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Code Reviews - Best Practices

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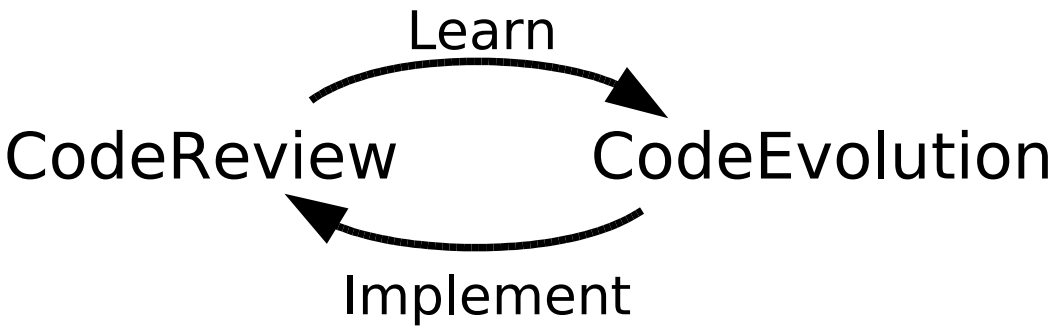
Contents

- Code Review in a Top-Down Approach
- Documentation from Code
- Code Evolution: Best Practices



Not Contents of this lecture:

- Brilliant theories – just many small tips
- Professional engineering – just practical experience in poorly equipped HEP environments
- Dilbert Cartoons

Why Code Reviewing ?

- Other people have engineered code for you
  - Maintenance
    - It's your honour to adjust this code where it shows suboptimal behaviour (= fix bugs)
  - Evolution
    - You need to add a feature. But where and how?
  - Learning
    - They were not completely stupid: You can learn from their ingenuity

Approaching an unknown body of code

- “Eagle method”: Stay on top - dive in only as required!
  - Don't try to read 100k lines of code from the beginning to the end
- Read in increasing level of detail
  1) Directory Level
  2) Structure Level
  3) Codeline level

Approaching an unknown body of code: Tools and Example

- Tools used in this lecture:
  - Free and Simple
  - Easily available (come with Linux'es / Downloadable)
  - No IDEs (not available everywhere)
  - Mostly Cmdline and WWW based
- Example used: The ROOT Source Code
  - Used by many HEP physicists in practice
  - Never hurts to know something about it
  - (More suggestions for practice:
    Geant4, Mozilla, Linux Kernel, offline sw of your experiment, ...)
- Starting point:

`root_v4.00.08.source.tar.gz`

Reading Code: Things to notice at Directory Level

- The Shell: First tool, even before the editor
- Size & Complexity ?
  - No. of Packages, Files, Classes, Lines of Code
- Documentation ?
  - Standard Set of README Files?
- Build Process ?
  - Configuration? Compilation? Linkage?
- Unit Tests ?
  - What is code, what are tests?

At Directory Level: **Project Organization**

Reading Code: Size and Complexity with *ls* and *wc*

- Most powerful tool: *ls*
  - Show organization
  - See filename conventions

Example

```
/root/html/Module.mk
/root/html/inc/THtml.h
/root/html/src/THtml.cxx
```

- Pipe output into *wc* for size estimates
- Example: Size of ROOT:
  - ls | wc ~ 90 top level directories (Packages)
  - ls -R1 * | wc ~ 6285 files
    ~ 772 *.cxx files (Classes)
  - cat */src/*.cxx | wc ~ 660k lines of code: a lot if read sequentially ...

Reading Code
Know your Editor

- We now start up or favorite editor
  - Lucky people have IDEs
  - The others have at least vi, Emacs, nedit, kate, ...
- Learn to profit from their features. They know:
  - Searching / Regular Expressions
  - Syntax Highlighting
  - ctags / idutils Index files
  - Block (un)indentation
  - Column selection
  - Block collapsing
  - File Browser / Tabbed Windows
  - ...

