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# Software Architecture

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# Configuration Management

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# Agenda for today

- Motivation
  - What is configuration management ?
  - Why do we need configuration management ?
- Configuration Management
  - Aspects of Configuration Management
  - Terms and Definitions
  - Problems and Solutions
- Tool Support
  - Available SCM Tools
  - Examples: CVS, Bugzilla, Xenofarm
- Summary
- PART 2: Subversion



# About your Future

- You will never work alone.
- Other people will mess up your code.
- You will mess up other peoples code.
- You will never write a (major) program from scratch.
- The software that you will work on was already there when you joined the company.
- The software that you will work on will still be there when you leave the company.





*"Configuration management is **unique identification, controlled storage, change control, and status reporting** of selected intermediate work products, product components, and products during the **life of a system.**"*

Anne Mette Jonassen Hass: *"Configuration Management; Principles and Practice"*



**Configuration Management** is about the role of

**TIME**

in software development.



Space

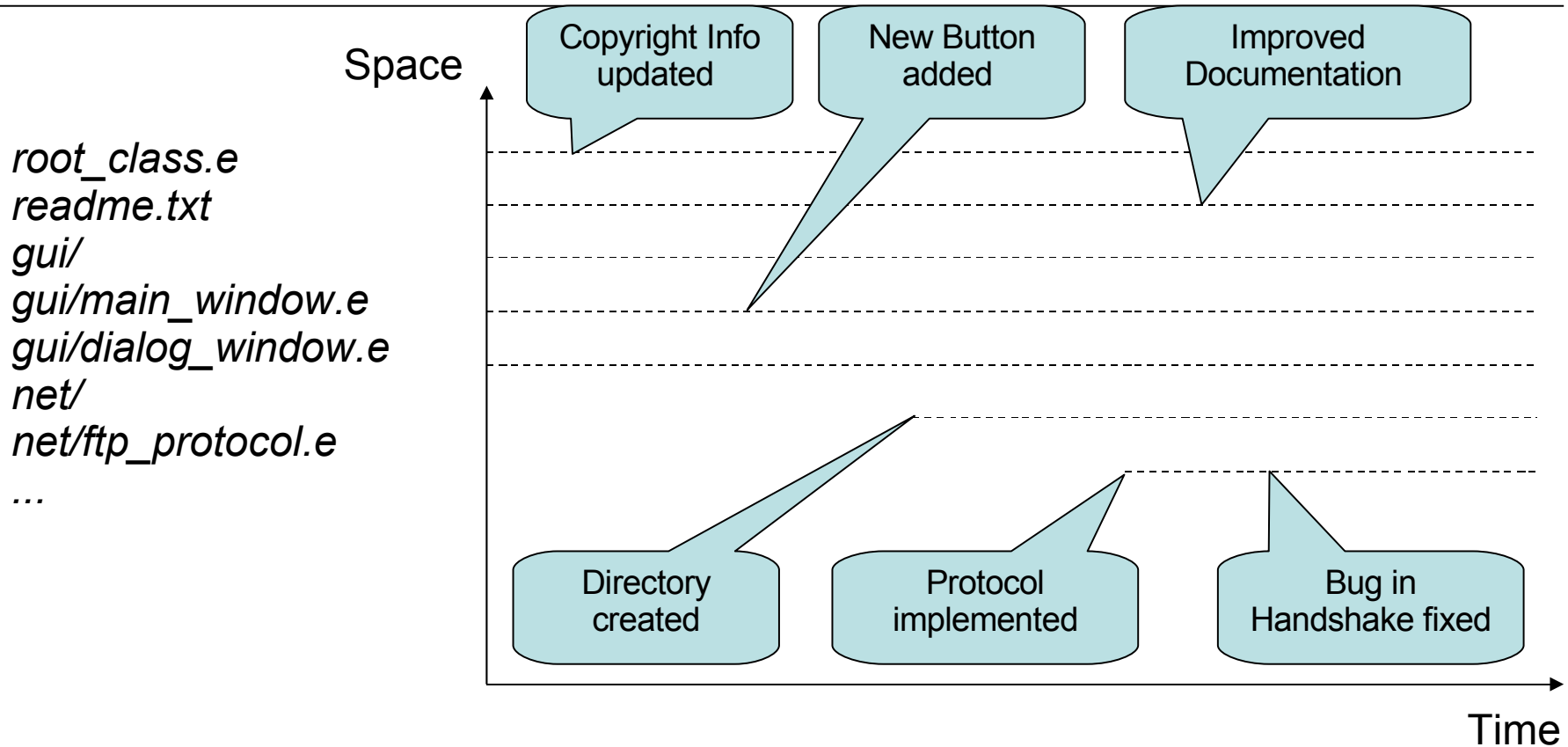
*root\_class.e*  
*readme.txt*  
*gui/*  
*gui/main\_window.e*  
*gui/dialog\_window.e*  
*net/*  
*net/ftp\_protocol.e*  
...



A system that stores and organizes documents over space is called a **FILE SYSTEM**.



# Space and Time



A system that stores and organizes documents over space and time is called a **REPOSITORY**.





- Configuration Management does manage not only **source code**, but also:
  - Binary versions of the software (Builds)
  - Requirement and analysis documents
  - Design documents, UML-diagrams
  - Test results
  - System configuration information
  - ...



