
```

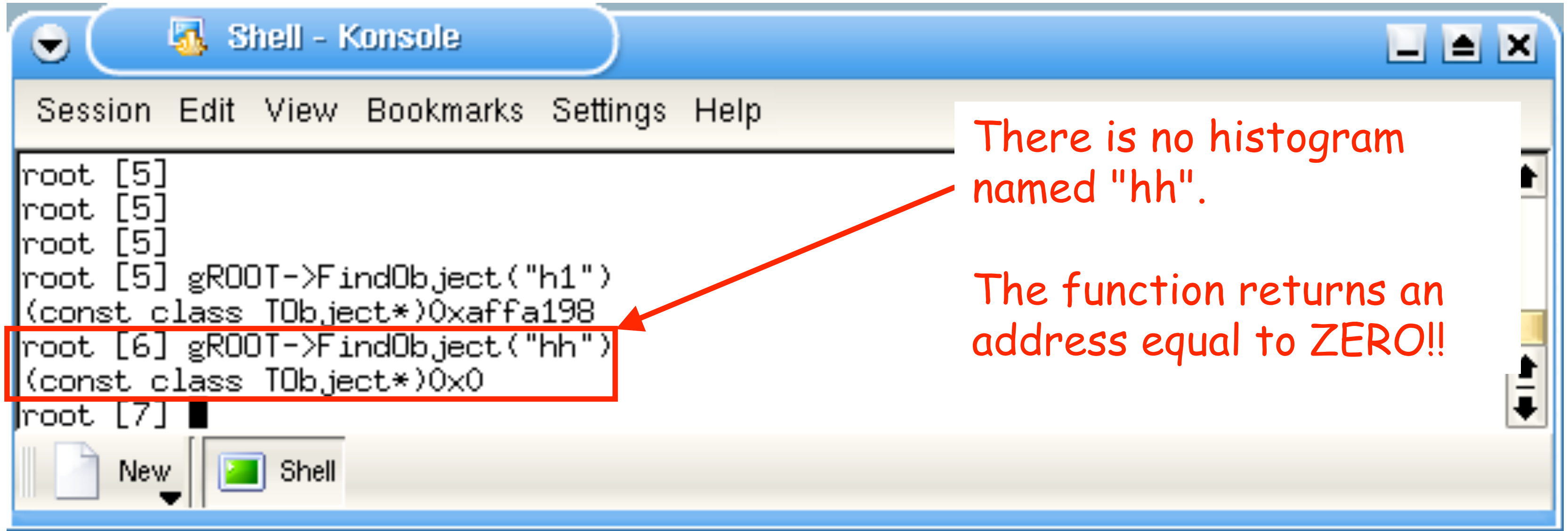
Testing if an object exists

- You use the same function to know if an object with a given name exists or not:



Testing if an object exists

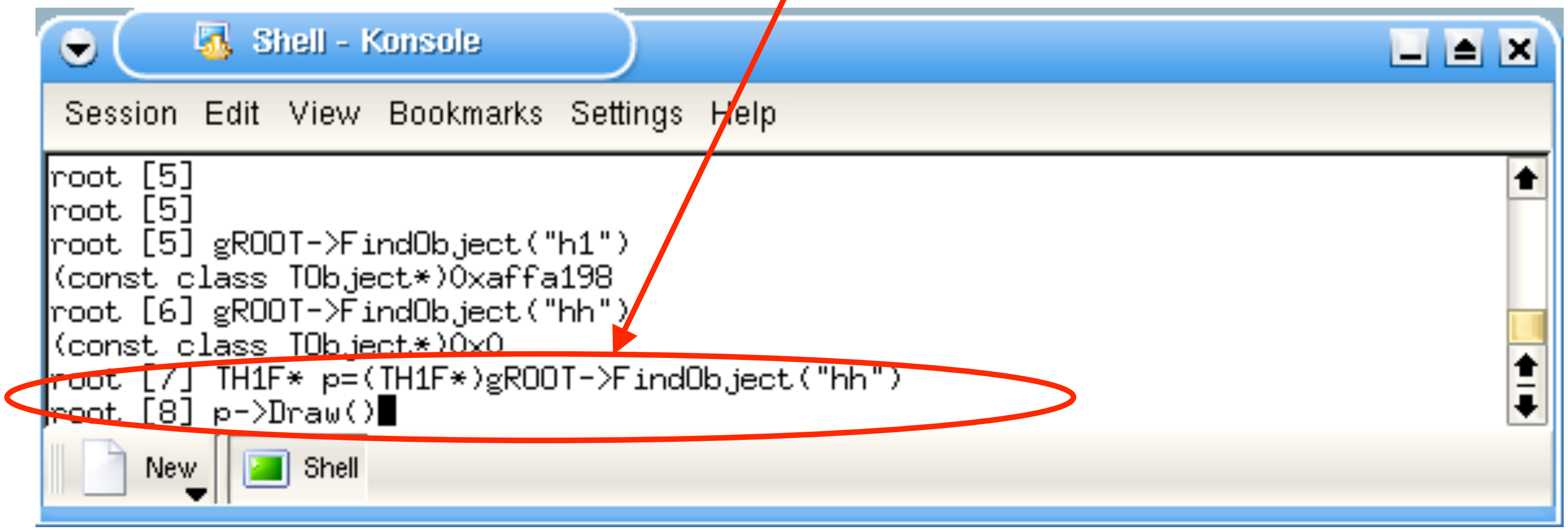
- You use the same function to know if an object with a given name exists or not:



Testing if an object exists

- To be rigorous, you should always test the value of a pointer before trying to use it…

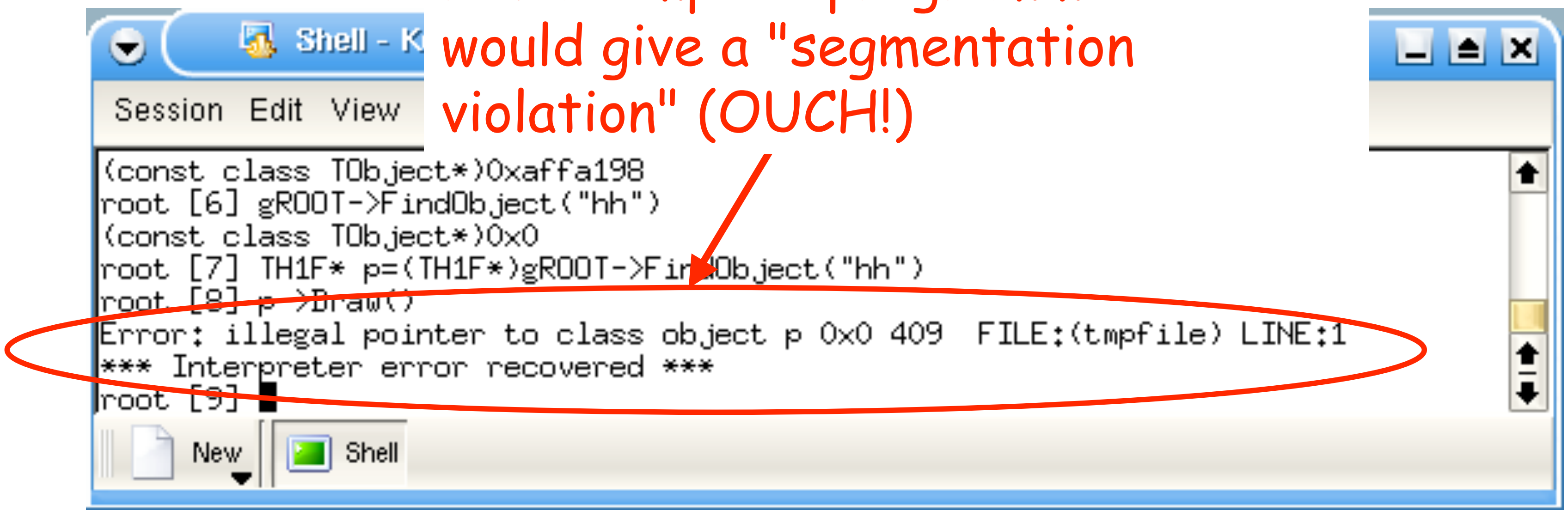
What happens if you try to use a pointer holding the address 0 ?



Testing if an object exists

- To be rigorous, you should always test the value of a pointer before trying to use it…

The interpreter is very kind…
…in a compiled programme this would give a "segmentation violation" (OUCH!)



Function programming

C++ for everybody…

A function

- Here is an example of a C++ function

fillHisto.C - /home/frankland/

