



ROOT Tutorials – Session 12

Signal/Slots, GUI and Carrot

Fons Rademakers



Signal and Slot Mechanism



Signals and Slots

- Integration of signal and slot mechanism into the ROOT core
 - TQObject, TQConnection, TQClass, ...
- Signal and slots were pioneered by Trolltech in their Qt GUI toolkit
- This mechanism facilitates component programming since it allows a total decoupling of the interacting classes

Signals and Slots Example: Emitting a Signal



```
class A {  
  RQ_OBJECT("A")  
private:  
    Int_t  fValue;  
public:  
    A() { fValue = 0; }  
    Int_t  GetValue() const { return fValue; }  
    void   SetValue(Int_t);      /*SIGNAL*  
};
```

Signals and Slots Example: Emitting a Signal



```
void A::SetValue(Int_t v)
{
    if (v != fValue) {
        fValue = v;
        Emit("SetValue(Int_t)", v);
    }
}
```

```
void TGBButton::Clicked()
{
    Emit("Clicked()");
}
```

Signals and Slots Example: Connecting a Signal to a Slot



```
A *a = new A();  
A *b = new A();  
a->Connect("SetValue(Int_t)", "A", b, "SetValue(Int_t)");  
  
a->SetValue(79);  
b->GetValue();           // this is now 79
```

```
fButton->Connect("Clicked()", "MyFrame", this, "DoButton()");
```



Signals and Slots

- The ROOT signal and slot system uses the dictionary information and interpreter to connect signals to slots
- Many different signals are emitted by:
 - TVirtualPad (TCanvas and TPad)
 - TSysEvtHandler (TTimer, TFileHandler)
 - All GUI widgets
- Let your classes emit signals whenever they change a significant state that others might be interested in



GUI



The ROOT GUI Classes

- Originally based on the XClass'95 widget library from Hector Peraza
 - A rich and complete set of widgets
 - Uses only X11 and Xpm (no Motif, Xaw, Xt, etc.)
 - Object oriented class library, no wrapper around a C library. Can be extended via inheritance
 - Small (12000 lines of C++)
 - Win95 look and feel



XClass'95 Integration in ROOT



- All X11 calls abstracted via the TVirtualX abstract graphics interface
- Use ROOT container classes, notably hash tables for fast lookup of frame and picture objects
- Added TObject inheritance to the few base classes to get I/O and extended RTTI capabilities
- Added many new widgets (now 35K lines)