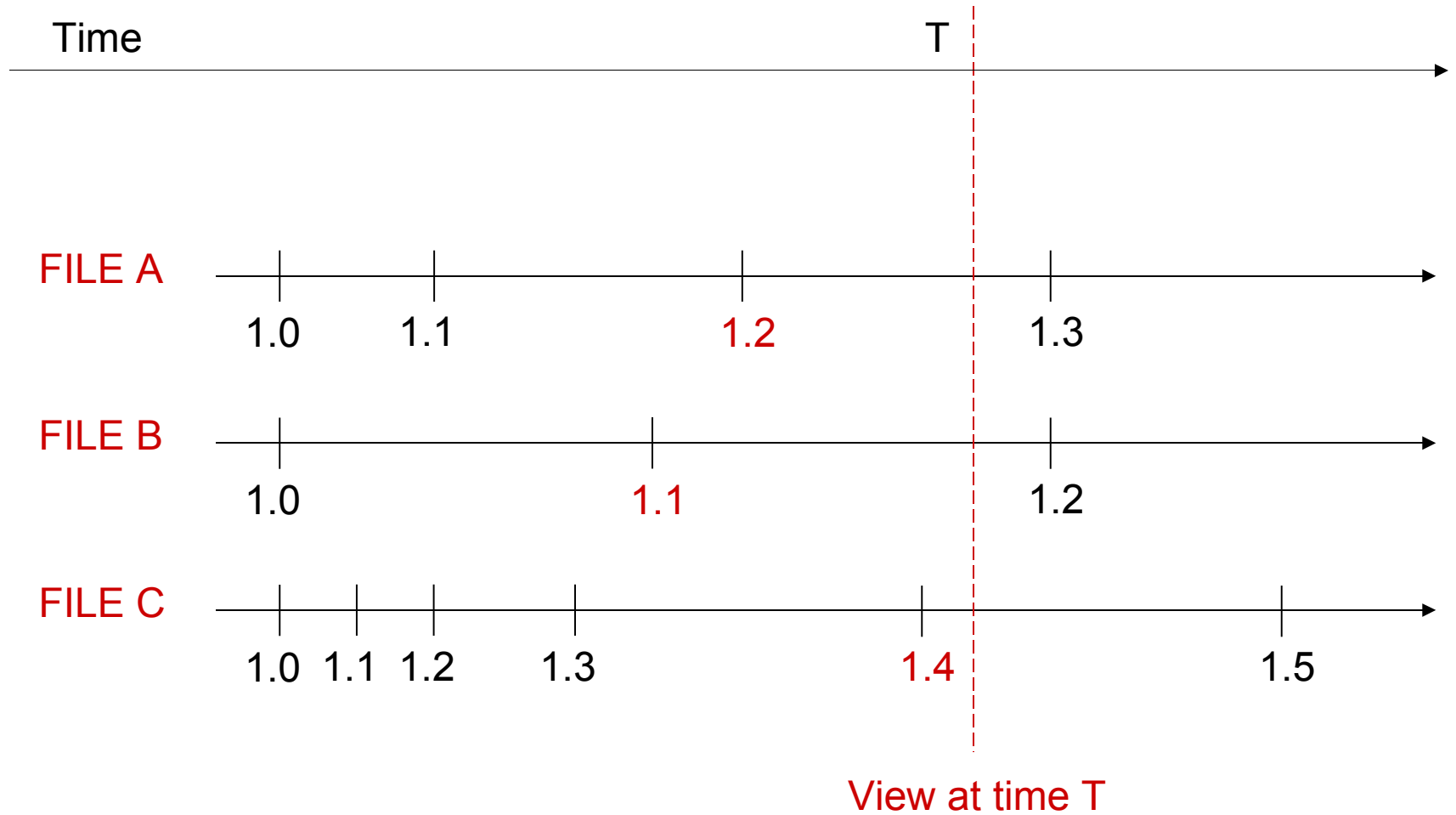
- ... knowing **who has done what to which document** in **the past**.
- ... enabling **different people at different locations** to work on the same set of documents at the **same time**.
- ... **going back** to an **old version** of the documents in the case that the path taken was not good.
- ... tracking the quality of the software **over time** and to stop **software regression**.

