New Developments In Analysis

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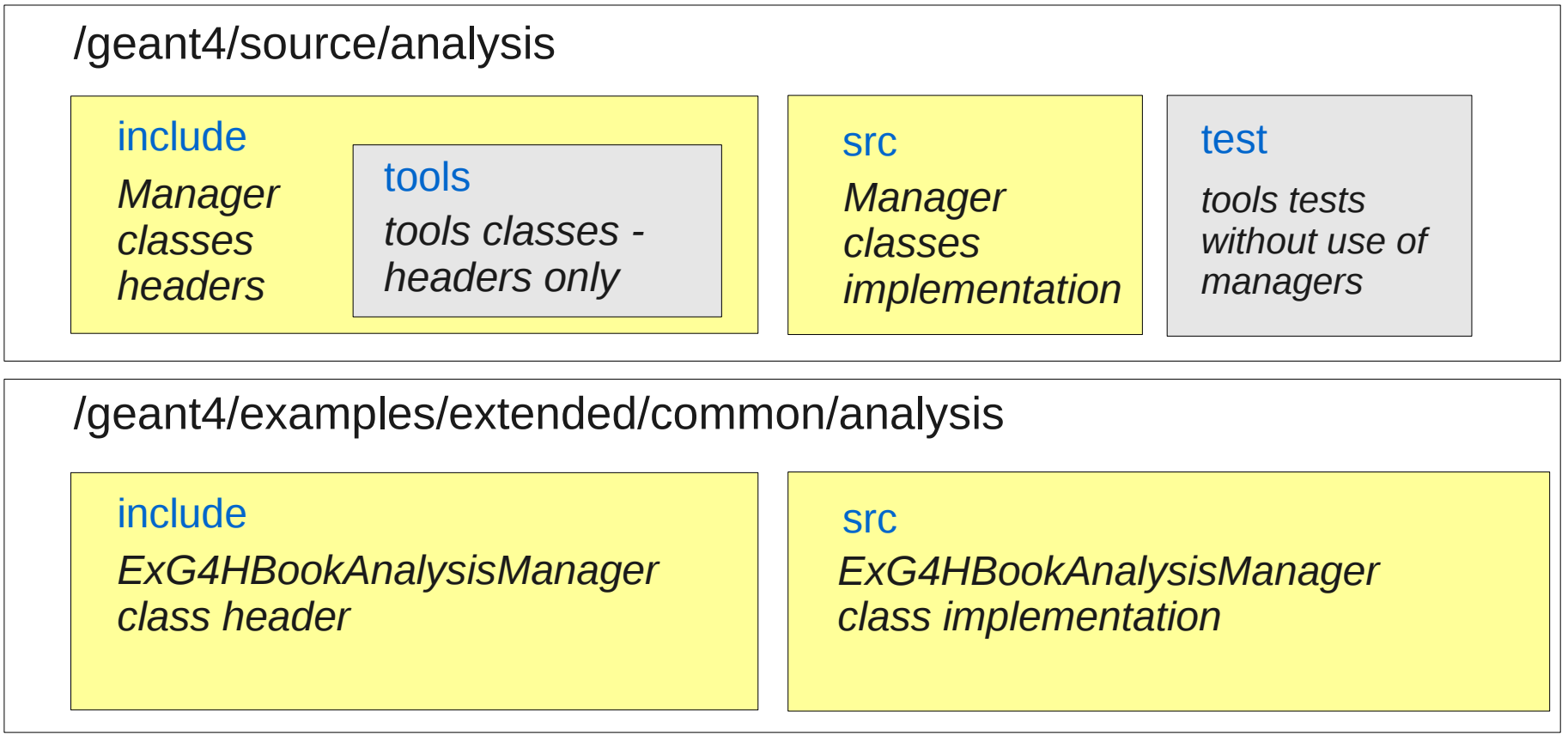
Analysis Category

- Provides “light” analysis tools
  - Available directly with Geant4 installation
  - No need to link a Geant4 application with an external analysis package



