Project Management

Overview

- How to manage a project?
- What is software configuration management?
- Version control systems
- Issue tracking systems
- Continuous integration

What is Project Management?

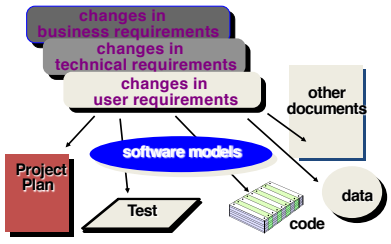
- Effective project management focuses on the 4 P's:
  - People: the most important element
    - recruiting, training, performance management
  - Product: the software to build
    - Project objectives, scope, alternative solutions
  - Process: define activities and tasks involved
    - Milestones, work products, QA points
  - Project: progress control
    - Planning, monitoring, controlling

The "First Law"

- **No matter where you are in the system life cycle, the system will change, and the desire to change it will persist throughout the life cycle.**

Bersoff, et al, 1980

What Are These Changes?



Software Configuration Management (SCM)

- Definition
  - The task of tracking and controlling changes in software
- SCM repository
  - tools that allow developers to effectively manage changes
    - Version control system
    - Issue tracking system
- CI servers

Version Control System

What Is Version Control System?

- VCS, also known as Revision Control System
- To manage changes to documents, programs, large websites, and other collections of information
  - CVS, SVN, Mercurial, GIT

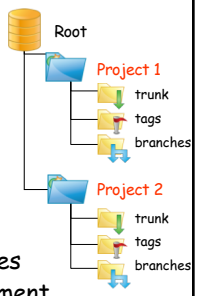
What Do We Mean by "Manage Changes" ?

- What changes have been made?
- Why are the changes made?
- Who makes the changes?
- Can we redo/undo some changes?
- Can we branch the project?

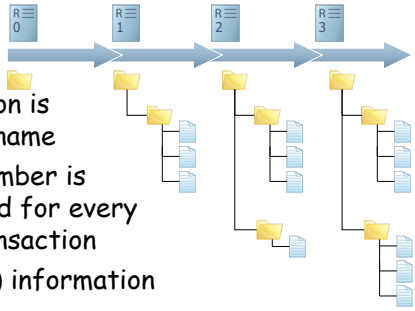
Subversion Version Control System (SVN)

Subversion Repository Layout

- One SVN server can hold many repositories
- One repository can hold many projects
- One project contains
  - Trunk: Main line of development
  - Tags: Markers to highlight notable revisions—major releases
  - Branches: Side lines of development



Each project has multiple revisions

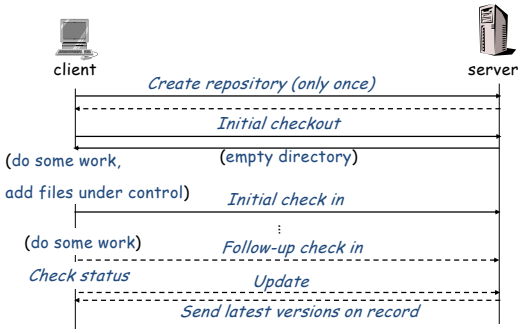


- Each revision is assigned a name
- Revision number is incremented for every commit transaction
- Delta (diff) information is recorded

Basic Features of a Repository

- Keep the history of all changes to files and directories
  - You can check in new versions
  - You can recover any previous version
- Access control
  - Read/write permission for users
- Logging
  - Author, date, and reason for a change

Typical Workflow



Additional Features

- Diff
- Branch
- Merge

Diff

- To display the differences between two revisions
  - What has been changed?
  - Add or delete a line of text
  - No update, or move

```
Version 1:          Version 2:
   x = 0;              x = 1;
   y = 1;              y = 1;
          Diff:
             - x = 0;
             + x = 1;
```


Key Points about Diff

- A key operation of version control systems
- A lot of features are based on diff
  - Save new versions
  - Recover a prior version
  - Patch
- We use Diff(v1, v2) to represent changes on v1 for v2
  - Diff(v1, v2) != Diff(v2, v1)

Diff: a Real Example

```
Index: trunk/compiler/org/eclipse/jdt/internal/compiler/ast/Expression.java
===================================================================
--- trunk/compiler/org/eclipse/jdt/internal/compiler/ast/Expression.java        (revision 9042)
+++ trunk/compiler/org/eclipse/jdt/internal/compiler/ast/Expression.java        (revision 9043)
@@ -223,7 +223,7 @@
                                this.implicitConversion = (runtimeTimeType.id << 4) + compileTime
                                break;
                        default : // regular object ref
-//                             if (compileTimeType.isRawType() && runtimeTimeType.isParameterize
+//                             if (compileTimeType.isRawType() && runtimeTimeType.isBoundParamet
//                                 scope.problemReporter().unsafeRawExpression(this, compileTime
//                             }
                }
```

