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Git for Developers

module

INTRODUCTION

Git Fundamentals

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Set up…

- Install Git CLI
  - https://git-scm.org
- Prove it

```
$ git --version
git version 2.13.3
```

- Sign up at github.com / gitlab
  - **Email me your username**
- Download the Slides
  - http://github.com/rm-training/resources
- Grab a cheat sheet
  - Github's
  - Atlassian's

Let's get started

- I'm Ryan Morris
- You?
  - What's your background?
  - Have you used any version control systems?
  - What is your experience with Git?
  - Any specific goals for this class?
- 50/50 Lecture & Labs
  - The slides serve as notes & examples
- Informal -- ask questions any time

Plan for the next two days

Day 1

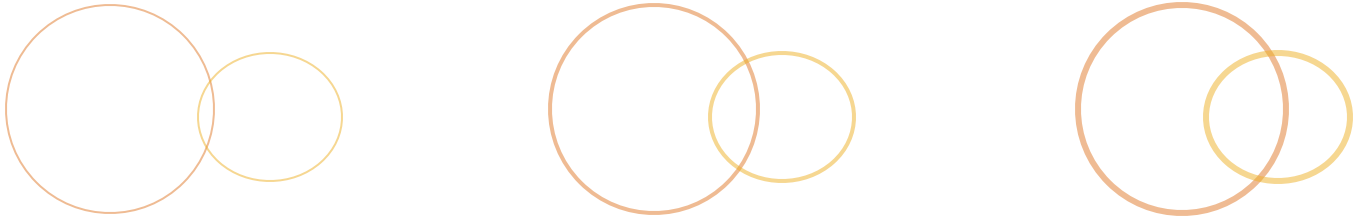
- Creating & Managing repositories
- Basic workflow of Git
  - Stage, commit
  - Branch, Merge
- Fixing Stuff
  - Undoing
  - Dealing with conflicts
- Odds & Ends
  - Stashing, tagging, etc...

Day 2

- Collaborating through Remotes
  - Staying up to date
  - Sharing your work
- Workflows
- Managing History
  - Rebase, Cherry-pick
- Reset

Resources

- The Git Parable
  - http://bit.ly/1isB3K4
- Pro Git, 2nd edition (for free!)
  - http://git-scm.com/documentation
- Think like a Git
  - http://think-like-a-git.net/
- Visualizing Git
  - http://pcottle.github.io/learnGitBranching



module

VERSION CONTROL

Why version control?

Why Version Control?

- ***Keep track*** of changes
- ***Go back*** to an older version
- ***View a history*** of changes
- ***Collaborate*** easily
- **Automate** operations

What things can we version control?

What things can we version control?

- ***Any file!***
  - The code for our website
  - My photo collection
  - My mp3 collection
  - My entire computer
  - These slides

All files & folders within this directory will be part of my project

- Our **project root** will be a top-level directory

/My Documents/projects/web-scrawler/

Stone-age version control

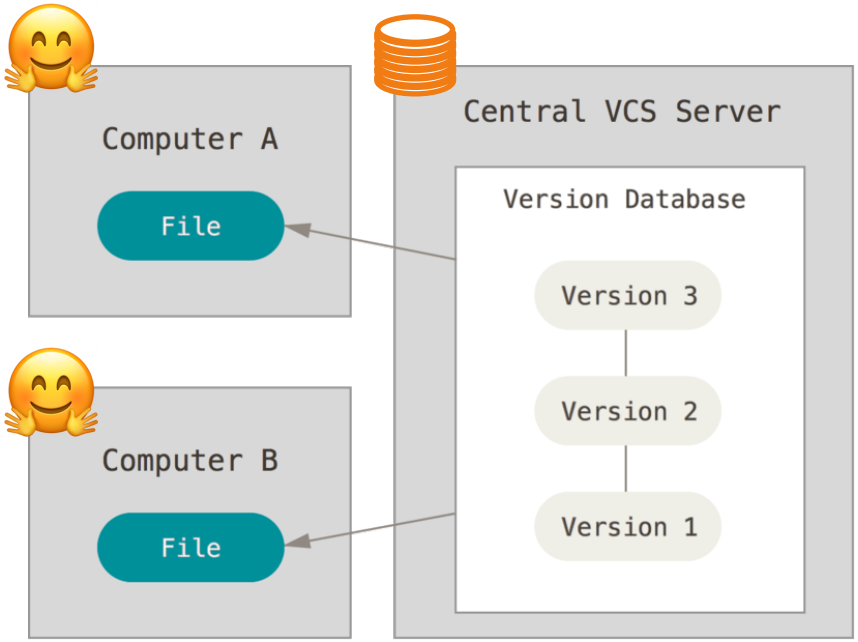
just me!

- A new file for each meaningful change

```
/book/chapter1.v1
/book/chapter1.v2
/book/chapter1.v3.draft
```

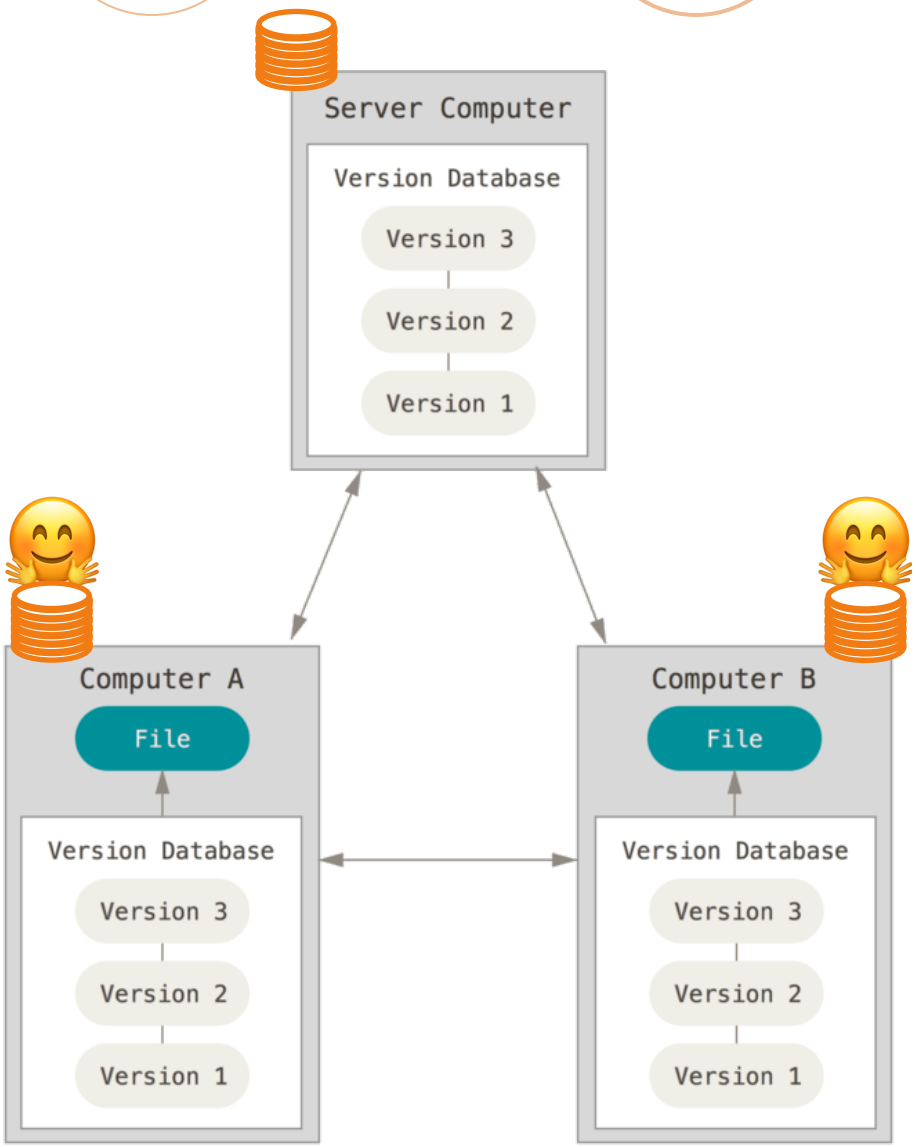
- Advantages
  - Easy
- Disadvantages
  - Error prone
  - Single point of failure

Old World: Centralized Version Control



- Central server manages all operations
  - ex: CVS, Subversion, Perforce
- Advantages
  - Fine-grained control
  - Easy to see who is doing what
- Disadvantages
  - Single point of failure
  - History is not local
  - Branching/merging is a pain

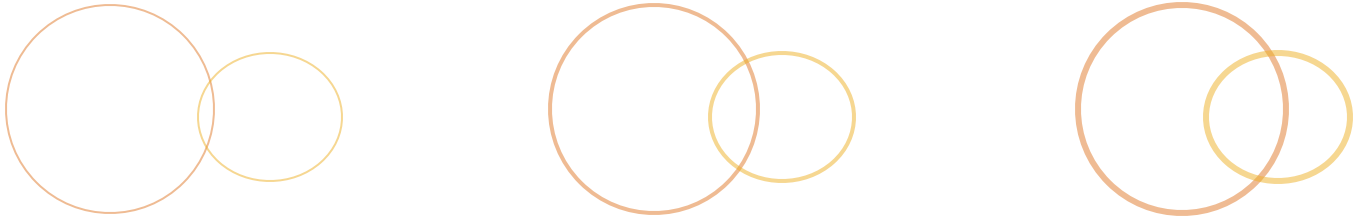
New World: Distributed Version Control



- All clients fully error the repository (incl. history)
  - ex: **Git**, Mercurial, Bazaar
- Advantages
  - No single point of failure
  - Easy to collaborate
  - Flexible workflows
- Disadvantages
  - Tend to favor open access
  - No file locking

History

- Linux (1991-)
  - No real version control from 1991-2002
  - **bitkeeper** from 2002-2005
  - created **git** in 2005 after relationship w/ bitkeeper broke down
- Git was made for:
  - Speed
  - Large projects
  - Large, distributed teams
  - Frequent changes
  - Lots of branching



module

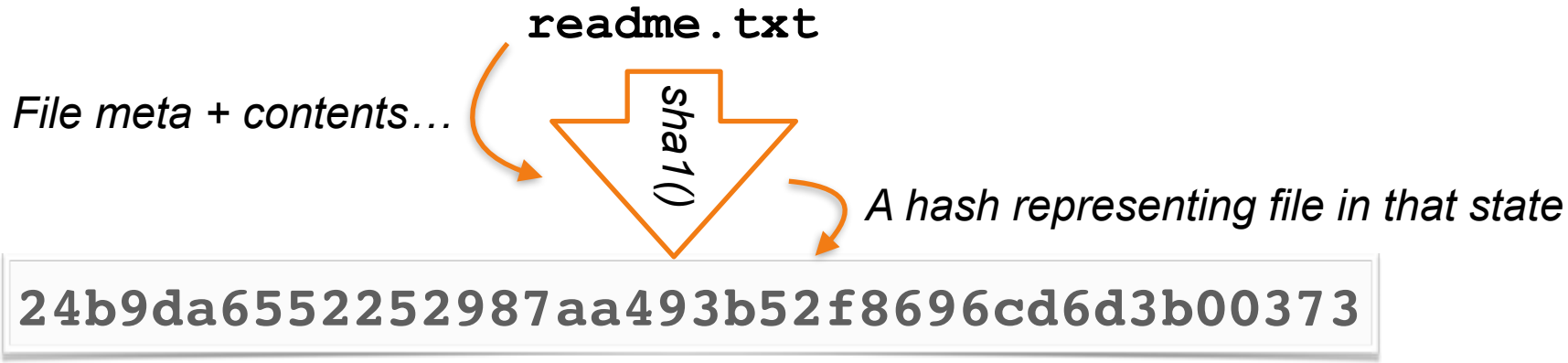
UNDERSTANDING GIT

Nearly every operation is local

- Entire repository is available **locally**
  - Full history
  - All branches
- You can work offline!
  - Create/Check out branches
  - Commit changes
- You *do* need a network connection to collaborate