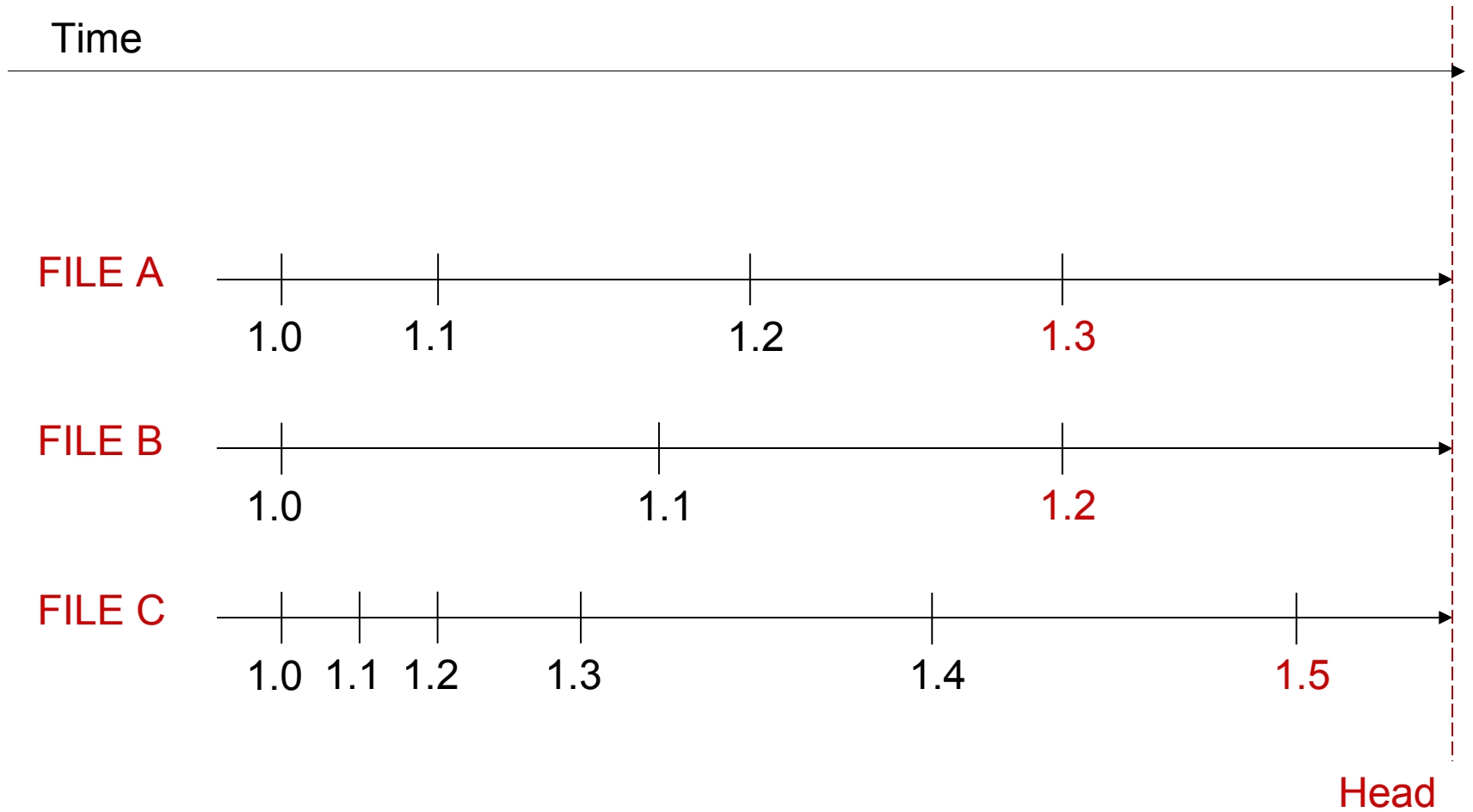


- Versions give a unique **time-dependent identification** to each document.
- Deciding for proper version names is the **basis for successful software configuration management**.
- There can be **multiple levels** of versioning schemes within one project. Examples:
  - Versions for written documents:
    - Example: REQDOC-20040103-R4
  - Versions for source code:
    - 1.1, 1.2, 1.3, 1.4, 1.4.1, ...
  - Versions for binary builds:
    - 610, 611, 612, ...



- CM has to record
  - **WHICH** document was changed.
  - **WHAT** was changed.
  - **WHO** has done the change.
  - **WHEN** was the change made.
- The history of the changes should be made visible.
- It should be possible to undo all changes.
- It should be possible to view the version of a document at a certain point in time.

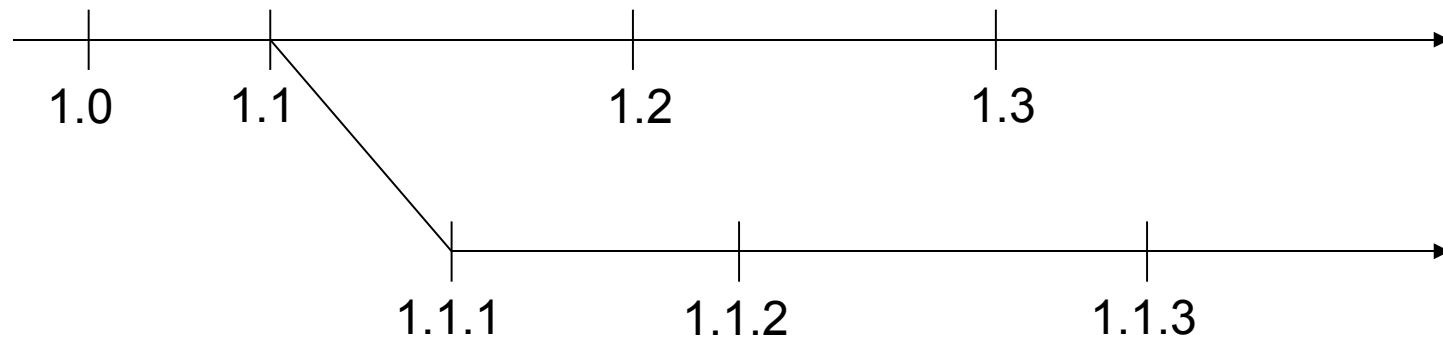




Head = View at time  $\infty$

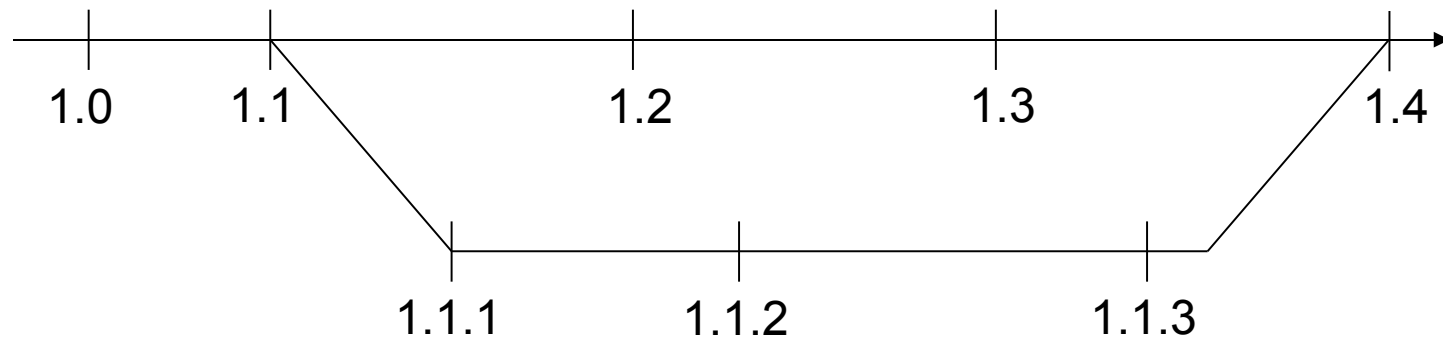


- Creating multiple versions of an existing set of documents is called **BRANCHING** (or **FORKING**):





