Version 1.4
12/19/19

Important Prerequisites and Setup

- Have a recent version of Git downloaded and running on your system

https://www.git-scm.org/

- If you don't already have one, sign up for a free Github account

https://www.github.com

- Download (and print if desired) labs doc from

https://github.com/brentlaster/safaridocs/blob/master/git-fun-labs.pdf
(Above is automatic download link. Can also go to https://github.com/brentlaster/safaridocs and get git-fun-labs.pdf.

Git Fundamentals

Brent Laster

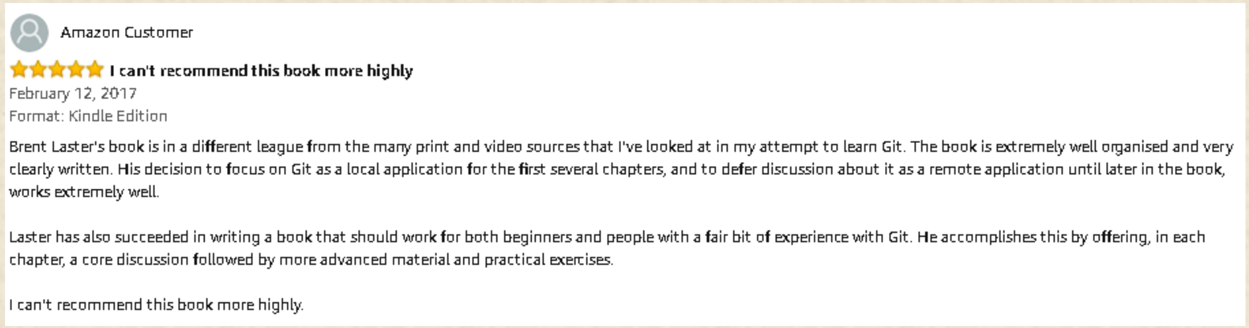
About me

- Director, R&D
- Global trainer – training (Git, Jenkins, Gradle, Gerriit, Continuous Pipelines)
- Author -
  - OpenSource.com
  - Professional Git book
  - Jenkins 2 – Up and Running book
  - Continuous Integration vs. Continuous Delivery vs. Continuous Deployment mini-book on Safari
- https://www.linkedin.com/in/brentlaster
- @BrentCLaster

Book – Professional Git

- Extensive Git reference, explanations, ar examples
- First part for non-technical
- Beginner and advanced reference
- Hands-on labs

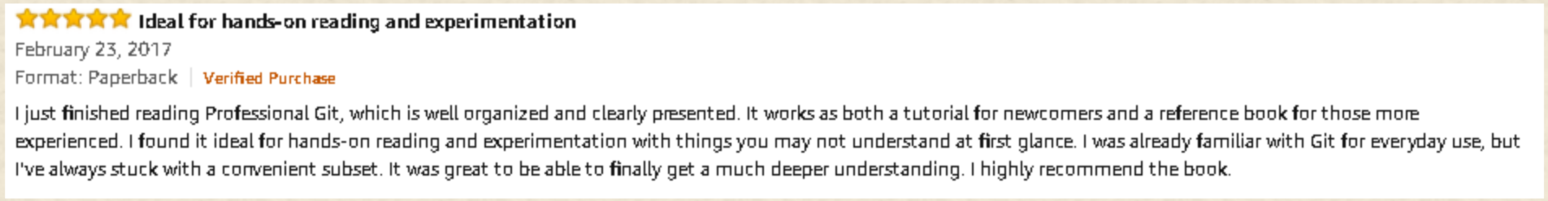
Professional Git 1st Edition
by Brent Laster (Author)
★★★★★ 7 customer reviews
Look inside


Amazon Customer
★★★★★ I can't recommend this book more highly
February 12, 2017
Format: Kindle Edition

Brent Laster's book is in a different league from the many print and video sources that I've looked at in my attempt to learn Git. The book is extremely well organised and very clearly written. His decision to focus on Git as a local application for the first several chapters, and to defer discussion about it as a remote application until later in the book, works extremely well.

Laster has also succeeded in writing a book that should work for both beginners and people with a fair bit of experience with Git. He accomplishes this by offering, in each chapter, a core discussion followed by more advanced material and practical exercises.

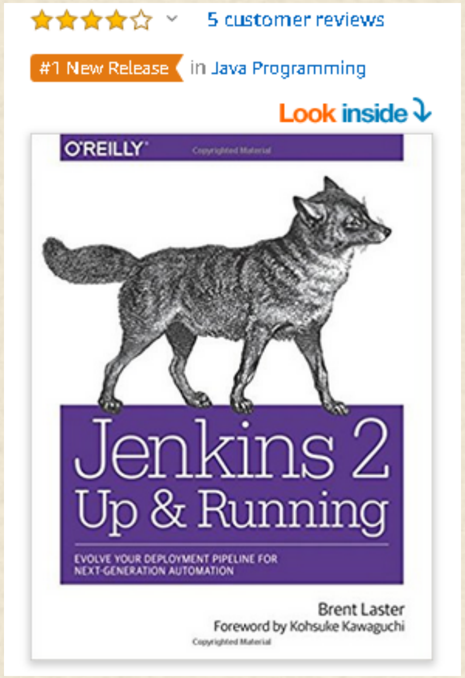
I can't recommend this book more highly.

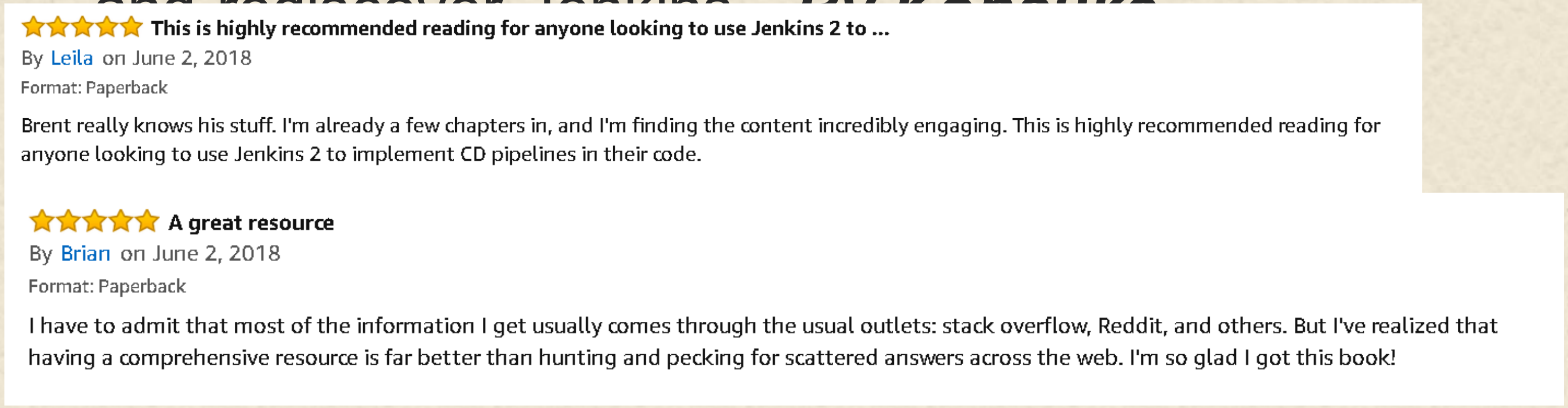

★★★★★ Ideal for hands-on reading and experimentation
February 23, 2017
Format: Paperback | Verified Purchase

I just finished reading Professional Git, which is well organized and clearly presented. It works as both a tutorial for newcomers and a reference book for those more experienced. I found it ideal for hands-on reading and experimentation with things you may not understand at first glance. I was already familiar with Git for everyday use, but I've always stuck with a convenient subset. It was great to be able to finally get a much deeper understanding. I highly recommend the book.

Jenkins 2 Book

- Jenkins 2 – Up and Running
- Deployment pipeline automation as code
- “It’s an ideal book for those who are new to CI/CD, as well as those who have been using Jenkins for many years. This book will help you discover and rediscover Jenkins.” *By Kohsuke*


5 customer reviews
#1 New Release in Java Programming
Look inside
O'REILLY
Jenkins 2
Up & Running
EVOLVE YOUR DEPLOYMENT PIPELINE FOR NEXT-GENERATION AUTOMATION
Brent Laster
Foreword by Kohsuke Kawaguchi


This is highly recommended reading for anyone looking to use Jenkins 2 to ...
By Leila on June 2, 2018
Format: Paperback

Brent really knows his stuff. I'm already a few chapters in, and I'm finding the content incredibly engaging. This is highly recommended reading for anyone looking to use Jenkins 2 to implement CD pipelines in their code.

A great resource
By Brian on June 2, 2018
Format: Paperback

I have to admit that most of the information I get usually comes through the usual outlets: stack overflow, Reddit, and others. But I've realized that having a comprehensive resource is far better than hunting and pecking for scattered answers across the web. I'm so glad I got this book!

What is Git?

- Distributed Version Control System
- Open source
- Available for multiple platforms
- Roots in source control efforts for Linux Kernel
- Primary developer – Linus Torvalds
- Been around since 2005

Git Design Goals

- Speed
- Simple design
- Strong support for branching
- Distributed nature
- Ability to handle large projects efficiently
- Disconnected support

Installation

Debian/Ubuntu

```
$ apt-get install git
```

Fedora (up to 21)

```
$ yum install git
```

Fedora (22 and beyond)

```
$ dnf install git
```

FreeBSD

```
$ cd /usr/ports/devel/git
$ make install
```

Gentoo

```
$ emerge --ask --verbose dev-vcs/git
```

OpenBSD

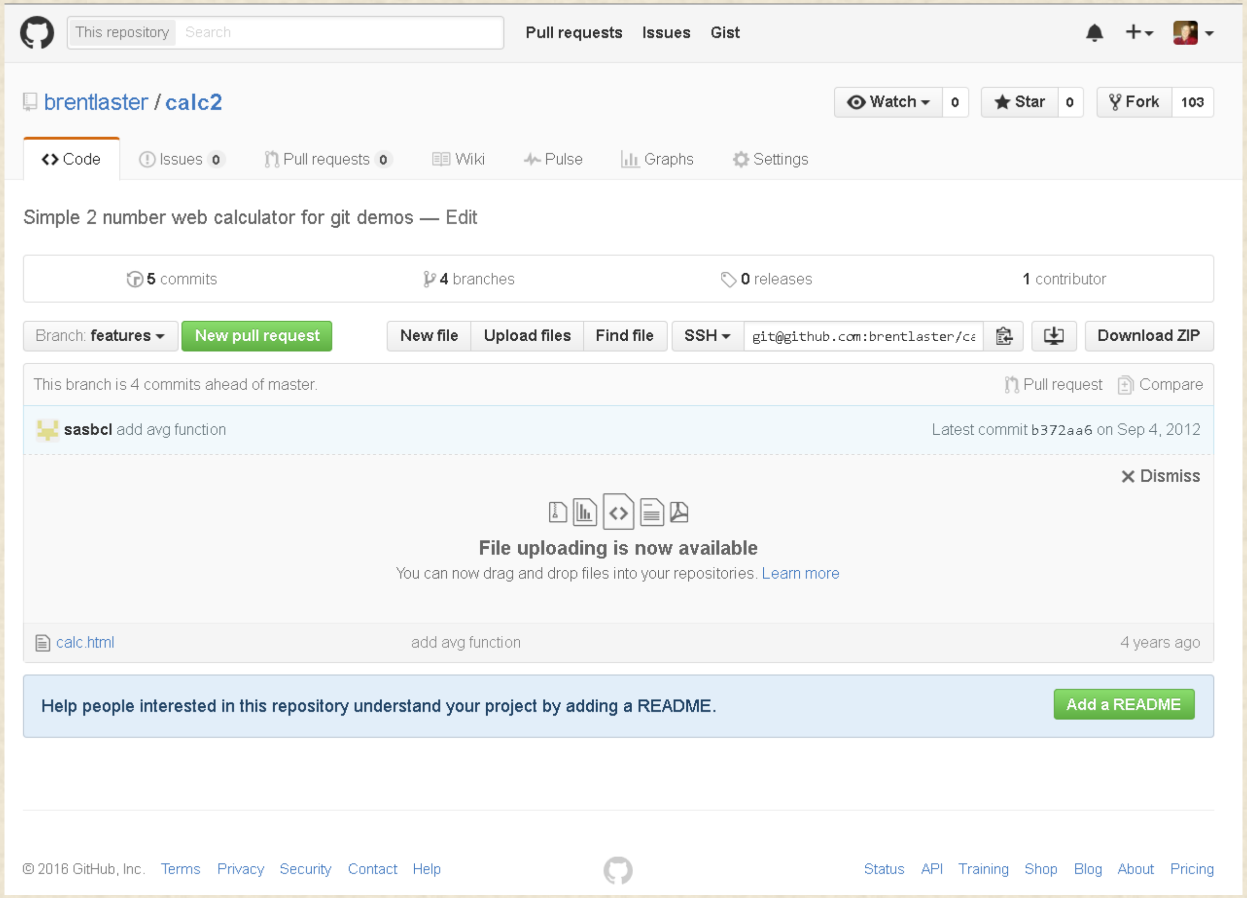
```
$ pkg_add git
```

Solaris 11 Express

```
$ pkg install developer/versioning/git
```

Ecosystem: Public hosting

- Github, Bitbucket, etc.



This repository | Search | Pull requests | Issues | Gist

brentlaster / calc2

Watch 0 | Star 0 | Fork 103

Code | Issues 0 | Pull requests 0 | Wiki | Pulse | Graphs | Settings

Simple 2 number web calculator for git demos — Edit

5 commits | 4 branches | 0 releases | 1 contributor

Branch: features | New pull request | New file | Upload files | Find file | SSH | git@github.com:brentlaster/ca | Download ZIP

This branch is 4 commits ahead of master. | Pull request | Compare

sasbcl add avg function | Latest commit b372aa6 on Sep 4, 2012

Dismiss

File uploading is now available

You can now drag and drop files into your repositories. Learn more

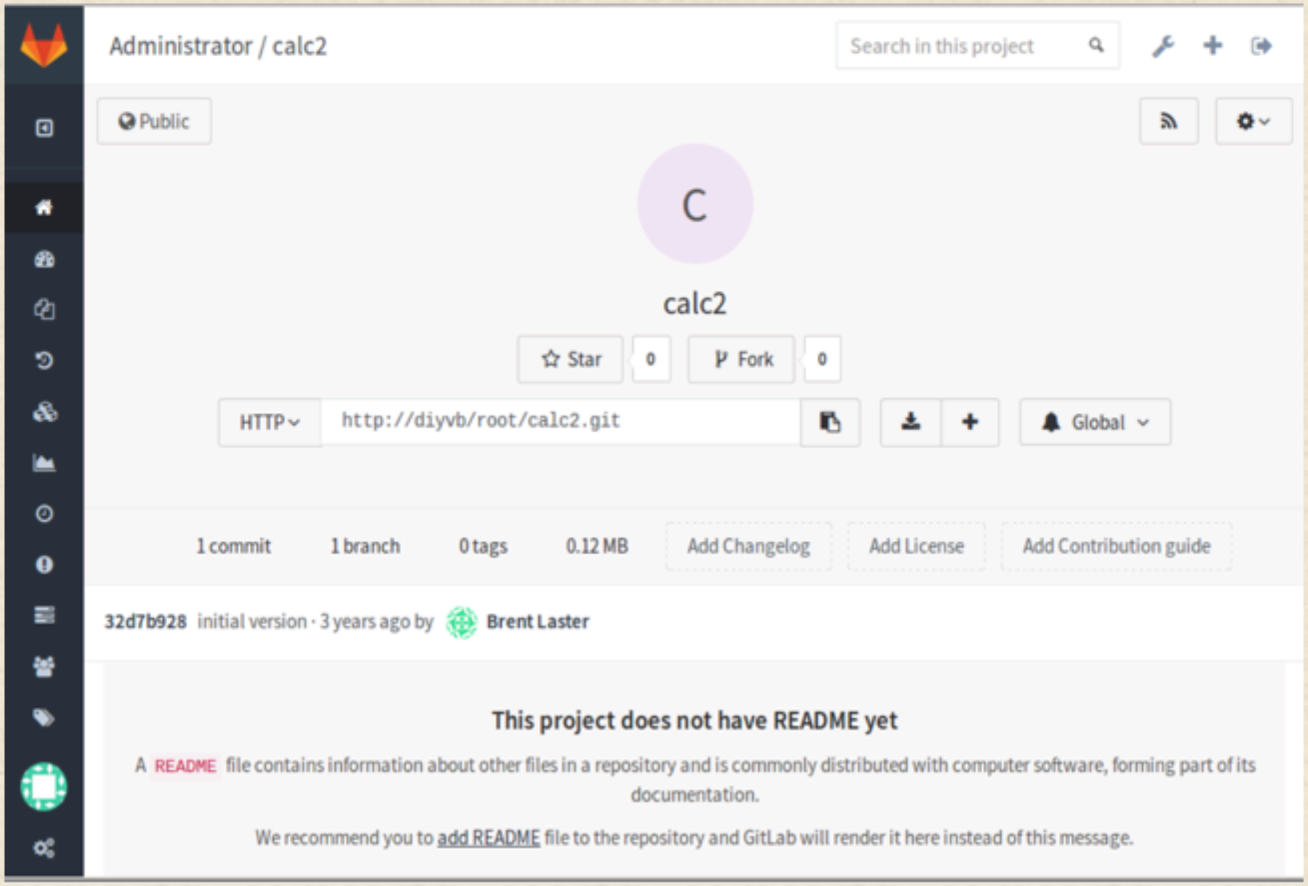
calc.html | add avg function | 4 years ago

Help people interested in this repository understand your project by adding a README. | Add a README

© 2016 GitHub, Inc. Terms Privacy Security Contact Help | Status API Training Shop Blog About Pricing

Ecosystem: Self-hosting

- GitLab, Enterprise GitHub



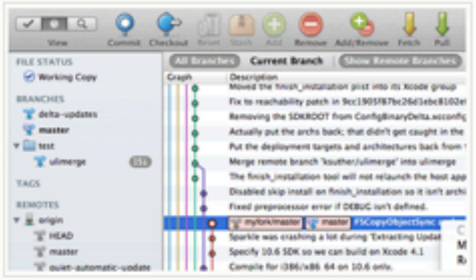
32d7b928 initial version · 3 years ago by Brent Laster

This project does not have README yet

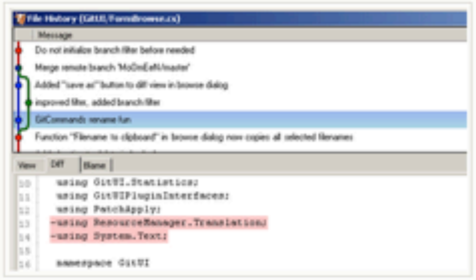
A README file contains information about other files in a repository and is commonly distributed with computer software, forming part of its documentation.

We recommend you to add README file to the repository and GitLab will render it here instead of this message.