Hash all the things

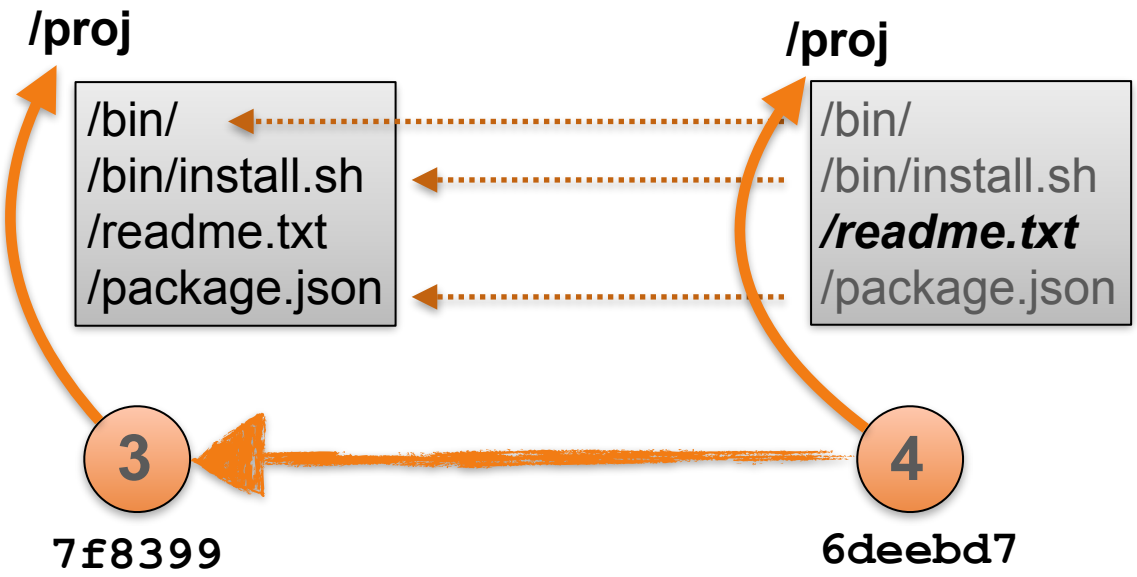
- All *things* in git are represented by unique hashes
  - Files, directories, commits, tags…



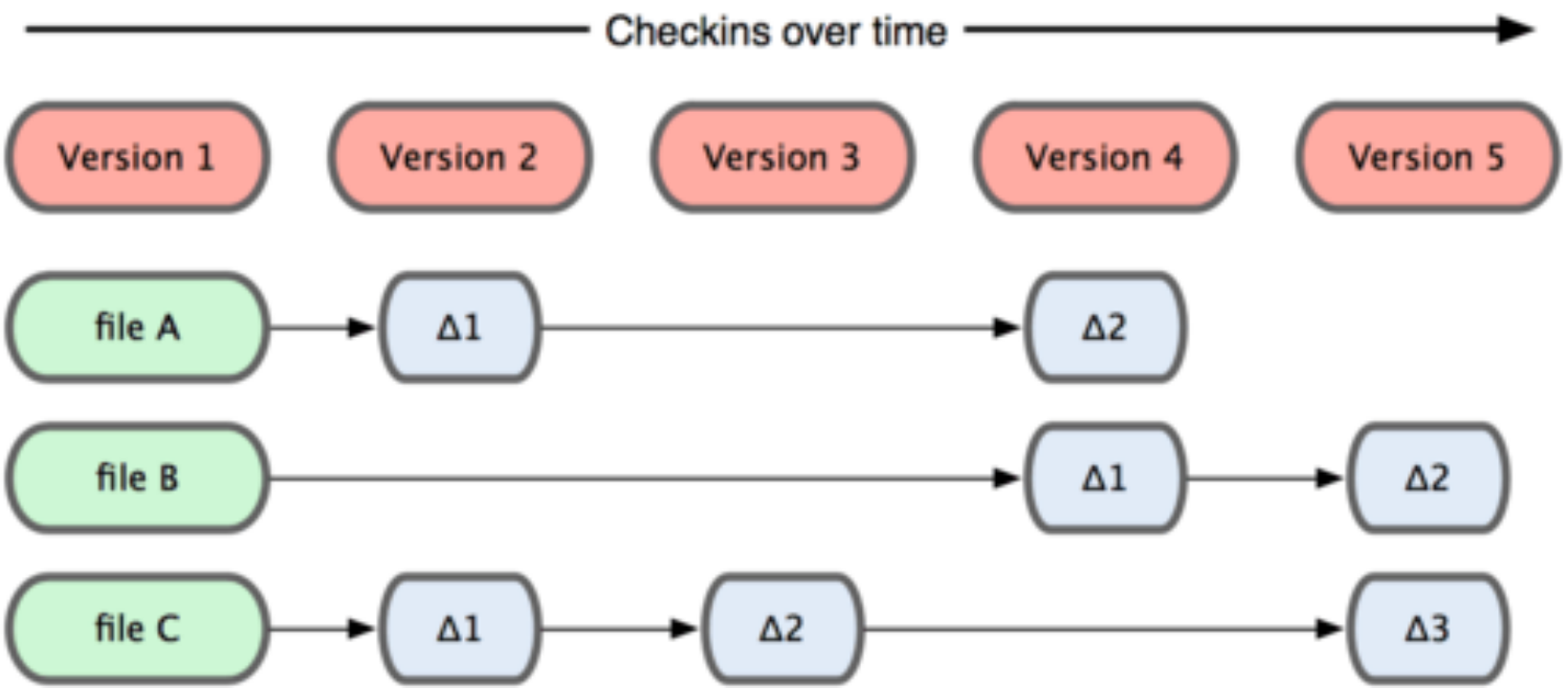
- Changes are tracked in this way
- Bonus: Tampering becomes obvious

Snapshots, not Deltas

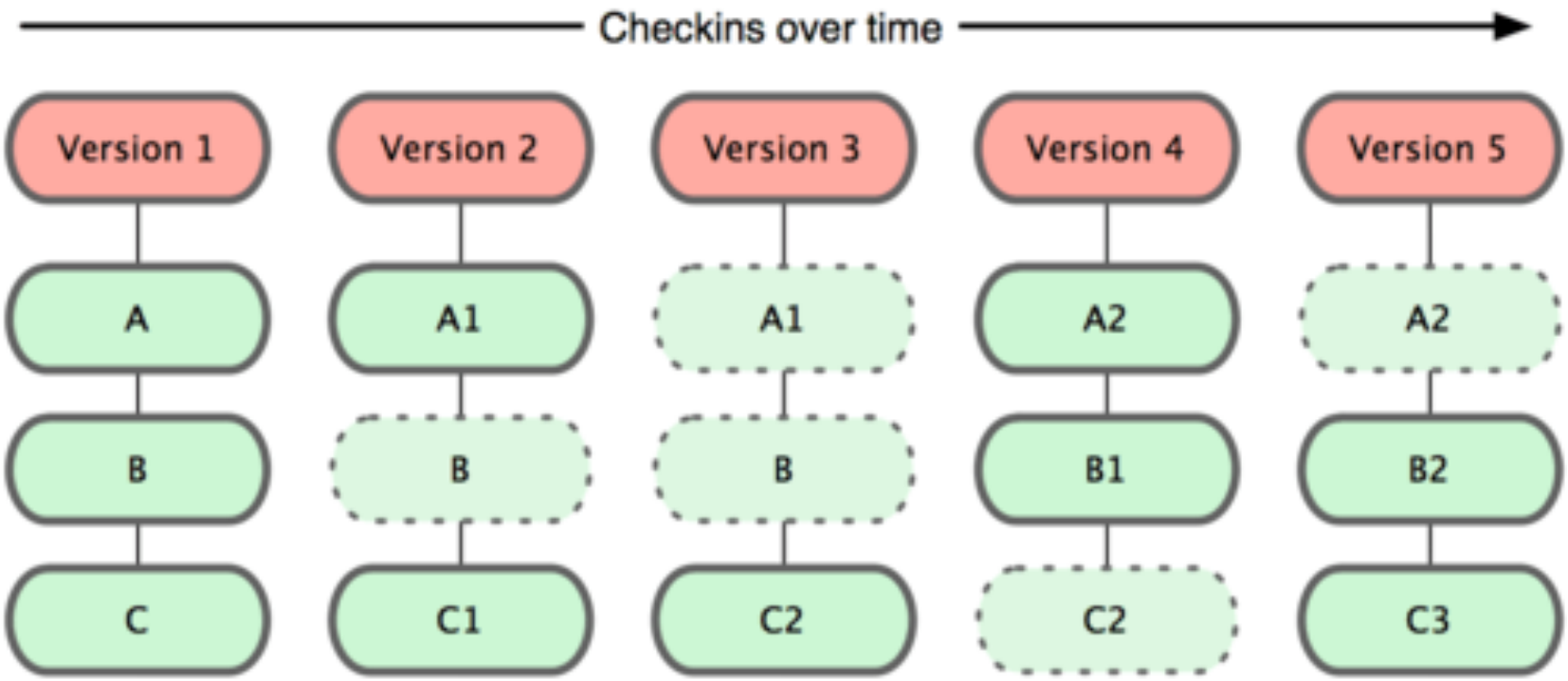
- Our "versions" (aka commits) reference *copies* of each file at the point in time the commit is made
  - However, git will not keep copies of files that did not change



Diffs / Deltas (SVN, etc)



Snapshops (Git)



Loose vs Packed

- One-liner change to a 1GB `readme.txt` file?
  - You now have two 1GB txt files in your repository!