Start line in the old version — Start line in the new version

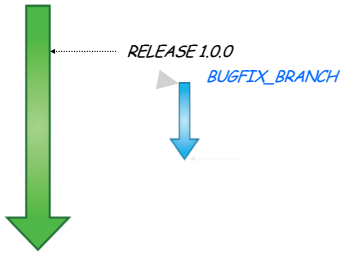
- svn diff -r v1:v2 filename
- "+": added lines, "-": deleted lines
- Some unchanged lines are shown to indicate program context

Changes Detected by Diff

- Addition/Deletion of directories
- Addition/Deletion of files
- A renamed file is reported as a separate addition and a separate deletion
- Addition/Deletion of lines

- Scenario
  - You deliver a great product to your customers: REL-1.0.0
  - Your development team continue adding new features on the trunk
  - Customers report a major bug in the product and ask for a fix
  - What do you do?

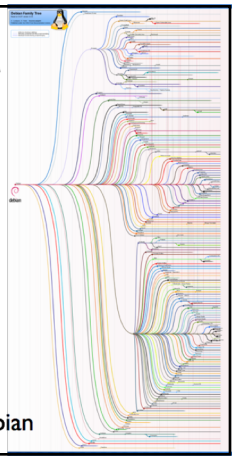
Branch and patch separately!



- svn copy path/to/trunk path/to/branch

Other reasons to branch

- Separate branches for
  - Tentative new features
  - Different products
  - Different teams
  - Different releases



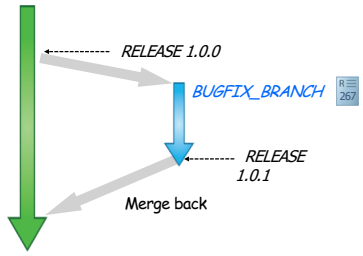
Debian

Pros and Cons of Branch

- Pros
  - Separation of concerns among teams and developers
  - Parallel version history without interference between branches
- Cons
  - Branches may diverge a lot
  - Hard to propagate changes across branches

- Scenario
  - After fixing the major bug on a branch, you have to apply the same/similar changes to the trunk
  - What do you do?

Merge back the patch!



- svn merge –reintegrate path/to/branch

What can happen when merging?

- Conflict
  - Two people edit the same file

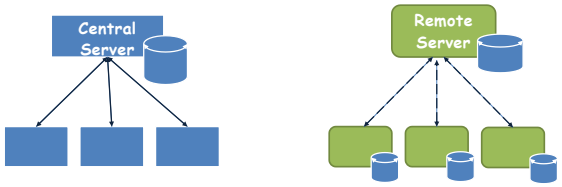
```
void f(int i) {
<<<<<<<< .mine
int j = 3;
========
int j = 4;
>>>>>>>> .r13
```

  - Resolve the conflict manually and checked in again

Distributed Version Control: GIT

- Everyone has their own local version control repository
  - Like a local branch of the project
  - Remote updates and commits are like branch merge
  - Local commits used to backup projects
  - Github allows developers to contribute by working on branches

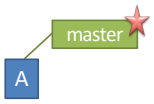
Centralized VC vs. Distributed VC[3]



Git Initialization

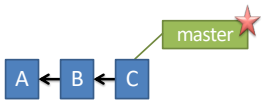
```
C:\> mkdir CoolProject
C:\> cd CoolProject
C:\CoolProject > git init
Initialized empty Git repository in
C:/CoolProject/.git
C:\CoolProject > notepad README.txt
C:\CoolProject > git add .
C:\CoolProject > git commit -m 'my first commit'
[master (root-commit) 7106a52] my first commit
 1 file changed, 1 insertion(+)
 create mode 100644 README.txt
C:\CoolProject > git remote add origin remote
repository URL
# Sets the new remote
C:\CoolProject > git push origin master
# Pushes the changes in your local repository to
the remote repository
```


Git Branch & Merge



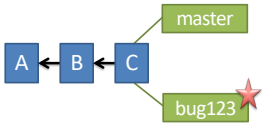

```
> git commit –m ‘my first commit’
```