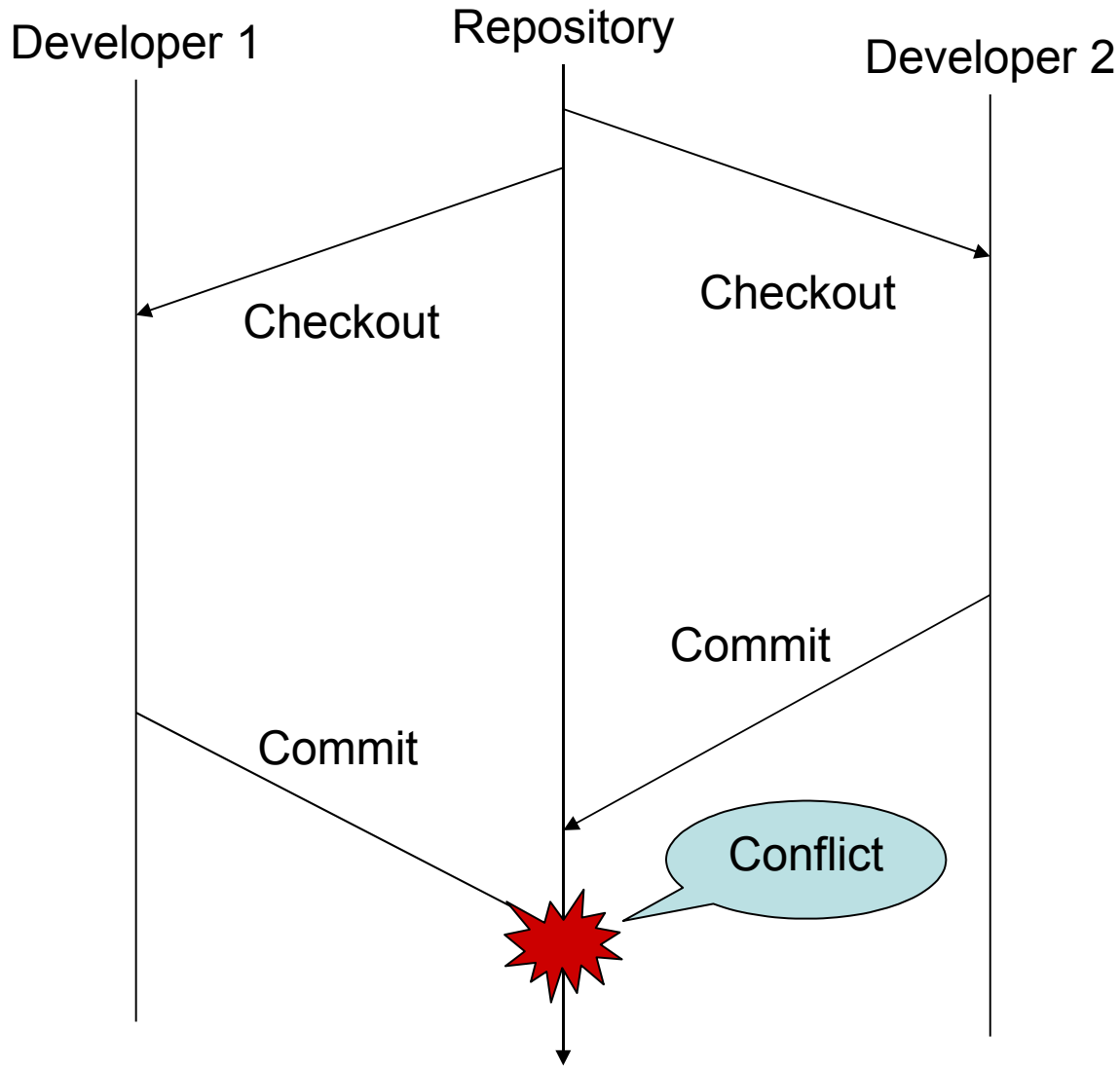
- Joining versions that were developed independently for some time is called **MERGING**:







# Distributed Development





- There are different levels of binary builds:
    - Daily (Nightly) Builds
    - Integration Builds
    - Stable Builds
    - Releases
      - Alpha Release
      - Beta Release
      - Release Candidate
      - Official Release
- ↑ Current, but not reliable.
- ↓ Not current, but reliable.



- Regression Testing tests features that **already worked in old versions** of the software, if they **also work in new versions** of the software.
  - A Test Suite is developed together with the software to verify its correctness.
  - The Test Suite is run on changed versions of the software to verify that the old parts are still working.
  - Regression Test are normally part of the **Commit Process** or of the **Daily Build**.



- Bug-Tracking is the term for an **infrastructure** that captures and manages bug-reports in a given project.
- The number and quality of bugs is normally a judgment for the **release-quality of software**.



- Repository, Commit, Update, Checkout, Head
- Branch/Fork, Merge
- Conflicts, Resolving Conflicts
- Tag, Label
- Release, Build
- Test Cases, Test Suite, Regression Tests



- Software Configuration Management (SCM) Tools
  - CVS, Subversion, Monotone, ArK, tla (FOSS)
  - ClearCase, BitKeeper, SourceSafe (Commercial)
- Bug-Tracking
  - Bugzilla (FOSS)
- Daily Build
  - Xenofarm (FOSS)
  - Tinderbox (FOSS)
  - Most projects have customized software

- Best known SCM tool.
  - <http://www.cvshome.org>
- Key to most open-source development projects and used in many companies.
- Based on RCS (Revision Control System)
- Command-line program (!)
- Graphical-User-Interfaces:
  - WinCVS (Windows) / GCVS (Unix)
  - Integration into Eclipse and many other IDEs



- Features of CVS:
  - Central repository
  - Checkout creates a copy of the files on the local machine.
  - File-based versioning
  - Distributed work over the Internet with PSERVER (insecure) or SSH (secure) protocols.
  - Can work with binary and ASCII encoded files, but is not very effective with binary files.
  - Can do some primitive conflict resolving.






- Open Source Bug-Tracking Tool
  - <http://www.bugzilla.org/>
- Developed for the Mozilla Browser Suite
- Web-Based Interface



# Bugzilla (cont.)

Search for bugs - Konqueror

Location Edit View Go Bookmarks Tools Settings Window Help

 mozilla.org

Bugzilla Version 2.17.6

Advanced Search Find a Specific Bug

[Give me some help](#) (reloads page.)