- Git will clean things up...
  - combine similar **files** across commits into diffs
  - compresses **objects** and diffs
  - prunes unreachable **objects**

Git is defensive

- Nearly all actions ***add*** data to the Git database
  - Once something is committed it is part of the project history *forever*
- It's easy to recover from mistakes
  - Lost commits and deleted branches can *typically* be recovered
- However, git *does* garbage collect dangling commits

Starts with a project root

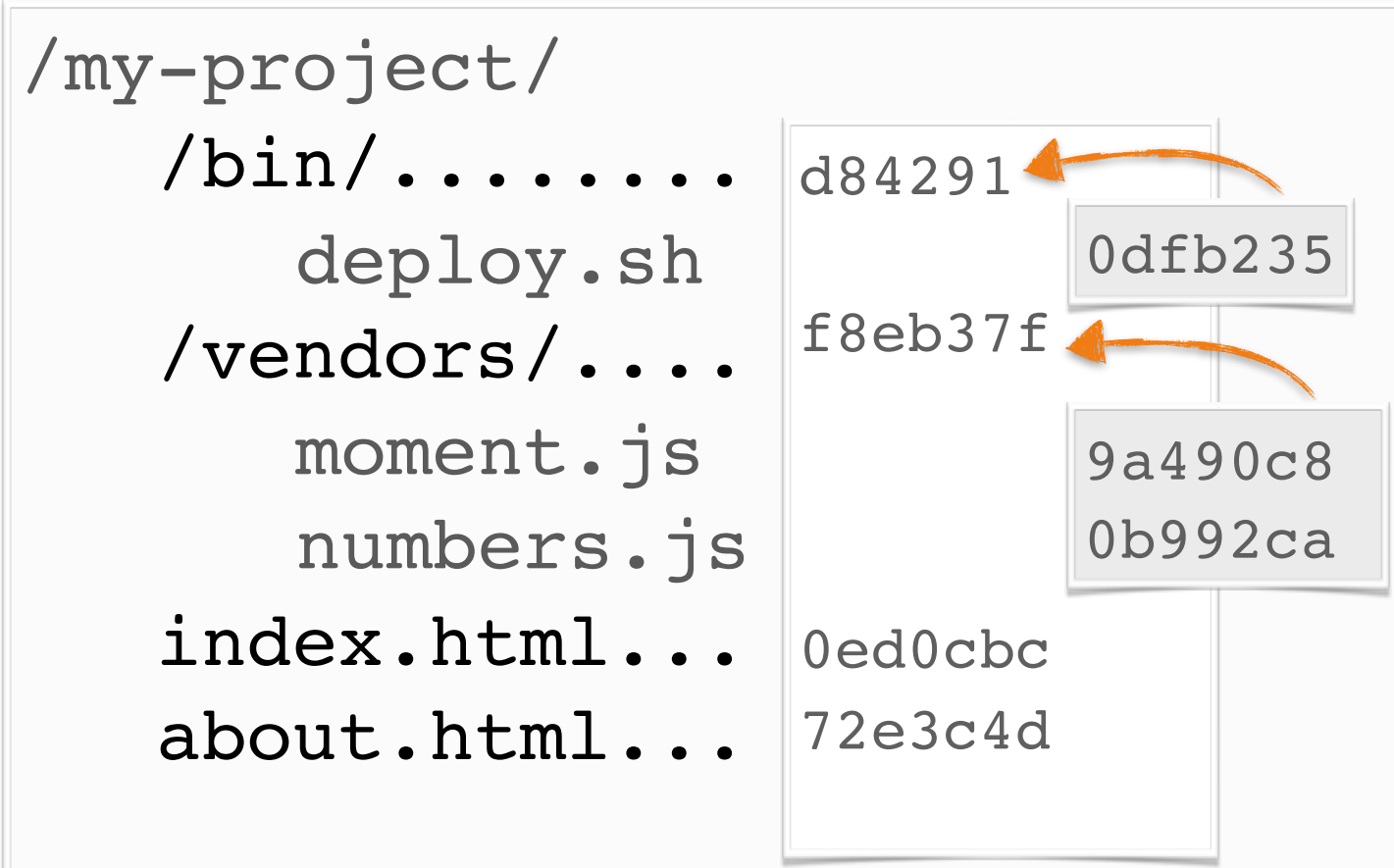
```
/my-project/
    /bin/
        deploy.sh
    /vendors/
        moment.js
        numbers.js
    index.html
    about.html
```

Each git project will track
A top-level directory (the root)

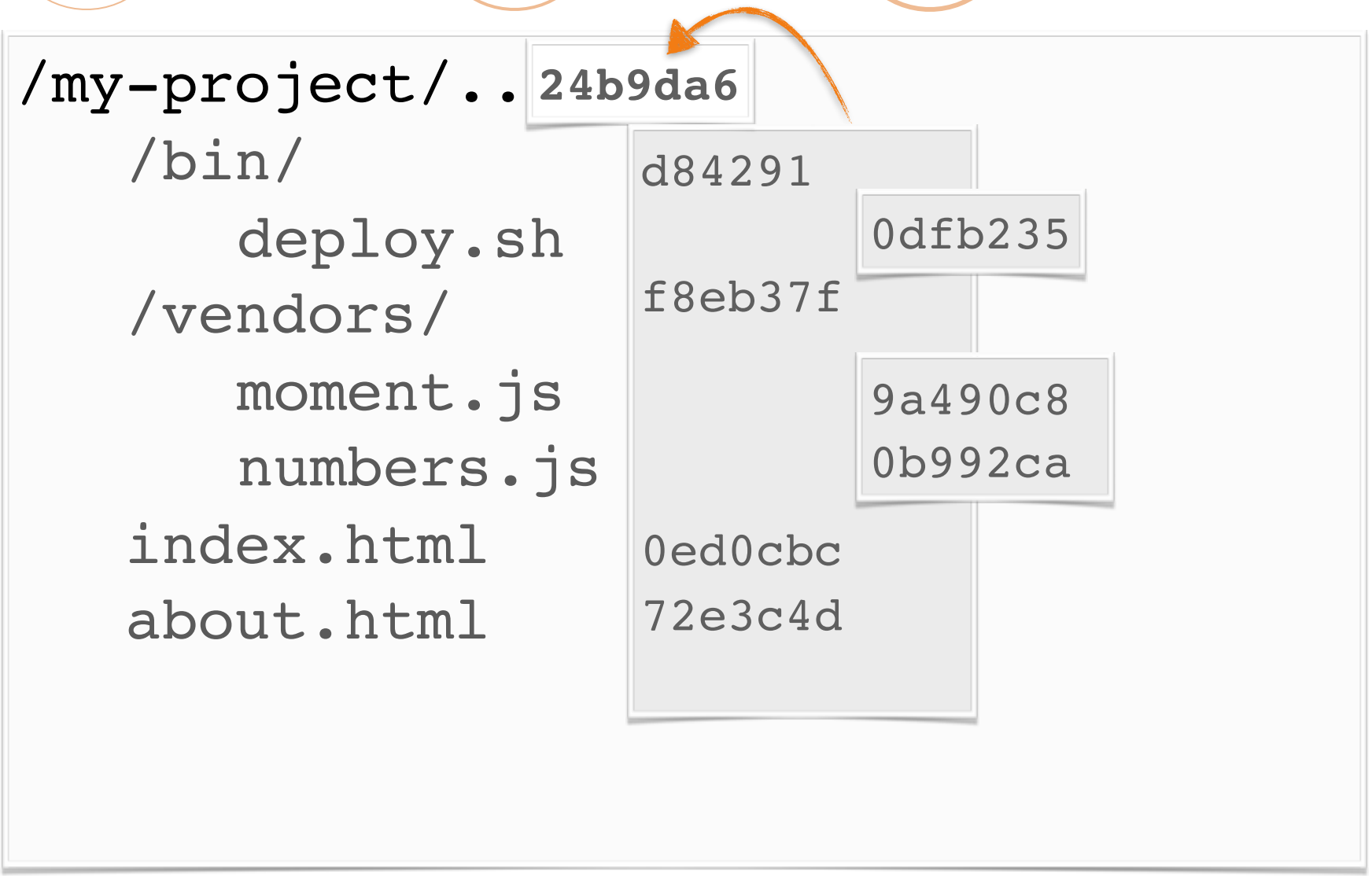
Everything is hashed

```
/my-project/
   /bin/
      deploy.sh.......  0dfb235
   /vendors/
      moment.js.......  9a490c8
      numbers.js......  0b992ca
   index.html
   about.html
```

Everything is hashed



Everything is hashed

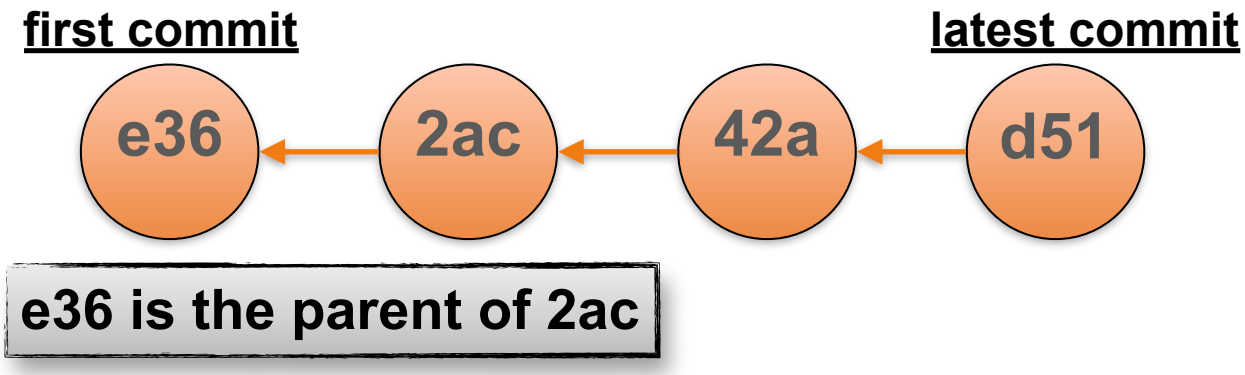


~~Versions~~ => Commits

- Commits represent a "version"
  - No sequential identifiers
  - Identifier is a hash (sha1 or sha256)

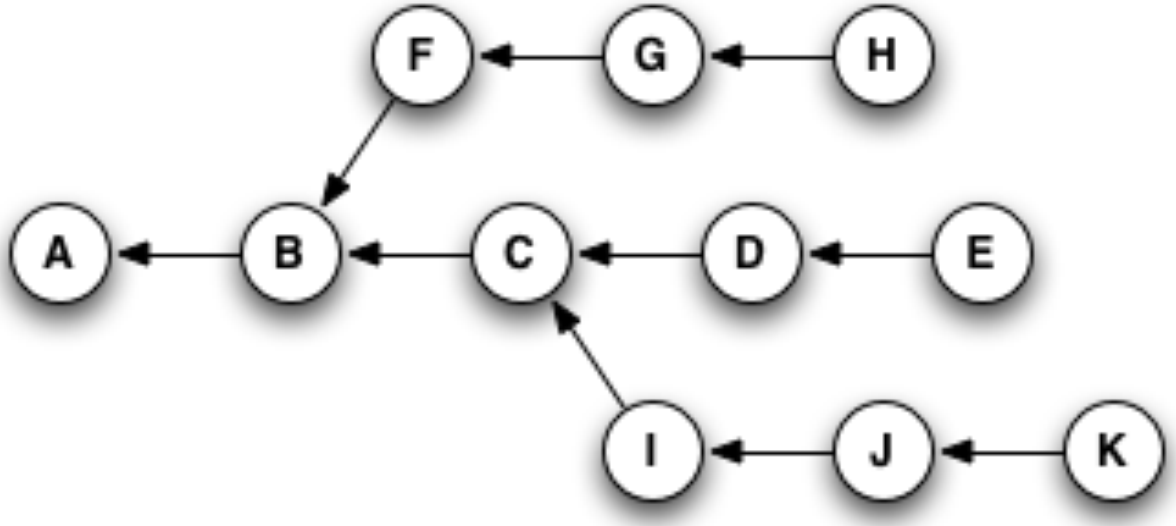
```
d842916416b7490e9b1b67b4a25748b1612465e8
```

- Each **commit** represents a "snapshot"
- Commits point to their parent commits