```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian()
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
    }
    h->Draw();
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = 20.*exp( -pow(x-50.,2)/2./pow(10,2) );
        h->Fill(x,f);
        gPad->Modified(); gPad->Update();
    }
}
```

HEADERS:
a declaration for each
class used in the function

A function

- Here is an example of a C++ function

fillHisto.C - /home/frankland/

File Edit Search Preferences Shell Macro Windows Help

```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian()
{
     TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
     if( h ){
          h->Reset();
     } else {
          h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
     }
     h->Draw();
     for(Double_t x=0; x<100; x++)
     {
          Double_t f = 20.*exp( -pow(x-50.,2)/2./pow(10,2) );
          h->Fill(x,f);
          gPad->Modified(); gPad->Update();
     }
}
```

DECLARATION:
type of value returned,
name of function,
arguments*

*void = no returned value
() = no arguments

A function

- Here is an example of a C++ function

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```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian()
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     } else {
          h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
     }
     h->Draw();
     for(Double_t x=0; x<100; x++)
     {
          Double_t f = 20.*exp( -pow(x-50.,2)/2./pow(10,2) );
          h->Fill(x,f);
          gPad->Modified(); gPad->Update();
     }
}
```

an 'if-else' block

A function

- Here is an example of a C++ function

```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian()
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
    }
    h->Draw();
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = 20.*exp( -pow(x-50.,2)/2./pow(10,2) );
        h->Fill(x,f);
        gPad->Modified(); gPad->Update();
    }
}
```

