Lecture 13: Version Control & RCS

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Version Control

- Things change…
  - new requirements lead to…
  - new or changed designs that lead to…
  - new or changed source code, etc.
  - or bugs are discovered and must be fixed
- …software engineers need to keep track of all these changes

Version Control, continued

- Versioning
  - Keeping track of the changes to a file from one editing session to the next
  - Computer Science has developed algorithms that can automatically detect the changes to a file
    - especially text files
  - One such algorithm is encapsulated in a Unix tool called `diff`

DIFF Example

- world1.cc

```
int main() {
    printf(“hello world”);
}
```

- world2.cc

```
int main() {
    printf(“HELLO WORLD!”);
}
```

```
% diff world1.cc world2.cc
2c2
<  printf("hello world");
---
>  printf(”HELLO WORLD!");

% diff world2.cc world1.cc
2c2
< printf(”HELLO WORLD!");
---
> printf("hello world");
```

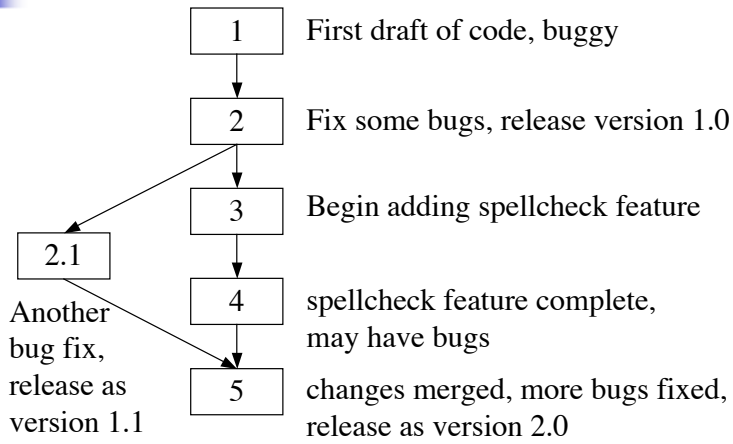

More on DIFF

- Command Line
  - diff file1 file2
    - “show me how to change file1 into file2”
- Output
  - Displays the “ed” commands needed to change file1 into file2
    - “2c2” in the previous example meant change line 2 in file1 into line 2 of file2
- See the diff and ed man pages for complete details

Version Control

- Tracks all changes associated with a file
- Why?
  - *Rollback*: Changes are not always an improvement. Often, you need to return to a prior version
  - *Experimentation*: Lets software engineers explore “what if” scenarios
  - *Internationalization*: Different versions for different languages
  - *Historical Record*: A customer reports a bug on version 1.1, but you are at version 2.3. You need a way to recreate version 1.1 to check out the bug

Tracking Changes



Version Graphs

- All changes to a single file are tracked via a graph
  - nodes are distinct versions
  - edges denote that the target node was derived from the source node
- There are three possible configurations
  - *Extension*: a single version derived from a single version
  - *Split*: multiple versions derived from a single one
  - *Merge*: a single version derived from multiple versions; merge typically done “by hand”

Version Control Files

- Version graphs are stored in version control files
- Space saving techniques are used
  - Forward deltas
    - The original version is stored, all subsequent versions are stored as sets of changes or “deltas”
  - Backward deltas
    - The most recent version is stored, all previous versions are stored as sets of changes

Version Control Systems

- Version Control Systems let you check versions out of a version control file
  - If I ask for version 2.2, and we are using a forward delta system
    - then it starts with the original file and applies all of the deltas that lead to version 2.2 in the version graph

RCS: Revision Control System

- The version control system for our class is RCS.
- RCS is a backward delta system
  - It stores the complete text for the most recent version of the file
  - And derives old versions by applying deltas to the recent version

Check-In and Check-Out

- Commonly used RCS commands
  - ci - check in
    - Used to check changes into a version control file; can also create an initial version control file
  - co - check out
    - Used to check out a specific version of a file

RCS Locks

- RCS has a notion of locks
  - If you check out a file, with a lock, no other person can check out that file for editing (they can still read it, however)
    - This prevents multiple people from changing the same file at once
    - This is a different strategy than one used by another popular version control system, CVS
      - CVS allows a file to be edited by multiple people, but then potentially requires a “merge” step when checking a file into the repository