Analysis Manager Classes in Geant4

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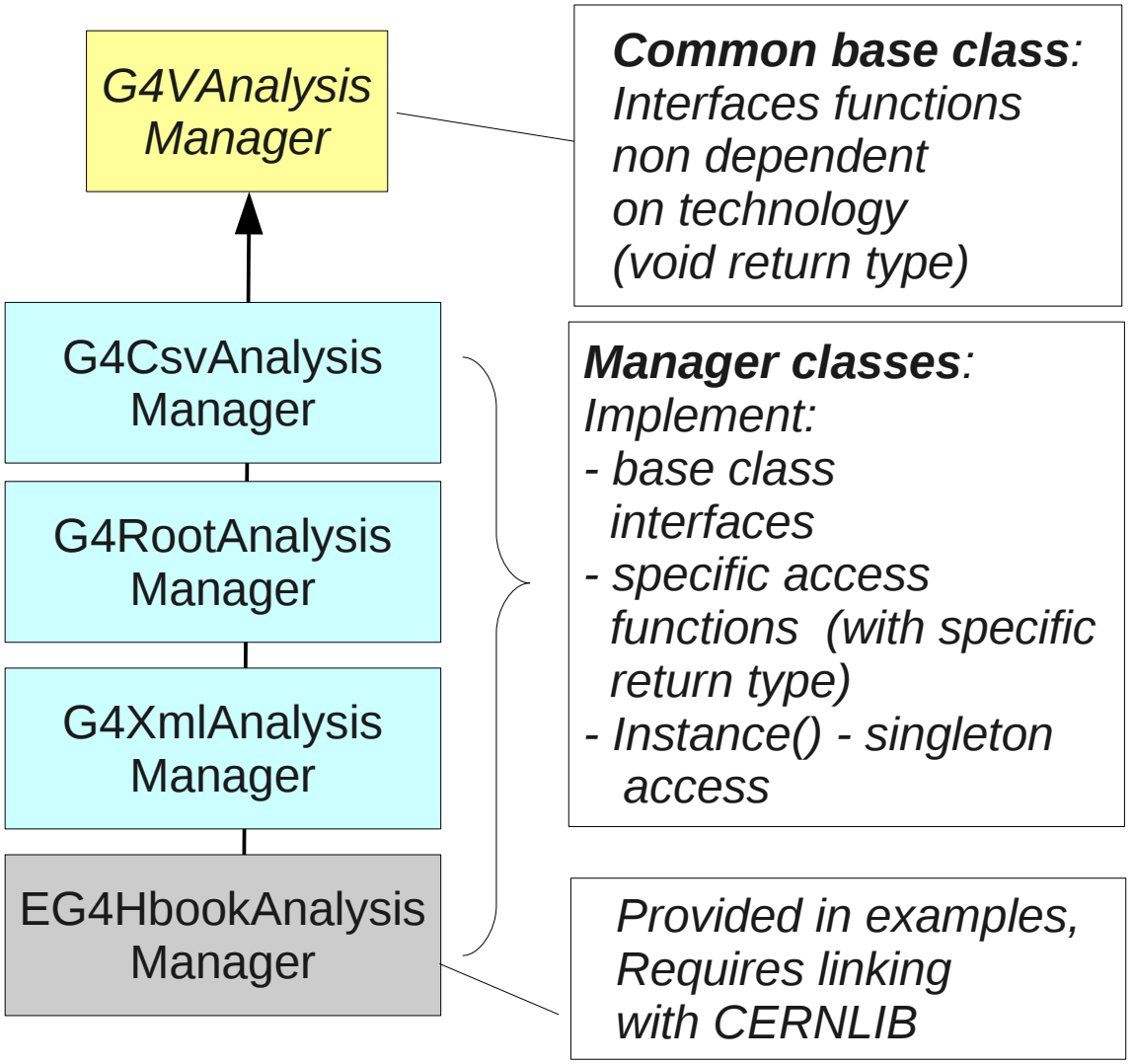
Why Manager classes?

Provide

- Uniform interface to g4tools
  - Hide the differences according to a selected technology (root, XML, HBOOK) from the user
- Higher level management of g4tools objects (file, histograms, ntuples)
  - Memory management
  - Access to histograms, ntuple columns via indexes
  - Histogram activation
- Integration in the Geant4 framework
  - Interactive commands
  - Units

Analysis Managers



- In plan:
- Separating the manager classes per object type: h1d, h2d, ntuple
- To reduce the classes size
- To avoid code duplication
  - Some manager classes handles the same object type; eg. h1d, h2d in XML and Root managers

New Developments

- Mostly requirements from the EM physics group
- Possibility to book a histogram before opening a file
- Possibility to set histogram properties (nbins, xmin, xmax) to an existing histogram
- Possibility to inactivate existing histograms
- New histogram properties:
  - Units - can be applied to filled values
  - Functions (log10, log, exp) – can be applied to filled values, and also combined with units
  - Write ASCII
  - Activation
- Interactive commands

G4AnalysisMessenger

Implements commands:

```
/analysis/setFileName  name
/analysis/setHistoDirName  name
/analysis/setNtupleDirName name
```

Setting files, directories

```
/analysis/h1/create nbins xmin xmax [unit] [fcn]
/analysis/h1/set nbins xmin xmax [unit] [fcn]
/analysis/h1/setTitle  title
/analysis/h1/setXAxis  title
/analysis/h1/setYAxis  title
```

H1 properties
(H2, ntuple on to do list)

```
/analysis/verbose level
```

Verbosity

Most of the code was just adapted from the HistoManager classes in EM examples developed by Michel Maire