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Reading Code: Survey using Birdseye Views

- Have a look at code from above using a tiny text size / multiple pages (Print Preview)
- Use a signature survey script
  - (http://c2.com/doc/SignatureSurvey/)
  - Strip code, show only brackets / delimiters
- Use syntax highlighting to lowlight comments, emphasize structure

```
/java/awt/print
409 Book ;;{}{}{;{;}{;}{}{;}{}{;}{{"";}{"";};}{;}{;}{;;;;;;{;}}{;}{;;{{;};;}{;}{;}}}
410 PageFormat {;{;;}{;;};}{;;{;}{;}{;};}{;;{;}{;};}{;{;;;;;"";};};}{;{;;;;;"";};};}{;
{;}{;};}{;{;}{;};}{}{}{;}{;}{{;}{;}}{;}{;;;;;;}{}{;{;;;;;;;;;;;;;;;;;;;;;;;};}}
411 Pageable ;{}{}{{};;;;}
412 Paper ;;{;;;;;;{;;;}{;{;}{;;};}{;}{;;}{;};{;}{;}{;}{;}{;}{;}}
413 Printable ;;{}{}{{};;{};{}{};}
414 PrinterAbortException ;{}{{;}{;}}
415 PrinterException ;{{}{;}}
416 PrinterGraphics ;{}{}{}{;}
```

Example
Signature of java/awt/print

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Reading Code: Things to at structural level

- What **Design Patterns** are used? How do they look like?
- What **Data Structures** are used? What is their interface?
- What are the **Framework Facilites** ?
  - Error Handling / Logging / Steering / Cmdline Parsing
  - Maths
  - GUI / Graphics
  - I/O
  - Wrappers / Interfaces to legacy code (FORTRAN)

- If you happen upon these during browsing: Remember them !
  - Either ... you must use them anyway
  - ... if not, you avoid reinventing the wheel

Reading Code: Things to notice at Line Level

- Coding Conventions used
  - Naming Conventions
  - Formatting Rules: Layout, Indentation ?
  - Commenting Rules / Comment Enrichment
  - Control Structures
- What Subset of C++ is used/allowed? STL? Templates?
- C++ Coding Standards in HEP are quite similar to each other
  - Taligent based: ROOT, ATLAS, ...
- Remember:
  - Advantage of Coding Standards comes mostly from **Consistent Use**
  - Even if they are suboptimal/outdated, continuing them makes sense within the same project

Reading Code: Things to skip at line level

- For quick reading, it's crucial to bypass skin and bones and get to the meat right away.
- Skip
  - Preprocessor Statements
  - Initialization
- Instead: Look for
  - Text (like window titles) or print-out you have seen
  - Comments marking important sections, like //FIXME
  - Tutorial Markers
  - Inner Loops

Layout and Indentation

- Scientific Studies exist on what is best (*see Refs*)
  - But most important is to be consistent
  - Advantages only gained when being consequent
- Also it is known what is not
  - Spaghetti Code
  - Inverse Polish Christmas Tree Notation (Align operators in center)
  - Dangling else
- Code beautifiers exist: indent (C/C++), Jalopy (Java)
- But Caveat:
  - Colleagues could get lost if you reformat their code
  - Time “lost” formatting code properly is regained only on second iteration (reviewing)

Reading Code
Searching and RegExps

- Most powerfull tool: *grep*
- Searching covers code and comments
- Stay general - Use word stem
- Chain *grep* to narrow your search

Documentation from Code Introduction

- Tools exist to convert code into readable, navigable formats (HTML, LaTeX, PDF ...)
- Source: Code itself + enriched comments
- Progenitor: javadoc (by Sun for Java)
- Many different tools exist
  - ~40 listed on Doxygen page
  - *http://www.stack.nl/~dimitri/doxygen/*
- Mostly incompatible formats - chose wisely ***before*** coding
- Examples:

  Javadoc, Doxgen, Thtml, LXR, custom

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Documentation from Code Javadoc

- Example: Convert java code to HTML

```
/**
 * Get a dummy object
 * @param  name An unused string
 * @return      Nothing (Null)
 * @see         Dummy
 */
public Dummy getDummy(
   String name) {
   return null;
}
```