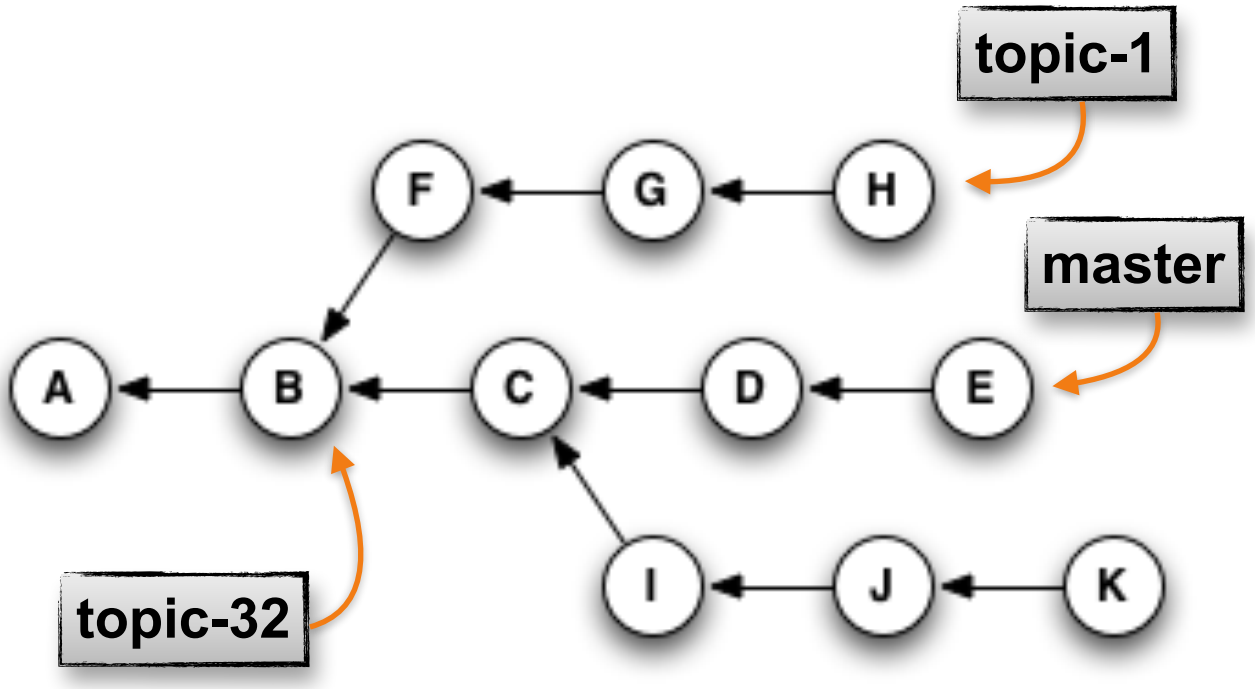
Git is building a Graph

- Commits are the nodes



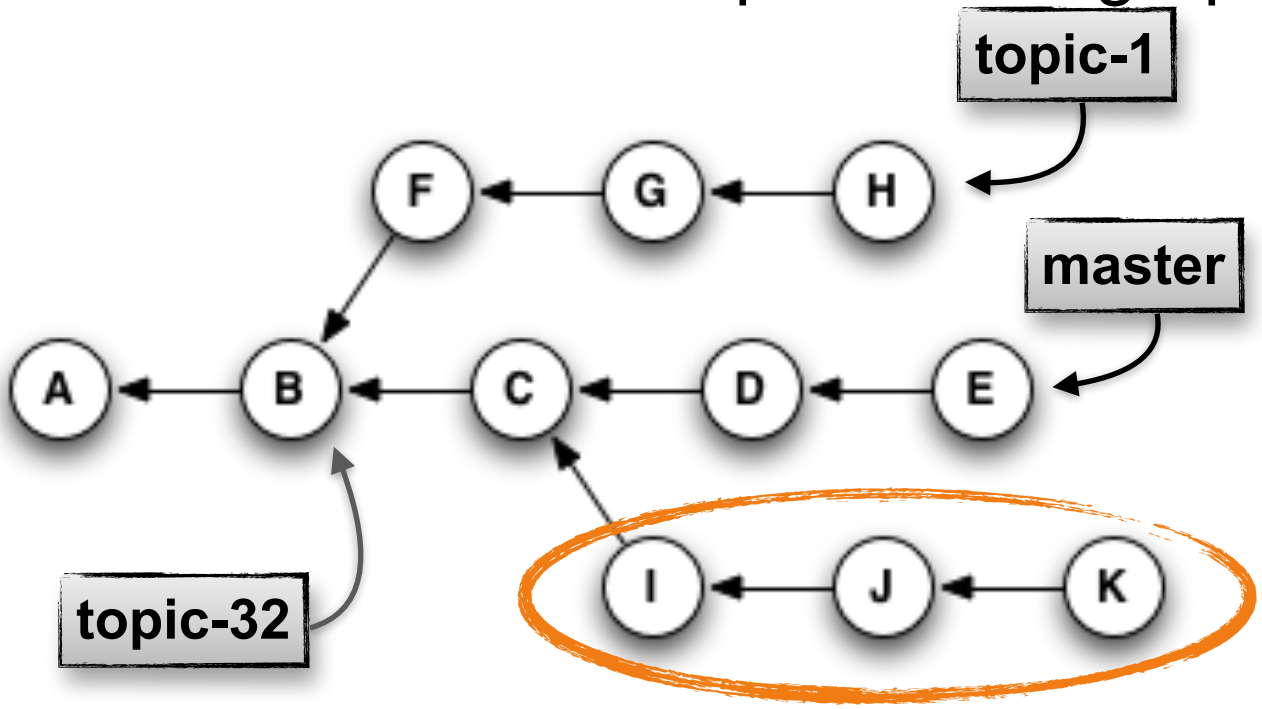
Git is building a Graph

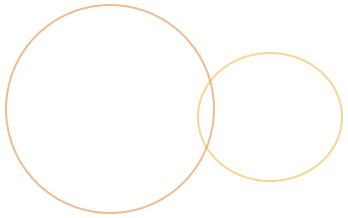
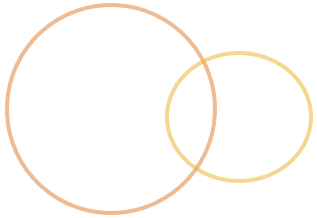
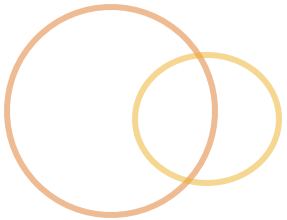
- Commits are the nodes
- We'll label special commits



Git is building a Graph

- Commits are the nodes
- We'll label special commits
- Unreachable stuff is still part of our graph



module

THE COMMAND LINE

Command line basics

- *How does everyone feel about using the cli?*

- *The Art of the Command Line*
  - *https://github.com/jlevy/the-art-of-command-line/blob/master/README.md*

Core commands

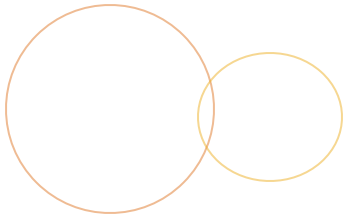
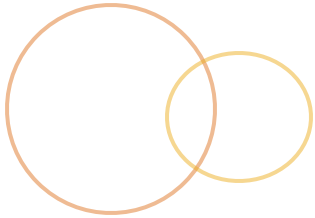
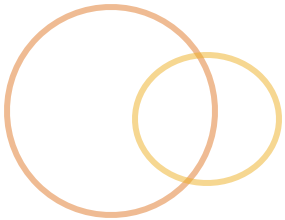
`cd <directory name>`	change directory
`cd ..`	go back a directory
`touch <filename>`	create a file
`mkdir <directory name>`	create a directory
`ls`	list files in this directory
`ls -la`	list all files in this dir
`rm <filename>`	remove a file
`rm -Rf <directory name>`	remove a directory
`clear`	clear my console
`pwd`	what is the present dir
`cat <filename>`	view file contents
`open <filename>`	open file with the main app

Editor commands

- **Vim**
  - Edit (insert mode)
    - `esc + "i"`
  - Save & Quit
    - `esc + ":wq"`
  - Quit without saving
    - `esc + ":q!"`
- **Emacs**

Dress up that CLI

- My command line prompt is formatted
- Yours may not be, don't be sad
- Options:
  - Grab one of many shell prompt formatters
  - Use a different shell like Zsh
    - Oh My Zsh
- All commands are the same

module

SETUP

Installed & Configured

- Install it: http://git-scm.com/download/

- Configure it for all your projects

```
git config --global user.name "Ryan Morris"
git config --global user.email "ryan@mnos.org"
```

- View a config value

```
git config --global user.name
```

- Unset a config value

```
git config --global --unset user.name
```

Per-Repository Configuration

- Configure individual projects

```
cd some/repository/directory
git config --local user.email "ryan@work.com"
```

Levels of Git Config

--system

`/etc/gitconfig`

Affects all users

Win:
in your git install
mingw32\etc

--global

`~/.gitconfig`

Affects all repositories for a single user

Win:
C:\Users\your-user

--local

per repository

`myrepo/.git/config`

Affects a single repo

Overrides any other config settings

having trouble finding it?

```
git config --edit --local
```

Handy configs

- core.editor (vi, emacs, notepad, etc)

```
git config --global core.editor vi
```

- core.autocrlf
- core.pager (less, more, '')
- push.followTags (true, false)
- pull.rebase (true, false)
- fetch.prune (true, false)
- And many more...

Common Editor Settings

This may be dated!
Google for your preferred editor:
ex: "sublime git editor"

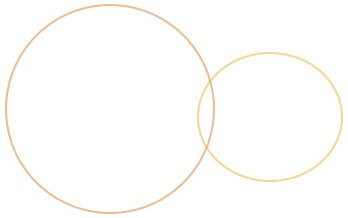
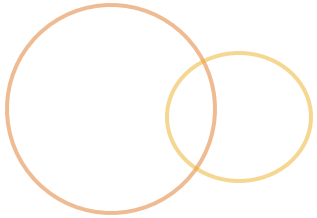
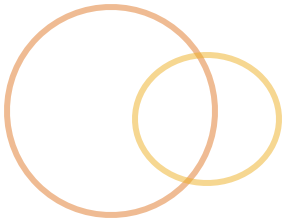
```
# Emacs
git config --global core.editor emacs

# Sublime (requires "subl" cli installation)
git config --global core.editor "subl -n -w"

# Text Wrangler
git config --global core.editor "edit -w"

# VS Code
git config --global core.editor "code --wait"

# Windows Notepad
git config --global core.editor notepad
```

You might already have...

- Your name & email
- GPG Signing enabled
  - `user.signingkey`
  - `gpg.program`
  - `commit.gpgsign`
- A proxy defined
  - `http.proxy`
- Auto squash on pull
  - `pull.rebase`

Lab: Set up checkpoint

- Make sure git is installed
  - `git --version`
- Set up your identity
  - `git config --global user.name "your name"`
  - `git config --global user.email me@gmail.com`
- *Optionally* set your text editor
  - `git config --global core.editor emacs`
  - `git config -e`
- Double-check your configurations
  - `git config --global --list`
  - `git config --global <key>`
- Inspect the config file(s)
  - `cat ~/.gitconfig`

module

REPO CREATION

We'll learn about...

- **Creating** repositories with **init**
- **Tracked** vs **Untracked**
- **Staging** & **Committing** ~~files~~ changes
  - The typical workflow
- The **Git Database**

I'll run through creating a repo, inspecting, staging and creating commits

Creating a repository

- Initialize a repository

```
git init <directory>
```

- More examples

```
git init ./
git init my-repo
git init any-folder-name
```

Inspecting our repository

- Check the status and the log

```
git status
git log
```

- Check what git has initialized

```
ls -la
ls -la .git
```

Files are considered...

- **untracked**
  - A file your repository hasn't seen before
  - The repository (git) is not going to touch it unless you "add/stage" it.
- **tracked**
  - A file your repository knows about
  - Changes will be noticed
  - Once you **stage** it... the file is *tracked*

Stage & Commit Workflow

- Create a file, *stage* it, *commit* it

```
touch README
git add .
git commit -m 'Initial README'
```

- Check the status and the log

```
git status
git log
```

Why Stage?