**Summary:** contains all of the words/strings  Search

**Product:** JSS  
MailNews  
Marketing  
Minimo  
Mozilla Localizations  
...

**Component:** Sidebar  
Simple MAPI  
Skinability  
Software Update  
Spanish

**Version:** 1.0 Branch  
1.01  
1.1  
1.2  
1.3

**Target:** ---  
Future  
3.0  
Jan  
M1

**A Comment:** contains the string

**The URL:** contains all of the words/strings

**Whiteboard:** contains all of the words/strings

**Keywords:** contains all of the keywords

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**Status:** UNCONFIRMED  
NEW  
ASSIGNED  
REOPENED

**Resolution:** FIXED  
INVALID  
WONTFIX  
DUPLICATE

**Severity:** blocker  
critical  
major  
normal

**Priority:** --  
P1  
P2  
P3

**Hardware:** All  
DEC  
HP  
Macintosh

**OS:** All  
Windows 3.1  
Windows 95  
Windows 98



- System for a „Daily Build“.
  - <http://xenofarm.tigris.org/>
- Developed for projects that target **many platforms**.
- Used in:
  - ArgoUML
  - Pike
  - Python
- Automated scripts will distribute the source code to **build machines**.
- Will run the **compilation process** and a set of **test-cases**.



# Xenofarm (cont.)

pike.ida.liu.se: Pike 7.4 - Konqueror

Location Edit View Go Bookmarks Tools Settings Window Help

|                           | 2004-05-25 07:56:14 (548) | 2004-05-25 09:51:17 (549) | 2004-05-27 13:20:07 (550) | 2004-05-27 16:49:34 (551) | 2004-05-28 09:42:46 (552) | 2004-05-28 13:09:50 (553) | 2004-06-01 19:12:09 (554) | 2004-06-08 12:13:41 (555) | 2004-06-13 13:35:14 (556) | 2004-06-13 15:30:33 (557) | 2004-06-14 09:15:03 (558) |   |
|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---|
| Node Name                 |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           | Platform                                |
| pike.ida.liu.se           | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | xenofarm_export (SunOS 5.8 sun4u sparc) |
| hal.lysator.liu.se        | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | AIX 4.2 000000042E00                    |
| castafiore.lysator.liu.se | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | AIX 4.3 000084275900                    |
| dupond.lysator.liu.se     | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | AIX 4.3 000090105700                    |
| lukushion.roxen.com       | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | AIX 5.1 ia64 CC=cc                      |
| sasserver2.emsphone.com   | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | AIX 5.2 0002CABA4C00 CC=gcc             |
| earl-grey                 | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | Darwin 6.8 Power Macintosh              |
| snok.pikefarm.ida.liu.se  | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 4.0-RELEASE i386                |
| dan.emsphone.com          | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2-CURRENT i386                |
| dan.emsphone.com          | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2-CURRENT i386                |
| dan.emsphone.com          | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2-CURRENT i386                |
| yoko.home.oav.net         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2.1-RELEASE-p4 i386           |
| jocke.snowfall.se         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2.1-RELEASE-p5 i386           |
| plonk.home.oav.net        | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | FreeBSD 5.2.1-RELEASE-p5 i386           |
| gosroth.roxen.com         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | Linux 2.4.3-12smp ia64                  |
| gosroth.roxen.com         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | Linux 2.4.3-12smp ia64 CC=ecc           |
| moghedien.lysator.liu.se  | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | ●                         | Linux 2.4.6 alpha                       |



- I have only given a glimpse at the topic of **Configuration Management**.
- Every software project should use it.
- Every software project should use it from the start.
- Having a large and long-term software project without it is foolish.
- Configuration Managements can be supported by proper tools.

But the key to successful configuration management lies in the discipline of the developers to use it.



# Part II: Subversion



# What is wrong with CVS ?

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- File based management
  - Rename file
  - Changing directory structure
- No atomic commits
- Network protocols are problematic
  - PSERVER is not encrypted
  - RSH is obsolete
  - SSH lacks anonymous access
  - Too much communication between client and server
- Inefficient storage of binary files