Available Widgets

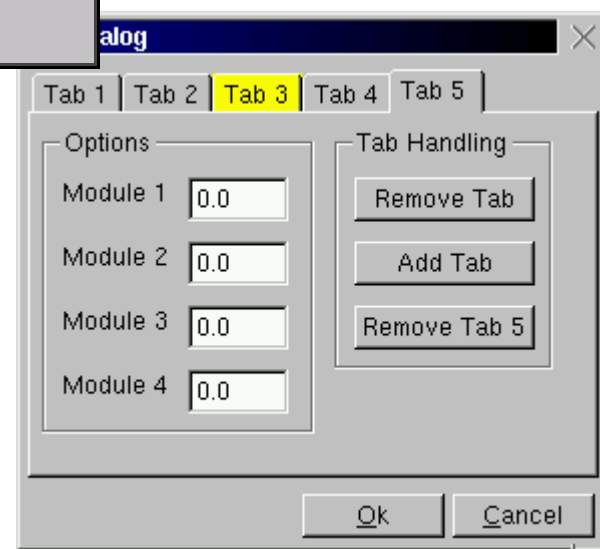
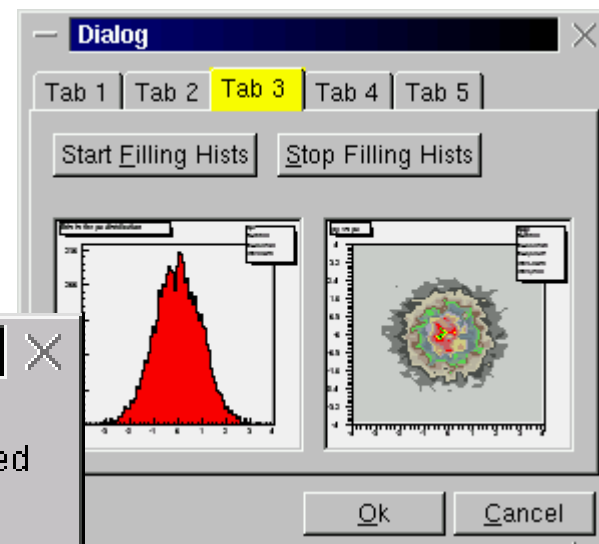
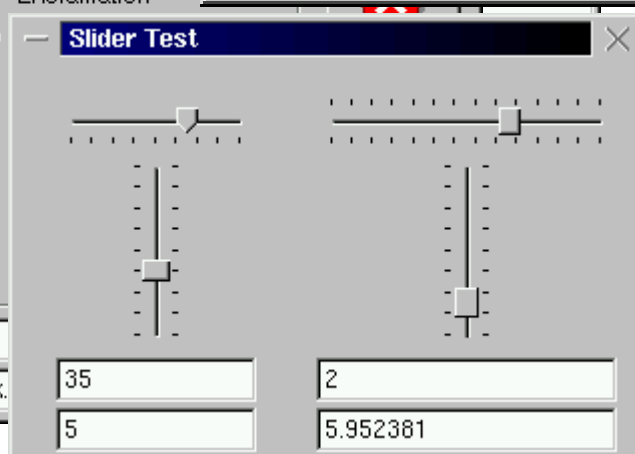
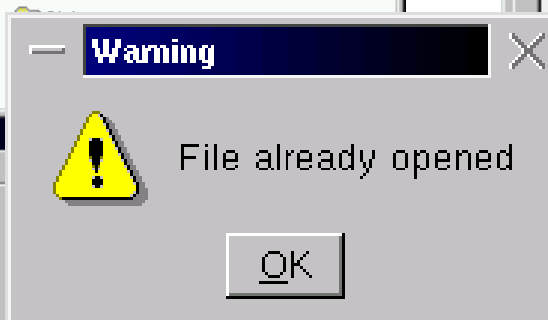
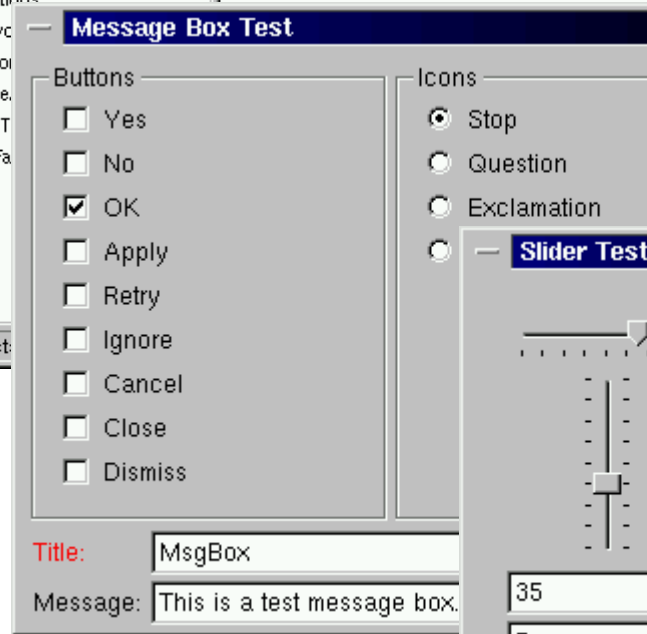
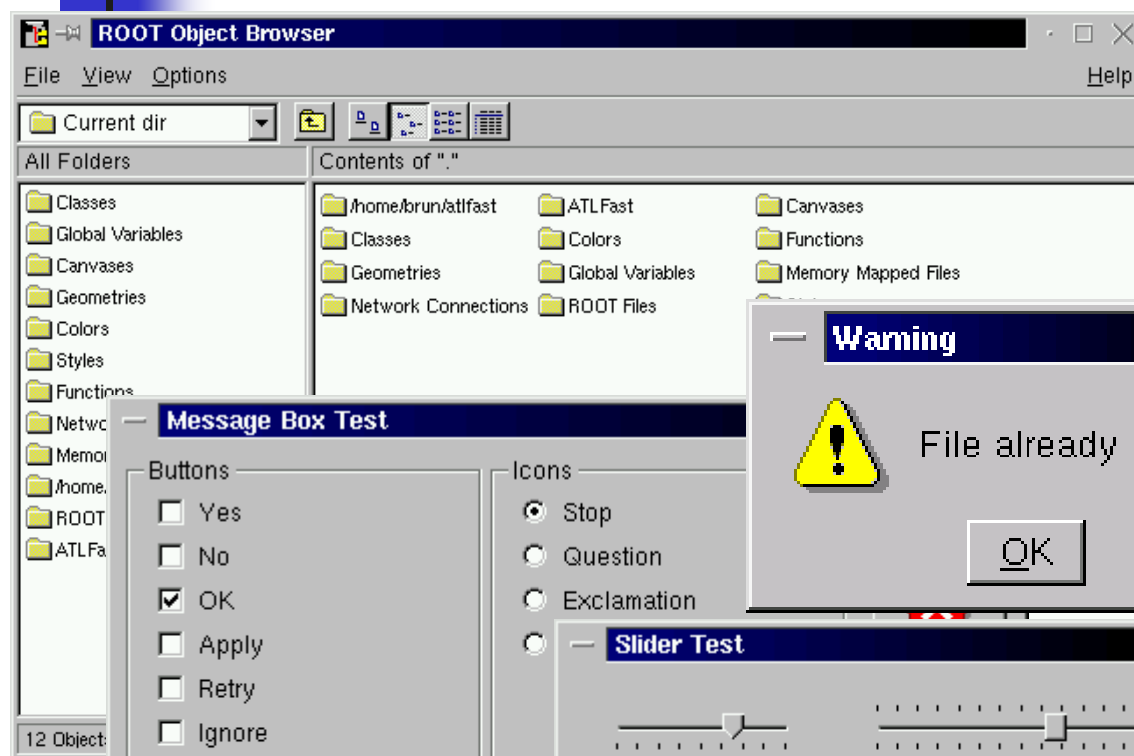
- Complete set of widgets:
 - label, icon, button, check button, radio button, picture button, button box, list box, combo box, list view, icon view, number entry, text entry, text view, text edit, tree view, tab view, scrollbar, slider, menubar, popup menu, cascading menu, statusbar, toolbar, message dialogs, file selection dialog, progress bars, tooltips, ...