A loop over 'x', from x=0 to x=99, incrementing x by 1 each time

A function

- Here is an example of a C++ function

fillHisto.C - /home/frankland/

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```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian()
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
    }
    h->Draw();
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = 20.*exp( -pow(x-50.,2)/2./pow(10,2) );
        h->Fill(x,f);
        gPad->Modified(); gPad->Update();
    }
}
```

Clear out the contents of the spectrum

gPad = pointer to the currently active pad or canvas

Compiling and using the function

- To compile and load the definition of the function:

```
.L fillHisto.C+
```

Name of file containing the function definition

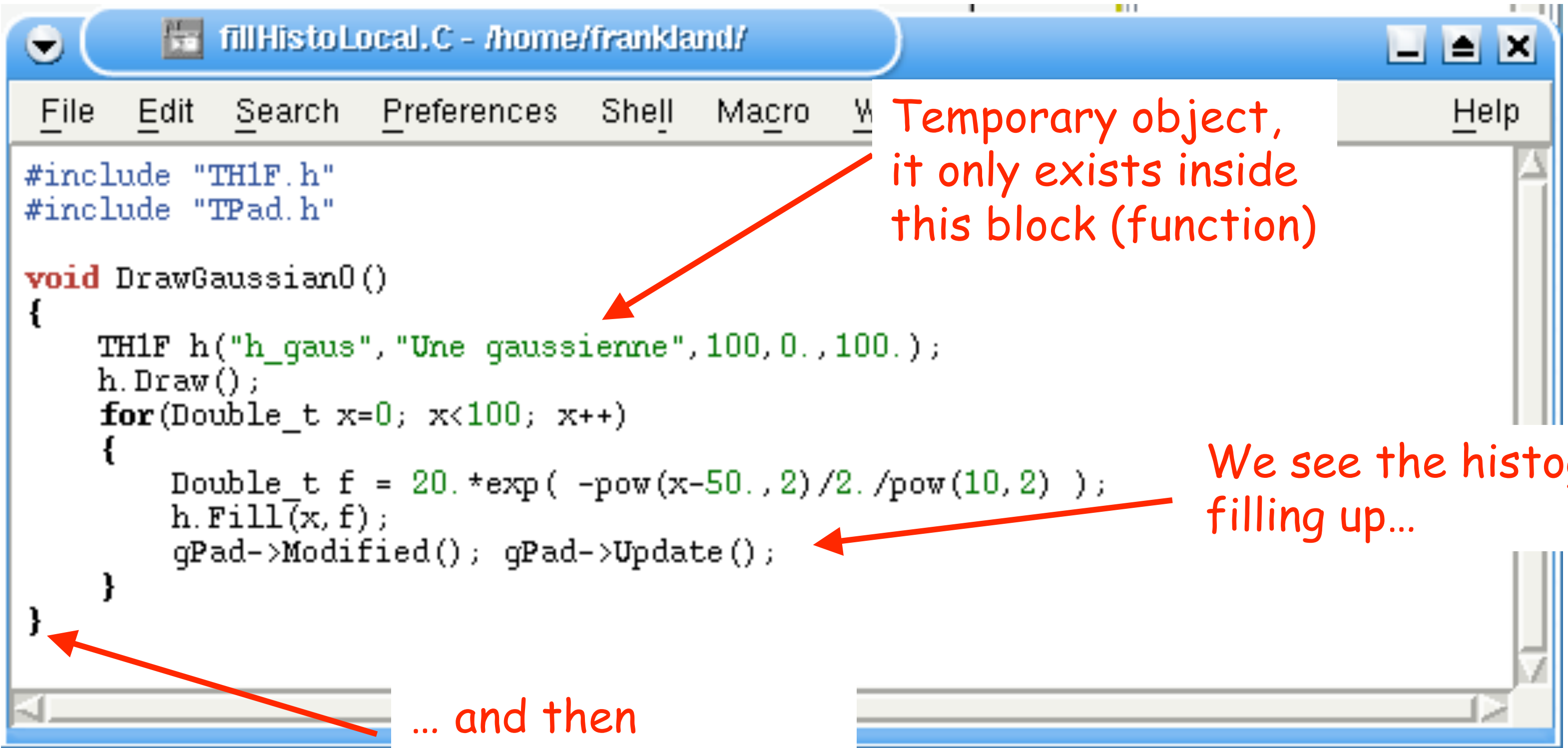
- To execute the function:

```
DrawGaussian()
```

Name of the function (don't forget the '()' !)

Why use 'new' to create the histogram ?

- Let's see what happens if we don't use "new"



Temporary object, it only exists inside this block (function)

We see the histogram filling up…

… and then disappear at the end of the function

Using functions with arguments

- A function with arguments:

fillHisto2.C - /home/frankland/

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```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian2(Double_t amp, Double_t moy, Double_t large)
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
    }
    h->Draw();
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = amp*exp( -pow(x-moy,2)/2./pow(large,2) );
        h->Fill(x,f);
        gPad->Modified(); gPad->Update();
    }
}
```

List of arguments with their type

Use of the arguments inside the function

Arguments with default values

fillHisto3.C - /home/frankland/

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```
#include "TH1F.h"
#include "TPad.h"

void DrawGaussian3(Double_t amp = 20., Double_t moy = 50., Double_t large = 10.)
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,0.,100.);
    }
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = amp*exp( -pow(x-moy,2)/2./pow(large,2) );
        h->Fill(x,f);
    }
    h->Draw(); gPad->Modified(); gPad->Update();
}
```

e.g. default width for the gaussian

DrawGaussian()	=> amp=20, moy=50, large=10
DrawGaussian(5)	=> amp=5, moy=50, large=10
DrawGaussian(5,30)	=> amp=5, moy=30, large=10
DrawGaussian(5,30,5)	=> amp=5, moy=30, large=5

Returning values/objects

- Functions can return ALL sorts of variables…

fillHisto4.C - /home/fran

File Edit Search Preferences … Help

```
#include "TH1F.h"
#include "TPad.h"

Double_t Gaussian(Double_t z, Double_t toto, Double_t tata, Double_t tutu)
{
        Double_t f = toto*exp( -pow(z-tata,2)/2./pow(tutu,2) );
        return f;
}