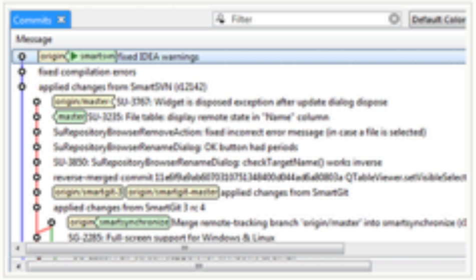
Ecosystem: Ease-of-use Packages



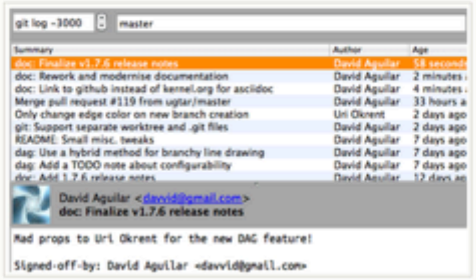
SourceTree
Platforms: Mac, Windows
Price: Free



Git Extensions
Platforms: Windows
Price: Free

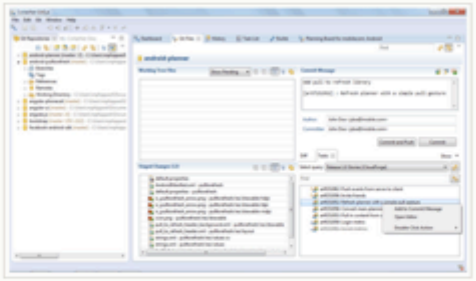


SmartGit
Platforms: Windows, Mac, Linux
Price: $79/user / Free for non-commercial use



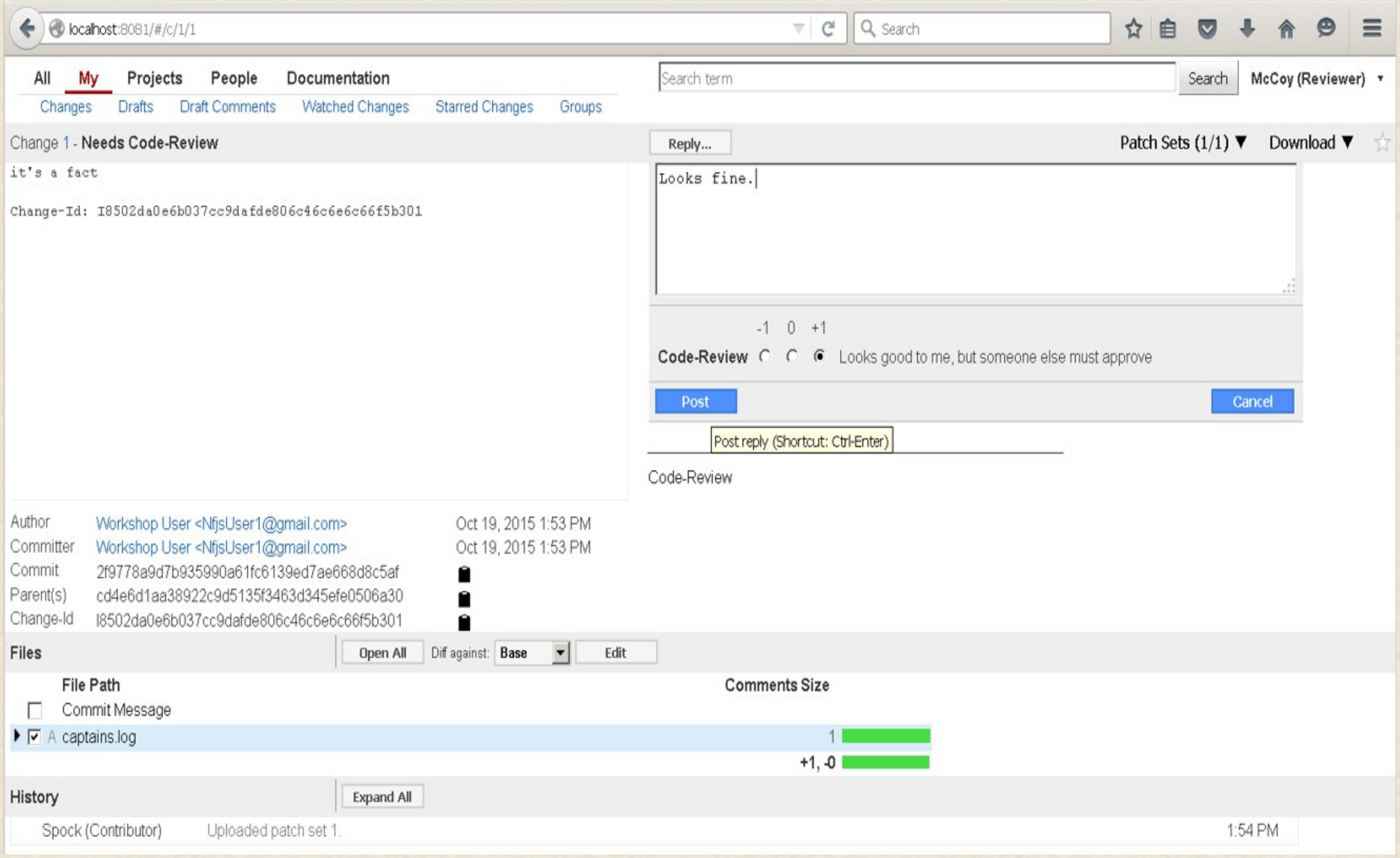
git-cola
Platforms: Windows, Mac, Linux
Price: Free

GitUp
Platforms: Mac



GitEye
Platforms: Windows, Mac, Linux

Ecosystem: Tools that Incorporate Git



Change 1 - Needs Code-Review

```
it's a fact

Change-Id: I8502da0e6b037cc9dafde806c46c6e6c66f5b301
```

```
Looks fine.
```

	-1	0	+1	
Code-Review	○	○	●	Looks good to me, but someone else must approve

Code-Review

Author	Workshop User <NfjsUser1@gmail.com>	Oct 19, 2015 1:53 PM
Committer	Workshop User <NfjsUser1@gmail.com>	Oct 19, 2015 1:53 PM
Commit	2f9778a9d7b935990a61fc6139ed7ae668d8c5af	
Parent(s)	cd4e6d1aa38922c9d5135f3463d345efe0506a30	
Change-Id	I8502da0e6b037cc9dafde806c46c6e6c66f5b301	

Files

	File Path	Comments	Size
☐	Commit Message		
☑ A	captains.log		1 🟩
			+1, -0 🟩

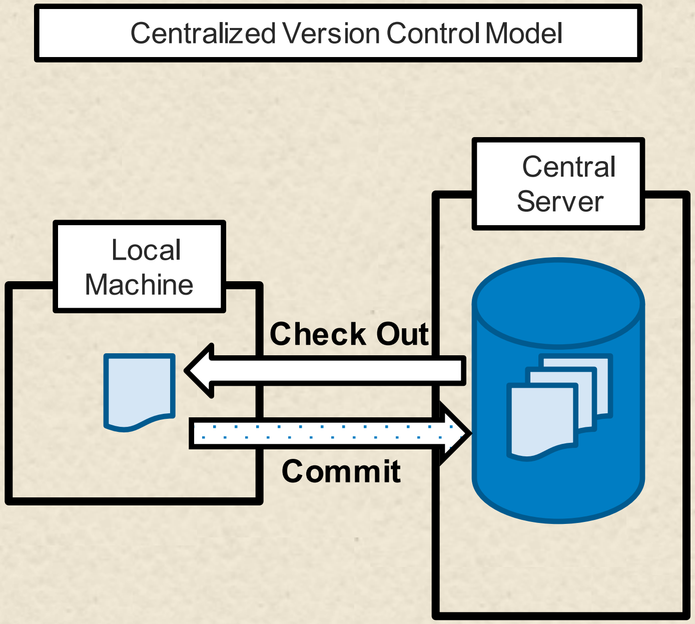
History

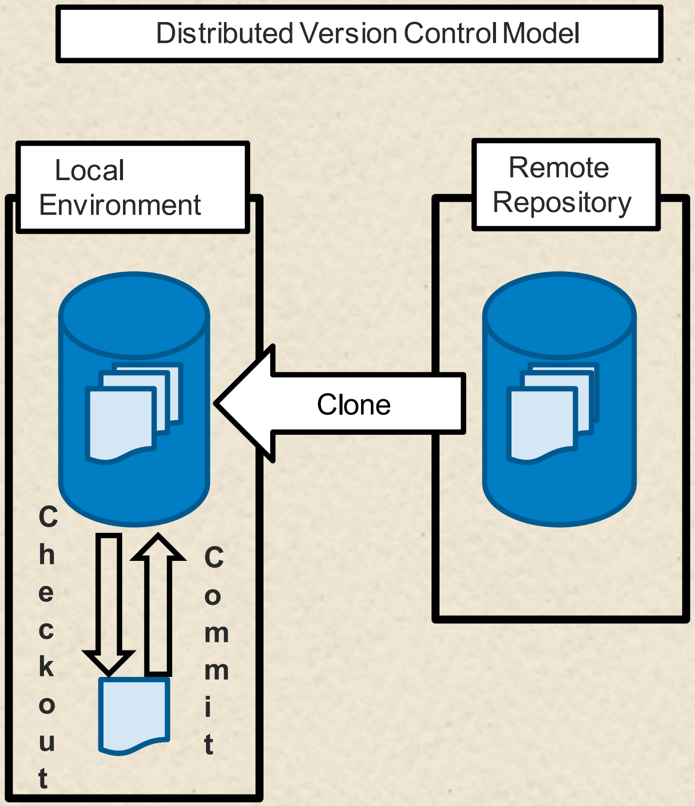
Spock (Contributor)	Uploaded patch set 1.	1:54 PM

Git Interfaces

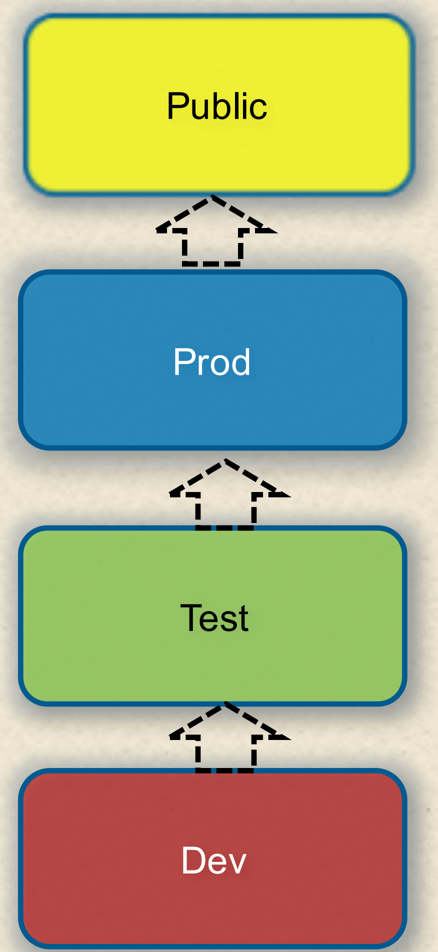
- Many different interfaces exist for working with Git
- Many GUI interfaces
- Command line interface
- Products that script the command line
- Other products such as Gerrit that wrap around Git
- We teach the command line interface because
  - GUI interfaces can all be different - there is not a standard
  - GUI interfaces may change or go away
  - If a GUI interface does not provide some piece of Git functionality, the functionality can be done with the command line
  - If you understand the command line, you can usually find which command in a GUI is used to do the operation

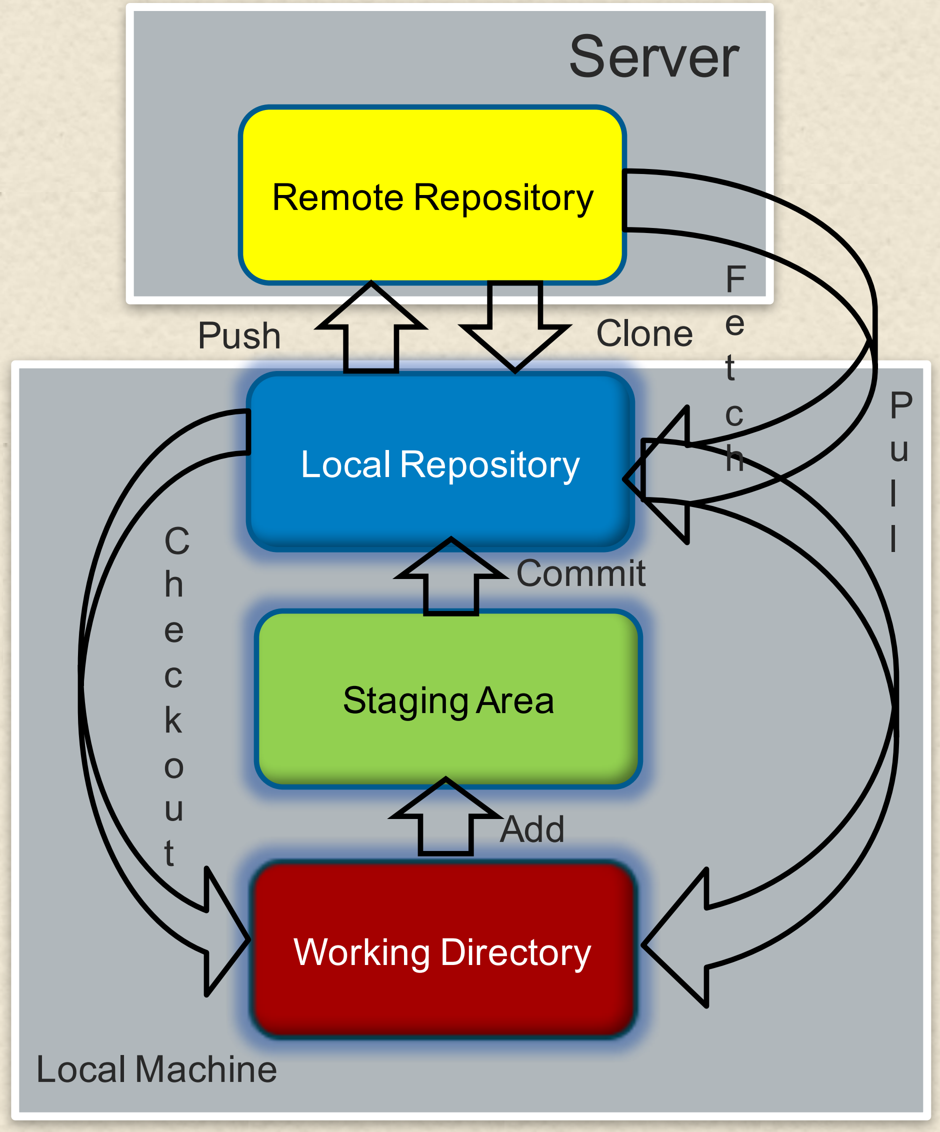
Centralized vs. Distributed VCS





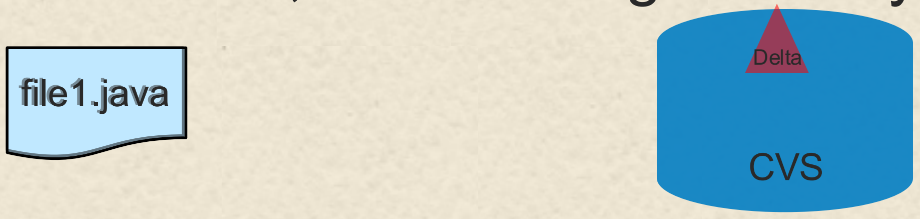
Git in One Picture



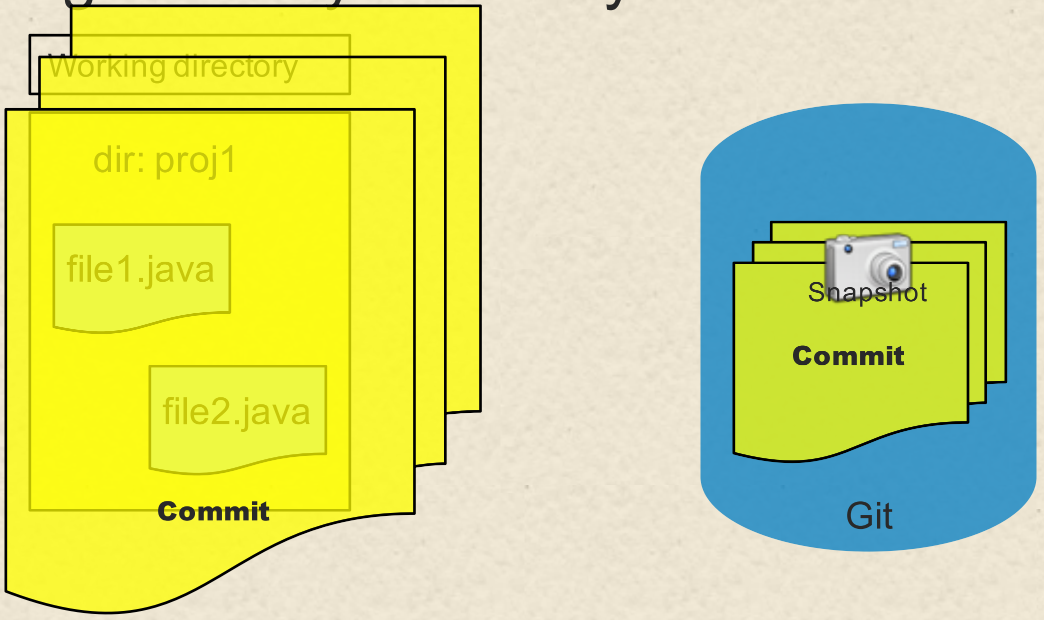


Git Granularity (What is a unit?)

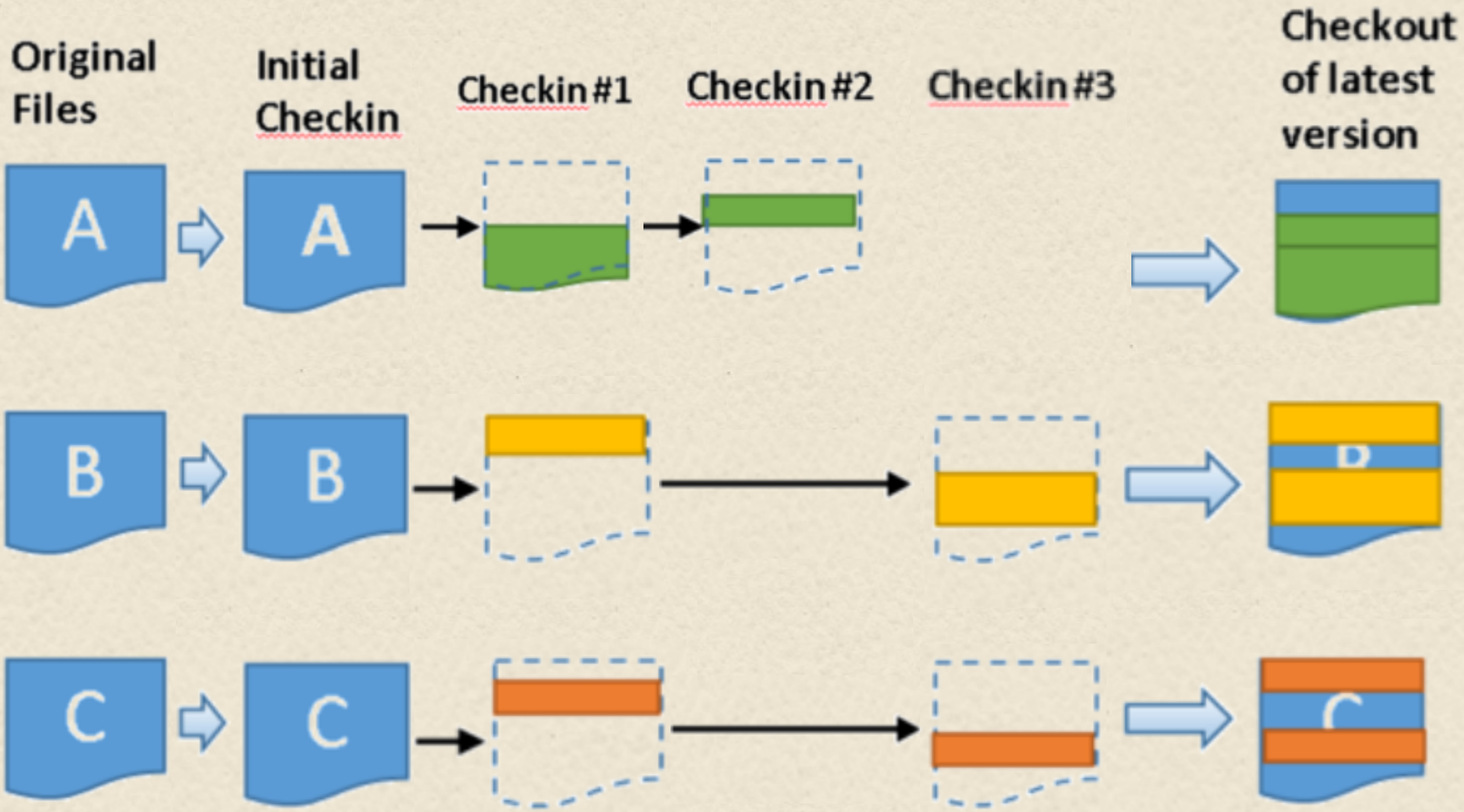
- In traditional source control, the unit of granularity is usually a file