javadoc

getDummy

```
public Dummy getDummy(String name)
```

Get a dummy object

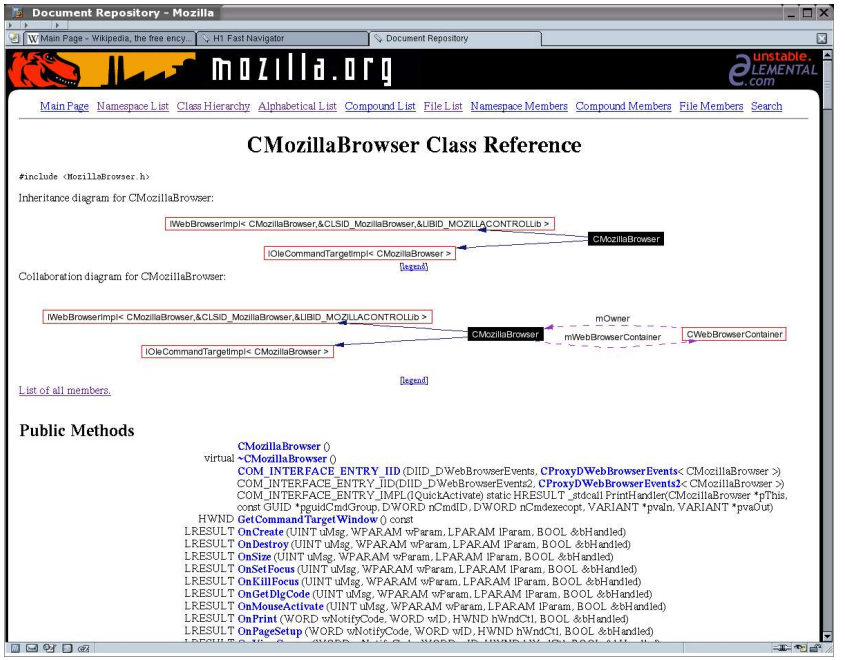
Parameters:
name - An unused string

Returns:
Nothing (Null)

See also:
Dummy

Documentation from Code Doxygen

- "King" of doc tools (popular)
- Output to LaTeX, RTF, PS, PDF, HTML, man
- Good results for any (unenriched) source
- Create indices, graphs, diagrams ...
- Too many bells & whistles?
  - Some people prefer less features



Example
Mozilla Code Documentation

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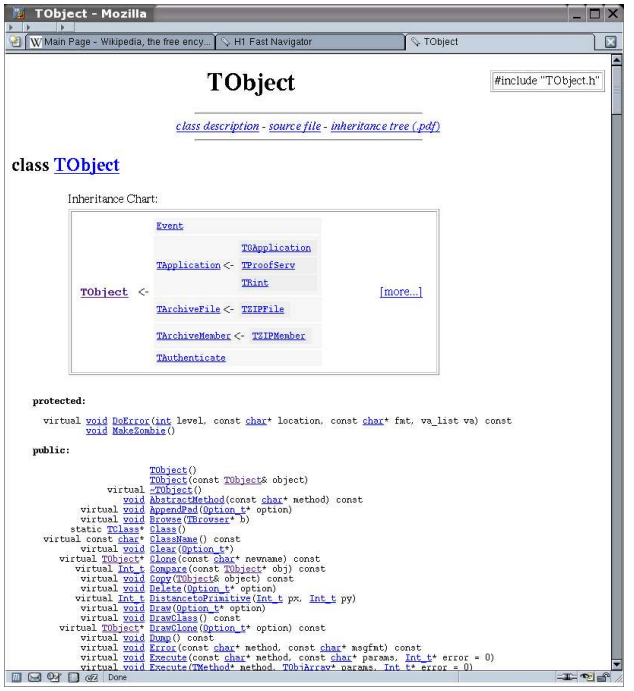
Documentation from Code THtml

- Doctool for the ROOT world
- Classes must be linked to ROOT executable
  - ClassImp, ClassDef Macros required
  - Non-*C*++-Files not documented

Example
Class TObject in HTML Format



- Inofficial outlook: THtml2
  - ROOT team choice: rewrite doc tool from scratch, incl. C++ parser etc.
  - more output formats, code browsing, ...

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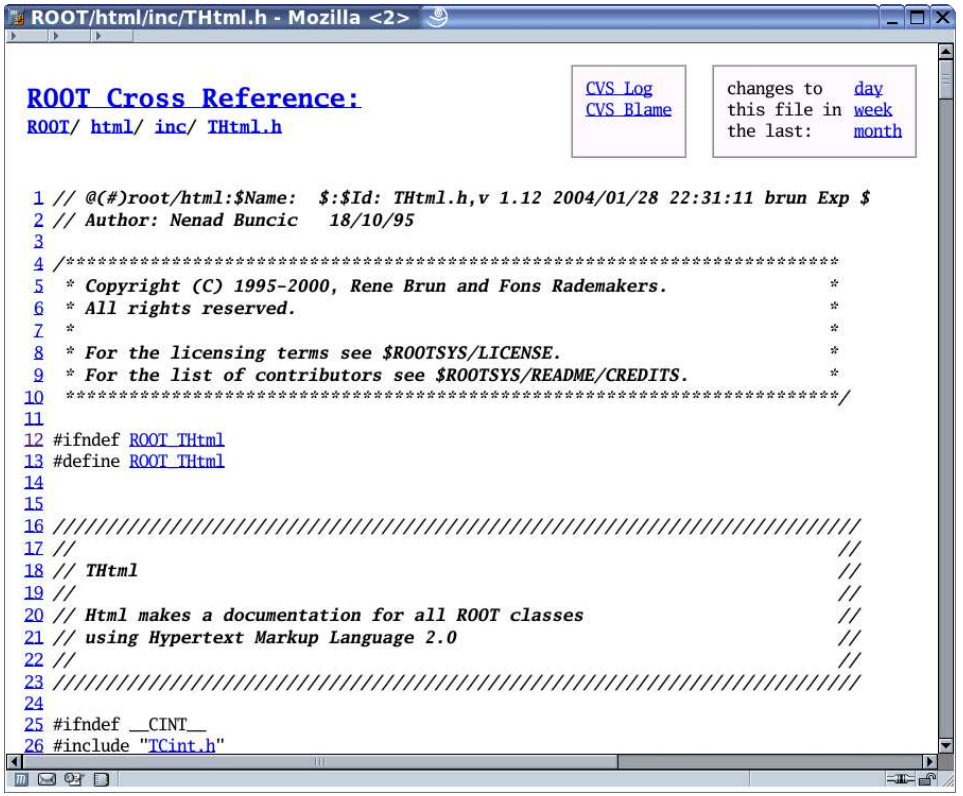
Documentation from Code LXR