TH1F* DrawGaussian4(Double_t amp = 20., Double_t moy = 50., Double_t large = 10.)
{
    TH1F* h=(TH1F*)gROOT->FindObject("h_gaus");
    if( h ){
        h->Reset();
    } else {
        h = new TH1F("h_gaus","Une gaussienne",100,
    }
    for(Double_t x=0; x<100; x++)
    {
        Double_t f = Gaussian(x,amp,moy,large);
        h->Fill(x,f);
    }
    return h;
}
```

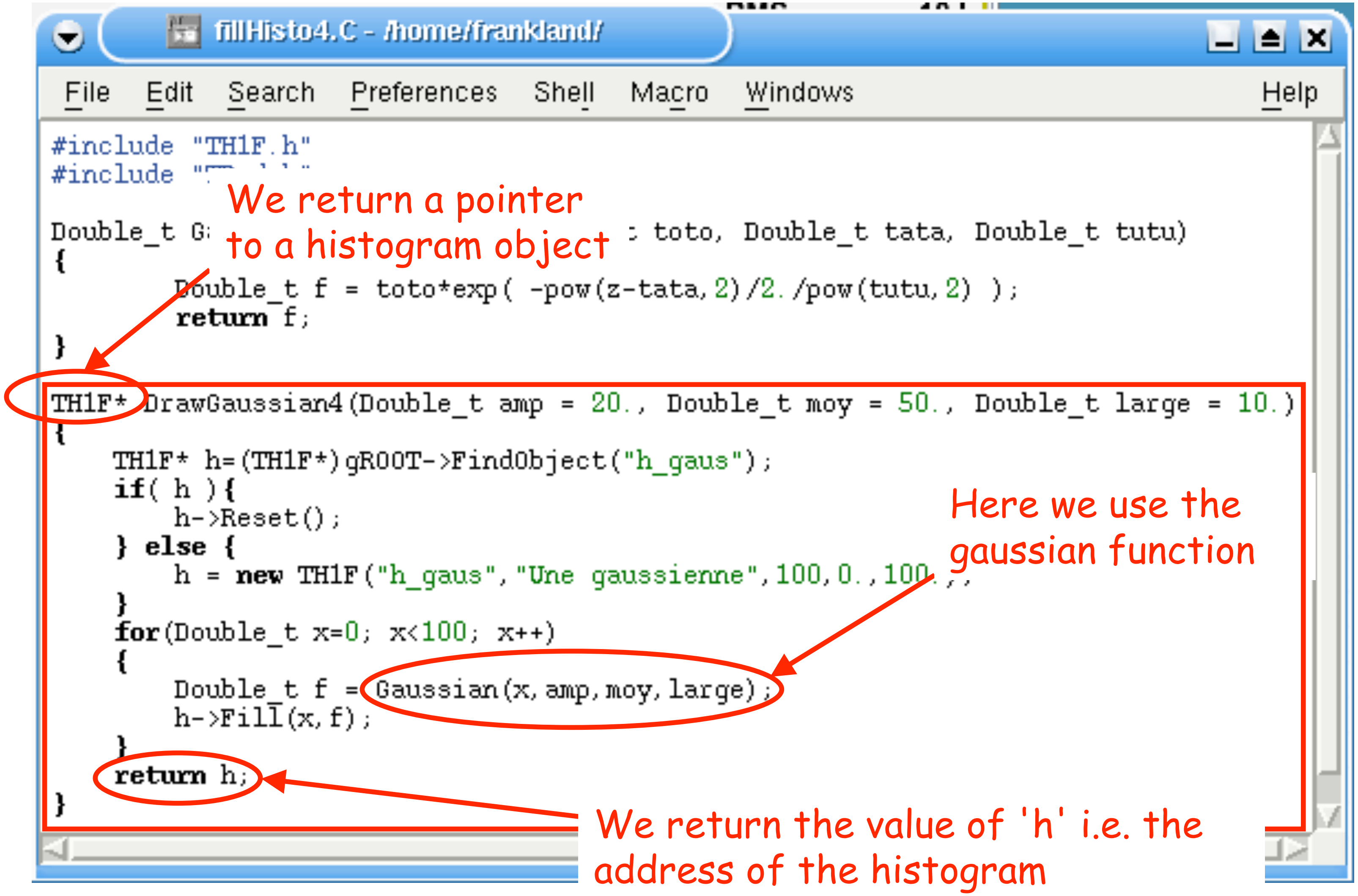
Type of returned value

We return the value of 'f'

Gaussian function

Returning values/objects

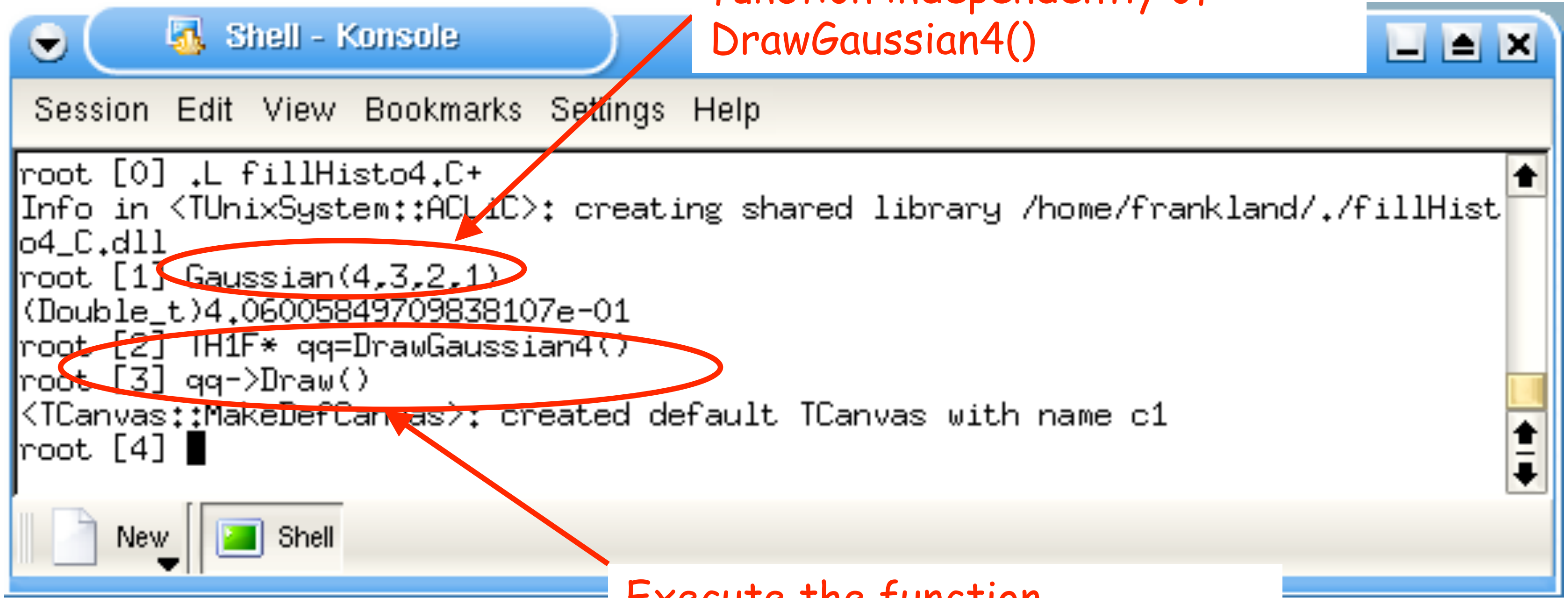
- Functions can return ALL sorts of variables…



Returning values/objects

- Compiling and using the functions:

We can use the gaussian function independently of DrawGaussian4()



Execute the function DrawGaussian4(), stock the address of the histogram in a pointer and plot it…

Analysis example

Analysis example

An example of an analysis script: we read the data from an ASCII file **basic.dat**; generate a few histograms; and save them in the file **basic.root**.

http://caeinfo.in2p3.fr/root/Formation/en/Day2/basic.dat

Declaration of the I/O system of ROOT/C++

this variable type means 'a string'