- Be thoughtful about your commit
  - Logically break up commits
  - Tell a story through your changes
- Selectively prepare a commit
  - Don't commit everything at once
  - You can specify lines to commit

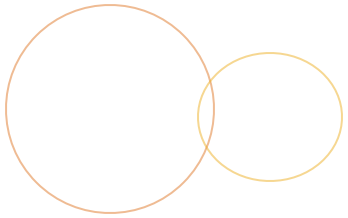
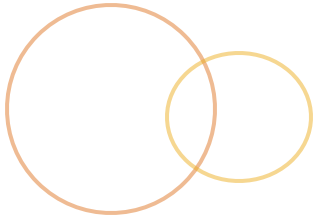
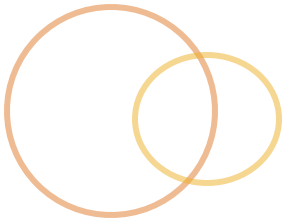
Optional

Lab: Create your first repo

- Initialize a repository called "**first-repo**"
  - `git init first-repo`
- Check the status and log
  - `git status`
  - `git log`
- Find the git database
  - `ls -la .git`
- Create a file with an editor or…
  - `echo "Hello World" > hello.txt`
- Stage the ~~file~~ change
  - `git add hello.txt`
- Check the status
  - `git status`
- Commit the change
  - `git commit`
- Check the log
  - `git log`

Don't forget to cd **into the new directory after you initialize**

Bonus (when you're done):
Delete your '.git' folder, what happened to your repository?

module

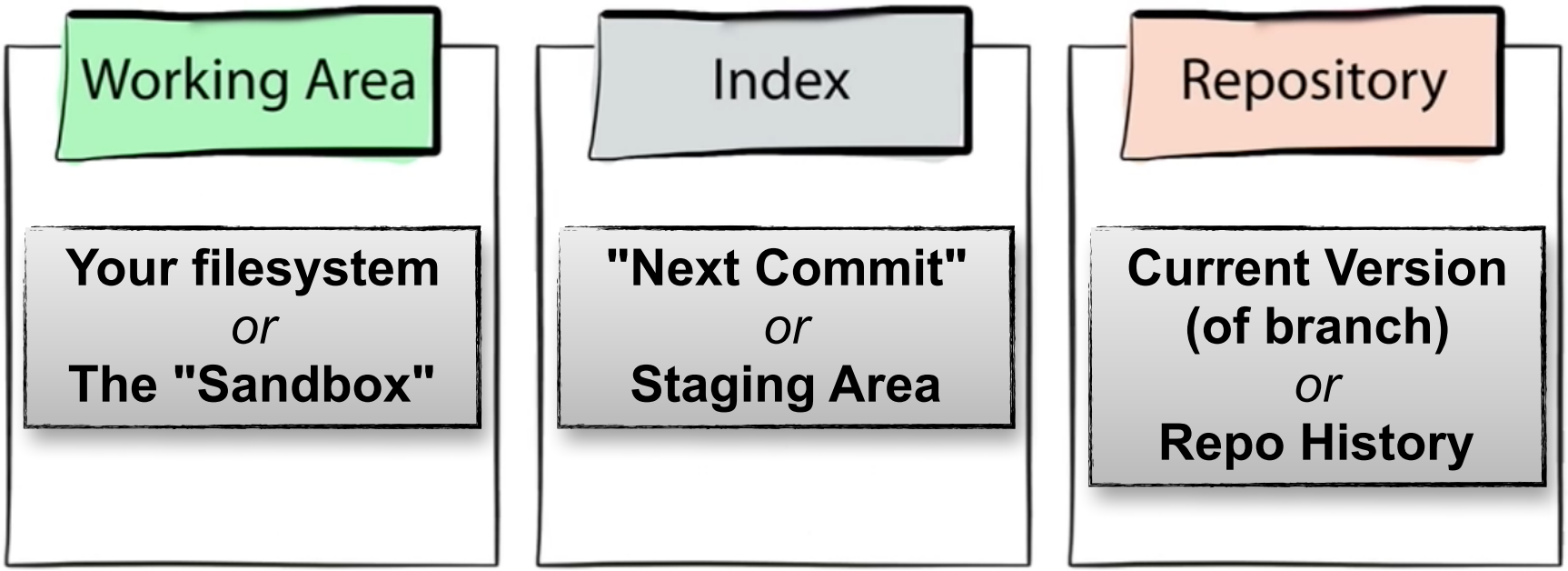
THE THREE TREES

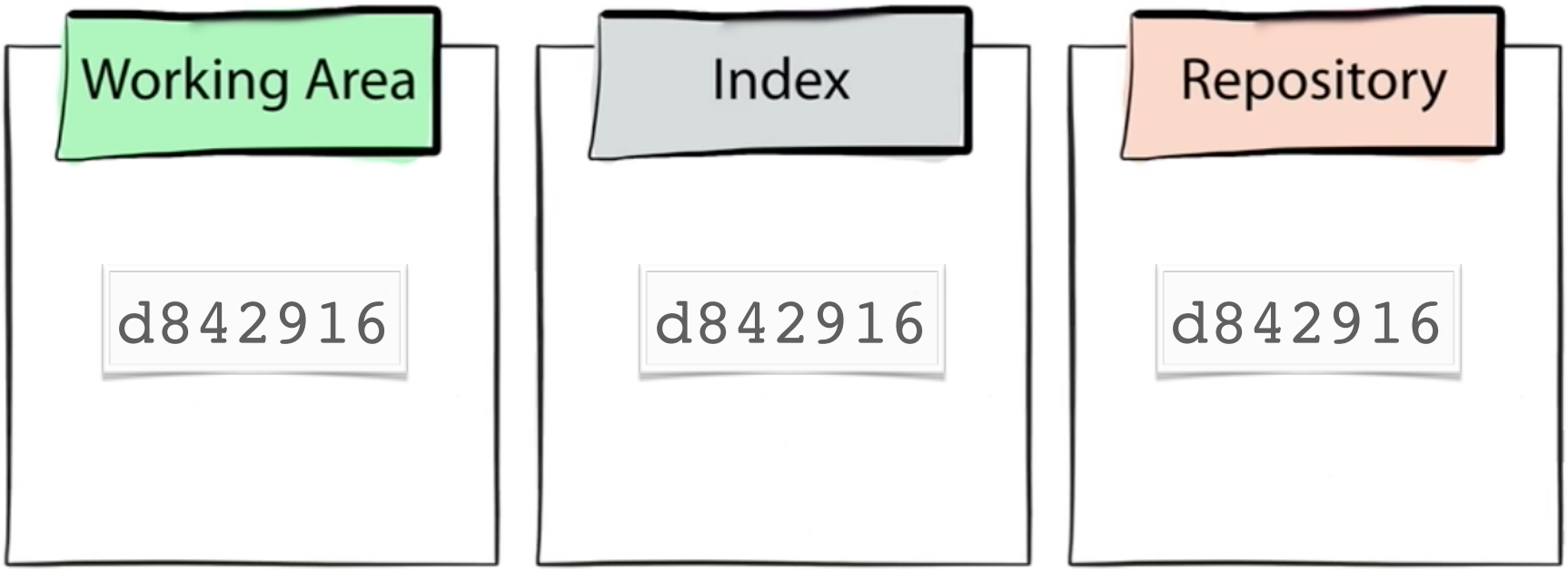
What we'll learn...

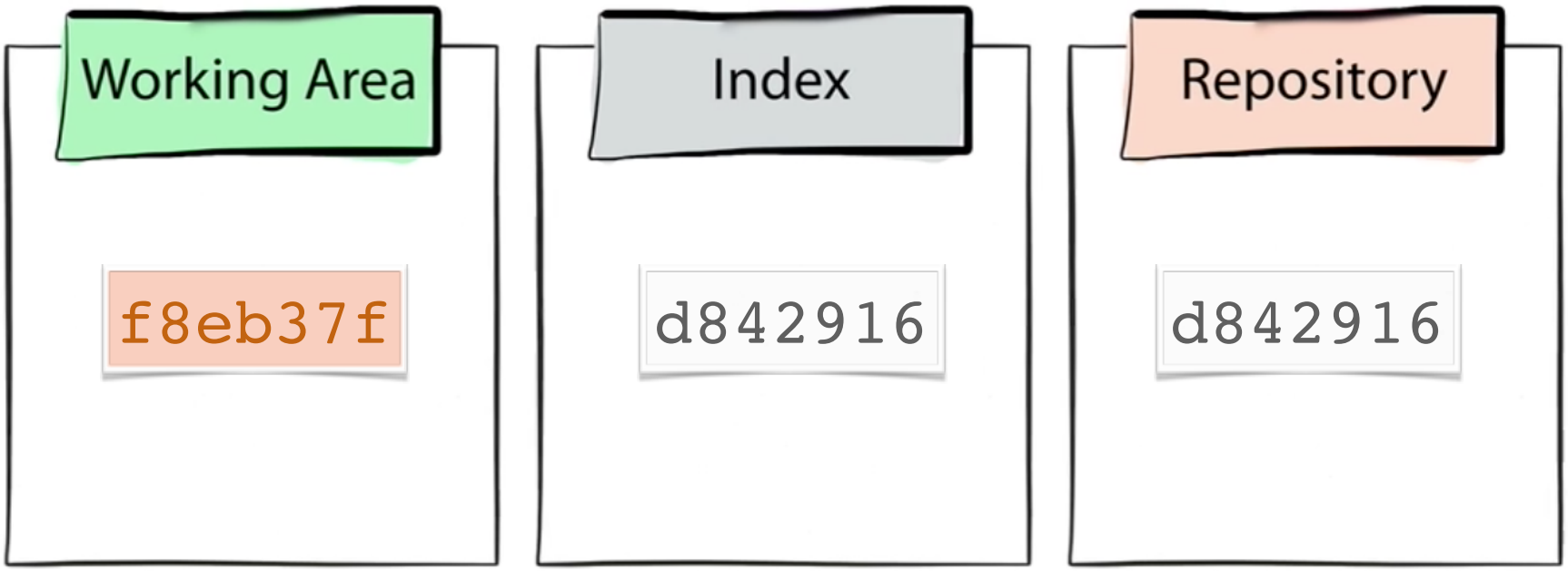
- The Three Trees
- Commit shortcuts
- Viewing diffs
- Checking the project's history
- Moving and Removing files with git

I'll run through separation of staging from WD, log viewing, diffs, show, mv and rm