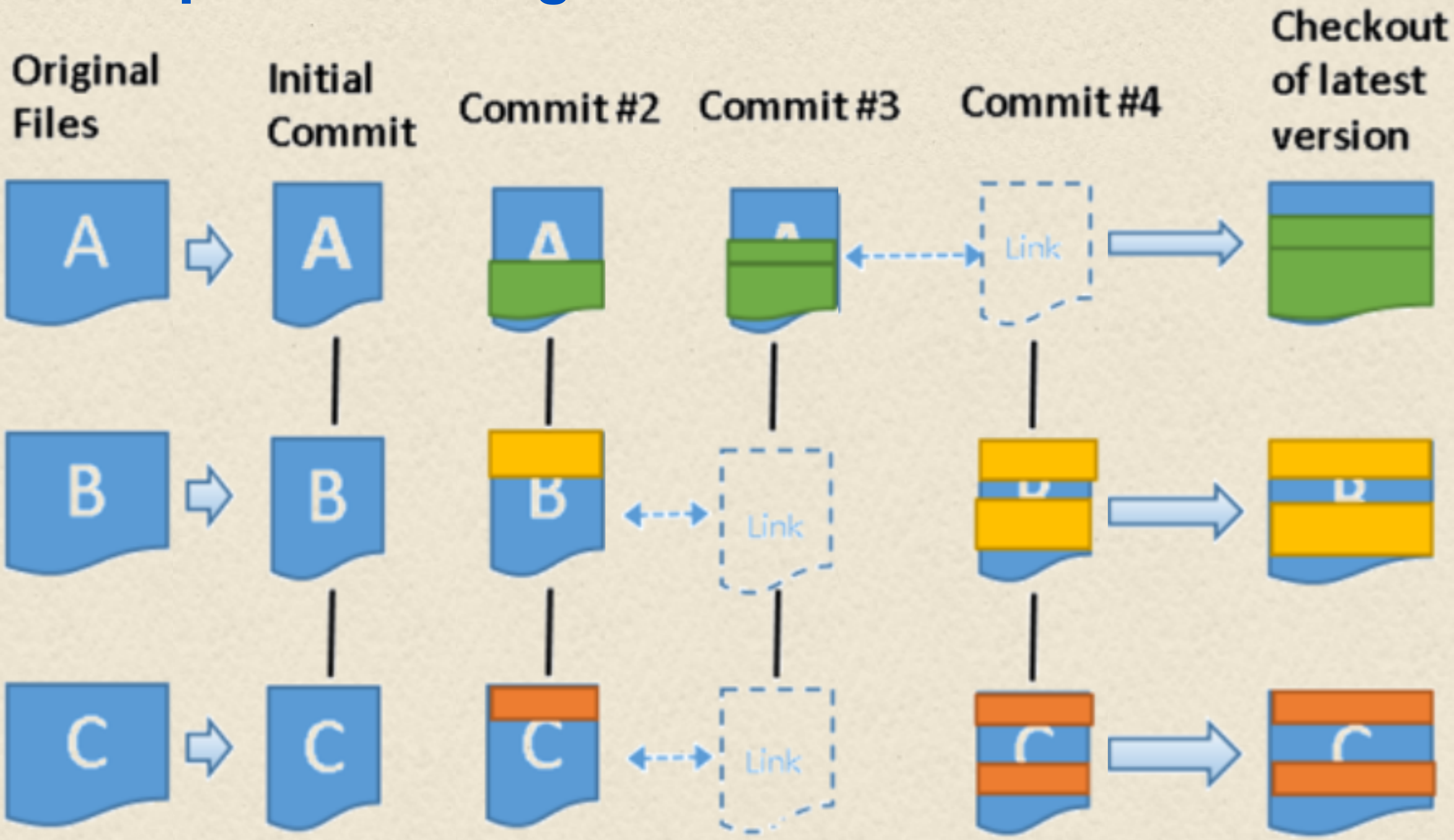
- In Git, the unit of granularity is usually a tree



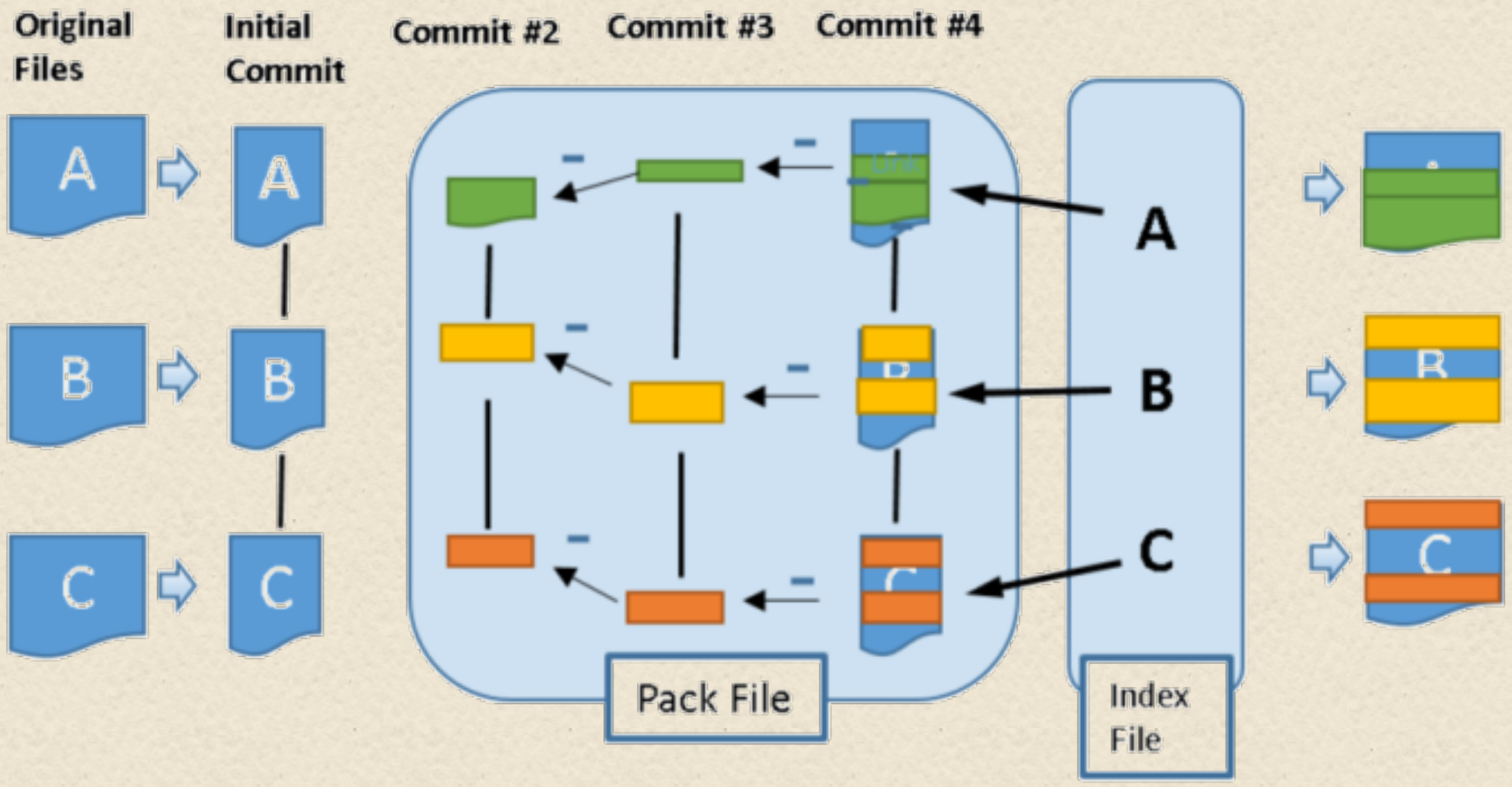
Delta Storage Model



Snapshot Storage Model



Compressing Files



Staging Area: Why?

Prepare

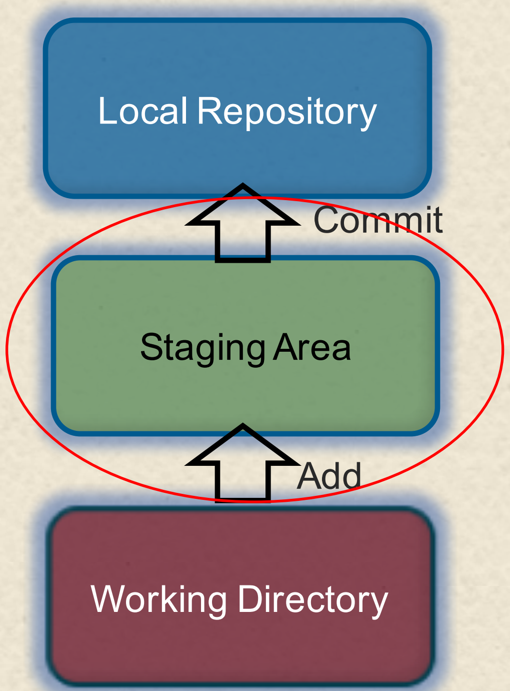
- ***Stores info about what will go into next commit***
- ***Allows you to control what part of the working tree go into the next commit***
- ***Allows you to queue up individual changes***
  - ***Bundle a collection of specific changes to go into a commit***
  - ***Get them out of your working directory (i.e. "check them off")***
- ***Helps you split up one large change into multiple commits***

Repair

- ***Allows you to "amend" last commit – redo***

Merging with conflicts

- ***When merge happens, changes that merge cleanly are updated both in working directory and in staging area***
- ***Changes that did not merge cleanly are left in your working directory***
- ***Diff between working directory and staging area shows differences***



Example Workflow and Terms

1. Modify files in working directory
2. Stage files, adding snapshot to staging area
3. Commit – promotes files from the staging area into permanent snapshot in the local repo (stored in .git directory)

Initializing a Repo and Adding Files (commands)

- git init
  - For creating a repository in a directory with existing files
  - Creates repository skeleton in .git directory
- git add
  - Tells git to start tracking files
  - Patterns: git add *.c or git add . (. = files and dirs recursively)
- git commit
  - Promotes files into the local repository
  - Uses –m to supply a comment
  - Commits everything unless told otherwise

SHA1

```
$ git commit -m "initial add of file1.c"
[master b41b186] initial add of file1.c
 1 file changed, 3 insertions(+)
 create mode 100644 file1.c
```

- Everything in Git is check-summed before it is stored and is then referred to by that checksum. Built into Git low-level functions.
- That means it's not possible to change the contents of any file or directory without Git knowing about it. i.e. avoids file corruption or tampering.
- Mechanism that Git uses for this checksum is called a SHA-1 hash.
- 40-character string of hex characters.
- Calculated based on contents of a file or directory struture.
- Example: b41b186552252987aa493b52f8696cd6d3b00373
- Used throughout Git.
- Git stores/points to everything by hash value of the contents in its database.

Remember: You can always get a handle to a snapshot via a SHA1.

Committing Changes

- Commits to local repo only - not remote
- Records a snapshot of your local working area that you can switch back to or compare to later
- Requires commit message
  - Pass by –m "<message>"
  - If no –m, brings up configured editor so you can type it
- Commit output

  - which branch you committed to

  - what SHA-1 checksum the commit has

  - how many files were changed

  - statistics about lines added and removed in the commit.

Git Workflow

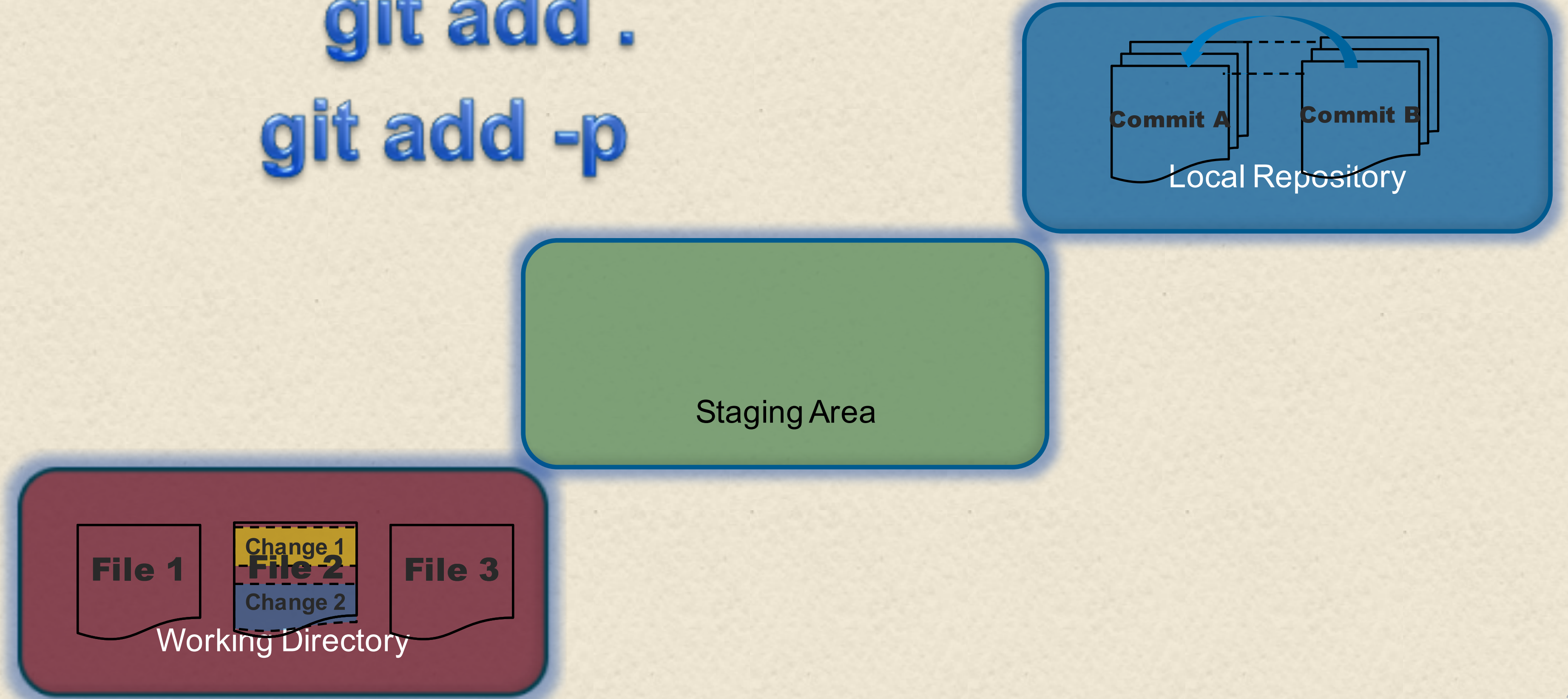
Staging Area Use: Prepare…

git add file 1

git commit -m “<comment>”

git add .

git add -p



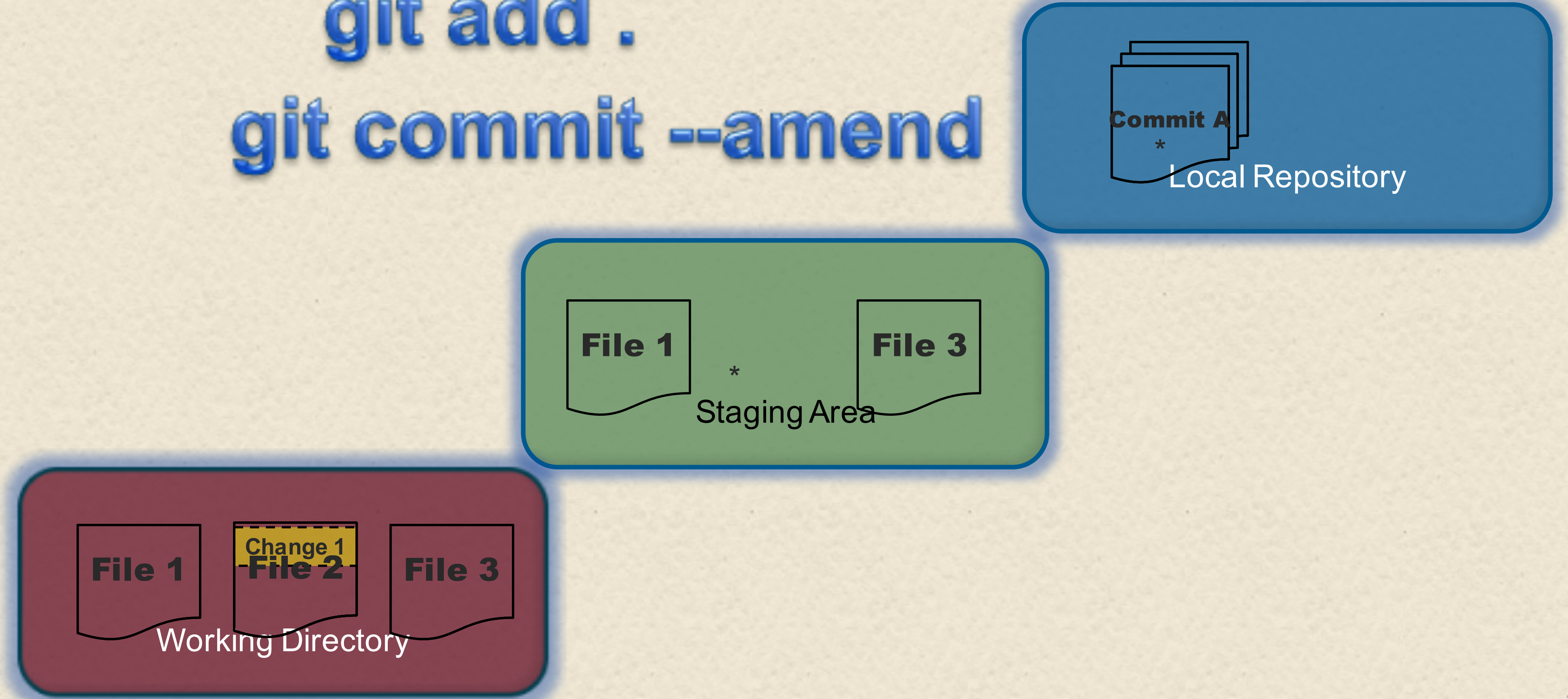
Undoing/Updating Things

- git commit --amend
  - Allows you to “fix” last commit
  - Updates last commit using staging area
  - With nothing new in staging area, just updates comment (commit message)
  - Example:
    - » git commit –m “my first update”
    - » git add newfile.txt (add command stages it into staging area)
    - » git commit --amend
    - » This updated commit takes the place of the first (updates instead of adding another in the chain)

Git Workflow

Staging Area Use:Repair…

```
git add .
git commit --amend
```



Initial User Configuration

- Command: git config
- Main things to set
  - User name

    ```
    $ git config --global user.name "John Doe"
    ```
  - Email address

    ```
    $ git config --global user.email johndoe@example.com
    ```

- Notes
  - Use --global to persist options for all repos of this user
  - Check config value with
    - $ git config --list (or git config –l)
    - $ git config <property> as in git config user.name
  - Can also set many other things – like diff tool and end-of-line settings

Configuring your default editor in Git

- Editor defaults (generally)
  - Windows : notepad, Linux : vim
- Can set via OS (for example export EDITOR variable)
- Setting for Git only
  - Set core.editor in your config file: **git config --global core.editor "vim"**
  - Set the GIT_EDITOR environment variable: **export GIT_EDITOR=vim**
- Examples
  - git config core.editor vim (Linux)
  - git config --global core.editor "nano" (mac)
  - git config --global core.editor "'c:\program files\windows nt\accessories\wordpad.exe'"(windows)
  - git config --global core.editor "'C:/Program Files (x86)/Notepad++/notepad++.exe'"
  - (Git bash shell for Windows)

Labs Logistics

Work through the steps – some questions for thought included

Creating Files

In the workshop, we're not concerned about contents of files.

We just need some files to play with.

