Version Control

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February 19, 2013

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Version Control

Version control (a.k.a. *version management* is concerned with the management of change in the software artifacts being developed.

- Sometimes considered a sub-area of the problem of configuration management

    - a.k.a., Software Configuration Management (SCM)

        * Oddly enough, many tools labeled as SCM tools only address version control

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2   Issues in Version Control

Issues

The issues addressed by version control are:

- History

    - How has the software changed since *date-or-version-number*? Who made those changes? Why were they made? Can we go back?

- Exploration

    - Can we try out a set of plausible changes without affecting the "main" software build? Even if exploration of the effects of those changes may take a long time?

- Collaboration

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    – Can we have multiple developers working on the code without interfering with one another's work?

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3   Background - Changing the Code Base

ed

    One of the earliest Unix text editors, **ed** applies a series of editing commands like 'a' to append to th end of a file, 'i' to insert a line at the current location, 'd' to delete the current line, etc.

- Few people use **ed** now

    – though its line-oriented "child", **sed** is still a popular scripting tool.

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diff

    diff compares two files line by line, listing the differences between them.

- Differences are listed as a series of line replacements, insertions, and/or deletions

    – Reduces each line to a hash code

    – Uses the dynamic programming algorithm for computing the Levenshtein distance between the two sequences of hash codes to obtain an approximately shortest sequence of commands

- Can emit differences as **ed** commands:

```
diff --ed file1 file2 > file12.diff
echo w file2 >> file12.diff
ed file1 < file12.diff
```

would "rebuild" file2 from file2 and the diff.

....

patch

    patch takes a slightly more sophisticated approach to the idea of applying a **diff** output to a file

```
diff file1 file2 > file12.diff
  ⋮
patch file1 file12.diff
```

- Allows a variety of different **diff** variants

- Can detect if file1 has already been changed so that the line numbers and other info in the patch file file12.diff are no longer accurate.

    – Attempts to compensate

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Integrating Changes

    Suppose that we have two patch files created from the same base file file1

```
patch −o file2a file1 patchA
patch −o file2b file1 patchB
```

Change integration is the problem of combining both sets of changes to form a desired file file2.

....

Two-way Change Integration

```
patch −o file2a file1 patchA
patch −o file2b file1 patchB
```

1. Compare `file2a` and `file2b`

2. Wherever the two are different, prompt the human to select the desired change.

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Three-way Change Integration
   Takes the base file into account as well as the two changed files.

```
patch −o file2a file1 patchA
patch −o file2b file1 patchB
```

1. Compare `file1` and `file2a`, then `file1` and `file2b`

2. Any lines that differ from `file1` in only one of the two other files can be applied automatically.

3. Wherever both `file2a` and `file2b` are different from `file1`, prompt the human to select the desired change.

   • This is called a *conflict*.

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4   Approaches and Tools

Version Control Systems

If we could extend patch multiple files at once, we could, in theory, patch an entire software system to move it from version 1 to version 2, then patch it again to move to version 3, etc.

- This would be the heart of a version control system,

. . . .

Approaches and Tools

- *Local* version control systems manage history by setting aside directories on the same file system where the software under control is housed.

    – **sccs**, **rcs**

- *Centralized* version control systems keep the system history at a centralized location accessible via the network.

    Developers check out a copy of the current (or a desired older) version of the software onto their own machines.

    – CVS, Subversion

- *Distributed* version control systems allow developers to keep the full system history on their own machines.

    A central location may hold a base copy for management/distribution purposes, but this is not required.

    – **git**

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