# Subversion (also known as SVN)

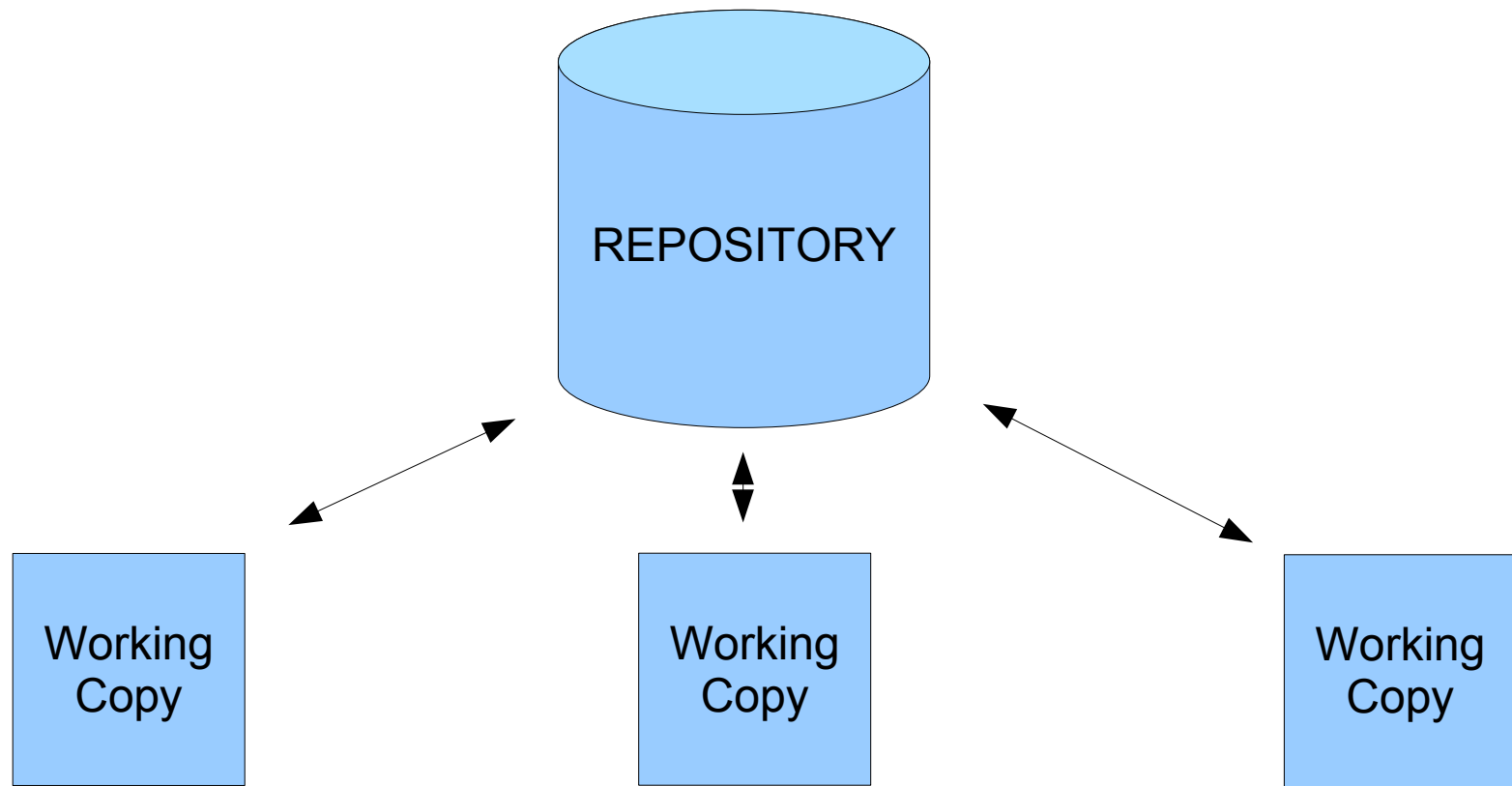
- Available at
  - <http://subversion.tigris.org/>
- Full book on Subversion available at
  - <http://svnbook.red-bean.com>

*“Subversion is meant to be a better CVS, so it has most of CVS's features. Generally, Subversion's interface to a particular feature is similar to CVS's, except where there's a compelling reason to do otherwise.”*

Subversion Homepage



- Subversion uses a client server architecture
- Every developer work on his/her “working copy”

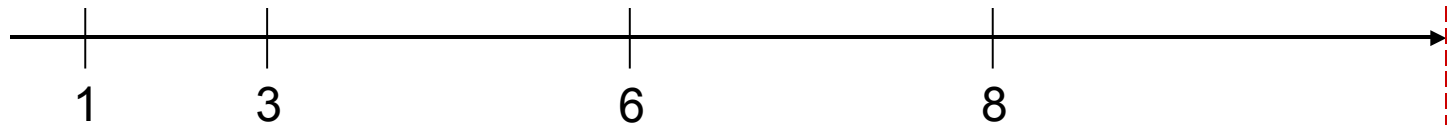


# Version numbering in Subversion

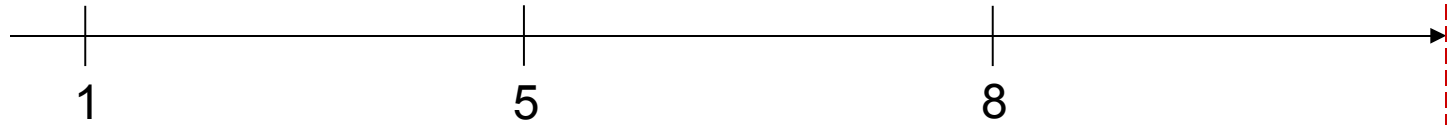
Version numbering is per “commit”

Time

FILE A



FILE B



FILE C



Head = View at time  $\infty$

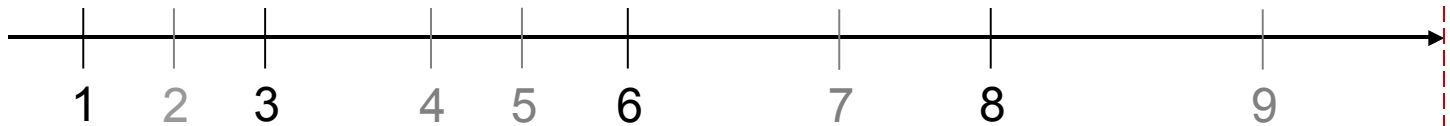
HEAD

# Version numbering in Subversion

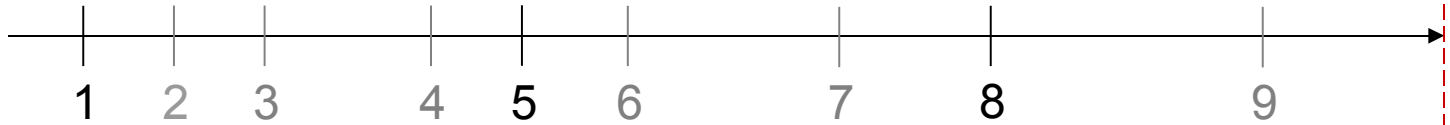
Version numbering is per “commit”

