Code Reviews - Best Practices

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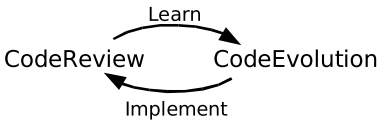
- Code Review in a Top-Down Approach
- Documentation from Code
- Code Evolution: Best Practices



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
  - ...

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

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

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;
}
```

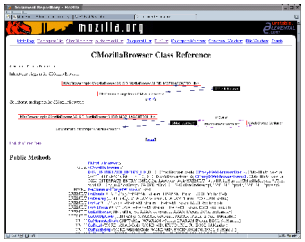
javadoc

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

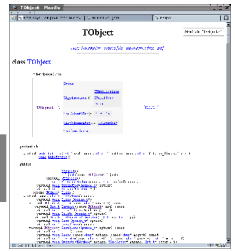
- "King" of doc tools (popular)
- Output to LaTeX, RTF, PS, PDF, HTML, man
- Good results for any (unenriched) source
- Create indices, graphs, diagrams ...
- Too many bells & whistles?
  - Some people prefer less features



Example
Mozilla Code Documentation

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



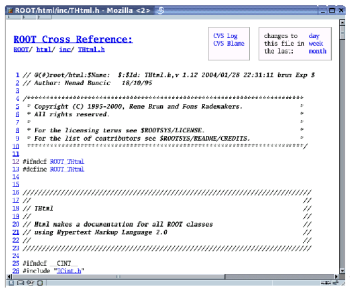
Example
Class TObject in HTML Format

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

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

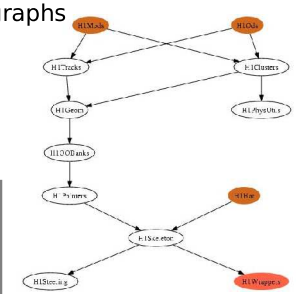
  but: not current state of repository!



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

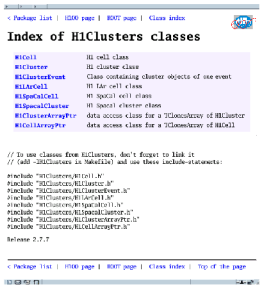


Example

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

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

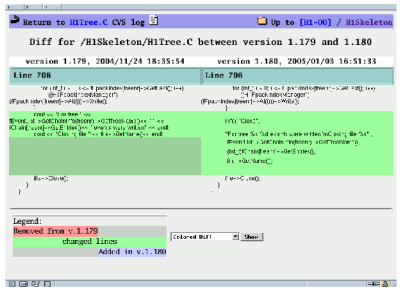
Package Index HTML page: Hyperized Directory Listing (Perl Script)

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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