Lazy way to create a file – in a terminal:

```
$ echo stuff > file1.c
```

(even lazier way `$ date > file1.c`)

Lazy way to append to a file – in a terminal:

```
$ echo “more stuff” >> file1.c
```

Can use editor if you prefer…

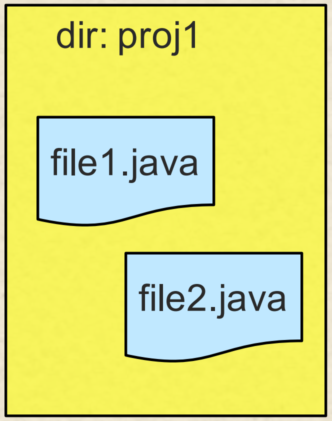
Git Fundamentals : Lab 1

Creating and Exploring a Git Repository and Managing Content

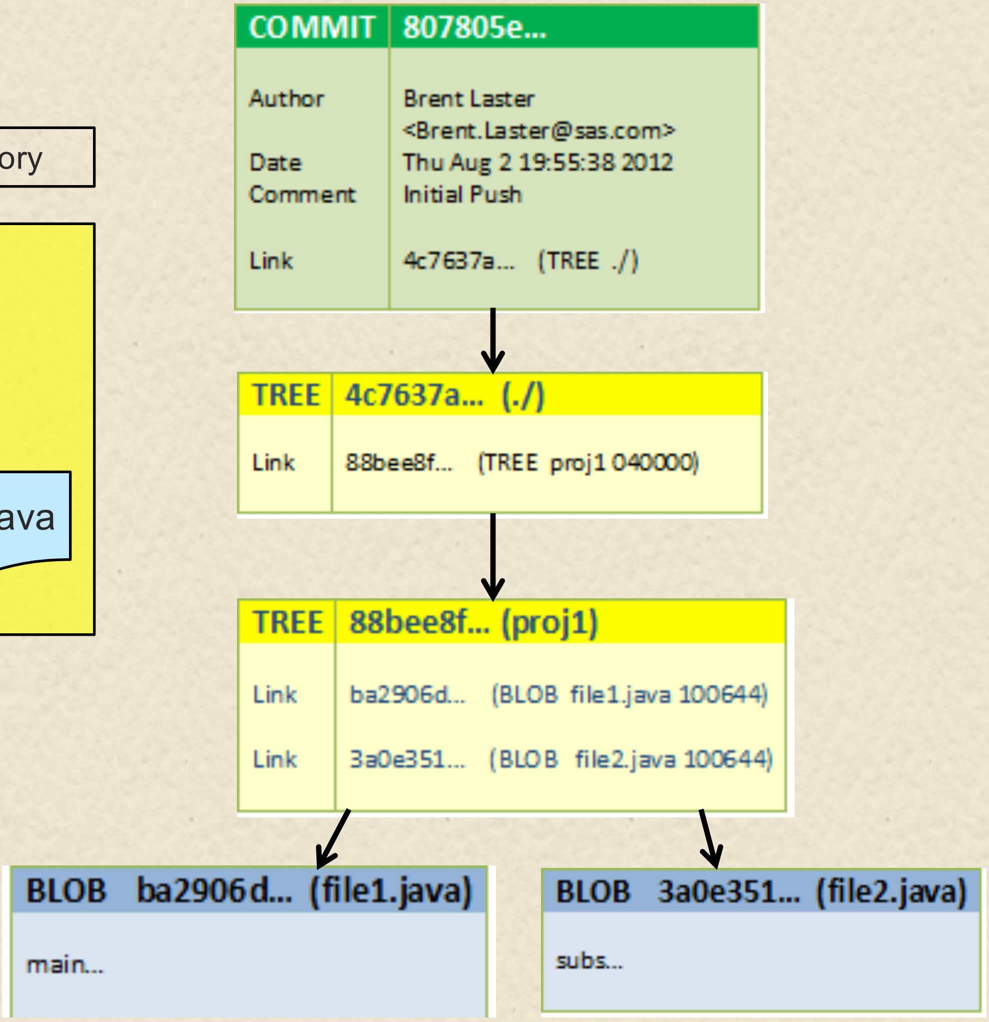
Purpose: In this lab, we'll create an empty Git repository on your local disk and stage and commit content into it.

Git and File/Directory Layouts

Working directory



Git snapshot



COMMIT	807805e...
Author	Brent Laster <Brent.Laster@sas.com>
Date	Thu Aug 2 19:55:38 2012
Comment	Initial Push
Link	4c7637a... (TREE ./)

TREE	4c7637a... (./)
Link	88bee8f... (TREE proj1 040000)

TREE	88bee8f... (proj1)
Link	ba2906d... (BLOB file1.java 100644)
Link	3a0e351... (BLOB file2.java 100644)

BLOB	ba2906d... (file1.java)
main...	

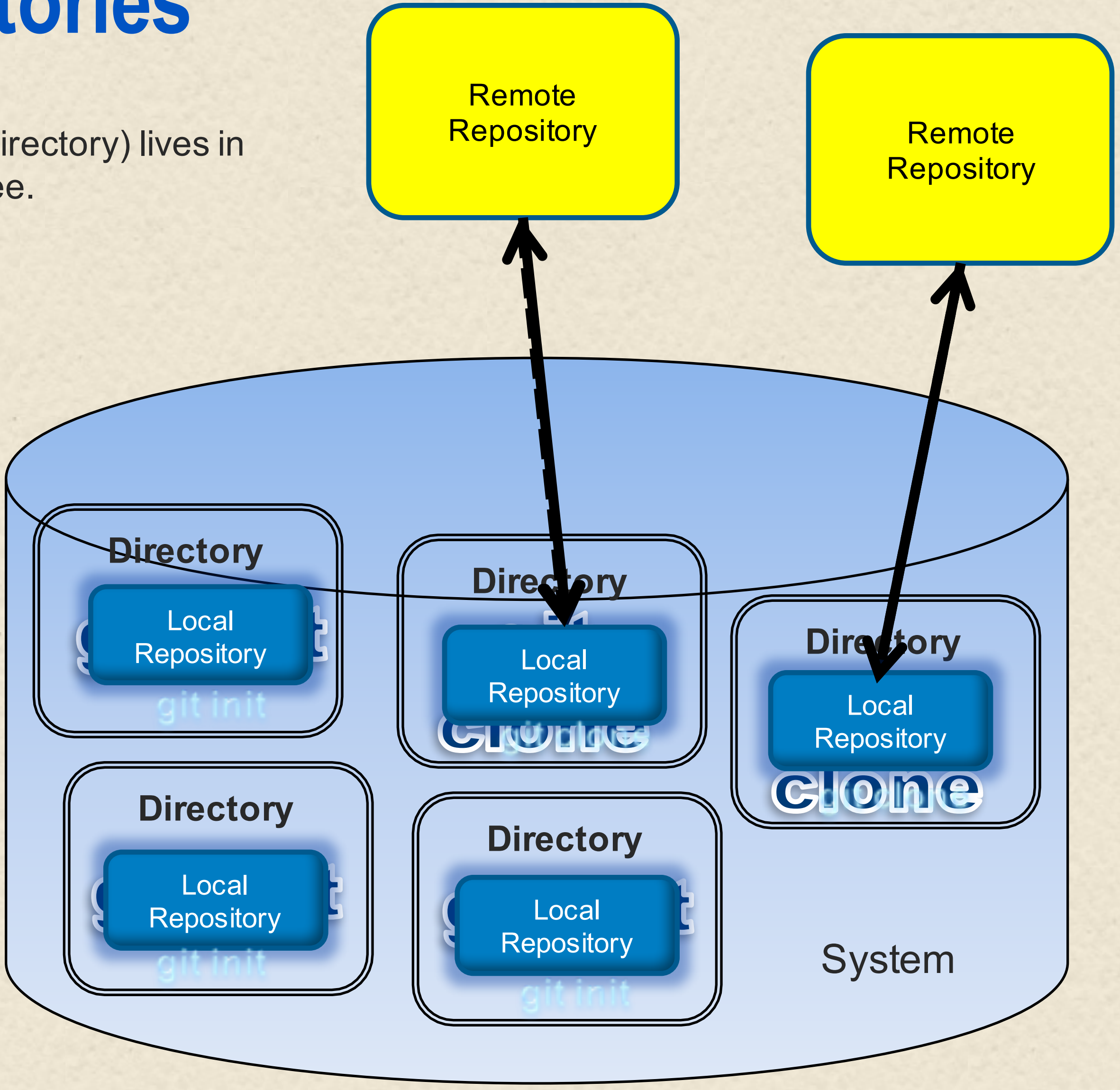
BLOB	3a0e351... (file2.java)
subs...	

Local Repository File Layout

```
$ tree.sh -* .git
COMMIT_EDITMSG
HEAD
config
description
hooks
        applypatch-msg.sample
        commit-msg.sample
        post-commit.sample
        post-receive.sample
        post-update.sample
        pre-applypatch.sample
        pre-commit.sample
        pre-rebase.sample
        prepare-commit-msg.sample
        update.sample
index
info
        exclude
logs
        HEAD
        refs
                heads
                        master
objects
        3a
                0e351dc84e32abec5d4dd223c5abdabd57b7f5
        4c
                7637a4b66aefc1ee877eaa1afc70610f0ee7cc
        80
                7805ea7ae9fdf1b06e876af6e9a69a349b52a3
        88
                bee8f0c181784d605eabe35fb04a5a443ae6b7
        ba
                2906d0666cf726c7eaadd2cd3db615dedfdf3a
        info
                *
        pack
                *
refs
        heads
                master
        tags
                *
```

Starting Work with Git – Multiple Repositories

The repository (.git directory) lives in the local directory tree.



Autocomplete

- Enabled in BASH shell
- Can be enabled in other environments via file in git source
- Git <start of command><tab> (may have to hit it twice if multiple options)
- Git command --<start of option><tab>
- Examples:
  - **git co <tab><tab>**
  - **git com <tab>**
  - **git list --s<tab> (note double –'s)**

Getting Help

- git <command> -h

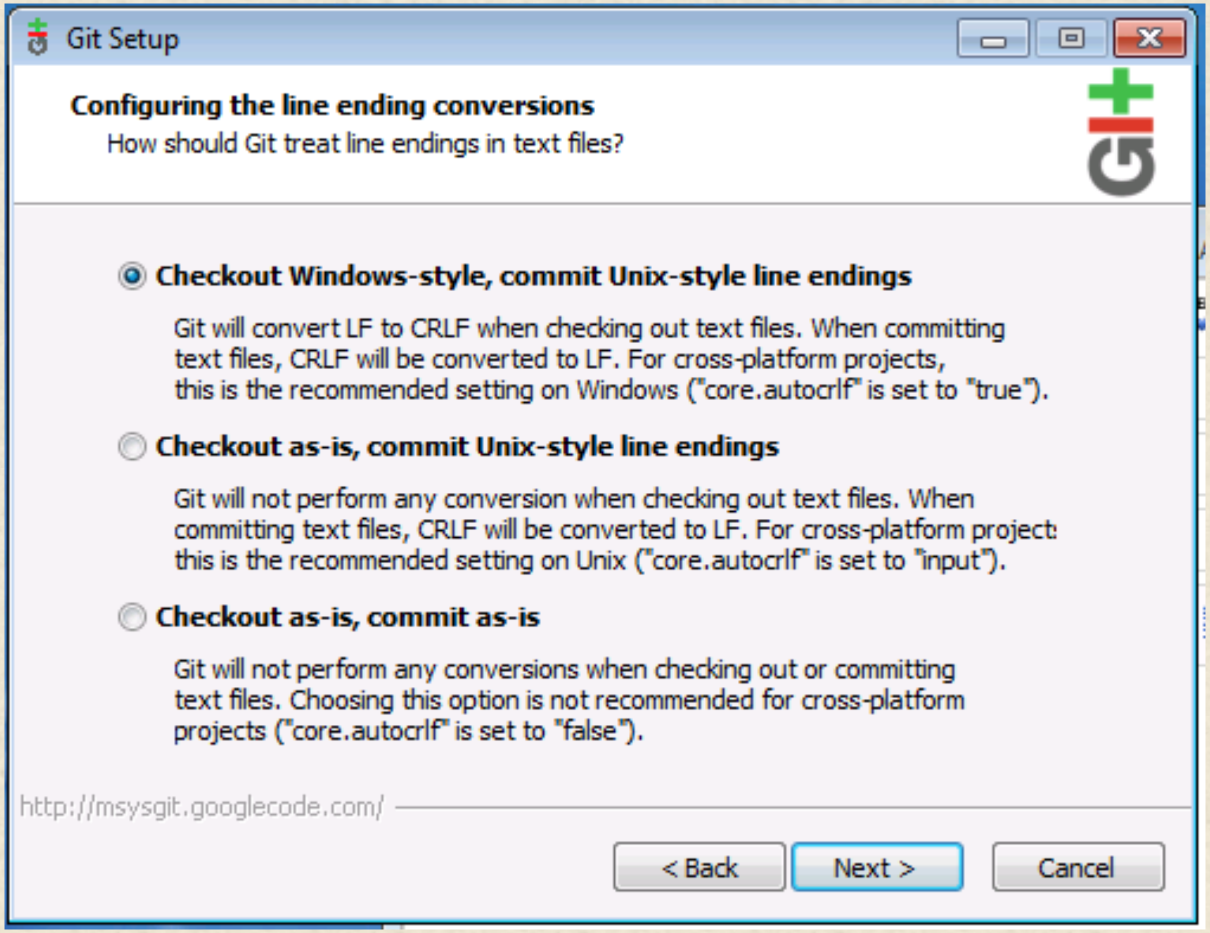
  Brings up on screen list of options

- git <command> --help
- git help <command>

  Brings up html man page

Line Endings

- git config core.autocrlf



Configuring the line ending conversions

How should Git treat line endings in text files?

[✓ **Checkout Windows-style, commit Unix-style line endings**]

Git will convert LF to CRLF when checking out text files. When committing text files, CRLF will be converted to LF. For cross-platform projects, this is the recommended setting on Windows ("core.autocrlf" is set to "true").

Checkout as-is, commit Unix-style line endings

Git will not perform any conversion when checking out text files. When committing text files, CRLF will be converted to LF. For cross-platform project: this is the recommended setting on Unix ("core.autocrlf" is set to "input").

Checkout as-is, commit as-is

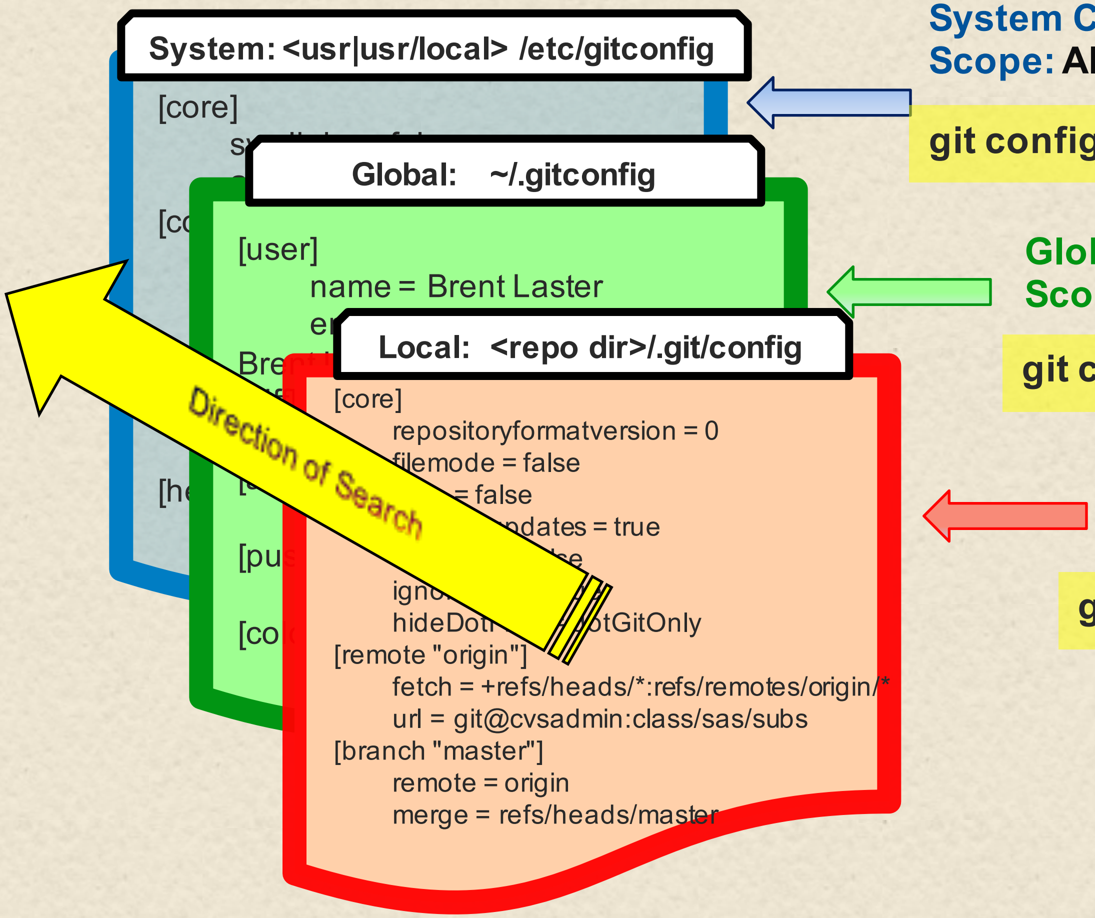
Git will not perform any conversions when checking out or committing text files. Choosing this option is not recommended for cross-platform projects ("core.autocrlf" is set to "false").

http://msysgit.googlecode.com/

Git Config file

- Scope
  - Local (repo)
    - » .git/config
  - Global (user)
    - » ~/.gitconfig
  - System (all users on a system)
    - » <usr|usr/local> /etc/gitconfig
- Divided into sections
- Can have user settings, aliases, etc.
- Text file that can be edited, but safer to use git config

Understanding Git Configuration Files Scope


System: <usr|usr/local> /etc/gitconfig
[core]
[co
[he
Global: ~/.gitconfig
[user]
name = Brent Laster
Bre
[pu
[co
Local: <repo dir>/.git/config
[core]
repositoryformatversion = 0
filemode = false
= false
dates = true
ign
hideDot
otGitOnly
[remote "origin"]
fetch = +refs/heads/*:refs/remotes/origin/*
url = git@cvsadmin:class/sas/subs
[branch "master"]
remote = origin
merge = refs/heads/master
Direction of Search

System Configuration File (if exists)
Scope: All users on system

git config --system

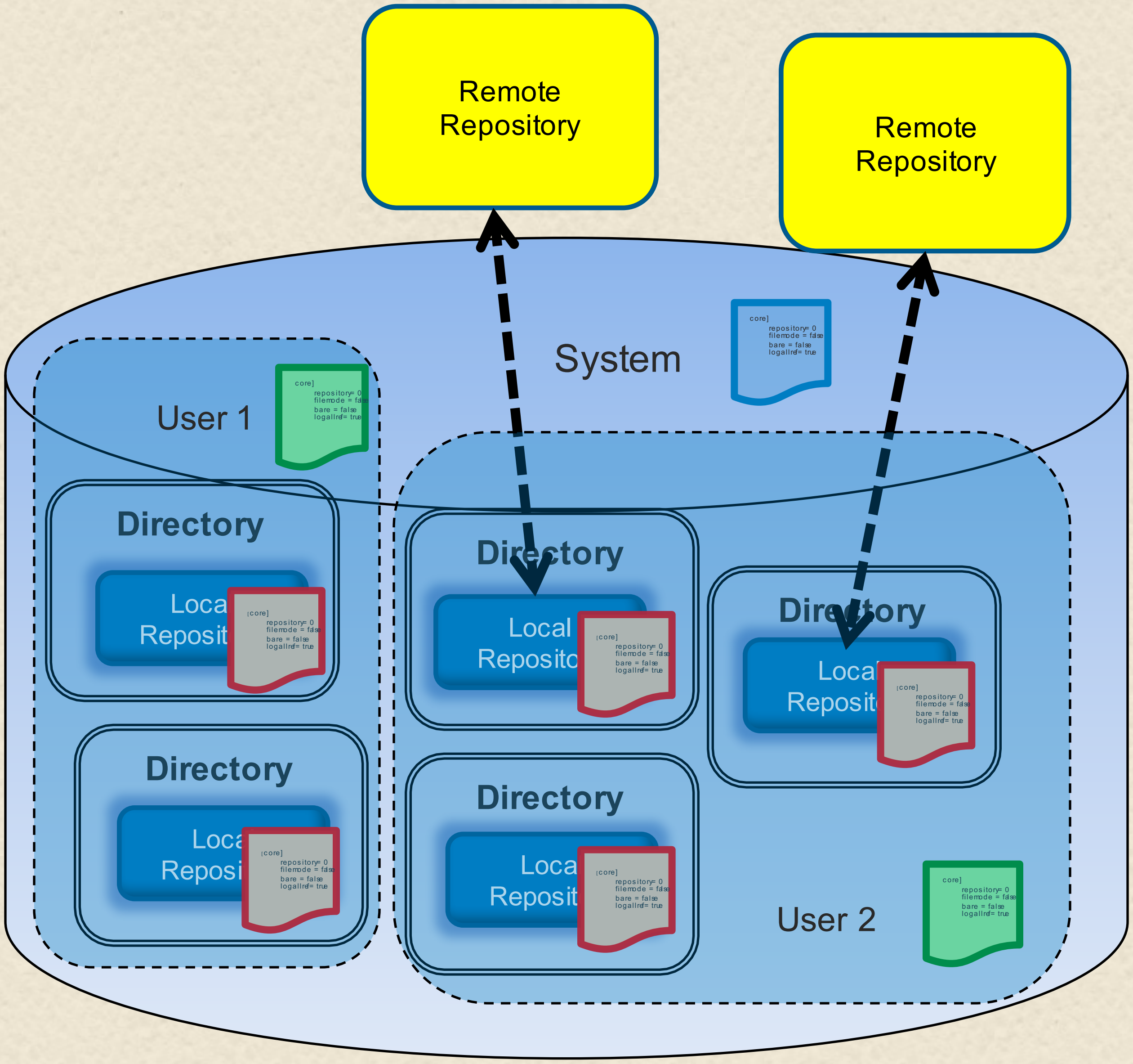
Global Configuration File
Scope: Current User

git config --global

Local Configuration File
Scope: Local repository

git config or git config --local

Git Configuration Layout – Multiple Configs



Terminology: File States in Working Directory

Files in your working directory can be in one of two main states:

- **Tracked**
  - Were in the last snapshot (last commit)
  - Can be
    - Unmodified - same as what's in Git
    - Modified - different from what's in Git
    - Staged

    - OR -
- **Untracked**
  - Everything else
  - Not in last snapshot
  - Not in staging area

3 questions to think about for determining status

- Is Git aware of the file (is it in Git)? tracked or untracked
- What is in the staging area?
- What is the relationship of the latest version in Git to the version in the working directory?