Branches Illustrated



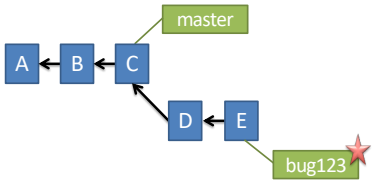

```
> git commit (x2)
```

Branches Illustrated



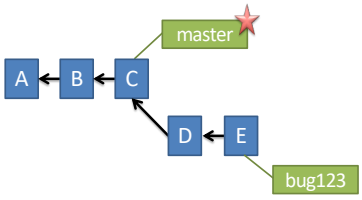

```
> git checkout –b bug123
```

Branches Illustrated



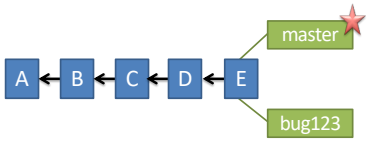

```
> git commit (x2)
```

Branches Illustrated



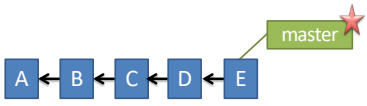

```
> git checkout master
```

Branches Illustrated




```
> git merge bug123
```

Branches Illustrated



Tips for Version Control

- Small commits
  - Check in logically relevant changes as a commit
- Write meaningful commit messages
  - Facilitate change understanding, applying, and reverting
- Avoid commit noise
  - Commit compliable or even deliverable code

Issue Tracking System

What Is Issue Tracking System?

- ITS, also known as trouble ticket system, support ticket, request management, or incident ticket system
- Manages and maintains lists of issues, as needed by an organization
  - To create, update, and resolve reported issues by customers or developers
  - Bugzilla, JIRA

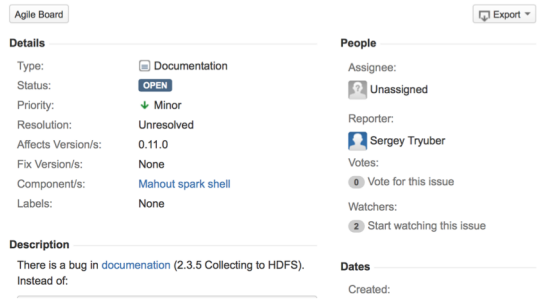
What Do We Mean by "Issues"?

- A unit of work to accomplish an improvement in a system
- It could be
  - a bug
  - a requested feature
  - a patch
  - missing documentation, …

Why Do We Need Issue Tracking?

- Developers need communication while making changes
  - Mailing List
    - Hard to manage, come with all other mails
    - Not well organized
  - Forum
    - Categorized by topic
    - Notify people when a reply is posted
    - No track to code and issue status

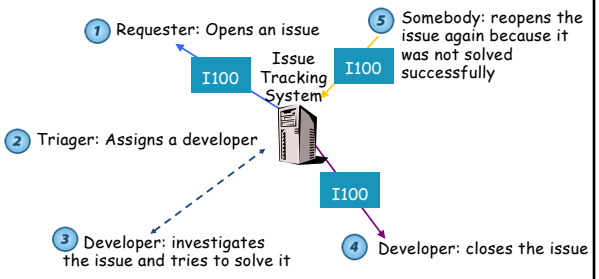
What Is Included in An Issue?



Basic Features

- Structurally describe issues
  - Solving status, severity levels
- Track status of the issue
- Assign a unique ID to each issue
  - Some system automates connection between commit and issue via issue ID

Typical Workflow



Resolution of An Issue

- Fixed
  - A bug is fixed, a feature is added, a patch is applied
- Invalid
  - Bug cannot be reproduced, features do not make sense, patch is not correct
- Duplicate
  - It is a duplicate of an existing issue
  - Get merged with the other issue

Resolution of An Issue

- Won't fix
  - The developers decide not to fix the bug or accommodate the new feature
  - Limited human resource, lack of essential information to reproduce a bug, lack of expertise

Issue Tracking & Version Control

- Many project hosting websites include issue tracking systems
  - Google Code
  - Github
  - BitBucket
  - Sourceforge

Continuous Integration

Martin Kropp[1]
Modified by Na Meng

Overview

- Why integration?
- What is Continuous Integration (CI)?
- Continuous Integration process
- CI infrastructure
- CI tools

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Integration

- Integration occurs when changes are merged with the source code repository

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Broken Integration

- You have a broken integration when:
  - Source code server does not build successfully
  - Shared component works in one system, but breaks others
  - Unit tests fail
  - Code quality fails (coding conventions, quality metrics)
  - Deployment fails

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Manual Integration

- Integration becomes expensive
  - if made manual (build, test, deployment, …)
  - if too few checkin's (months or years…)
  - if integration problems and bugs are detected too late
- Reduces desire to refactor
  - long time between integration increases risk of merge

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What is Continuous Integration?