- Perl to HTML – Source Code Cross Referencing Script
- Serves pages through webserver
- Used by Mozilla, FreeBSD, ROOT, ...
- Freetext search possible
- Updates several times a day

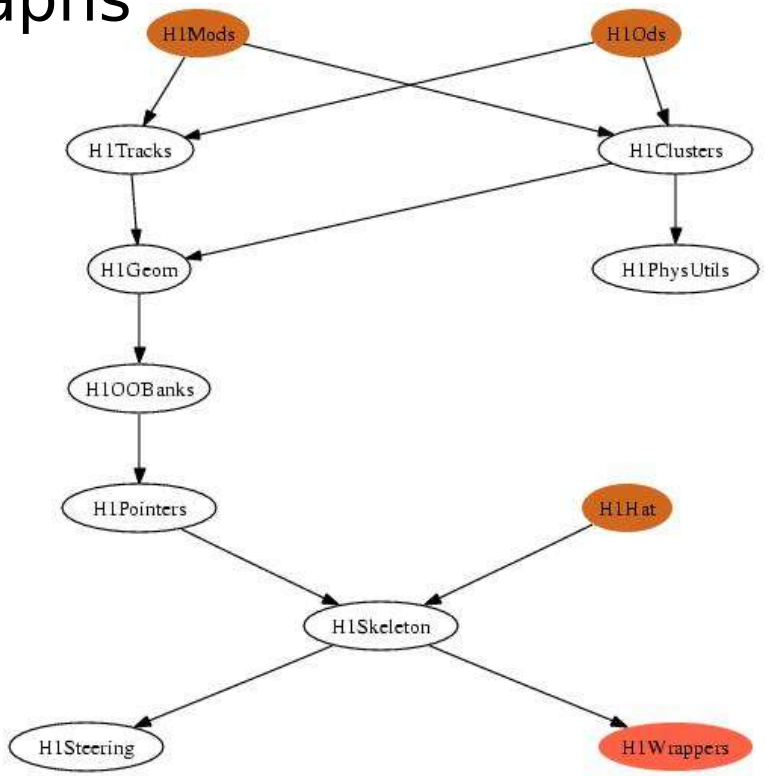
  but: not current state of repository!



Example
Class THtml in LXR

Documentation from Code GraphViz

- Free Graph generation package from BellLabs
- Simple Syntax - can be generated automatically
- Graphical representation of code structure
- Used by Doxygen for its graphs



Example

H1 Analysis Software
Package Dependencies Graph
(Perl to GraphViz Script)

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Docu from Code: Do it yourself !

- Your doctool is missing a feature? Write your own tool!
- Code is written to be parsed – do so
- Possible in *ix world since 30 years
  - Classic tools: grep, sed, ...
- And of course there are Perl, Python, Ruby ...