File Status Lifecycle

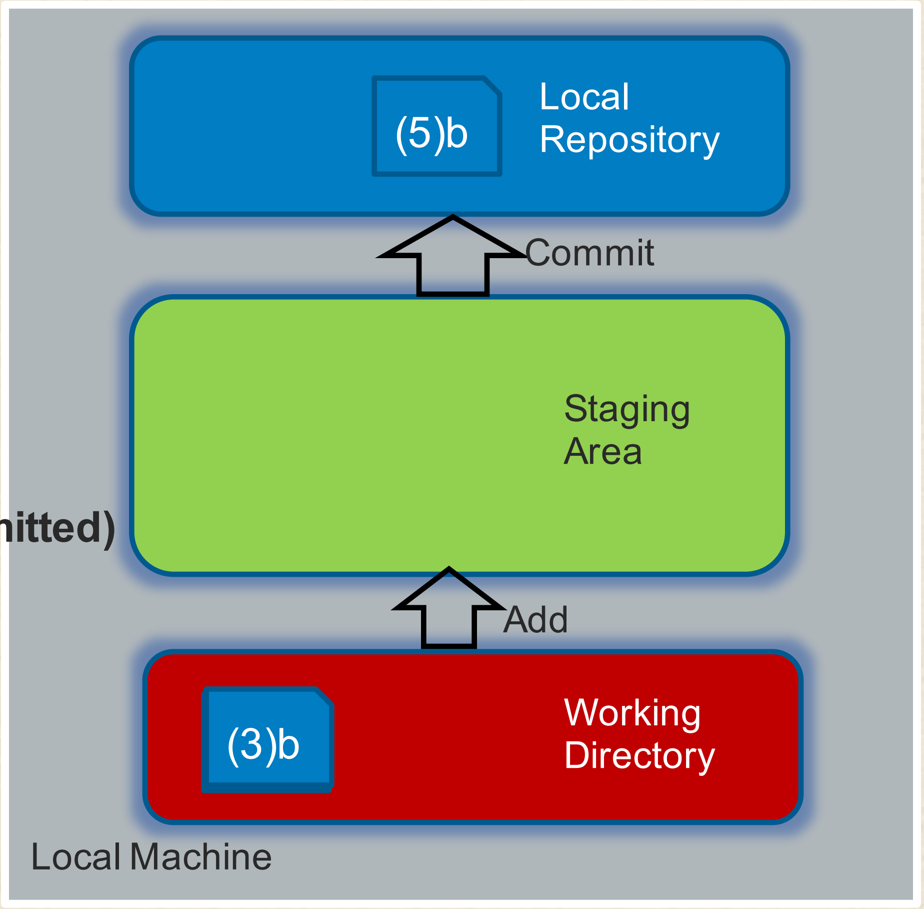
1. Files start out in wd (rev a)
Git aware? No – **untracked** files
Anything staged? No = Changes **not staged** for commit
Git compared to WD: N/A

2. (Git) Add file.
Git aware: Yes – **tracked**
Anything staged? Rev a staged = Changes **to be committed**
Git compared to WD: Same - **unmodified**

3. Edit in working directory (rev b)
Git aware: Yes – **tracked**
Anything staged? Rev a **staged (to be committed)**
Git compared to WD : Different – **modified**

4. (Git) Add file. **Tracked**, rev b **staged** (rev a overwritten), **unmodified**

5. (Git) Commit. **Tracked**, Staged: Nothing, **unmodified**
"nothing to commit (working directory clean)"



* "Changes to be committed" = staged
* "Changes not staged for commit" = wd

Git Status

- Command: git status
  - Primary tool for showing which files are in which state
  - -s is short option - output <1 or more characters><filename>
    - » *??* = untracked
    - » *M* = modified
    - » *A* = added
    - » *D* = deleted
    - » *R* = renamed
    - » *C* = copied
    - » *U* = updated but unmerged
  - -b option – always show branch and tracking info
- Common usage: git status -sb

Updating a file that Git knows about

- How do we update a file that git knows about?
  - **Stage it (git add .)**
  - **Commit it (git commit)**
  - **Shortcut syntax : git commit –am "<comment>"**
    - » **Doesn't add new files (untracked ones)**

Git Special References: Head and Index

- Head
  - Snapshot of your last commit
  - Next parent (in chain of commits)
  - Pointer to current branch reference (reference = SHA1)
  - Think of HEAD as pointer to last commit on current branch
- Index (Staging Area)
  - Place where changes for the next commit get registered
  - Temporary staging area for what you're working on
  - Proposed next commit
- Cache - old name for index
- Think of cache, index, and staging area as all the same

Showing Differences

- Command : git diff
- Default is to show changes in the working directory that are not yet staged.
- If something is staged, shows diff between working directory and staging area.
- Option of --cached or --staged shows difference between staging area and last commit (HEAD)
- git diff <reference> shows differences between working directory and what <reference> points to – example "git diff HEAD"

Understanding File Diffs

1. Assume file (rev a) created, added and committed to local repo.

2. Now we modify the WD version

Git diff compares: WD to Staging Area (nothing there), Staging Area to Local Repo

Results: Same

Output: Nothing

3. What if we compare WD against Local Repo?

Git diff HEAD compares: WD to Local Repo

Results: Different

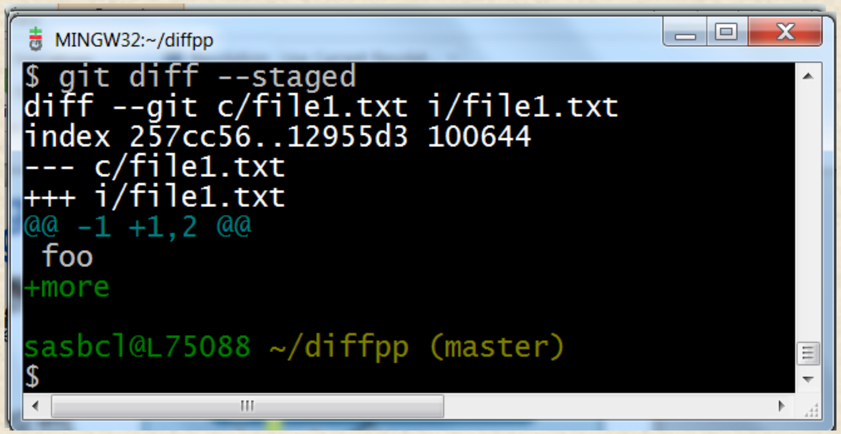
Output: Differences between WD and Local Repo

4. Let's add our changed WD version to the Staging Area (index) – or use the --staged / --cached option

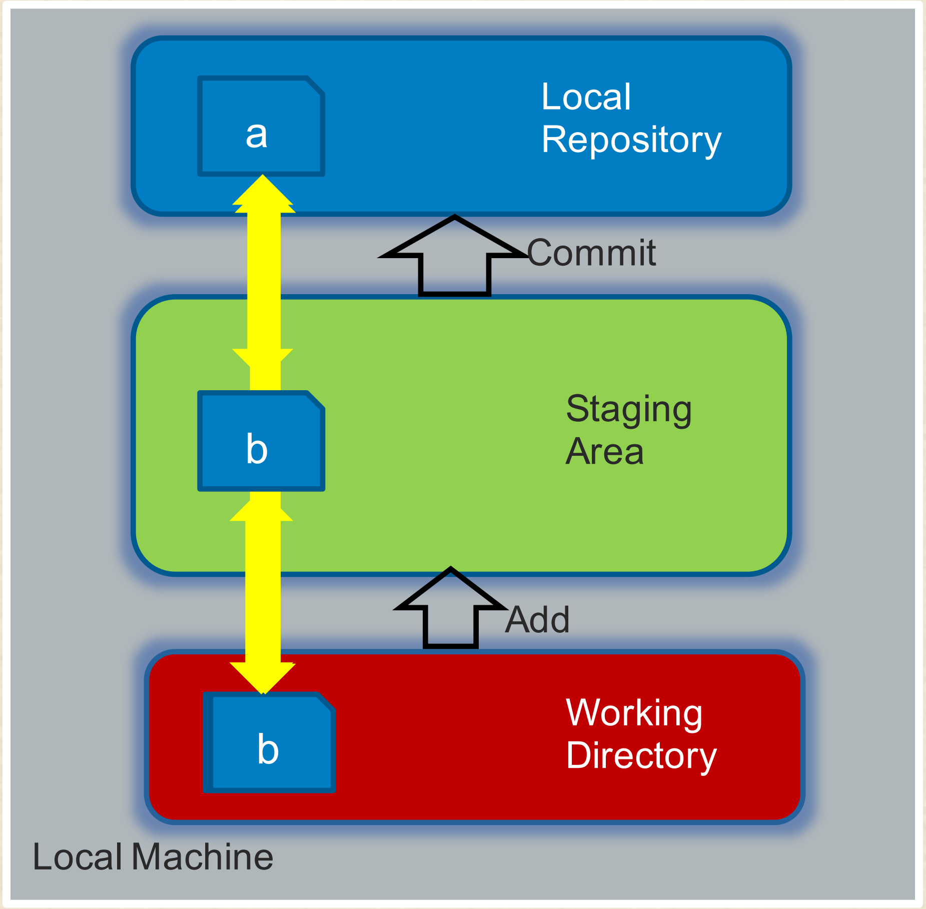
Git diff --staged compares: Staging Area to Local Repo

Results: Different

Output: Differences between Staging Area and Local Repo



```
$ git diff --staged
diff --git c/file1.txt i/file1.txt
index 257cc56..12955d3 100644
--- c/file1.txt
+++ i/file1.txt
@@ -1 +1,2 @@
 foo
+more

sasbcl@L75088 ~/diffpp (master)
$
```



Git Fundamentals: Lab 2

Tracking Content through the File Status Lifecycle

Purpose: In this lab, we'll work through some simple examples of updating files in a Local Environment and viewing the status and differences between the various levels along the way.

History

- Command: git log
- With no options, shows name, sha1, email, commit message in reverse chronological order (newest first)
- -p option shows patch – or differences in each commit
  - Shortcut : git show
- -# -shows last # commits
- --stat – shows statistics on number of changes
- --pretty=oneline|short|full|fuller
- --format – allows you to specify your own output format
- --oneline and --format can be very useful for machine parsing
- Time-limiting options --since|until|after|before (i.e. --since=2.weeks or --before=3.19.2011)
- gitk tool also has history visualizer

Sample git log format

- git log --pretty=format:"%h %ad | %s%d [%an]" --graph --date=short
- In detail…
  - --pretty="..." defines the output format.
  - %h is the abbreviated hash of the commit
  - %d commit decorations (e.g. branch heads or tags)
  - %ad is the commit date
  - %s is the comment
  - %an is the name of the author
  - --graph tells git to display the commit tree in the form of an ASCII graph layout
  - --date=short keeps the date format short and nice

Git log examples

- git log --pretty=oneline --max-count=2
- git log --pretty=oneline --since='5 minutes ago'
- git log --pretty=oneline --until='5 minutes ago'
- git log --pretty=oneline --author=<your name>
- git log --pretty=oneline --all
- git log --oneline --decorate

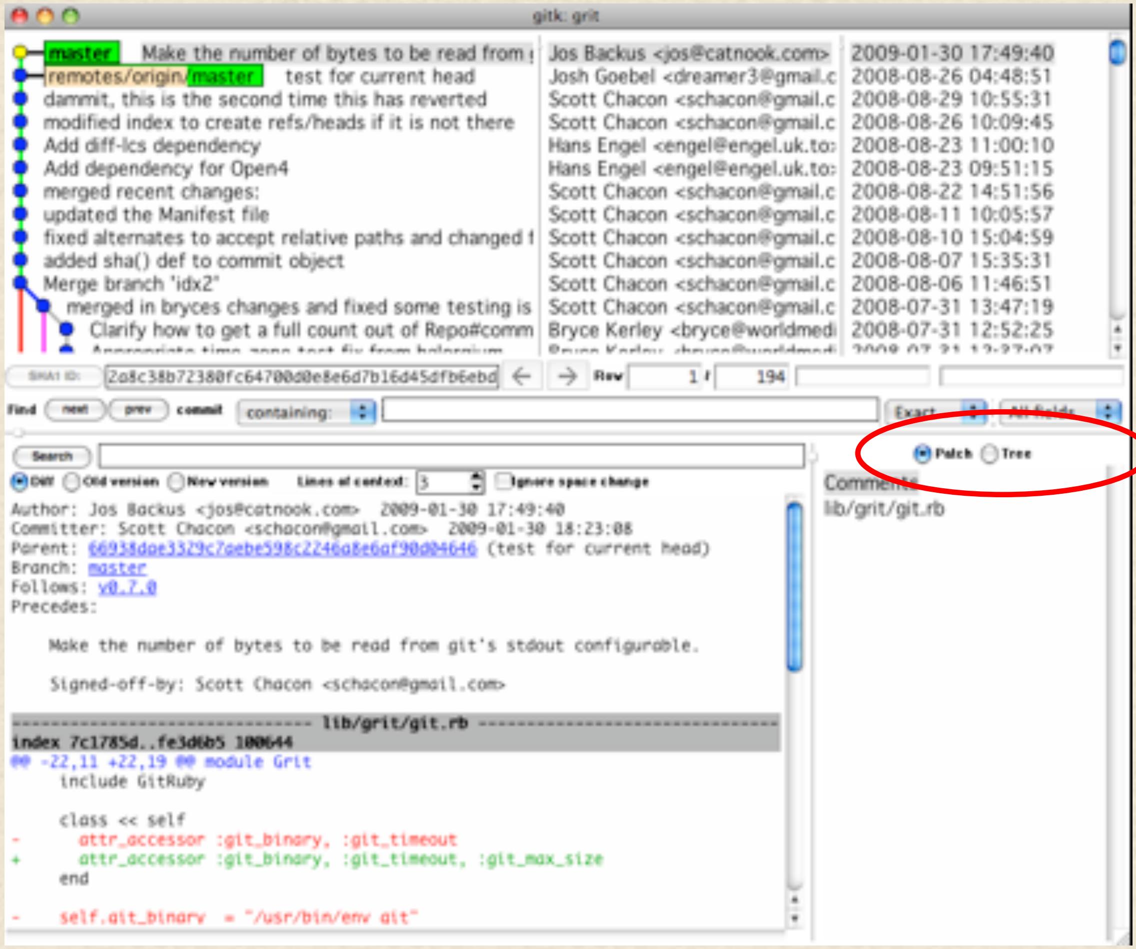
Git Aliases

- Allow you to assign alternatives for command and option strings
- Can set using
  - git config alias.<name> <operation>
- Example
  - git config --global alias.co checkout
  - After, “git co” = “git checkout”
- Example aliases (as they would appear inside config file)

```
[alias]
        co = checkout
        ci = commit
        st = status
        br = branch
        hist = log --pretty=format:\"%h  %ad | %s%d [%an]\" --graph --date=short
```

Seeing History Visually

- gitk – graphical interface that comes with most git
- Shows history of local repository (not remote) in working directory
- Also useful to be able to see how changes look graphically



```
master  Make the number of bytes to be read from |  Jos Backus <jos@catnook.com>      2009-01-30 17:49:40
remotes/origin/master  test for current head     |  Josh Goebel <dreamer3@gmail.c    2008-08-26 04:48:51
dammit, this is the second time this has reverted |  Scott Chacon <schacon@gmail.c   2008-08-29 10:55:31
modified index to create refs/heads if it is not there | Scott Chacon <schacon@gmail.c 2008-08-26 10:09:45
Add diff-lcs dependency                           |  Hans Engel <engel@engel.uk.to:  2008-08-23 11:00:10
Add dependency for Open4                          |  Hans Engel <engel@engel.uk.to:  2008-08-23 09:51:15
merged recent changes:                            |  Scott Chacon <schacon@gmail.c   2008-08-22 14:51:56
updated the Manifest file                         |  Scott Chacon <schacon@gmail.c   2008-08-11 10:05:57
fixed alternates to accept relative paths and changed f | Scott Chacon <schacon@gmail.c 2008-08-10 15:04:59
added sha() def to commit object                  |  Scott Chacon <schacon@gmail.c   2008-08-07 15:35:31
Merge branch 'idx2'                               |  Scott Chacon <schacon@gmail.c   2008-08-06 11:46:51
  merged in bryces changes and fixed some testing is | Scott Chacon <schacon@gmail.c 2008-07-31 13:47:19
    Clarify how to get a full count out of Repo#comm | Bryce Kerley <bryce@worldmedi 2008-07-31 12:52:25
```

```
SHA1 ID: 2a8c38b72380fc64700d0e8e6d7b16d45dfb6ebd   Rev 1 / 194
```

Lines of context: 3

lib/grit/git.rb

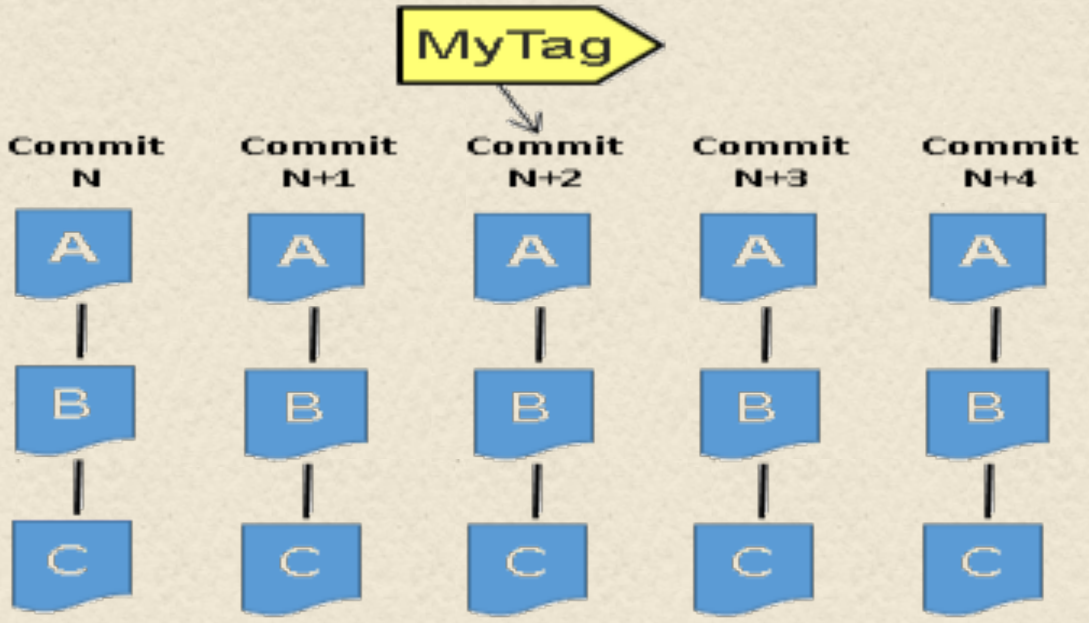
```
Author: Jos Backus <jos@catnook.com>  2009-01-30 17:49:40
Committer: Scott Chacon <schacon@gmail.com>  2009-01-30 18:23:08
Parent: 66938dae3329c7aebe598c2246a8e6af90d04646 (test for current head)
Branch: master
Follows: v0.7.0
Precedes:

    Make the number of bytes to be read from git's stdout configurable.

    Signed-off-by: Scott Chacon <schacon@gmail.com>

------------------------------ lib/grit/git.rb ------------------------------
index 7c1785d..fe3d6b5 100644
@@ -22,11 +22,19 @@ module Grit
     include GitRuby

     class << self
-      attr_accessor :git_binary, :git_timeout
+      attr_accessor :git_binary, :git_timeout, :git_max_size
     end

-    self.git_binary  = "/usr/bin/env git"
```

Tags in git

- Command: git tag
- Two types
  - Lightweight – like regular tag, pointer to specific commit
  - Annotated – stored as full object in the database
    - » Checksummed
    - » Contain full email and date, tagger name, and comment
    - » Created by git tag –a <tag> -m <message>
- Create a tag
  - Git tag <tagname> <hash>
- Show tags
  - Git tag (lists tags out)
  - Git show <tag> - shows detail

Notes about Tags

- You tag commits (hashes), not files
- A tag is a reference (pointer) to a commit that stays with that commit
- To reference a file via a tag, you need to qualify with the file name (since the tag refers to entire commit)



Git Fundamentals: Lab 3

Working with Changes Over Time and Using Tags

Purpose: In this lab, we'll work through some simple examples of using the Git log commands to see the flexibility it offers as well as creating an alias to help simplify using it. We'll also look at how to tag commits to have another way to reference them.