RCS Version Control File

- The version control file for RCS has a suffix “,v”
- You can think of this file as a tar file
  - A single file with multiple files stored within
  - This time the contained files are just different versions of the same file
    - And all but one are stored as “deltas”

RCS Example

- Start with a file

```
rw- CommentBook
%ci CommentBook
initial revision: 1.1
r-- CommentBook,v
```

- To Retrieve original file

```
%co CommentBook
r-- CommentBook
r-- CommentBook,v
```

Note: the version control file is created in the same directory as the original file UNLESS there is a directory called RCS

If RCS exists, the version control file is created in the RCS directory

RCS Example, continued

- The checked out file is called “the working file”
  - You can always retrieve a working file from the version control file

```
r-- CommentBook
r-- CommentBook,v

%rm CommentBook
r-- CommentBook,v

%co CommentBook
r-- CommentBook
r-- CommentBook,v
```

RCS Example, continued

- A normal co command produces a read-only working file; to get a writeable version, you must lock the working file

```
%co -l CommentBook
rw- CommentBook
r-- CommentBook,v
```

- After you have made changes, you can check them in to make a new version

```
%ci CommentBook
new revision: 1.2
r-- CommentBook,v
```


Flags for CO

- `-r# - Retreive revision number #`
- `-l  - Retrieve a locked working file`
- `-u  - Retrieve an unlocked working file`
- `-p  - Print contents of file to stdout, do not retrieve a working file`
- `-f  - force overwrite of working file`
- `-q  - Quite mode; diagnostics not printed`
- `-I  - Interactive Mode`
- `See man page for more info`

Flags for CI

- `-r# - Save as revision number #`
- `-l  - Save and retrieve a new locked working file`
- `-u  - Save and retrieve an unlocked working file`
- `-i  - Initial check in, report error if a ,v file already exists`
- `-f  - Force creation of new version`
- `-q  - Quite mode`
- `-I  - Interactive Mode`
- `See man page for more info`

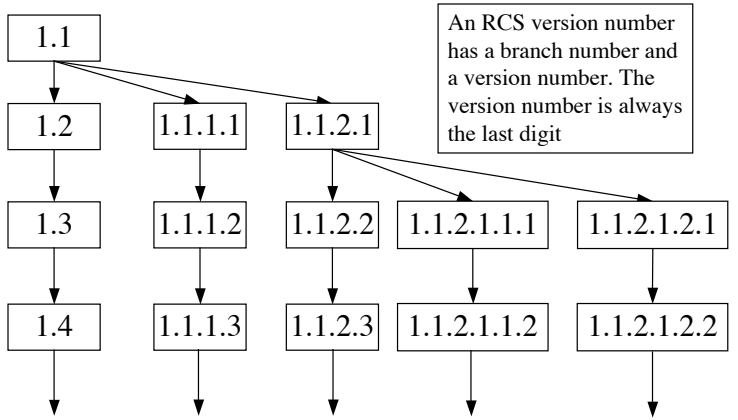
RCS Keywords

- RCS will look for certain keywords in a file and will substitute values for them during check-in and check-out
  - Think of these keywords as Make Macros, where RCS provides the definition for the Macro
  - Keywords are delimited with two dollar signs
    - Example:if $Author$ appears in a text file stored in RCS
    - then when checked out, RCS replaces the above string with:
    - $Author: kena $
    - or more generically with $Author: <username> $

Example Keywords

- $Author$ - name of user who performed ci
- $Date$ - The date and time of a ci
- $Locker$ - name of the user who locked a revision
- Log - log message supplied during ci
- $Revision$ - revision number assigned during ci
- $Name$ - The name of a revision (if named)
- $RCSfile$ - The name of the RCS file without path info
- $Source$ - The full pathname of the RCS file
- $Header$ - See co man page for details
- Id - See co man page for details

RCS Version Numbering



Other RCS Tools

- rcs - an admin tool; can perform tasks such as breaking locks, change log messages, erase versions, etc. See man page for details.
- `rlog` - display log messages for a particular file (each time you check in a file, you are asked to enter a log message describing the changes)
- rcsdiff - a diff command for rcs versions
  - e.g. rcsdiff -r1.1 -r1.2 CommentBook will show the differences between the specified versions without checking those versions out