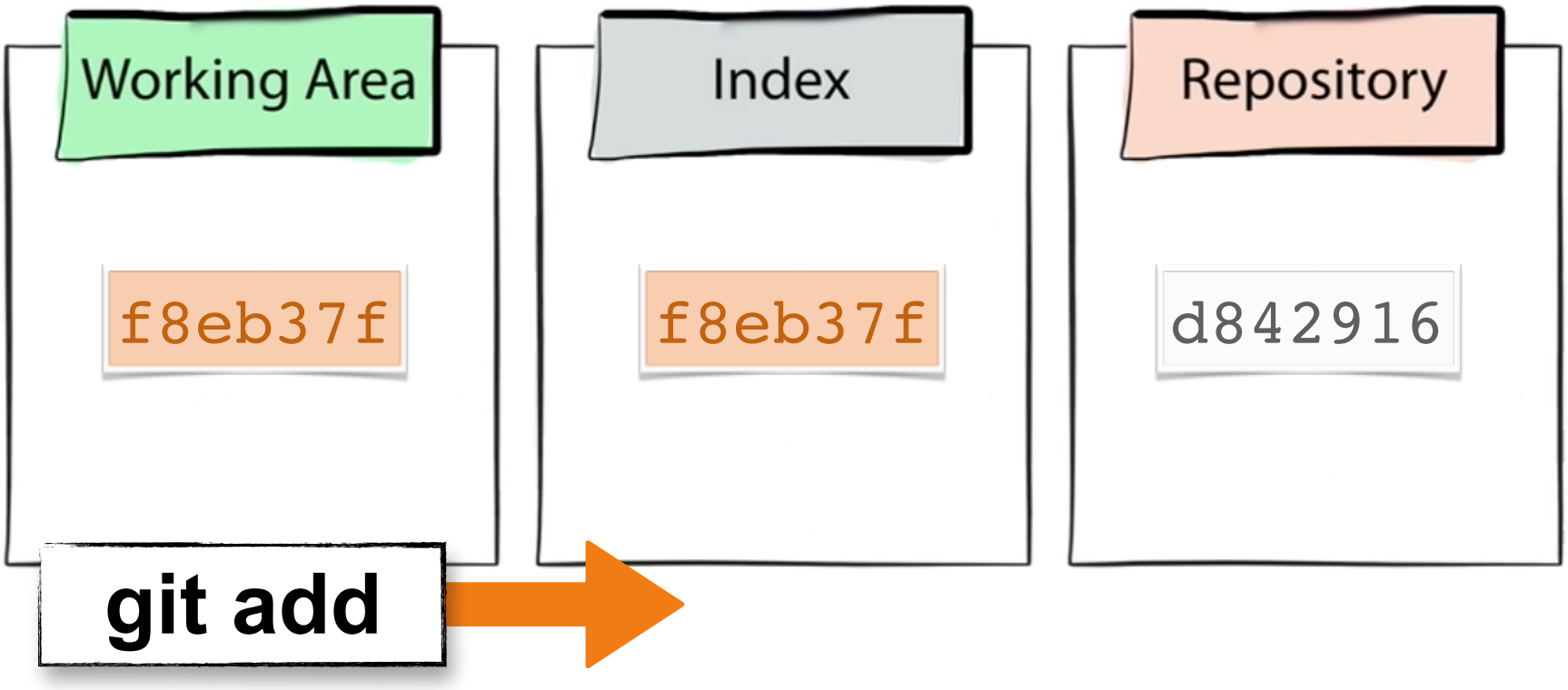
The Three Trees




Working Area
d842916
Index
d842916
Repository
d842916



I make one or more edits to my local files...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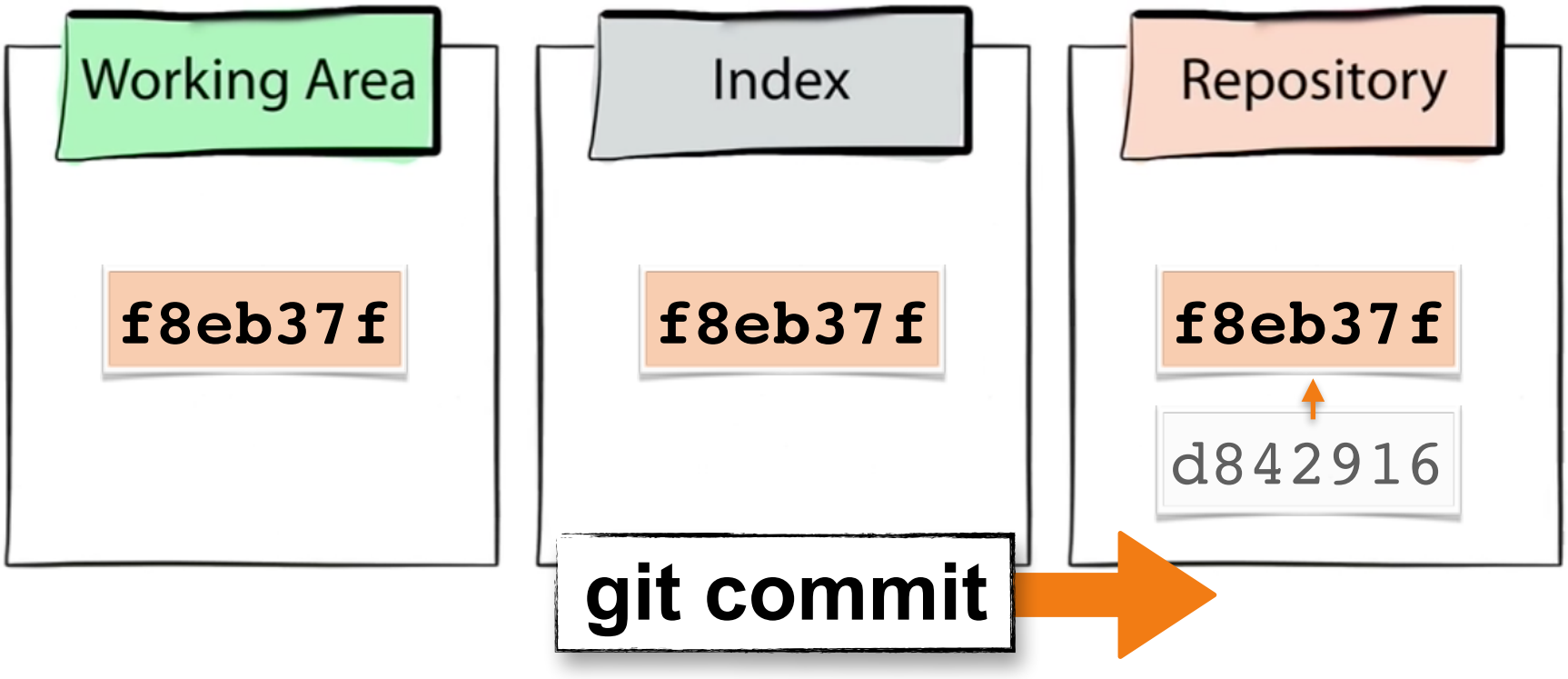
Index
Repository
f8eb37f
f8eb37f
d842916
git add


Working Area
f8eb37f
Index
f8eb37f
Repository
f8eb37f
d842916
git commit

Git status

```
git status
```

- *Info* about your **current branch**
- *Changes staged* in the **staging area (index)**
- *Changes* in the **working directory**
- *Hints* for undoing things

```
# quick stats
git status -s
```

Stage with add

```
git add <pattern, file or files>
```

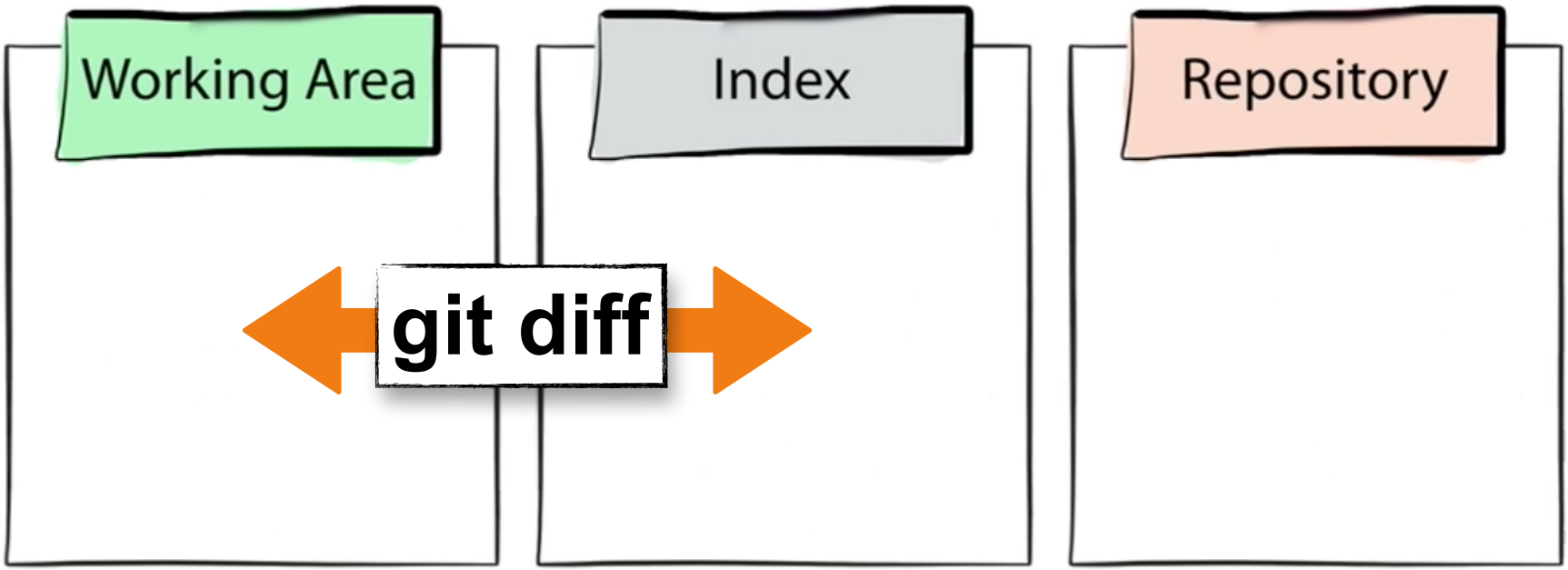
- Stages the file(s) or changes
- Begin tracking new files
- Later... marking conflicts as resolved

```
# staging all changes in a directory
git add bin

# staging with pattern matchers
git add bin/*.sh
git add *.html
git add .
```

Seeing what has changed

```
git diff
```

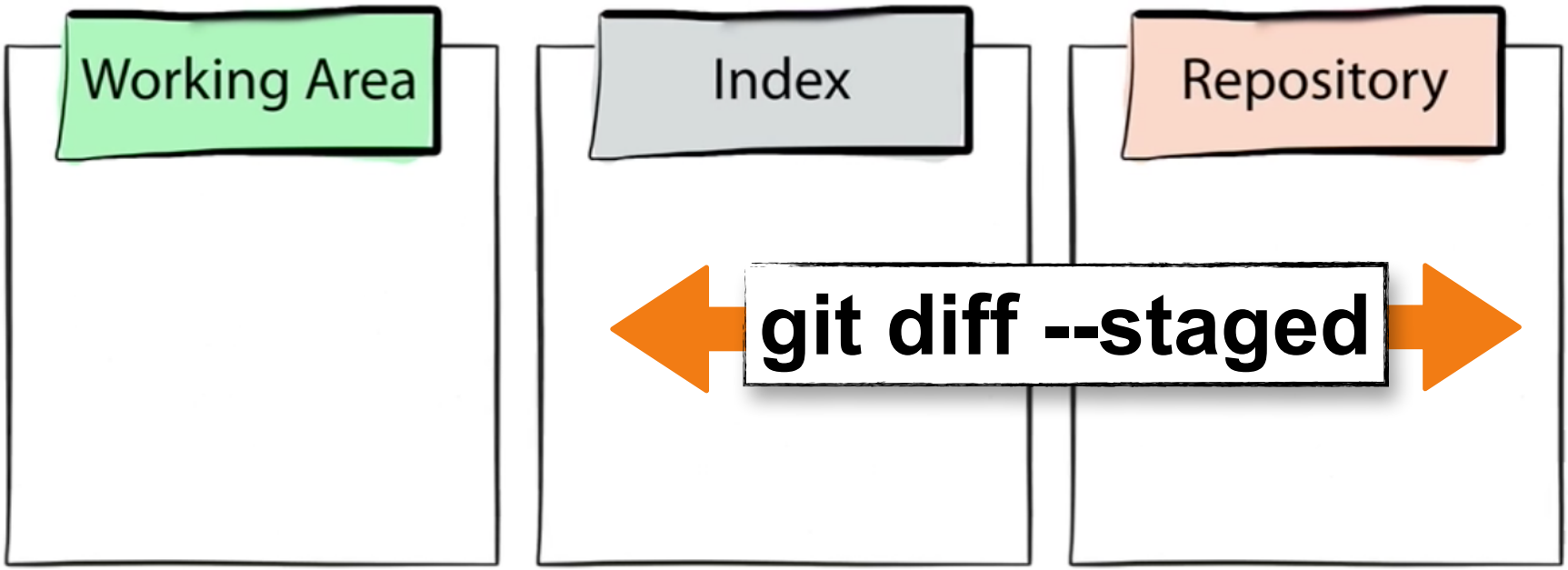
- Shows difference between **working directory** and **index**
- Does not include untracked files