Supporting Files - .gitignore

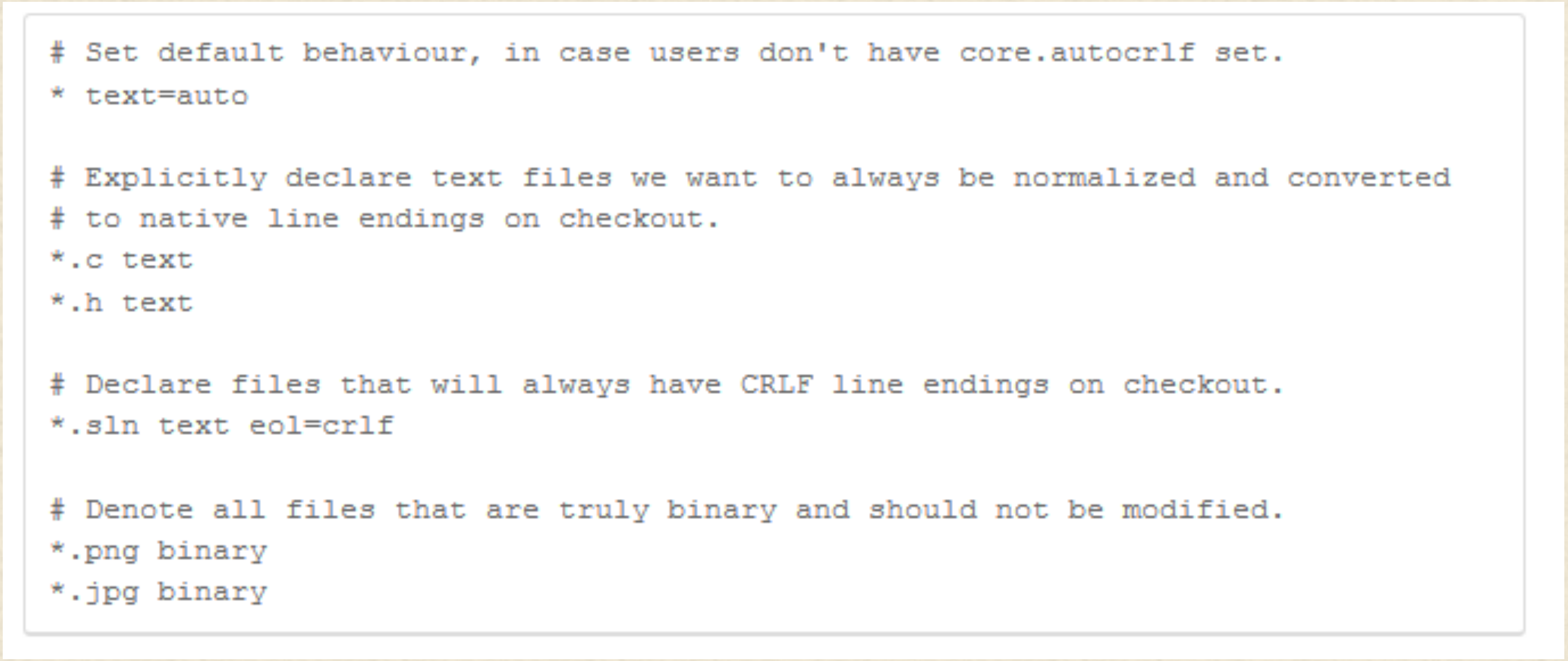
- Tells git to not track files or directories (normally listed in a file named .gitignore)
- Operations such as git add . will skip files listed in .gitignore
- Rules
  - Blank lines or lines starting with # are ignored.
  - Standard glob patterns work.
  - You can end patterns with a forward slash (/) to specify a directory.
  - You can negate a pattern by starting it with an exclamation point (!).
- What types of things might we want git to ignore?

Supporting Files - .gitattributes

- A git attributes file is a simple text file that gives attributes to pathname – meaning git applies some special setting to a path or file type.
- Attributes are set/stored either in a .gitattributes file in one of your directories (normally the root of your project) or in the .git/info/attributes file if you don't want the attributes file committed with your project.
- Example use: dealing with binary files
- To tell git to treat all obj files as binary data, add the following line to your .gitattributes file:
- *.obj binary
  - With this setup, git won't try to convert or fix eol issues. It also won't try to compute or print a diff for changes in this file when you run git show or git diff on your project.

Git Attributes File – Example

- Basic example



```
# Set default behaviour, in case users don't have core.autocrlf set.
* text=auto

# Explicitly declare text files we want to always be normalized and converted
# to native line endings on checkout.
*.c text
*.h text

# Declare files that will always have CRLF line endings on checkout.
*.sln text eol=crlf

# Denote all files that are truly binary and should not be modified.
*.png binary
*.jpg binary
```

- Advantage is that this can be put with your project in git. Then, the end of line configuration now travels with your repository. You don't need to worry about whether or not all users have the proper line ending configuration.
- Some sample gitattributes files in GitHub for certain set of languages.

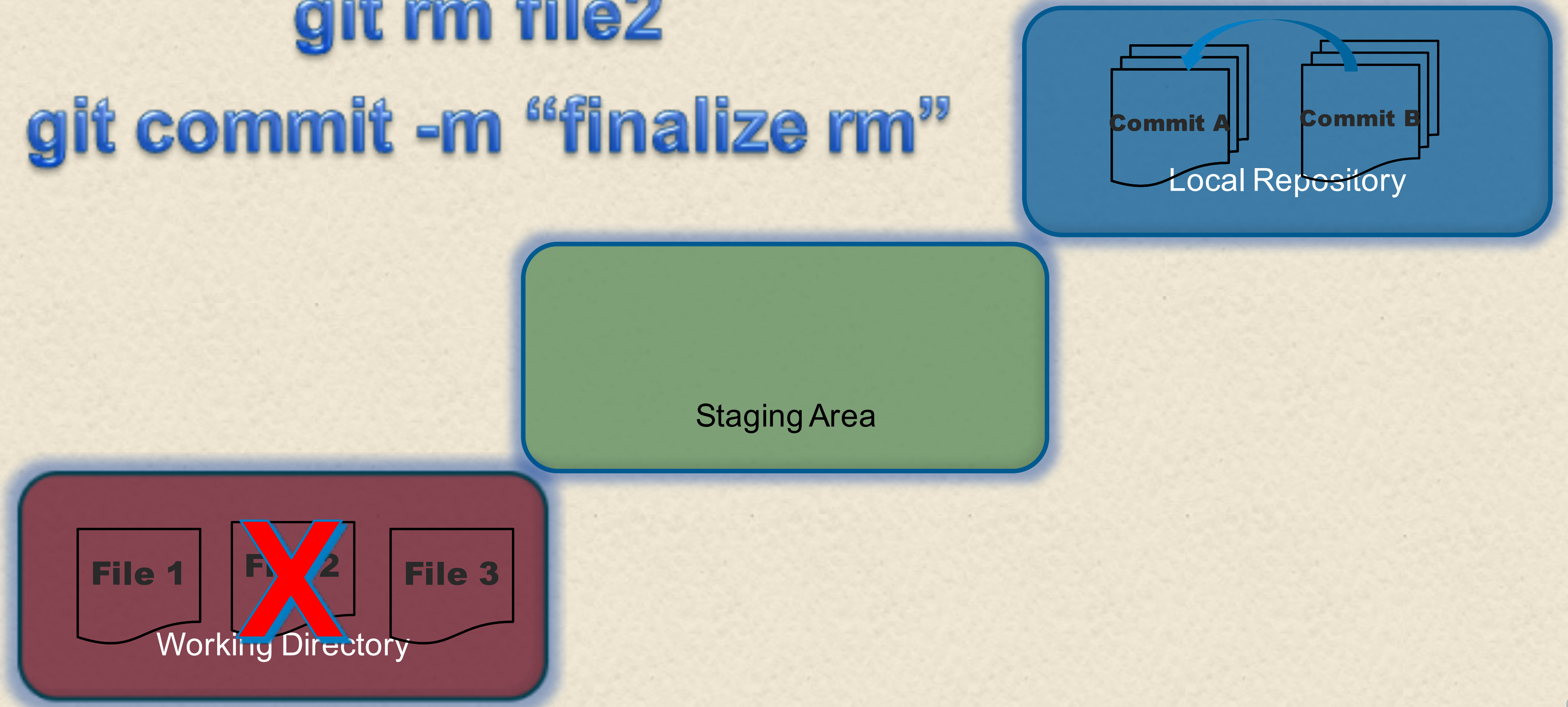
Removing files

- Command: git rm
- Process: Operations removes from tracked files, stages deletion, and then you commit to complete it
- Git rm
  - Removes it from your working directory (via rm <file>) so it doesn't show up in tracked files
  - Stages removal
- If you have a staged version AND a different modified version, git will warn you
  - Use the –f option to force the removal
- Can remove just from the staging area using --cached option on git rm
- Can provide files, directories, or file globs to command

Git Workflow for operations like rm

1. Git performs the operation in the working directory
2. Git stages the change
3. User commits to finalize the operation in the repository.

```
git rm file2
git commit -m "finalize rm"
```



Discarding Changes

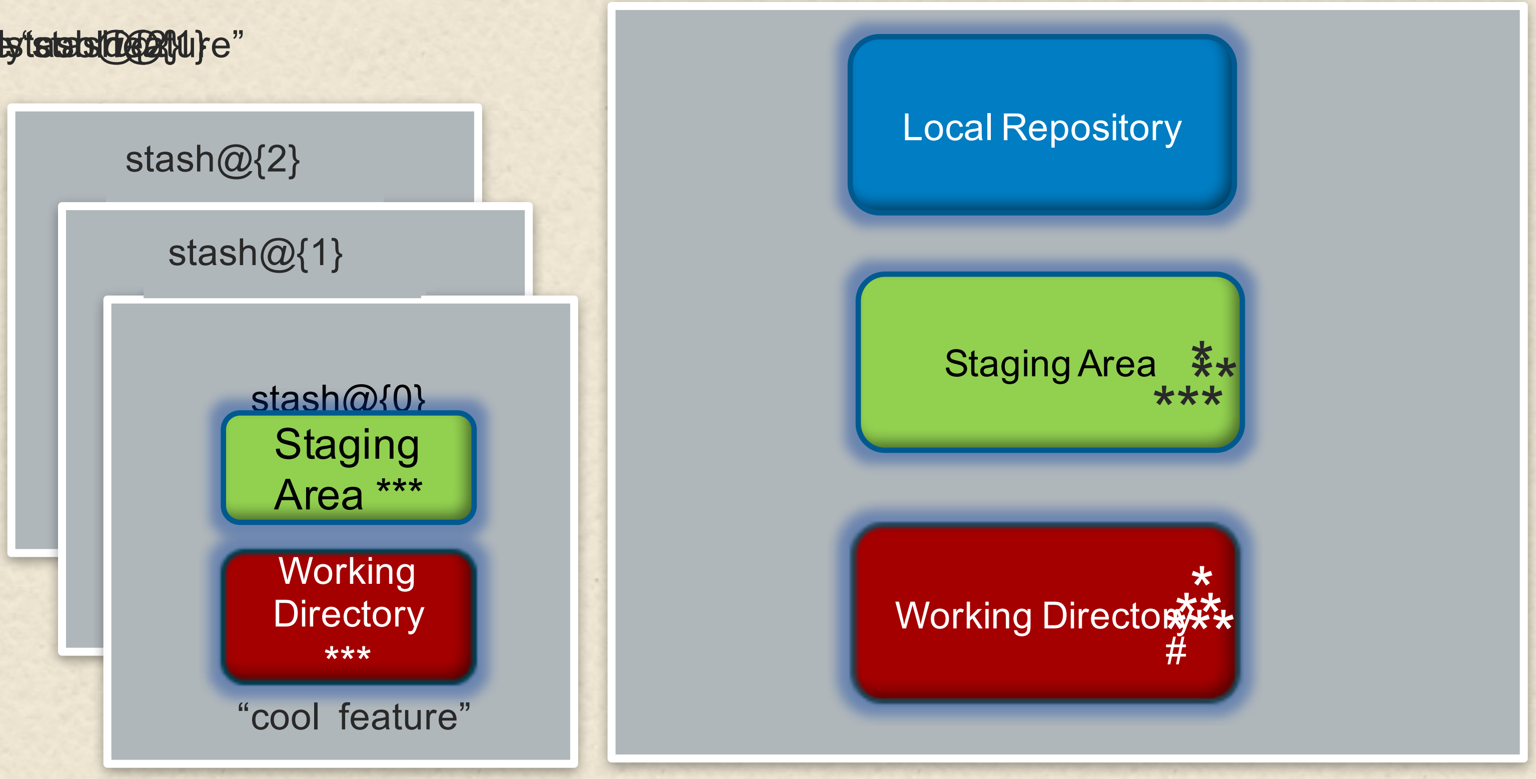
- Local changes before staging
  - use git checkout (to get latest version from repository to working dir)
- Changes already staged
  - git reset HEAD <filename>
    - » Resets branch pointer
    - » Can use manual edit or checkout to update directory
- Getting back to a clean working directory AND staging area

  - git reset --hard HEAD
- Think of reset as a “rollback” (moves HEAD pointer back to a previous commit but does not delete existing commits)
- Supporting command: git stash
  - saves off state
  - use git stash pop or git stash apply to get old state back

Git Stash

- Keep a backup queue of your work
  - command: git stash
  - saves off state
  - use git stash pop or git stash apply to get old state back

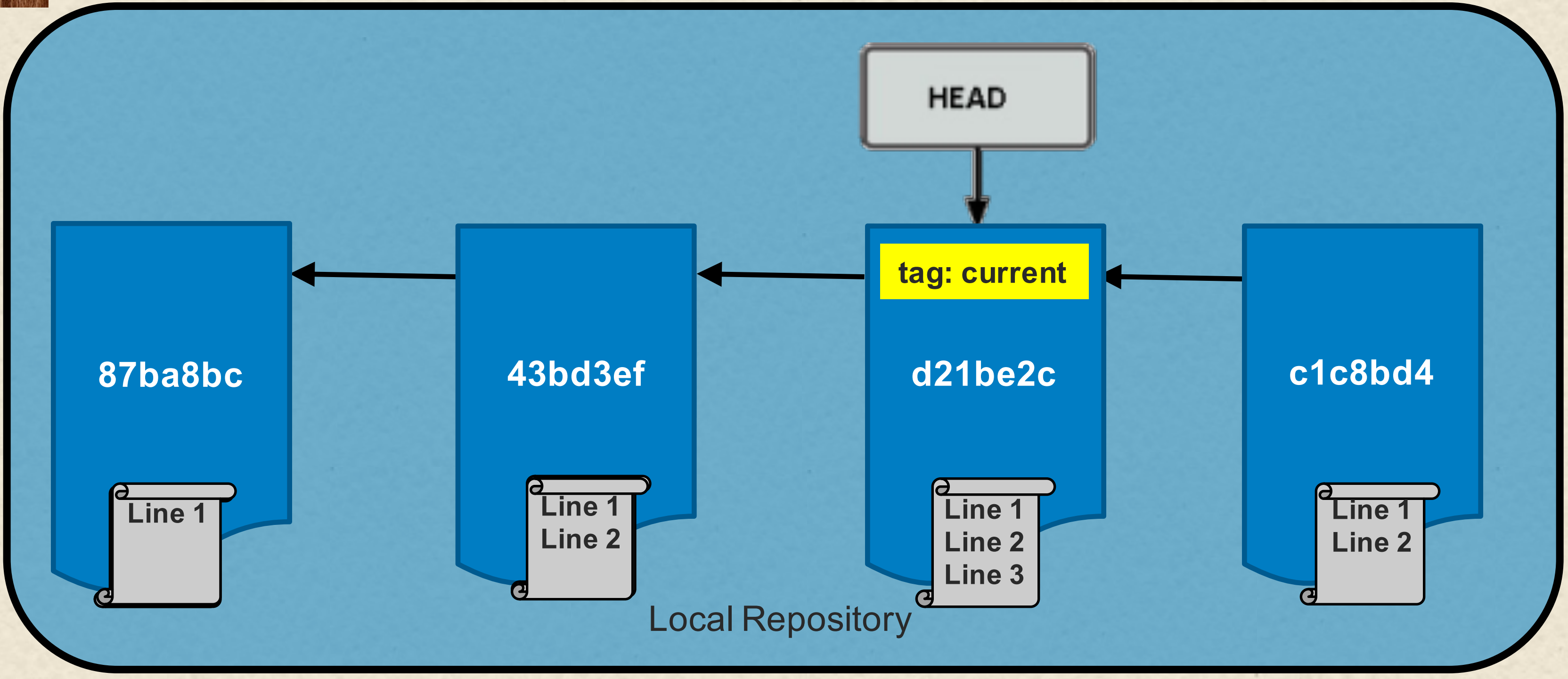
```
$ git stash save “cool feature”
```



Reset and Revert

- Reset -- allows you to “roll back” so that your branch points at a previous commit ; optionally also update working directory to that commit
- Use case - you want to update your local environment back to a previous point in time; you want to overwrite or a local change you’ve made
- Warning: --hard overwrites everything
- Revert -- allow you to “undo” by adding a new change that cancels out effects of previous one
- Use case - you want to cancel out a previous change but not roll things back
- Note: The net result of using reset vs. reset can be the same. If so, and content that is being reset/revert has been pushed such that others may be consuming it, preference is for revert.

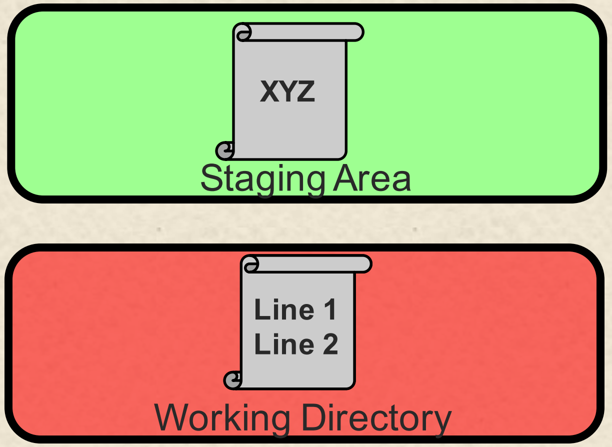
Reset and Revert



git reset --hard 87ba8bc

git reset current~1 [--mixed]

git revert HEAD



Renaming Files

- Git doesn’t track metadata about renames, but infers it
- Git mv command renames a file
- Git will show “renamed” in status after a mv
- The mv command is equivalent to:
  - mv (old local file) (new local file)
  - git rm old file
  - git add new file

What is a branch in source control?