Creating a GUI

- The widgets are laid out in frames
 - TGFFrame, TGCompositeFrame, TGMainFrame, TGTransientFrame, TGroupFrame
- And arranged by layout managers
 - TGHorizontalLayout, TGVerticalLayout, TGRowLayout, TGListLayout, TGTileLayout, TGMatrixLayout, ...
- Using a combination of layout hints
 - TGLayoutHints (left, center x, right, top, center y, bottom, expand x, expand y and fixed offsets)
- Event handling by messaging (as opposed to callbacks). Like Win32. And by signals and slots. Like Qt.

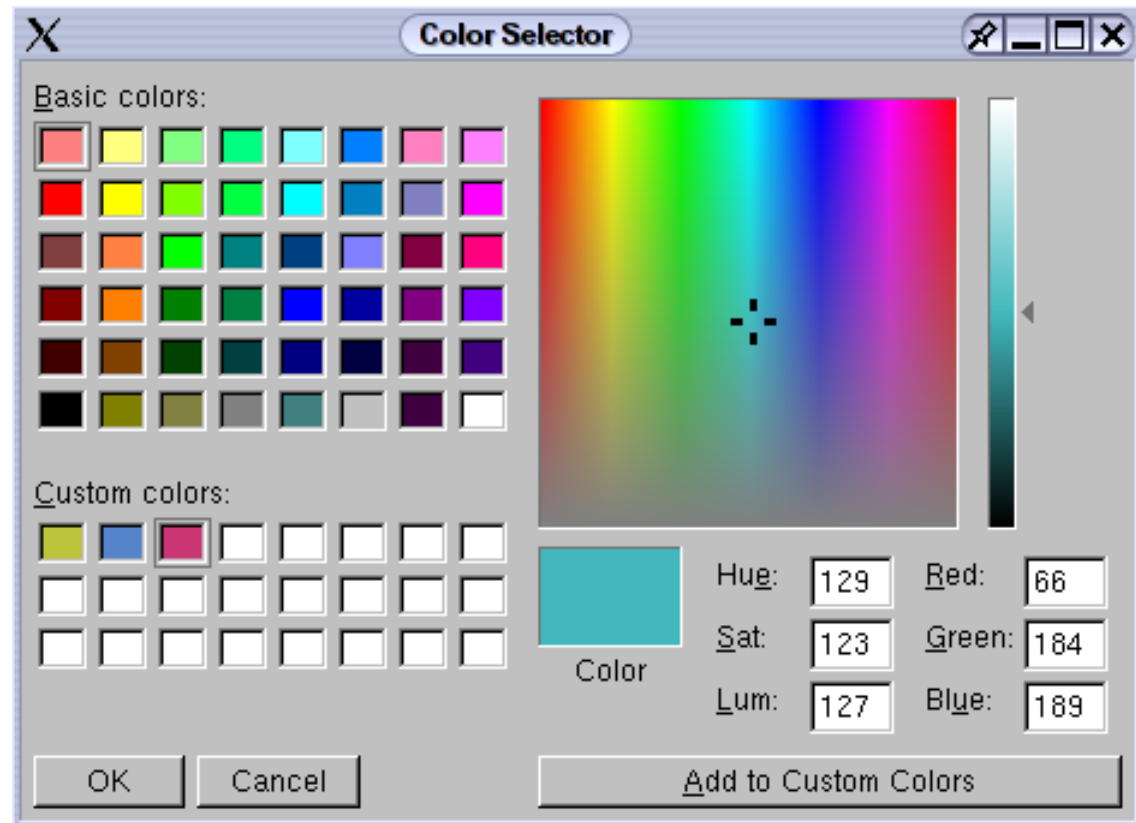
Basic Widgets



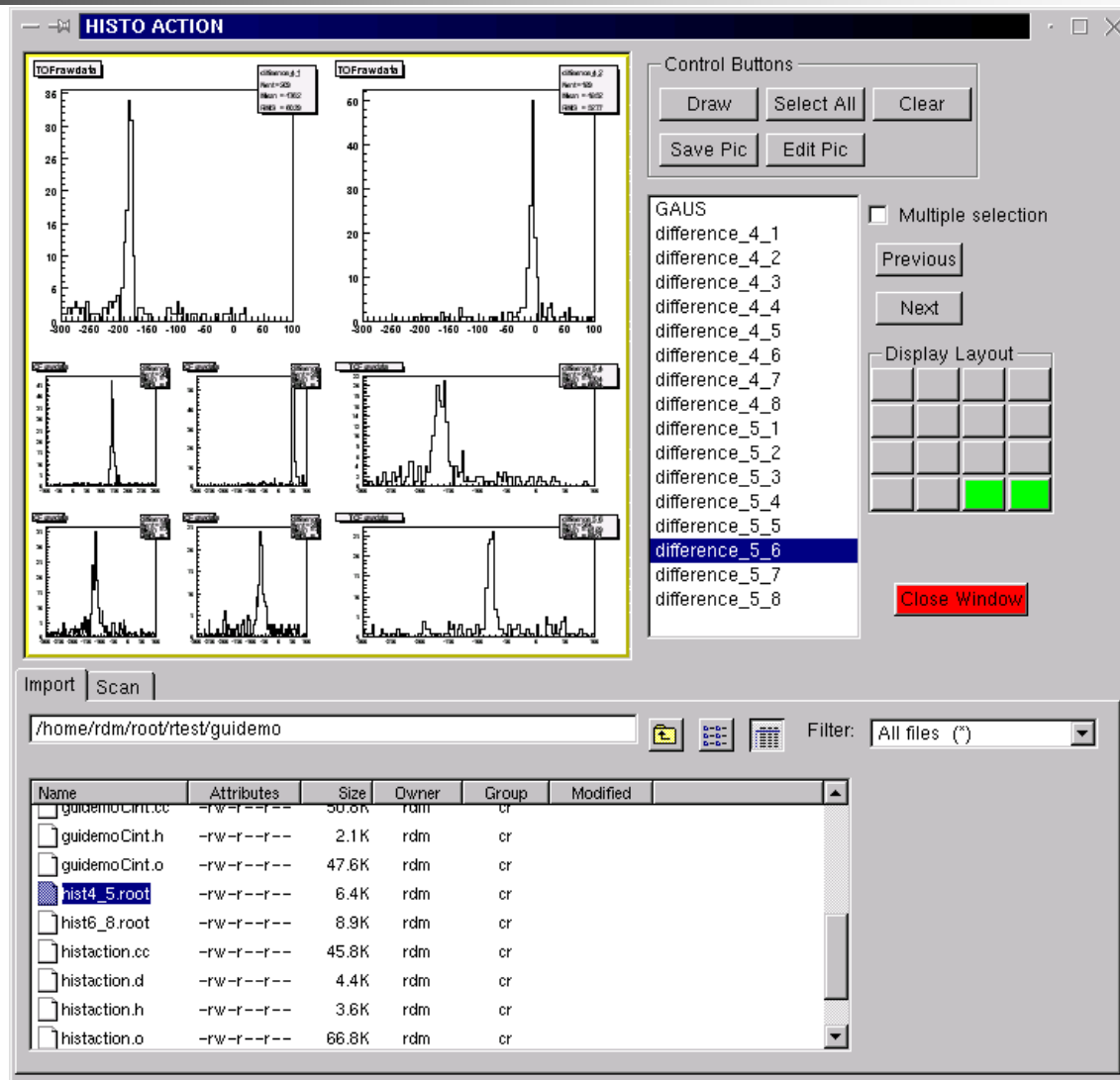


Advanced Widgets

- Color selector dialog: TGColorDialog



GUI Examples – Histogram Browser



More GUI Examples – Periodic System



Select Element

Periodic Table

Group	1	2
Period		
1	1 H	
2	3 Li	4 Be
3	11 Na	12 Mg
4	19 K	20 Ca
5	37 Rb	38 Sr
6	55 Cs	56 Ba
7	87 Fr	88 Ra

* Lanthanoids

** Actinoids

Select Element/Reaction

Material

Element: Hydrogen

Charge (Z): 1 Atomic Mass: 1.00794 (7)

Density: 8.988E-5 Oxidation: +1, -1

Melting Pt (C): -259.34 Boiling Pt (C): -252.87