Time

FILE A



FILE B



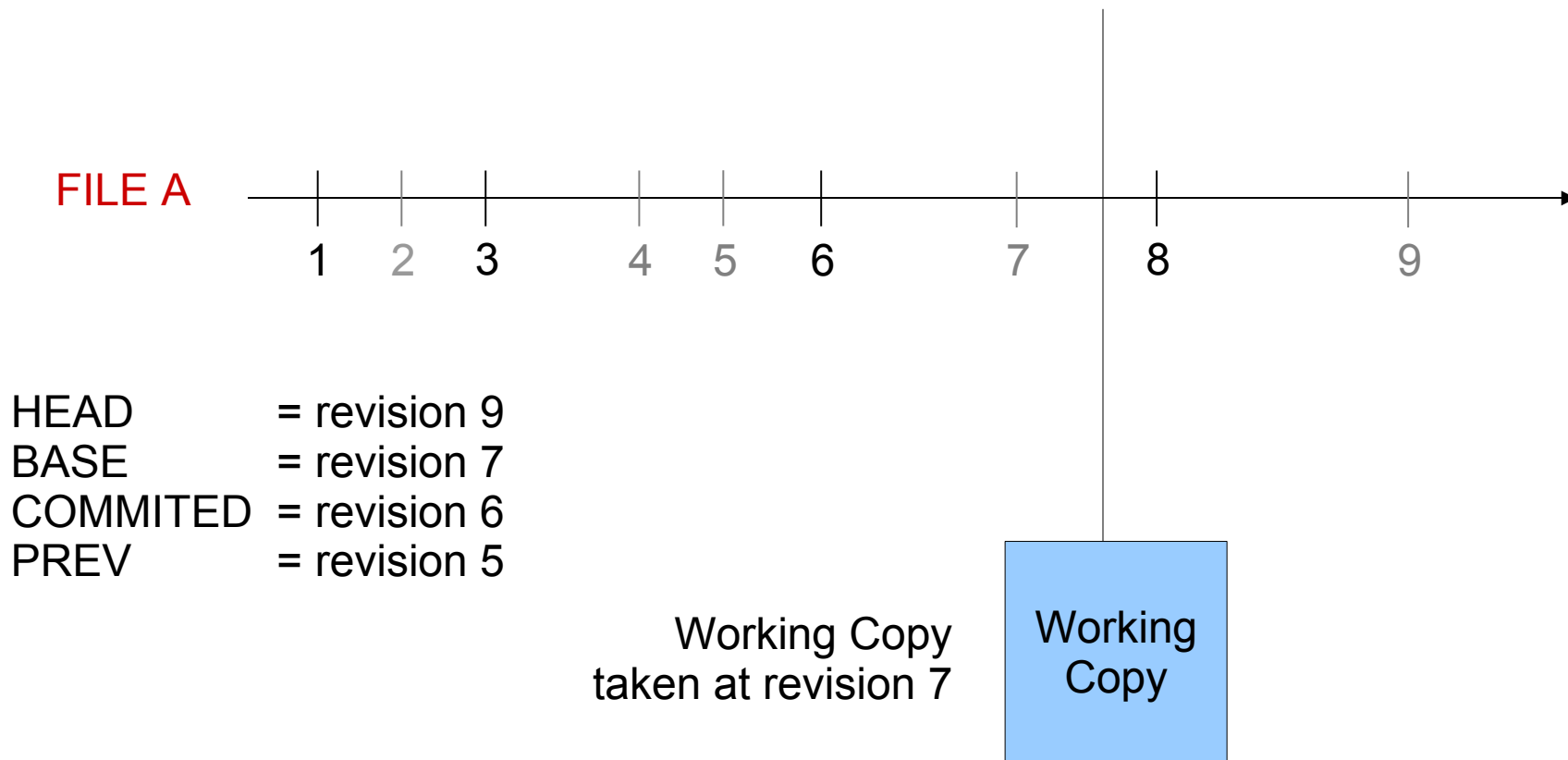
FILE C



Head = View at time  $\infty$

HEAD

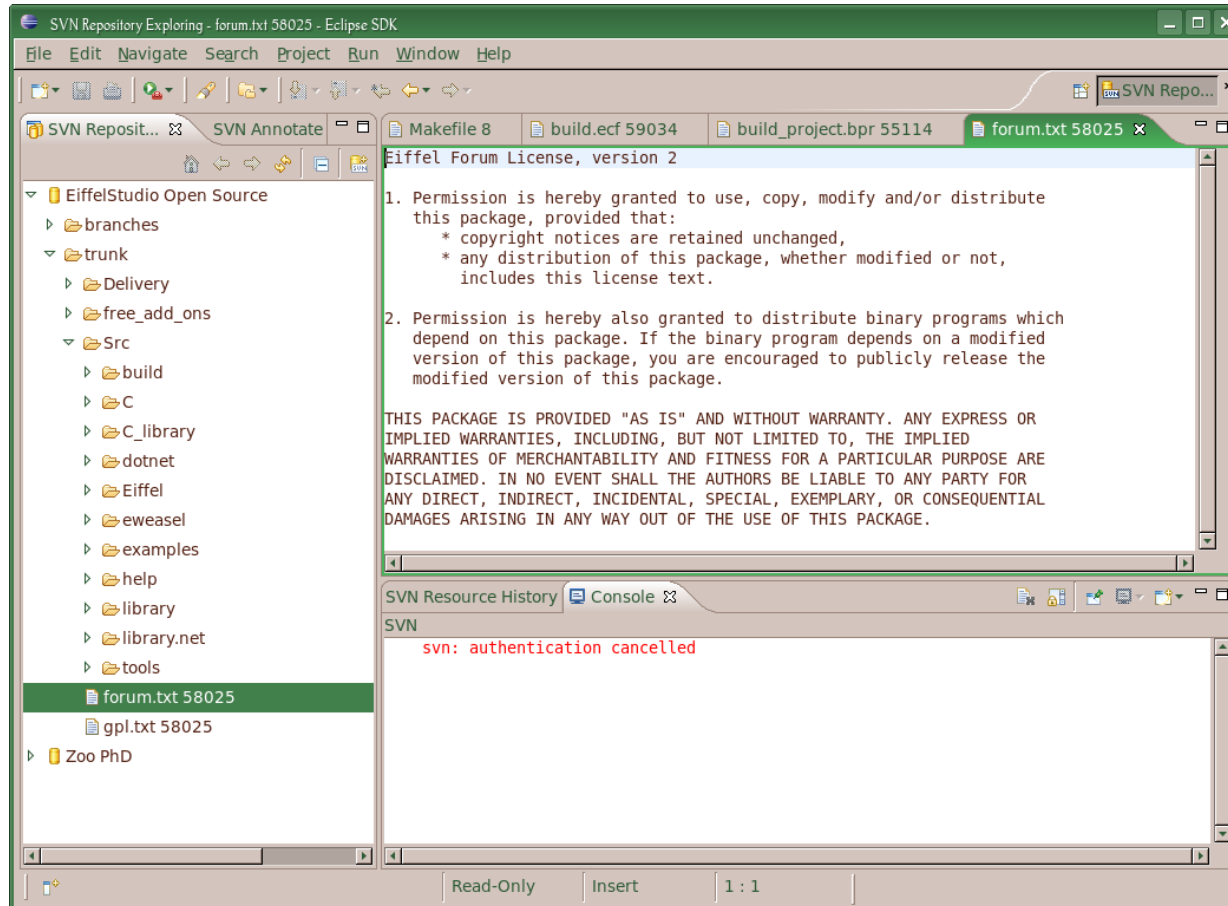
# HEAD, BASE, COMMITTED and PREV



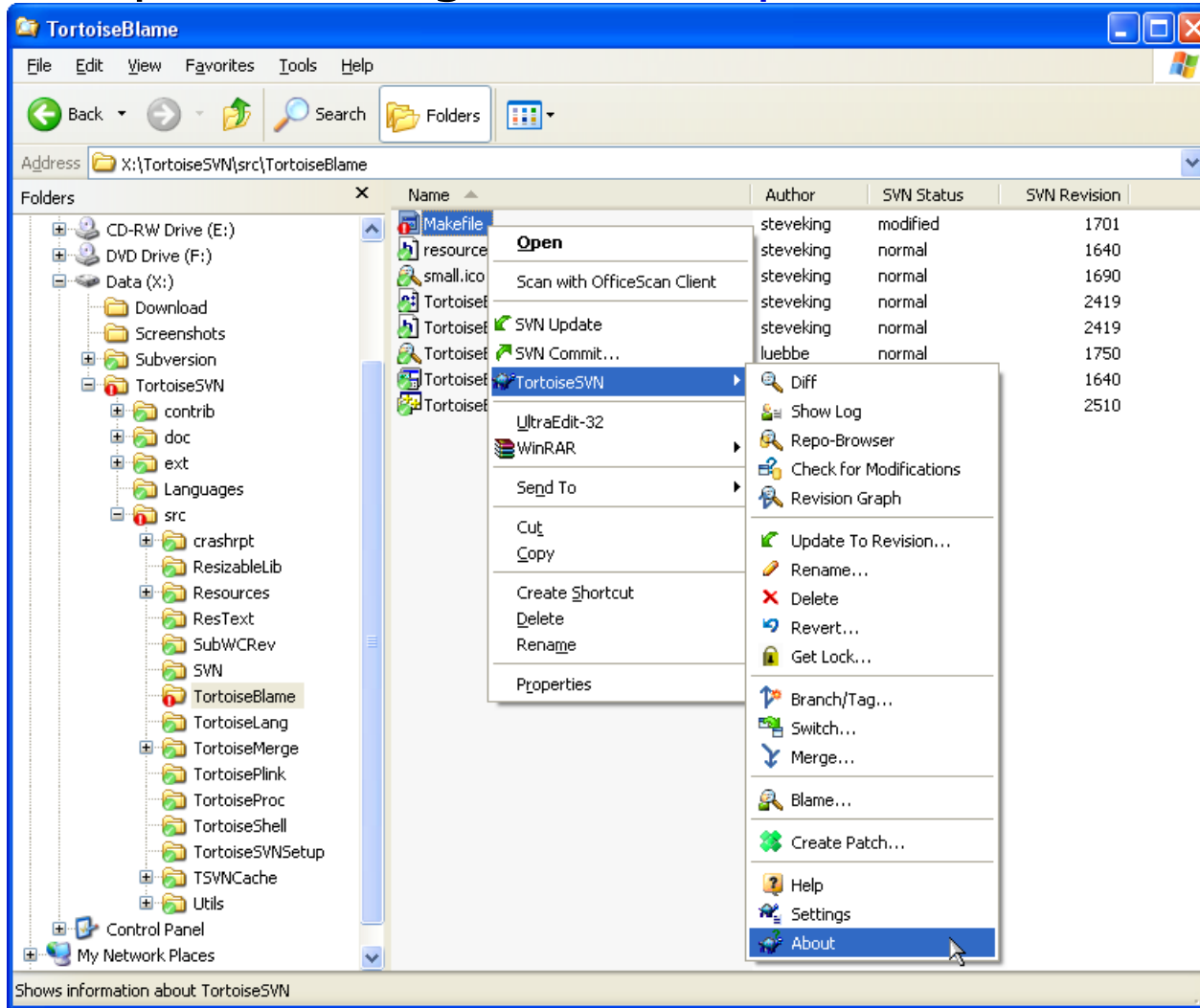


- `svn checkout`
- `svn update` / `svn revert`
- `svn commit`
- `svn info` / `svn log` / `svn status`
- `svn add` / `svn delete` / `svn move` / `svn mkdir`
- `svn copy`
- `svn diff`
- `svn merge` / `svn resolved`
- `svn cat` / `svn list` / `svn blame`
- `svn export` / `svn import` / `svn switch`

## Eclipse Plugin subclipse (<http://subclipse.tigris.org>)



Windows Explorer Integration: <http://tortoisesvn.tigris.org>



- Using the command line, I will:
  1. Create a repository
  2. Import some files
  3. Checkout a working copy
  4. Modify and commit
  5. Rename a file
  6. Create a branch
  7. Modify branch and trunk
  8. Merge branch back into trunk