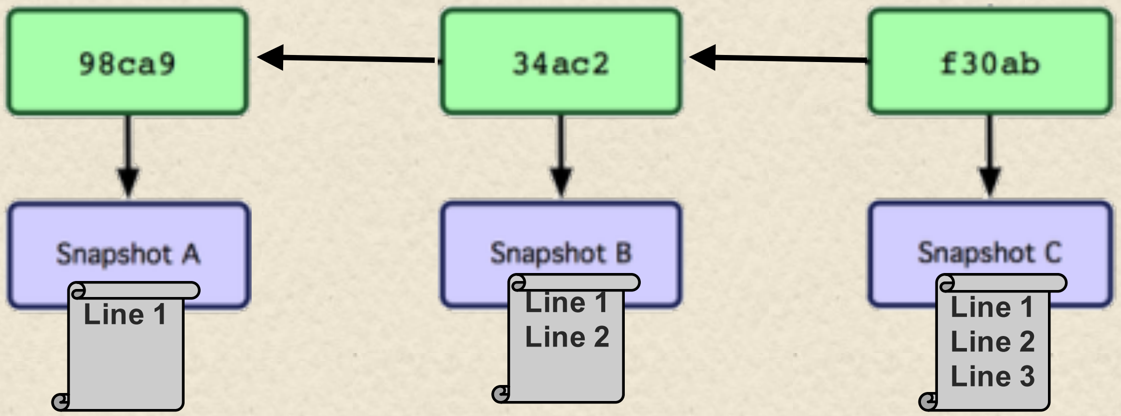
- Line of development
- Collection of specific versions of a group of files tagged in a common way
  - cvs rtag -a -D <date/time> -r DERIVED_FROM -b NEW_BRANCH PATHS_TO_BRANCH
- End result is I have an easy "handle" to get all of the files in the repository associated with that identifier – the branch name
  - cvs co –r BRANCH_NAME PATHS
- So – what you end up with in your working directory when you check out a branch is a set of specific versions of the files from the group, or a …

Snapshot! What is a snapshot (in GIT)?

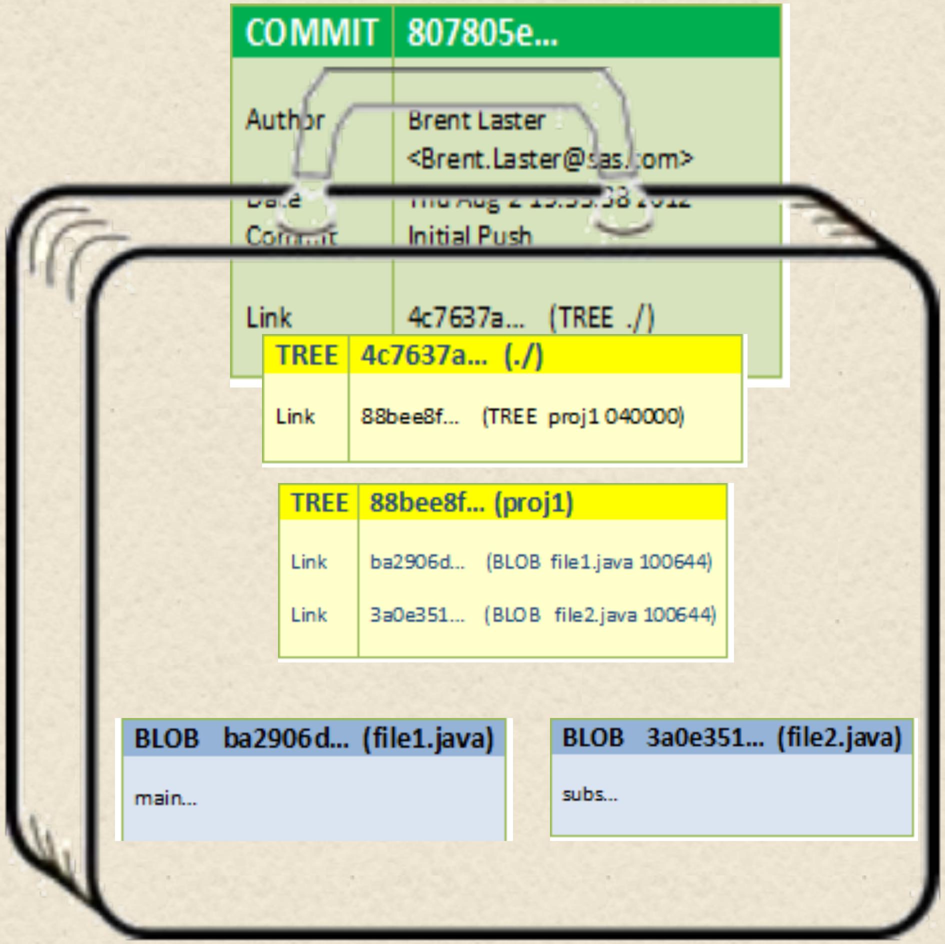
- Line of development associated with a specific change
- Collection of specific versions of a group of files associated with a specific commit
- End result is I have a "handle" to get all of the versions of files in the repository associated with that commit – handle = SHA1 for that commit
- What you end up with in your working directory when you check out a branch is a set of specific versions of the files from the group.

Branches

- Remember, git stores data as a series of snapshots, not deltas or changesets
- Commits point to snapshots – and the commit that came before them

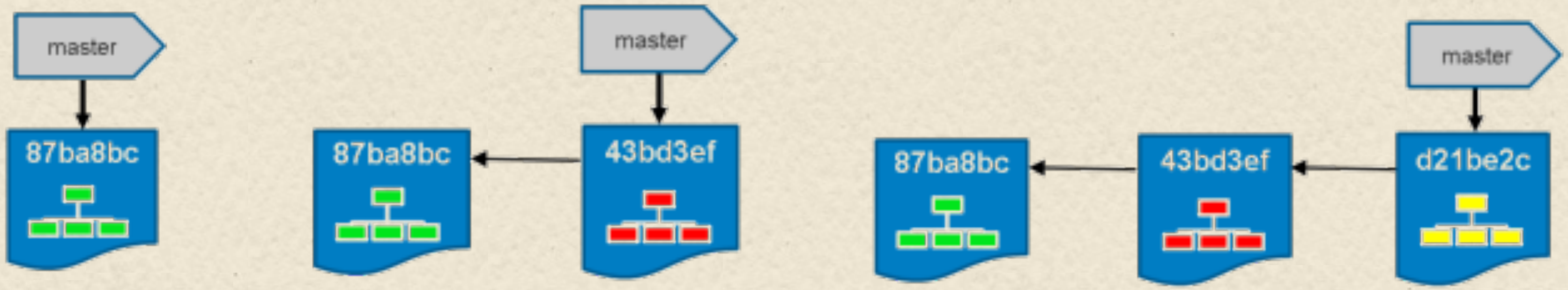


Commit SHA1's are a handle to a snapshot


COMMIT 807805e…
Author Brent Laster <Brent.Laster@sas.com>
Date Thu Aug 2 15:55:58 2012
Commit Initial Push
Link 4c7637a… (TREE ./)
TREE 4c7637a… (./)
Link 88bee8f… (TREE proj1 040000)
TREE 88bee8f… (proj1)
Link ba2906d… (BLOB file1.java 100644)
Link 3a0e351… (BLOB file2.java 100644)
BLOB ba2906d… (file1.java)
main…
BLOB 3a0e351… (file2.java)
subs…

Lightweight Branching

- A branch in git is simply a lightweight, movable pointer to a commit
- Default branch is named master
- As you initially make commits, you're given a branch pointer that points to the last commit you made. Every time you commit, it moves forward automatically.



- A branch in Git is just a simple file that contains the 40 character SHA-1 checksum of the commit it points to, branches are cheap to create and destroy. Creating a new branch is as quick and easy as writing 41 bytes to a file (40 characters and a newline).
- And, because we're recording the parents when we commit, finding a proper merge base for merging is automatically done for us and is generally very easy to do.

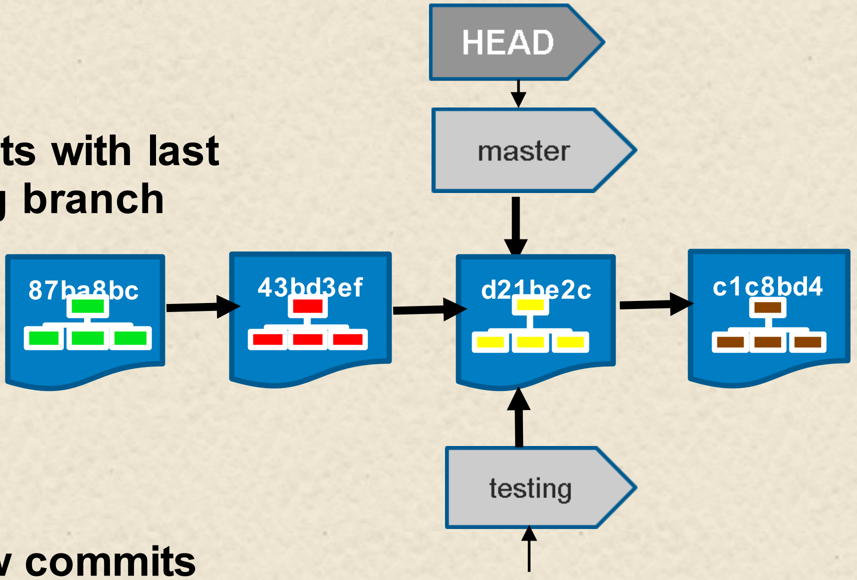
Creating and using a new branch

- Create a branch : git branch <branch>
  - Creating a new branch creates a new pointer

git branch testing

Git keeps a special pointer called HEAD that always points to the current branch.

- Change to a branch: git checkout <branch>
  - Moves HEAD to point to <branch>
  - Updates working directory contents with last commit from <branch> - if existing branch



git checkout testing

- Branch pointers advance with new commits

Switching between Branches

Command: git checkout <branch>

git checkout master

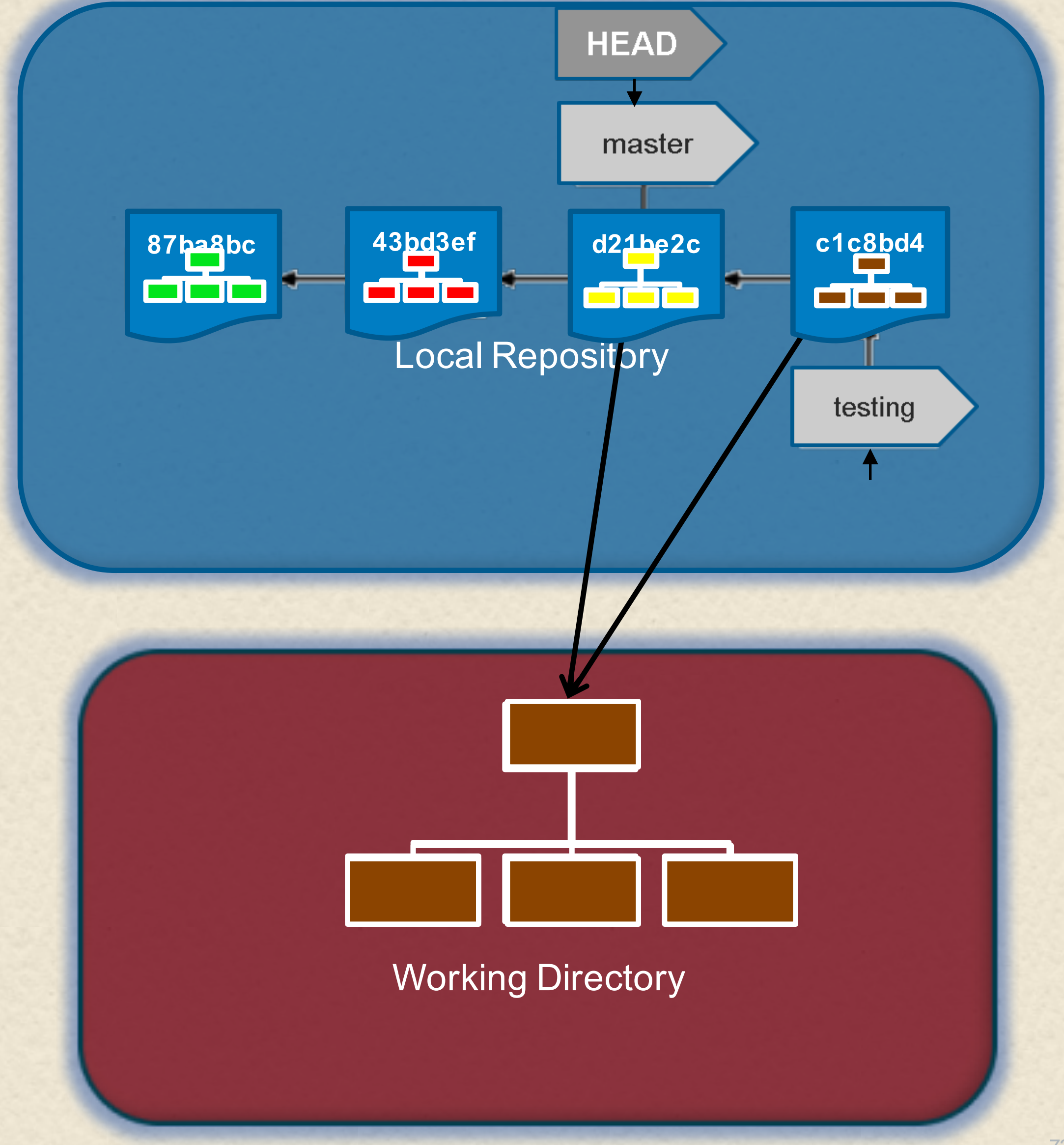
- Does three things
  - Moves HEAD pointer back to <branch>
  - Reverts files in working directory to snapshot pointed to by <branch>
  - Updates indicators

git checkout testing

git checkout master

git checkout testing

- git branch
  * master
  * testing



Which Branch am I on/in?

- Command: git branch <no arguments>
- "*" is indicator of which one you're on
- Prompt will also change in some configurations
  - **If it doesn't, can be setup.**

“Topic and Feature Branches”

- Topic Branches
  - Term for a temporary branch to try something out
  - Easy to try things in or come back to later
  - Generally, create simple name based on type of work you’re going to try – i.e. web_client
  - Maintainer of a project may “namespace” these – as in adding initials on the front – i.e. abc/web_client
  - Create just as any other branch

```
$ git branch abc/web_client
$ git checkout –b web_client
```

- Feature Branches
  - Term for a branch to develop a feature
  - Intended for limited lifetime
  - Merge back into main line of development

Git Fundamentals : Lab 4

Working with Branches

Purpose: In this lab, we'll start working with branches by creating a new branch and making changes on it.

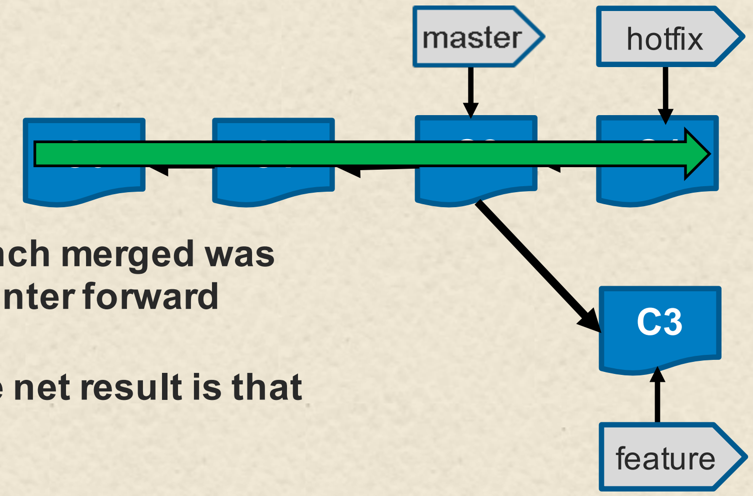
Merging Branches

- Command: git merge <branch>
- Relative to current branch
- Current branch is branch being merged into
- <branch> is branch being merged from
- Ensure everything is committed first

Merging: What is a Fast-forward?

- Assume you have three branches as below
- You want to merge hotfix into master (so master will have your hotfix for future development)

```
$ git checkout master
$ git merge hotfix
Updating f42c576..3a0874c
Fast Forward
README  |  1-
1 files changed, 0 insertions(+) 1 deletions (-)
```

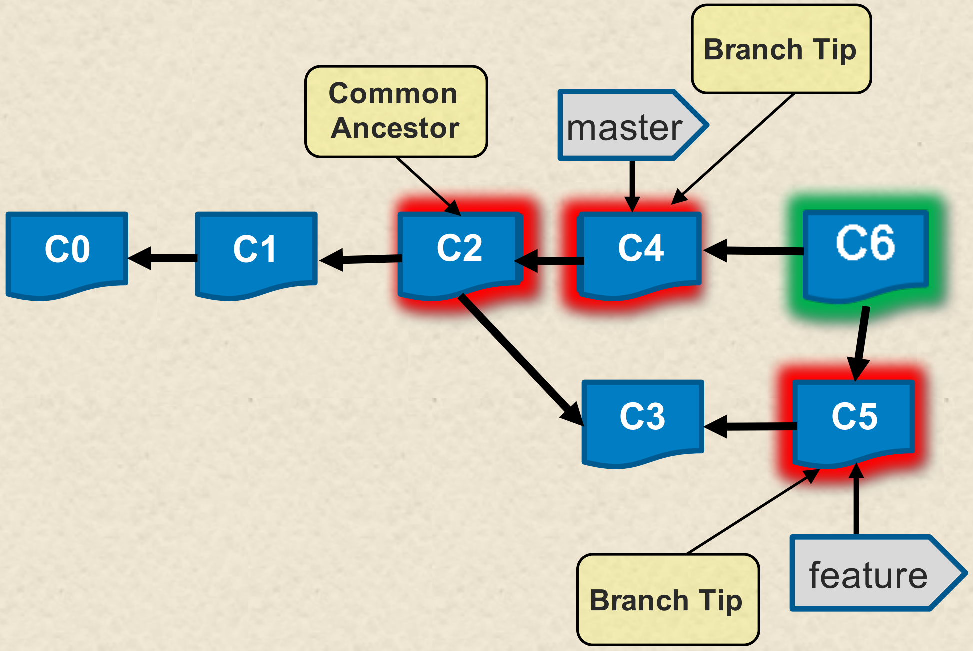


About "Fast Forward" – because commit pointed to by branch merged was directly "upstream" of the current commit, Git moves the pointer forward

(Both branches were in the same line of development, so the net result is that master and hotfix point to the same commit)

Merging: What is a 3-way Merge?