Example

Package Index HTML page:
Hyperized Directory Listing
(Perl Script)

< Package list | H1OO page | ROOT page | Class index

Index of H1Clusters classes

H1Cell	H1 cell class
H1Cluster	H1 cluster class
H1ClusterEvent	Class containing cluster objects of one event
H1LArCell	H1 LAr cell class
H1SpaCalCell	H1 SpaCal cell class
H1SpacalCluster	H1 Spacal cluster class
H1ClusterArrayPtr	data access class for a TClonesArray of H1Cluster
H1CellArrayPtr	data access class for a TClonesArray of H1Cell

```
// To use classes from H1Clusters, don't forget to link it
// (add -lH1Clusters in Makefile) and use these include-statements:

#include "H1Clusters/H1Cell.h"
#include "H1Clusters/H1Cluster.h"
#include "H1Clusters/H1ClusterEvent.h"
#include "H1Clusters/H1LArCell.h"
#include "H1Clusters/H1SpaCalCell.h"
#include "H1Clusters/H1SpacalCluster.h"
#include "H1Clusters/H1ClusterArrayPtr.h"
#include "H1Clusters/H1CellArrayPtr.h"

Release 2.7.7
```

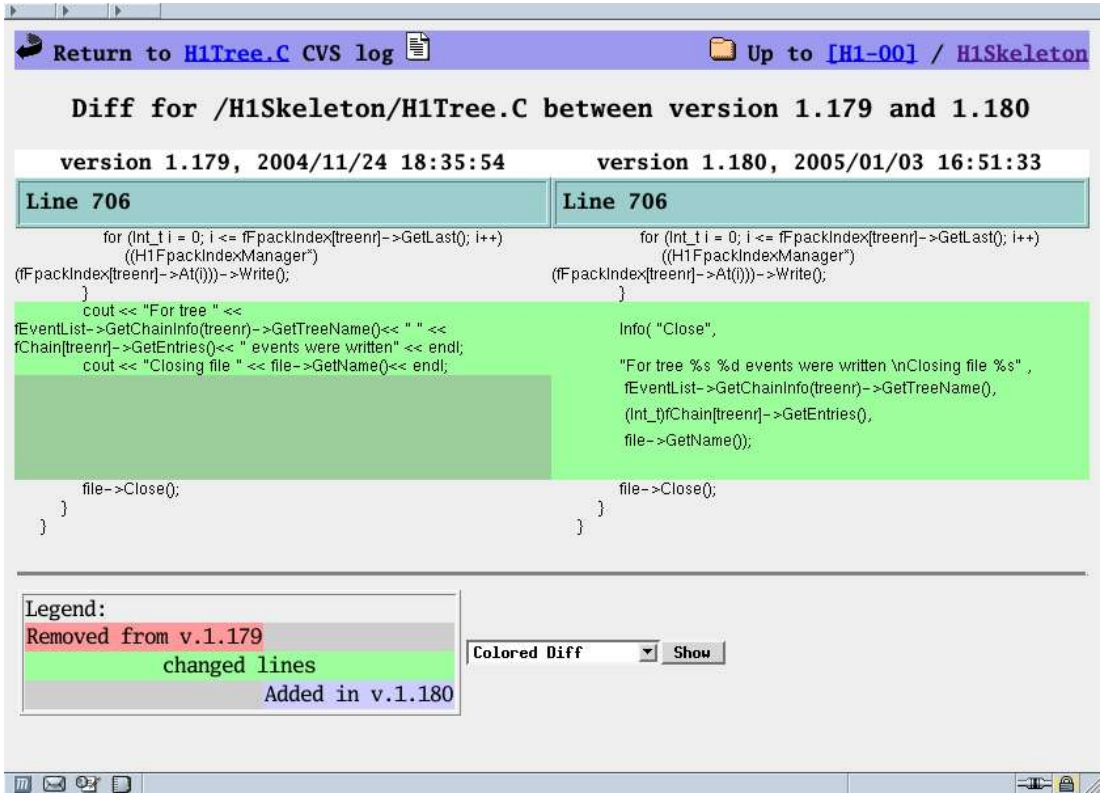
< Package list | H1OO page | ROOT page | Class index | Top of the page

Code Evolution

- When adding new code it is time to apply the best practices learned in code reading
- If possible use tools to check contributions
- Compiler
  - Is a professional code reader
  - Tell him to be verbose, eg. on gcc use -Wall
- Regression Testing
  - Remember junit, cppunit
  - Often simpler testing possible
  - For HEP software exploit that the output must make sense in terms of physics
- cvs diff

Evolution of Code
CVS Browsers

- Most useful tools for manual checks of changes to code
- View the CVS Repository in the web browser
- Popular: CVSweb, ViewCVS



Summary

- Reading Code
  - Is a "soft skill" to be learned by experience
  - Can be automized using tools: General ones (ls, wc), Dedicated ones (doctools) and your own
  - Goes hand in hand with writing new code
- Documentation from Code
  - Is easy to extract using doctools
- Evolution of Code
  - Can be monitored by tools

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