TestEm5 in ref-07

```
#include "g4root.hh"
//#include "g4xml.hh"
////#include "g4hbook.hh"

class HistoManager
{
  public:

    HistoManager();
   ~HistoManager();

    void SetFileName   (const G4String& name) { fileName[0] = name;};
    void book();
    void save();
    void SetHisto (G4int,G4int,G4double,G4double,const G4String& unit="none");
    void FillHisto(G4int id, G4double e, G4double weight = 1.0);
    void Normalize(G4int id, G4double fac);
    void PrintHisto  (G4int);

    G4bool    HistoExist  (G4int id) {return fExist[id];}
    G4double  GetHistoUnit(G4int id) {return fUnit[id];}
    G4double  GetBinWidth (G4int id) {return fWidth[id];}

  private:

    G4String         fileName[2];
    G4bool           factoryOn;

    G4int            fNbH ist;
    G4int            fHistId[MaxHisto];
    G4AnaH1*         fHistPt[MaxHisto];
    G4bool           fExist[MaxHisto];
    G4String         fLabel[MaxHisto];
    G4String         fTitle[MaxHisto];
    G4int            fNbins[MaxHisto];
    G4double         fVmin [MaxHisto];
    G4double         fVmax [MaxHisto];
    G4double         fUnit [MaxHisto];
    G4double         fWidth[MaxHisto];
    G4bool           fAscii[MaxHisto];

    HistoMessenger*  fHistoMessenger;

  private:
    void saveAscii();
}
```

HistoManager in TestEm*

Selection of the output format

TestEm5 in ref-08:

```
#include "g4root.hh"
//#include "g4xml.hh"
////#include "g4hbook.hh"

class HistoManager
{
  public:
    HistoManager();
   ~HistoManager();

  private:
    void  Book();
    G4String fFileName;
};
```

No user HistoMessenger class

Macro with new analysis commands

gammaSpectrum.mac in TestEm5 in **ref-07**

```
#
/testem/histo/setFileName gammaSpectrum
/testem/histo/setHisto  3 200 0.01 10 MeV   #gamma: energy at vertex
/testem/histo/setHisto  5 200 0.01 10 MeV   #gamma: energy at vertex (log)
/testem/histo/setHisto 20 200 0 6 MeV       #gamma: energy at exit
/testem/histo/setHisto 40 200 0 6 MeV       #gamma: energy at back
```

gammaSpectrum.mac in TestEm5 in **ref-08**

```
#
/analysis/setFileName gammaSpectrum
/analysis/h1/set  3 200 0.01 10 MeV          #gamma: energy at vertex
/analysis/h1/set  5 200 0.01 10 MeV log10    #gamma: energy at vertex (log10)
/analysis/h1/set 20 200 0 6 MeV              #gamma: energy at exit
/analysis/h1/set 40 200 0 6 MeV              #gamma: energy at back
```

g4tools

Guy Barrand, LAL

New Features, Code

- configure() methods to change the booking.
  - It permits a "recreate" but by keeping the object.
- annotations
  - Permit to deposit "hints for plotting" as *axes title*.
  - For these, we have arranged to save them in .root and .aida files. (More "hints" could be added...)
- Root format : save the "free segments" infos.
  - It permits to open the file from CERN-ROOT in *"UPDATE mode"*.
- Platforms
  - Mac, handle clang-3.0 (faster than g++ !).
  - Windows : build test programs from CYGWIN by using the VisualC++ compiler.
  - Various slight modifications as the ones to please "g++ --shadow" option (see history file).

Future ?

- IMPORTANT : with the same logic, we could bring the **inlib/exlib plotting** in g4tools...
  - It is based on GL-ES (which is available everywhere (including smartphone/tablets)) and
  - freetype2 (if wanting nice fonts for title and axes labels). But freetype2 is not mandatory, the plotting can embark the drawn "Hershey" fonts that was used in HPLOT.
- See the **g4view**, ioda apps available on YOUR PHONE (iOS, Android) and tablets to have a glimpse.
- It can produce jpeg, png, postscript files.
- It has also a "pure batch" mode that permits to produce jpeg, png of a plot without having to link to GL-ES ! (Only C++, STL needed) (and freetype2 if wanting nice fonts).
- *Handling plotting could be a nice project done in conjunction with visualization...*

Web

- Now one "portal":
  http://softinex.lal.in2p2.fr
- Pages for g4tools, but also g4view, ioda, inlib/exlib, etc...

Conclusions

- The analysis category is used in basic example (B4) without any difficulties reported by users since the 9.5 release
- Migration of most of extended examples for 9.6
  - Which resulted in many extensions in the manager classes and also several in g4tools
  - Credits to Michel Maire whose code was moved from examples in manager classes
- No need for external packages with the code in kernel
  - HBOOK manager requiring CERNLIB is not built with kernel libraries
- Many thanks to Michel Maire for ongoing feedback and testing of new tags