- **Assume branching scenario below**
  - master and feature branches have both diverged (changed) since their last common ancestor (commit/snapshot)
- **Intent is to change to master and merge in feature**
- **Current commit on target branch isn't a direct ancestor of current commit on branch you're merging in (i.e. C4 isn't on the same line of development as C5)**
- **Git does 3-way merge using common ancestor**
- **Instead of just moving branch pointer forward, Git creates a new snapshot and a new commit that points to it called a "merge commit"**



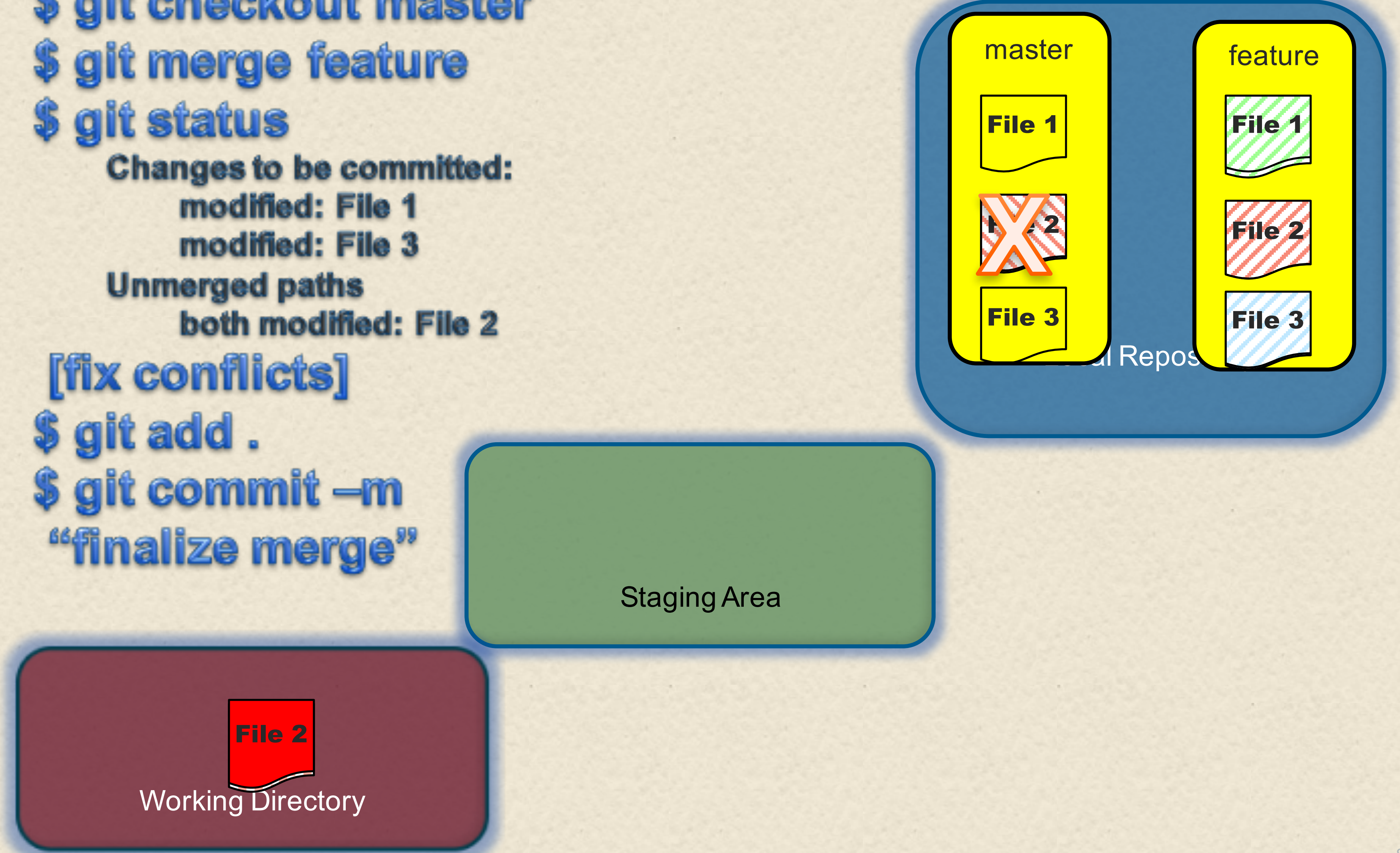
```
$ git checkout master
$ git merge feature
```

Merge Conflicts

- **If you encounter a merge conflict during a merge operation**
  - **Will get CONFLICT message**
  - **Git pauses merge in place**
  - **To see which files are unmerged, use git status – will see "unmerged: or both modified: <filename>"**
  - **Adds <<<<< and >>> markers in the file**
- **After resolution, run git add and then commit**
- **Can also run git mergetool to resolve graphically**

Merge Scenario – Branches with Conflicts

```
$ git checkout master
$ git merge feature
$ git status
    Changes to be committed:
        modified: File 1
        modified: File 3
    Unmerged paths
        both modified: File 2
 [fix conflicts]
$ git add .
$ git commit –m
 "finalize merge"
```

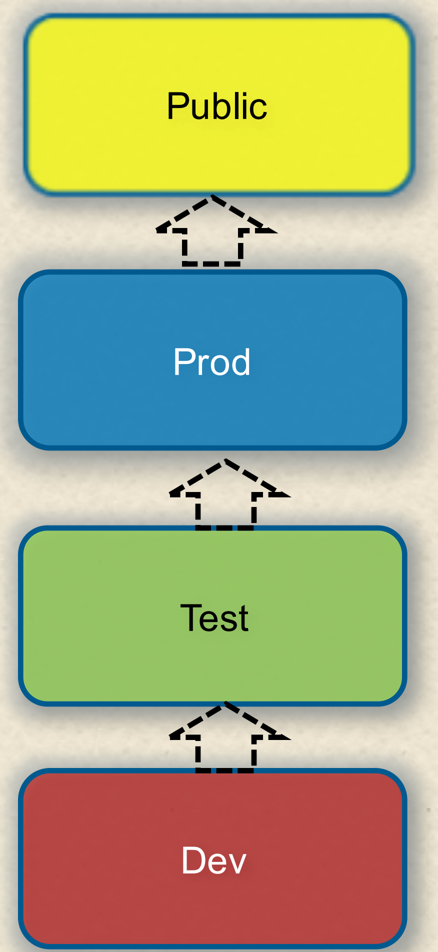


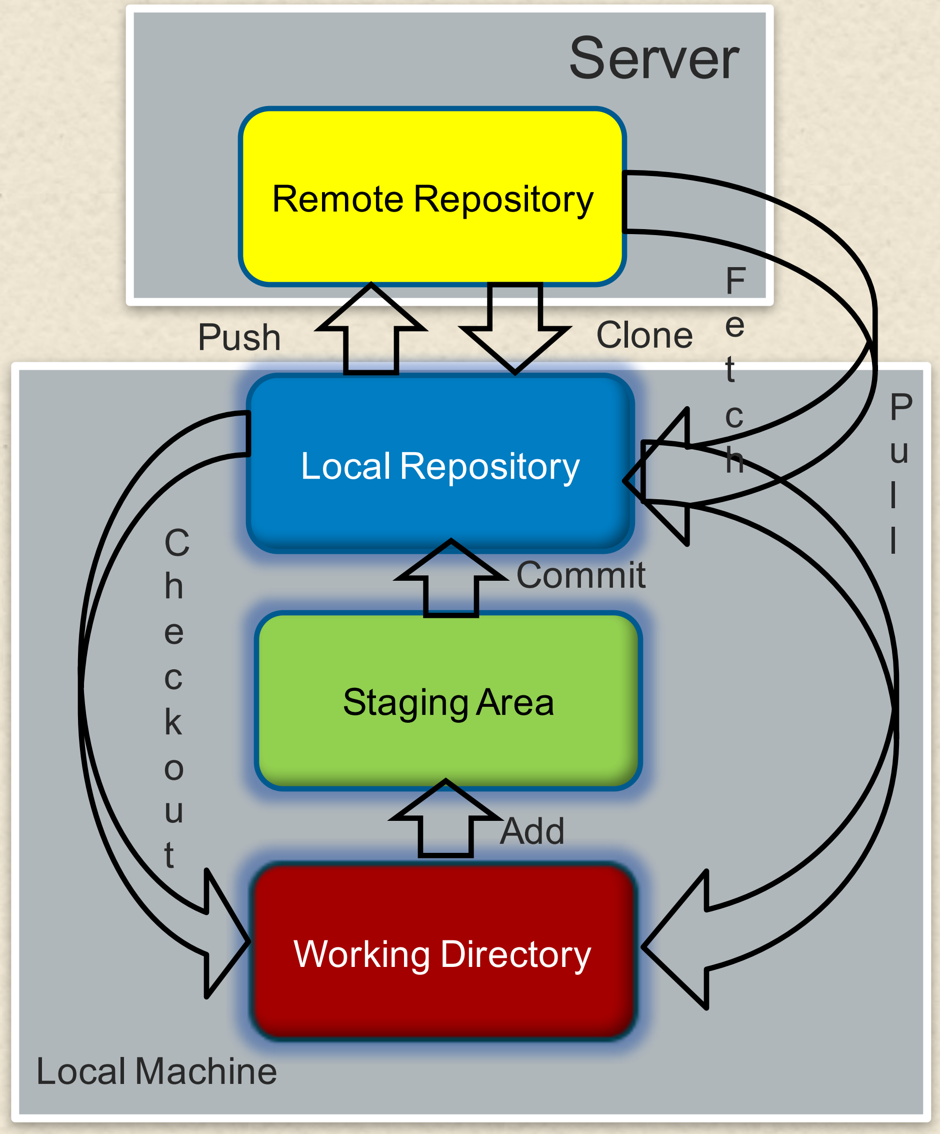
Git Fundamentals : Lab 5

Practice with Merging

Purpose: In this lab, we'll work through some simple branch merging.

Git in One Picture





Cloning a Remote Repo to get a Local Repo

- Command: git clone
  - Use to get a copy of an existing repository from a system
  - Syntax: git clone <url> <optional new name>
  - Clone vs. checkout
    - » Git pulls nearly all data from cloned area – files, history, etc.
    - » Creates a directory with the project name
    - » Checks out working copy of latest version
    - » Does a bit more than fetch and pull – tracks local branch to remote branch
  - After cloning, have full access to files, histories, etc.

Git Remote References "remotes"

- The term "remote" can either refer to:
  - An actual remote repository
  - A reference to such a repository
- For local use, Git provides references/aliases/nicknames that map to a remote repository location
- The default one of these is "origin"
- The reference "origin" is automatically setup (mapped) for you when you clone
- Example: origin = https://github.com/<path>
- This mapped name is what you use in local commands to tell git you want to push/pull/fetch/clone to/from the mapped remote repository
- Example: git pull origin <branch>

Git Remote Repositories

- Remote repositories
  - Think “server-side”
  - Versions of projects hosted on network or internet
  - Push or pull from (as opposed to checkout/add/commit)
  - Generally have read-only or read-write access
  - Handle + url
- Public as opposed to private (local)
- Multiple protocols for data transfer
  - Local – shared folder, easy for collaboration, slow, not for widespread use
  - SSH – standard with authentication, no anonymous access
  - Git – fastest, but no authentication
  - Http - easy, but inefficient
  - Https – easy and authenticated (temporarily)

Working with Handles to Remotes

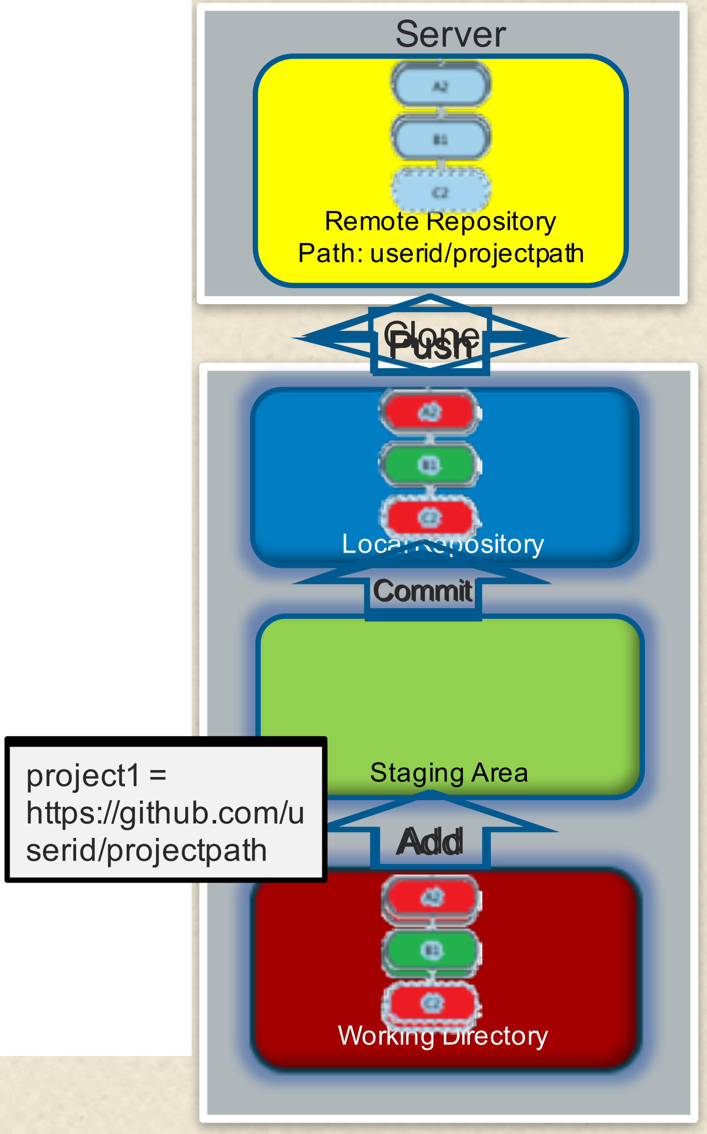
- Seeing what you have access to
  - Git remote (short handle by default, -v shows url)
  - "origin" – special name that git gives to remote you cloned from
  - Ssh urls (git@<blah> vs. git protocol git://) and https indicates ones you can push to
  - Git remote show (shortname) – shows extended info about remote
- Adding a remote
  - Think of adding access to existing one
  - Git remote add [shortname (handle)] [url]
    - » Example : git remote add remote2 https://github.com/userid/projectpath
- Renaming shortname
  - Git remote rename <old> <new>
  - Renames remote branches too
- Removing a reference
  - Git remote rm (shortname)

Working with Remotes

- Retrieve latest from git remote (getting what you don't have)
  - Git fetch (shortname) as in git fetch brent
  - Note that you are getting the full repository (history, branches, basically everything)
  - Fetch pulls the data to the local repository – it doesn't merge or disturb your local content
- Retrieve latest and merge
  - Git pull
  - By default, git clone automatically sets up to track changes on master branch
  - Pull does a "fetch and merge"
- Pushing back to the server (remote)
  - Git push (shortname) (branch)
  - Only works if you have correct access and remote content hasn't been change
  - If remote content has been changed, then would have to fetch latest and merge (like cvs up-to-date check)

Git Remotes Example

```
$ git clone https://github.com/userid/projectpath
$ git remote -v
origin https://github.com/userid/projectpath(fetch)
origin https://github.com/userid/projectpath (pull)

$ <edit File A and File C>
$ git commit –am "…"
$ git push origin master
  (default is origin and master so could just "git push")

$ git remote rm origin
$ git remote add project1 https://github.com/userid/projectpath
$ git remote -v
project1 https://github.com/userid/projectpath(fetch)
project1 https://github.com/userid/projectpath (pull)

$ <edit File B>
$ git commit –am "…"
$ git push project1
(or git push project1 master)
```



project1 =
https://github.com/userid/projectpath

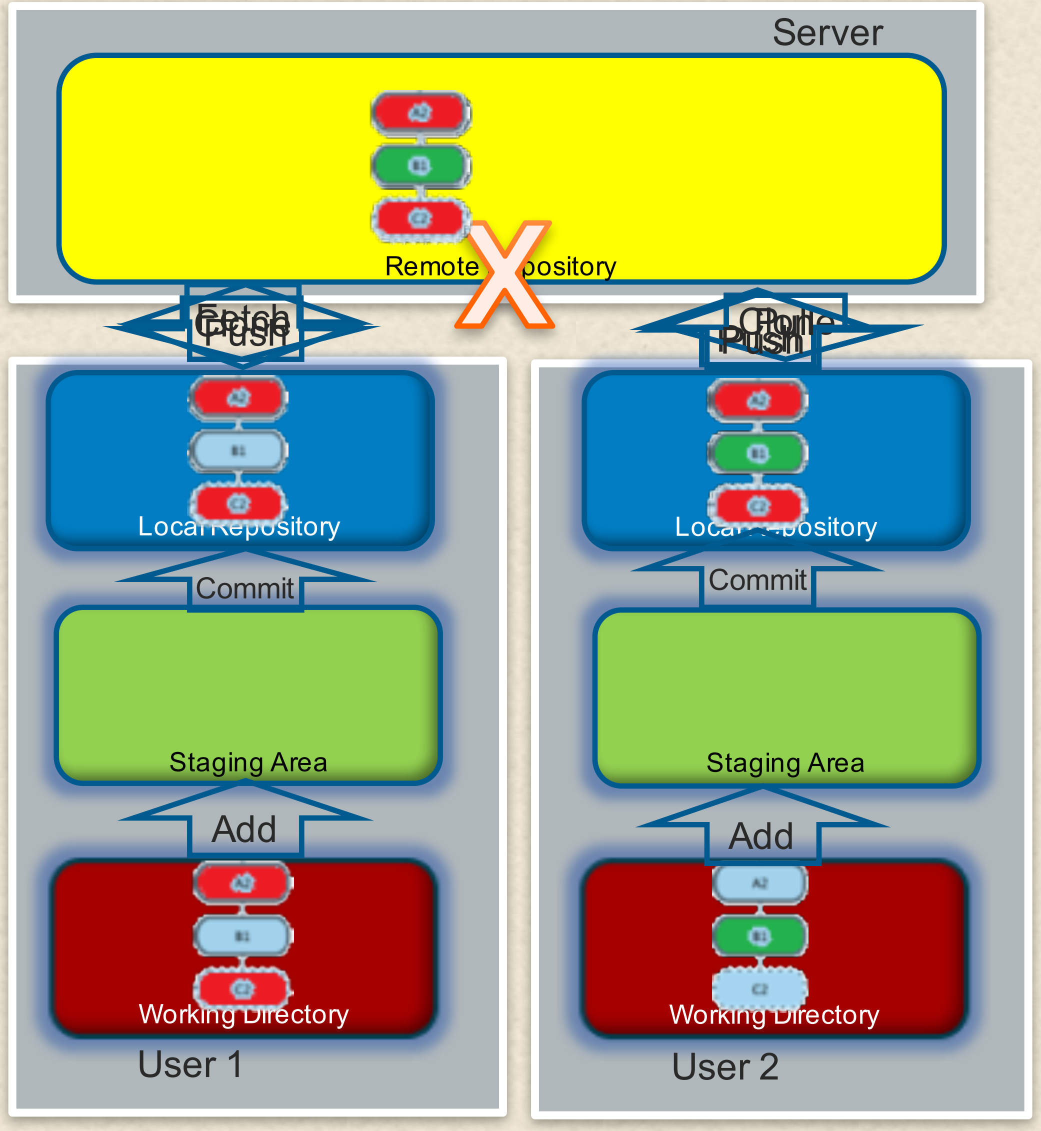
Working with a Remote and Multiple Users

User 1

```
$ git clone …
$ <edit File A and File C>
$ git commit –am "…"
$ git push
$ git fetch
```

User 2

```
$ git clone …
$ <edit File B>
$ git commit –am "…"
$ git push
$ git pull
$ git push
```



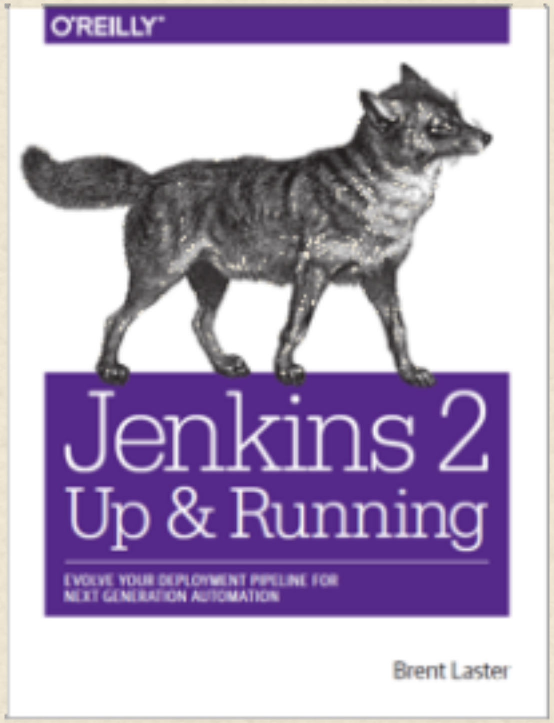
Git Fundamentals : Lab 6

Using the Overall Workflow with a Remote Repository

Purpose: In this lab, you'll get some practice with remotes by working with a Github account, forking a repository, cloning it down to your system to work with, rebasing changes, and dealing with conflicts at push time.

That's all - thanks!

Professional Git 1st Edition
by Brent Laster (Author)
★★★★★ 7 customer reviews
Look inside


O'REILLY
Jenkins 2
Up & Running
EVOLVE YOUR DEPLOYMENT PIPELINE FOR NEXT GENERATION AUTOMATION
Brent Laster