```
#include "Riostream.h"
#include "TFile.h"
#include "TH1.h"
#include "TNtuple.h"

void basic(const Char_t* fdata="basic.dat", const Char_t* froot="basic.root")
{
    //   example of macro to read data from an ascii file and
    //   create a root file with an histogram and an ntuple.
    // Arguments :
    //   fdata = nom du fichier ascii a lire (default : basic.dat)
    //   froot = nom du fichier ROOT resultat (default : basic.root)

   ifstream in;

    // we assume a file basic.dat in the current directory
    // this file has 3 columns of float data
   in.open(fdata, ios::in);
```

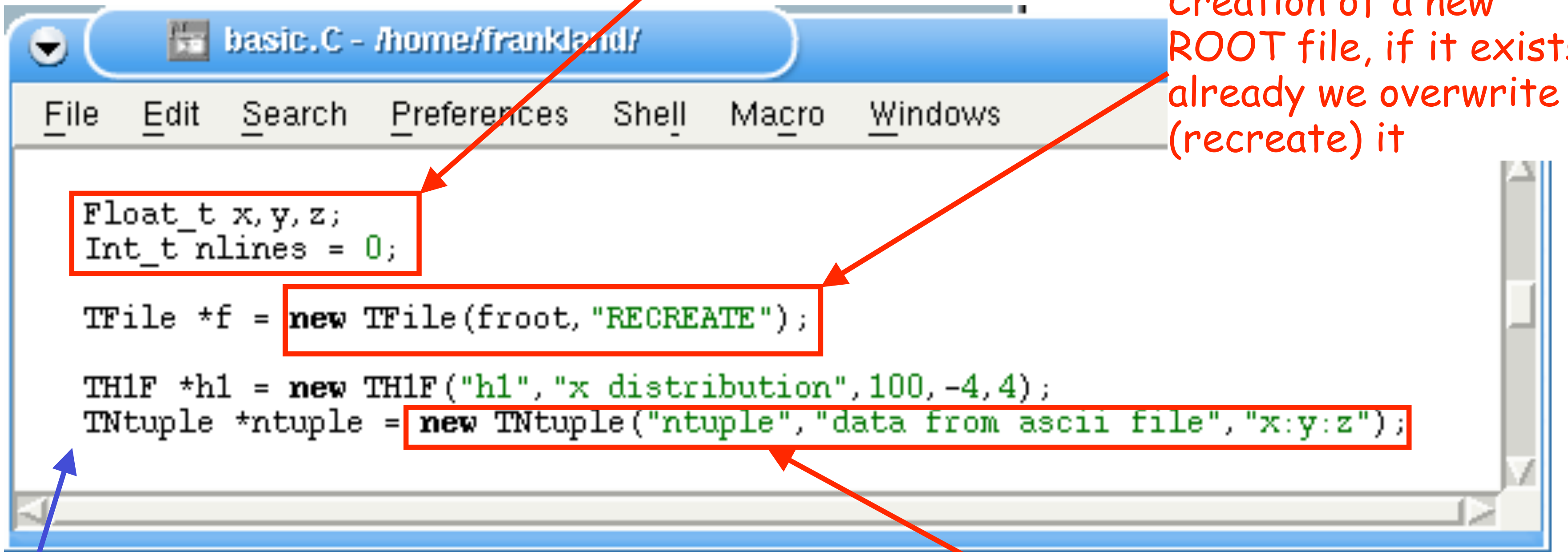
Object for reading an ASCII file

opening the ASCII file

Analysis example

Declaring a few working variables

Creation of a new ROOT file, if it exists already we overwrite (recreate) it



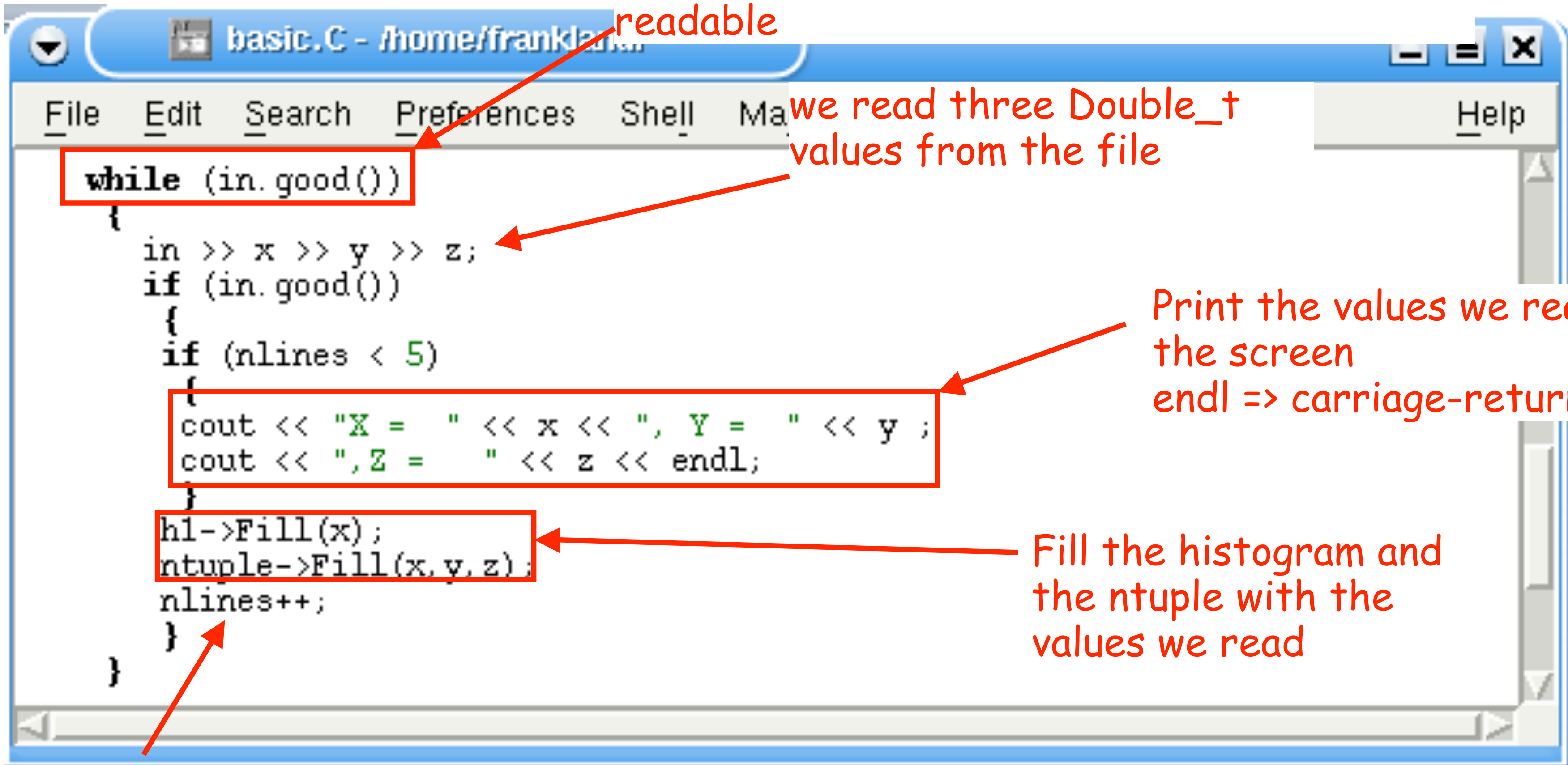