- "*Continuous Integration is a software development practice where members of a team integrate their work frequently, usually each person integrates at least daily - leading to multiple integrations per day. Each integration is verified by an automated build (including test) to detect integration errors as quickly as possible.*"

http://martinfowler.com/articles/continuousIntegration.html

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Why continuous integration ?

- Maintain a code repository
- Automate the build
- Make the build self-testing
- Everyone commits to the baseline every day
- Every commit (to baseline) should be built
- Keep the build fast

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Why continuous integration ? (cont'd)

- Test in a clone of the production environment
- Make it easy to get the latest deliverables
- Everyone can see the results of the latest build
- Automate deployment

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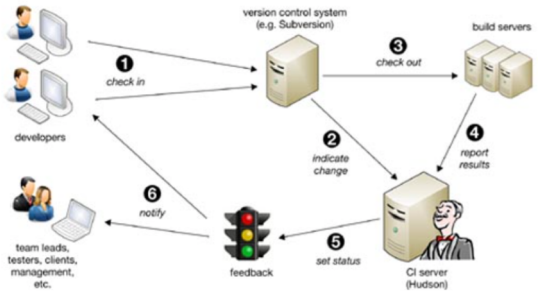
CI Workflow



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Realizing Continuous Integration

- Monitor a VCS repository for changes
  - If changes are found, then start the build
- Build your application
  - through your existing Ant or Maven scripts
- Run your xUnit Test suite
- Run code audit tools
  - Checkstyle, code coverage, …

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Realizing Continuous Integration (cont'd)

- Report on the build results
  - Send formatted email notifications
  - Publish results to a website
- (Optionally) Publish the application
- Configuration is through a central XML file

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The Agile Process

- Continuous Integration is only one aspect of an overall process. For it to work best, you need to
  - Plan iteratively
    - Schedule regular releases with evolving levels of functionality
  - Implement incrementally
    - Identify and implement small work tasks
    - refactor if necessary

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The Agile Process (cont'd)

- Report proactively
  - Identify exactly the contents (CIs) of any build, in both file and content
  - Automate reports!

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CI Benefits

- Reduced Risks
  - Always aware of current status of the project
  - Less time spent investigating integration bugs
    - Integrating testing performed early
    - Integration bugs caught early
  - Less time wasted because of broken code in VCS
    - Broken builds caught early

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CI Benefits (cont'd)

- Prove your system can build!
- Increase code quality with additional tasks

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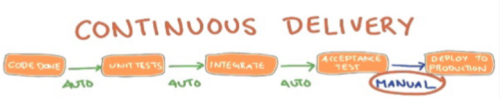
Continuous Delivery

- Continuous Delivery is the ability to get changes of all types—including new features, configuration changes, bug fixes and experiments—into production, or into the hands of users, *safely* and *quickly* in a *sustainable* way.



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Continuous Deployment

- The next step of continuous delivery: Every change that passes the automated tests is deployed to production automatically. Continuous deployment should be the goal of most companies that are not constrained by regulatory or other requirements.

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CI Obstacles [2]

- 1. Individuals may see CI counterproductive
  - Product managers want to launch new features
  - Project managers want the team to meet the deadline
  - Programmers want to fix the bug they are working on
  - It seems that keeping the build is an extra burden on people
  - Solution: team leaders help employees understand the costs and benefits of CI

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- 2. Tough to integrate CI into an existing development flow
  - Solution
    - Give enough time for people to develop their new workflow
    - Ensure them that the company has their backs even if things might not go very smoothly at the beginning

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- 3. Requiring developers of writing more test cases
  - Solution
    - Emphasize that writing test cases from early on could save a lot of time for your team and ensure high test coverage of your product
    - Embed the idea in the company culture that test cases are as valuable assets as the codebase itself.

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- 4. Developers ignoring error messages
  - Developers ignore or mute the overwhelming amount of CI notifications, and may miss the updates that are relevant to them
  - Solution
    - Only send critical updates
    - Only send the notification to developers who are in charge of fixing it

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- 5. Creating Fear-Driven Development
  - Being afraid of breaking the build or not passing tests could build up pressure and fear in individuals.
  - Solution
    - Make team members consider failed test as positive results, the earlier their tests fail the earlier they can resolve problems.

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Reference

[1] Martin Kropp, Continuous Integration, https://web.fhnw.ch/plattformen/swc/Literatur e/10-continuousintegration.pdf. Last visited: 1/18

[2] 5 Challenges That Can Break Your Continuous Integration Efforts, https://medium.com/flow-ci/5-challenges-that-can-break-your-continuous-integration-efforts-94aded600b3d. Last visited: 1/18

[3] Mark Groves, Introducing Git version control into your system, PPT

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