Isotope (A): Isotope Info: 1/2+ 7.289 99.985%

Reaction

Projectile:
 Temperature: Reaction:
 Database:
 Reaction Info: -

Options

Line Width: Line Color:

Marker Style: Marker Color:

Marker Size: ErrorBar Color:

Information

Symbol name: 1-H - 1

Laboratory: LANL

Evaluation Date: EVAL-OCT89

Author(s): HALE, DODDER, SICILIANO, WILSO

Reference: NO REF TO DATE

Distribution Date: DIST-SEP91

Last Revision Date: REV1-JUL91

Master Entry Date: 910806

Select Element

15	16	17	18
			2 He
7 N	8 O	9 F	10 Ne
15 P	16 S	17 Cl	18 Ar
33 As	34 Se	35 Br	36 Kr
51 Sb	52 Te	53 I	54 Xe
83 Bi	84 Po	85 At	86 Rn
115 Uup	116 Uuh	117 Uus	118 Uuo
69 Tm	70 Yb		
101 Md	102 No		

Ok Close

Ok Execute Reset Close



Saving a GUI

- Any GUI can be saved as C++ code by hitting ctrl-s in the GUI
- This will be an important component of the coming GUI builder



Carrot



What is Carrot?

- Carrot is a module for Apache web server which enables the use of C++ as an HTML-embedded scripting language as well as executing C++ macros. It is similar to PHP, in functionality:

http://carrot.cern.ch/index_C.so?about