All histograms, Ntuples, trees (Day 4) created *after* the creation of the file *belong* to the file…

Creation of a Ntuple

Analysis example

A 'while' loop: keeps executing as long as the condition is true i.e. as long as the file is readable

we read three Double_t values from the file



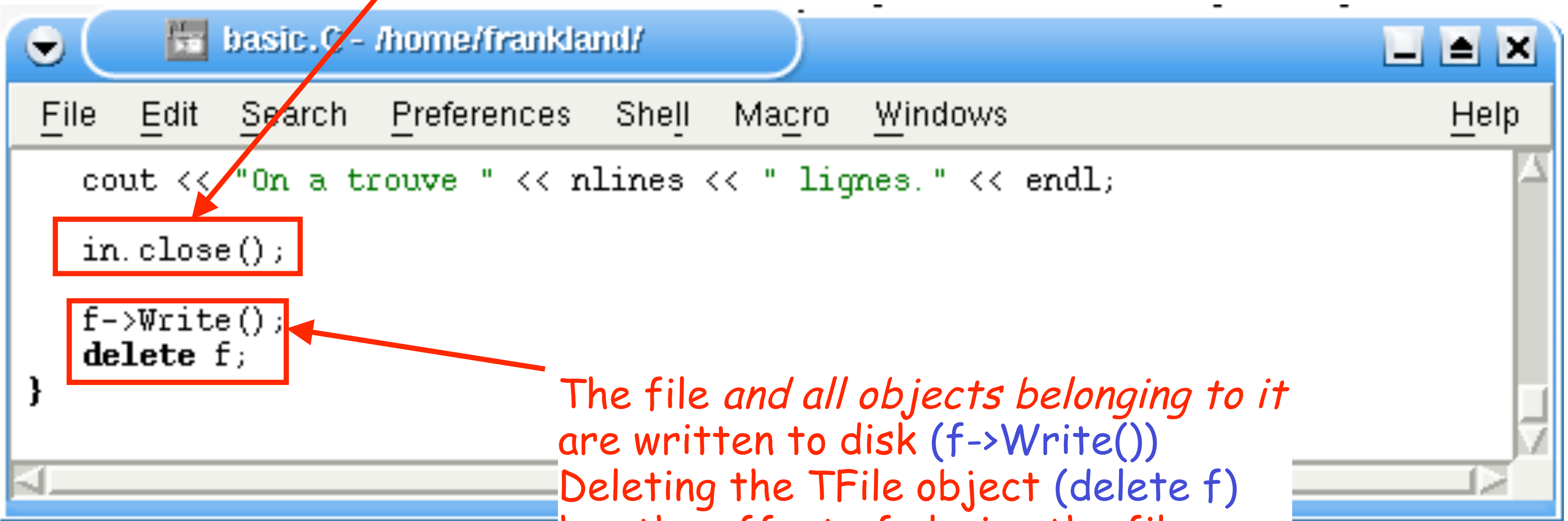
Print the values we read on the screen
endl => carriage-return

Fill the histogram and the ntuple with the values we read

Increment the number of lines read

Analysis example

Close the
ASCII file



The file *and all objects belonging to it* are written to disk (f->Write())
Deleting the TFile object (delete f) has the effect of closing the file.

WARNING:
once the file has been closed, the objects belonging to it no longer exist in memory (only on disk)!

Perform the analysis and look at the results

- Compile and execute:

```
.L basic.C+
basic()
```

- Open the file and plot spectrum 'h1':

```
TFile* fich = new TFile("basic.root")
fich->ls()
TH1F* histo = (TH1F*) fich->Get("h1")
histo->Draw()
```

Print the contents of the file

Copy the object 'h1' into the memory. Return the address of this copy.

The last two lines in one:

```
fich->Get("h1")->Draw()
```

Closing remarks

Some hints and tips for those dark moments of the soul (when it's just you and the C++ compiler)

Examples of functions/scripts

- On the ROOT web site, under the heading Tutorials, you can find lots of useful examples
- Caution! if the file doesn't have a proper function declaration then you can't compile it:

Executing a script without full declaration

```
.x toto.C
```

In this case, the code will be *interpreted*, not compiled.

WARNING: we really don't recommend you do this for your own scripts!!

The 'rootlogon.C' file

- This script without a function declaration is executed automatically when ROOT is launched from the same directory as the file

This way all your 2-D histograms will have nice colours (aah!)

```
{
gStyle->SetPalette(1);
cout << "Salut " << gSystem->Getenv("USER") << "!" << endl;
gSystem->Exec("date");
}
```

Returns the value of the system environment variable 'USER'

Executes the system command 'date'

For more information, see classes TStyle & TSystem

Exercise

Another example of analysing data

Exercise
(Episode 1: The ROOT menace)

http://caeinfo.in2p3.fr/root/Formation/en/Day2/exo_j2.data

- Write a script to analyse the data in ASCII file **`exo_j2.data`** . Each line of the file has 4 values corresponding to variables x,y,z et e (How original!)

  x de -25 à 25, y de -25 à 25,
  z de -10 à 10, e de -500 à 2500

  – Create and fill the following histograms:
    - 1-D: 'z' distribution (**TH1F**)
    - 2-D: 'y' vs 'x', 'z' vs 'x', 'z' vs 'y' (**TH2F**)
    - Profiles: <e> vs x, <e> vs y (**TProfile**)
    - 3-D: 'z' vs 'y' vs 'x', 'e' vs 'y' vs 'x' (**TH3F**)

  – Save them in a ROOT file called **`exo_j2.root`**.

Exercise (Episode 2: The return of exo_j2.root)

- Open **`exo_j2.root`**.
- Find the 3 most populated intervals of 'z'
  - *Keep a note of them!*
- Using the FitPanel:
  - fit the TProfile "<e> vs x" with a polynomial and *note* the values of the last two parameters, *ex1* et *ex2*.
  - fit the TProfile "<e> vs y" with a polynomial and *note* the values of the last 3 parameters, *ey1*, *ey2* et *ey3*.
- Close **`exo_j2.root`**.

Exercise (Part 3: The analysis strikes back)

- Write another script to analyse **exo_j2.data.**
  - Create and fill the following:
    - 1-D: histogram (**TH1F**) of **de=e-ex1*x-ex2*x*x-ey1*y-ey2*y*y-ey3*y*y*y**
    - 2-D: 'y' vs 'x' for each 'z' interval determined in Part 2 (**TH2F**)
    - 2-D Profiles: <z> vs y vs x, <e> vs y vs x (**TProfile2D**)
  - ADD them to file **exo_j2.root**.

Exercise
(Part 4: The final shot)

- Find the width of the `de` distribution by fitting with a gaussian.
- Write a script to display, on the same canvas, the following 4 figures:
  - 'y' vs 'x' for z < 1 with option **`col`**
  - 'y' vs 'x' for 3 < z < 5 with option **`box`**
  - <z> vs y vs x with option **`zcol`**
  - <e> vs y vs x with option **`surf1`**
- Save the picture in a ".gif" file