Seeing what has changed pt.2

```
git diff --staged
```

- Compare changes between staging area and the latest version in the repository.
- What you will commit

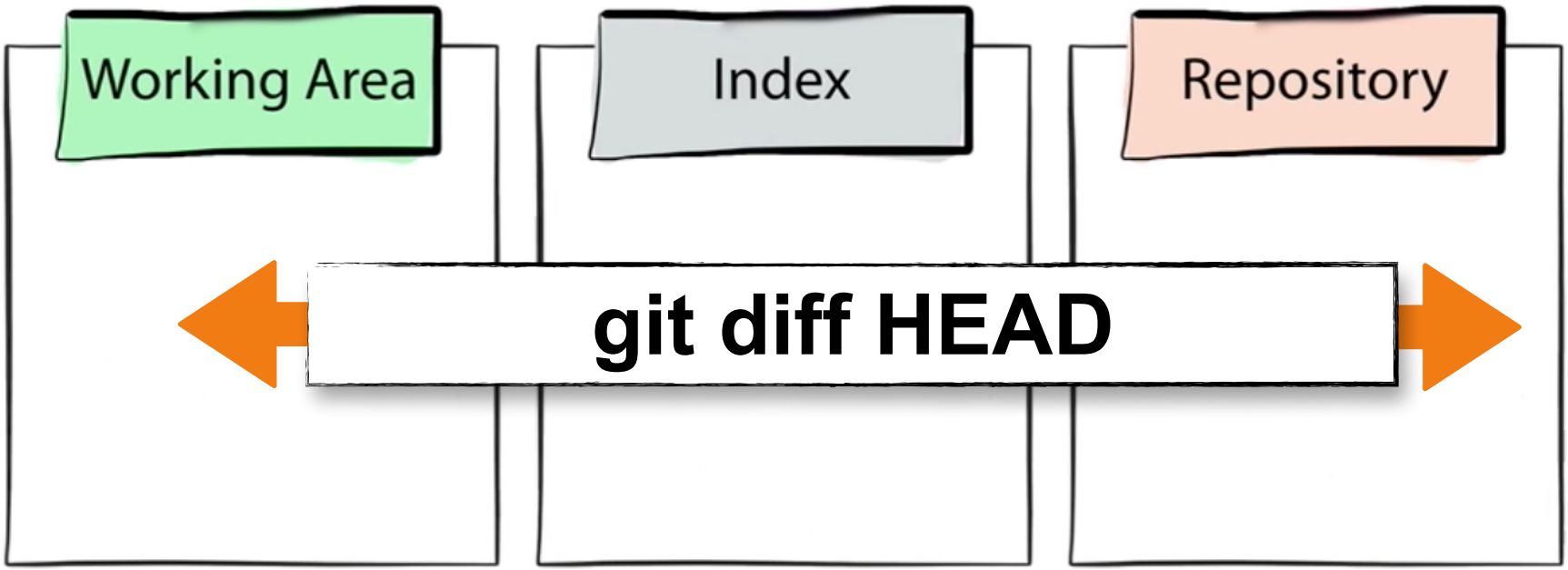


Seeing what has changed (pt3)

- Viewing all changes you've made, combined

```
git diff HEAD
```

"What is different between my files (WD) and the last commit (Repo)"



Committing

```
git commit
```

- Applies files/changes from the staging area into the repo
- …by creating a **commit object** in your git database

Commit Messages

- All commits *require* a message
- You can commit with a message (shortcut)

```
git commit -m "My commit message"
```

- You can also commit an empty object

```
git commit --allow-empty
```

Inspecting commits

`git show`

- Shows info about a commit

```
# latest commit
git show

# inspect a specific commit
git show 42d484c401f0a19cc8a954c16240821329acefac

# or use the abbreviated commit id
git show 4234
```

View your history

```
git log
```

- Show history from current commit, back
- Lots of options
  - `--oneline`
  - `--graph`
  - `-<n>`

Git rm and mv

- Delete a file or directory

```
git rm [-r] <file or dir>
```

- Move a file or directory

```
git mv <old> <new>
```

- Why use them?
  - Auto-stages the change
  - Avoid mistakes, ie: deleting a file with changes
  - Can bundle a move and an edit in one commit

Skipping staging

- It is possible to commit w/out staging...

```
# auto-stage and commit
git commit -a

# or..
# this skips staging entirely
# committing the file changes
git commit <filename>
```

- *I don't recommend using this...*

Recap

- **git init -** initialize a new repo
- **git status -** status of working directory, changes to stage or that have been staged
- **git add -** stage changes, prepare to commit
- **git commit -** commit changes, adds the change into the repository as a commit object
- **git diff -** see what you've been editing
- **git show -** to see info about a commit
- **git log -** view the history of commits

Lab: "About me" repo

After each step be sure to check status and the diff

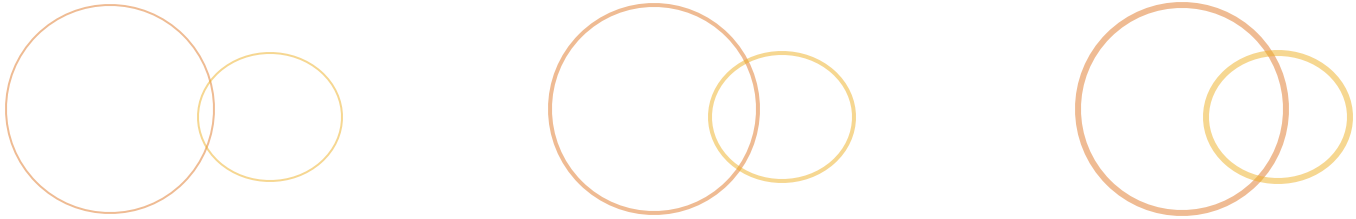
1. **Create** a new repository, "about-me"
2. Create a txt file named with your name
   - `Touch <yourname>.txt`
3. **Stage** the change
4. **Commit** the change
   - Check the log
   - Use "`git show`" on the commit id you just created
5. **Edit** the file to add a short profile about you:
6. **Stage** those changes
7. Then **commit**

All done?

- Try creating a new file, "test", add then commit it
- Try renaming it to "rename-test", add then commit that change

Toolkit

```
git init
git add
git status
git commit
git show
git log
git diff
git diff --staged
```



module

UNDOING

What we'll learn

- Undo edits in your **working directory**
- **Un-staging** changes to a file or directory
- Undoing a **commit**
- Learning more about what **HEAD** is
- Introduction to **reset**

I'll run through clearing my wd, staging area, un-doing a commit and amending

Throw out changes in my WD

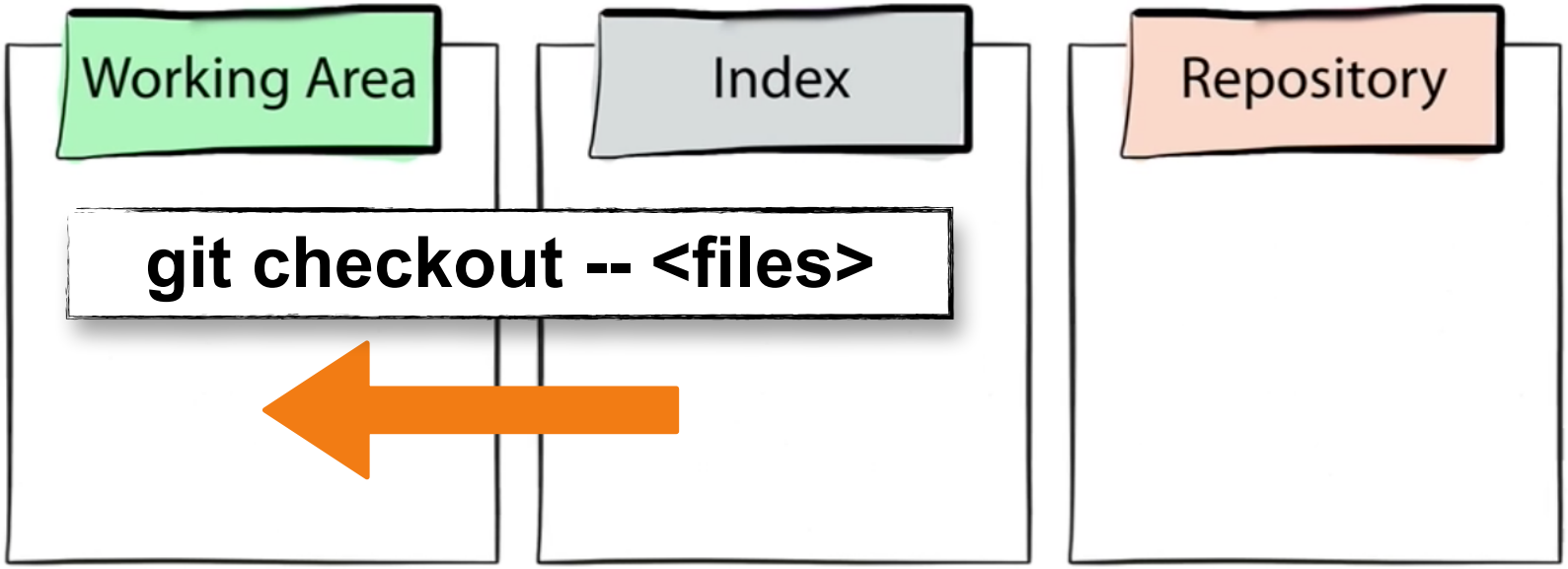
- Checkout can remove **un-staged** changes in your **working directory**
  - One of a few potentially lossy operations

```
git checkout -- readme.txt
git checkout -- src/*.js
git checkout -- .
```

- You can *also* use checkout to switch to a commit's version of a file, folder, etc. (Affects the WD only)

```
git checkout 145820e -- readme.txt
```

Checkout on files/folders



A *staged* change can't be "undone" with checkout...

Un-staging

- `Reset` can remove changes in your staging area
  - Totally safe, unless you find yourself doing --hard

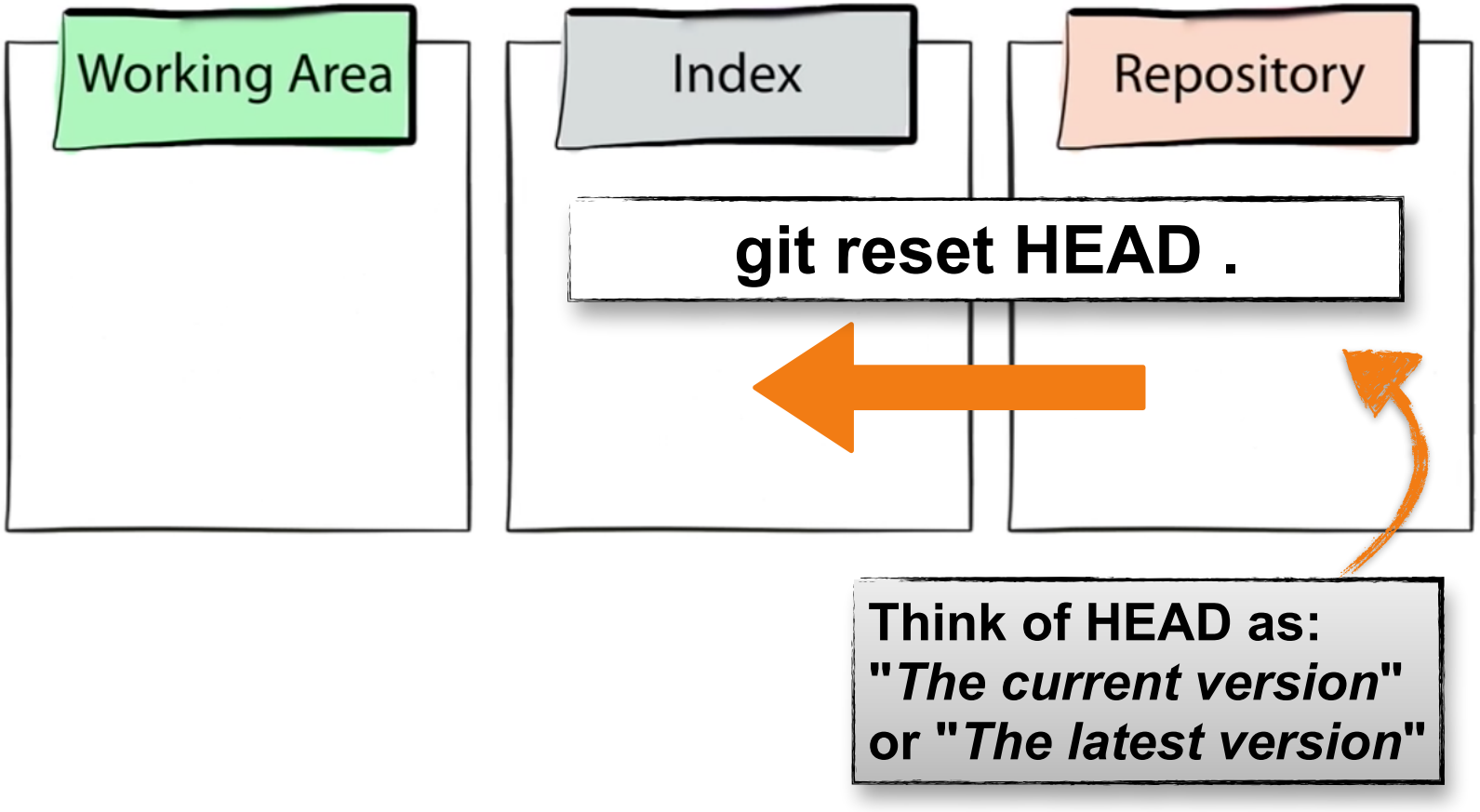
```
# stage it...
git add readme.text
# now un-stage it...
git reset HEAD readme.txt
```

- You can also reset to a specific commit's version
  (Affects staging area only -- this produces oddness)

```
git reset 145820e readme.txt
```

Reset w/ files

- *In this scenario, `reset`... updates the index to be the 'version' the repository is currently at (HEAD)*



Amending the last commit

- Amend is useful to modify your last commit message

```
git commit -m "Stuff!"
git commit --amend
# git will allow you to edit the commit msg
```

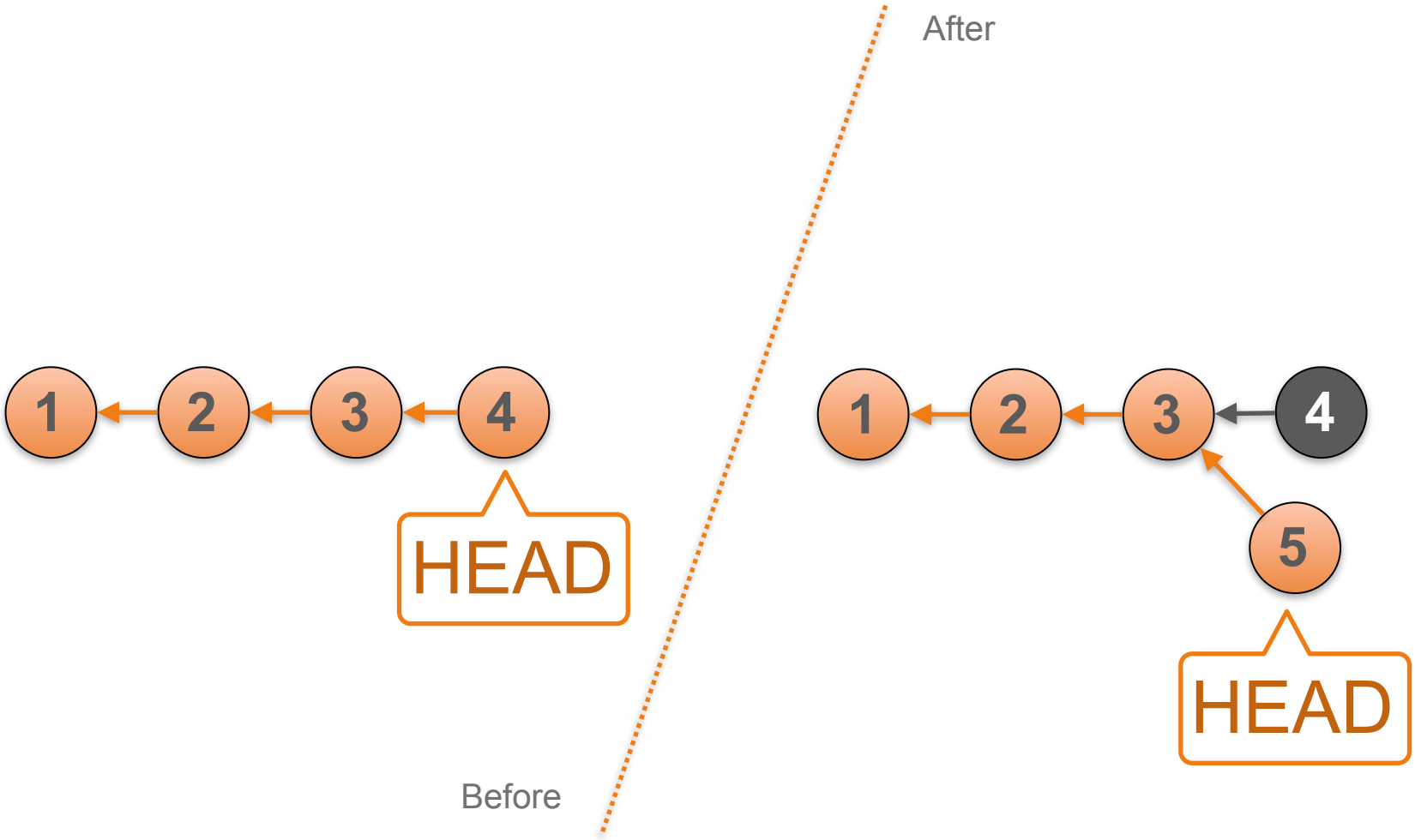
"Re-do the latest commit"

More with amend

- With amend you can update your last commit entirely

```
git commit -m "Stuff!"

# want to change that commit?
# ...edit files...
# then stage
git add .
# then amend...
git commit --amend
```

What did `--amend` do?



Undo your last commit

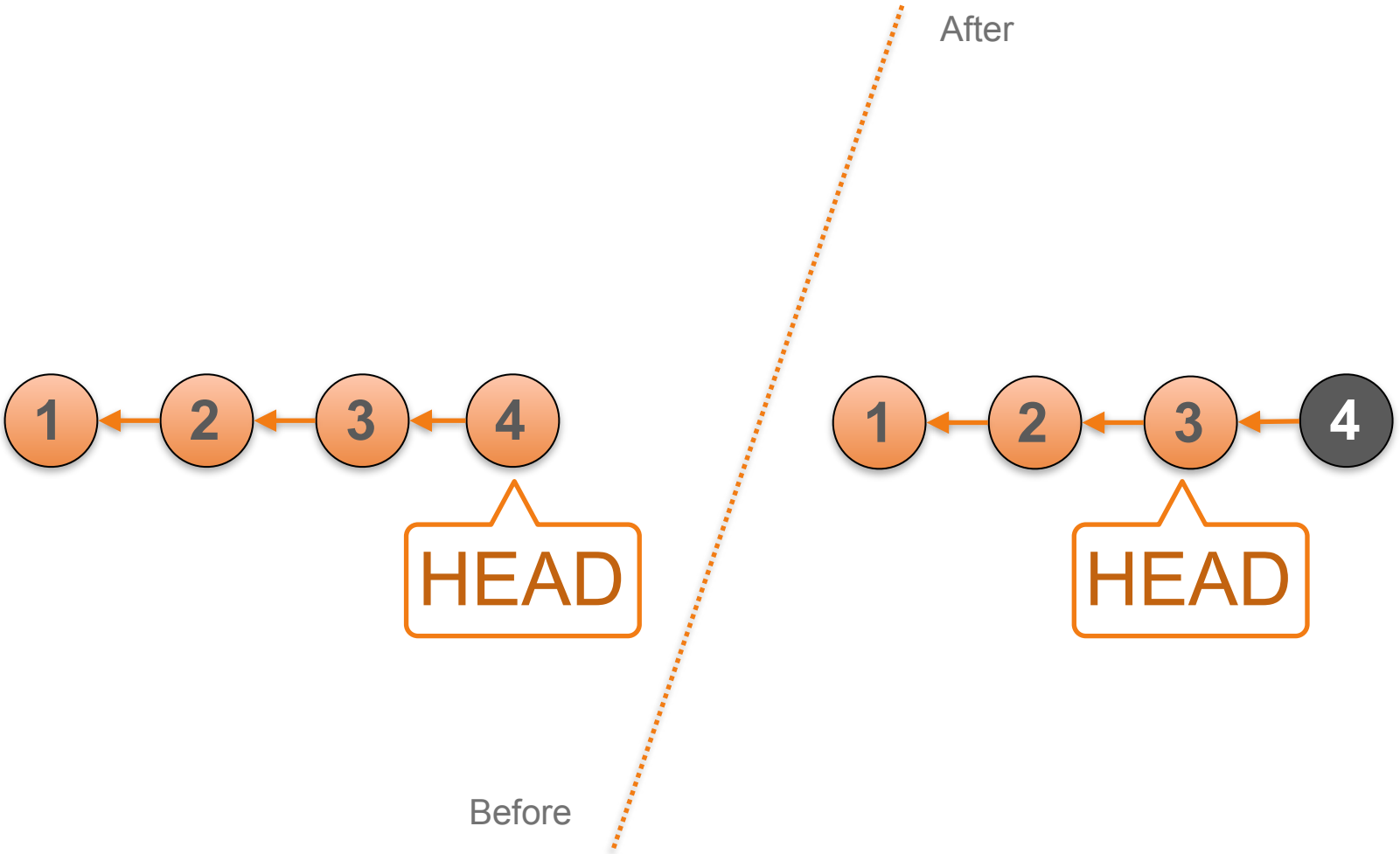
- Reset allows you to change your branch pointer

```
# move back by one commit
git reset HEAD^

# same(ish) thing
git reset HEAD~1
```

"Reset my BRANCH to point back one commit"

- Does *not* throw out your changes

What did Reset HEAD^ do?



Reset anywhere...

- Yup, you can reset your history to anywhere

```
# moves history back 5 commits
git reset HEAD~5

# moves history back to specific commit
git reset ab3f9s
```

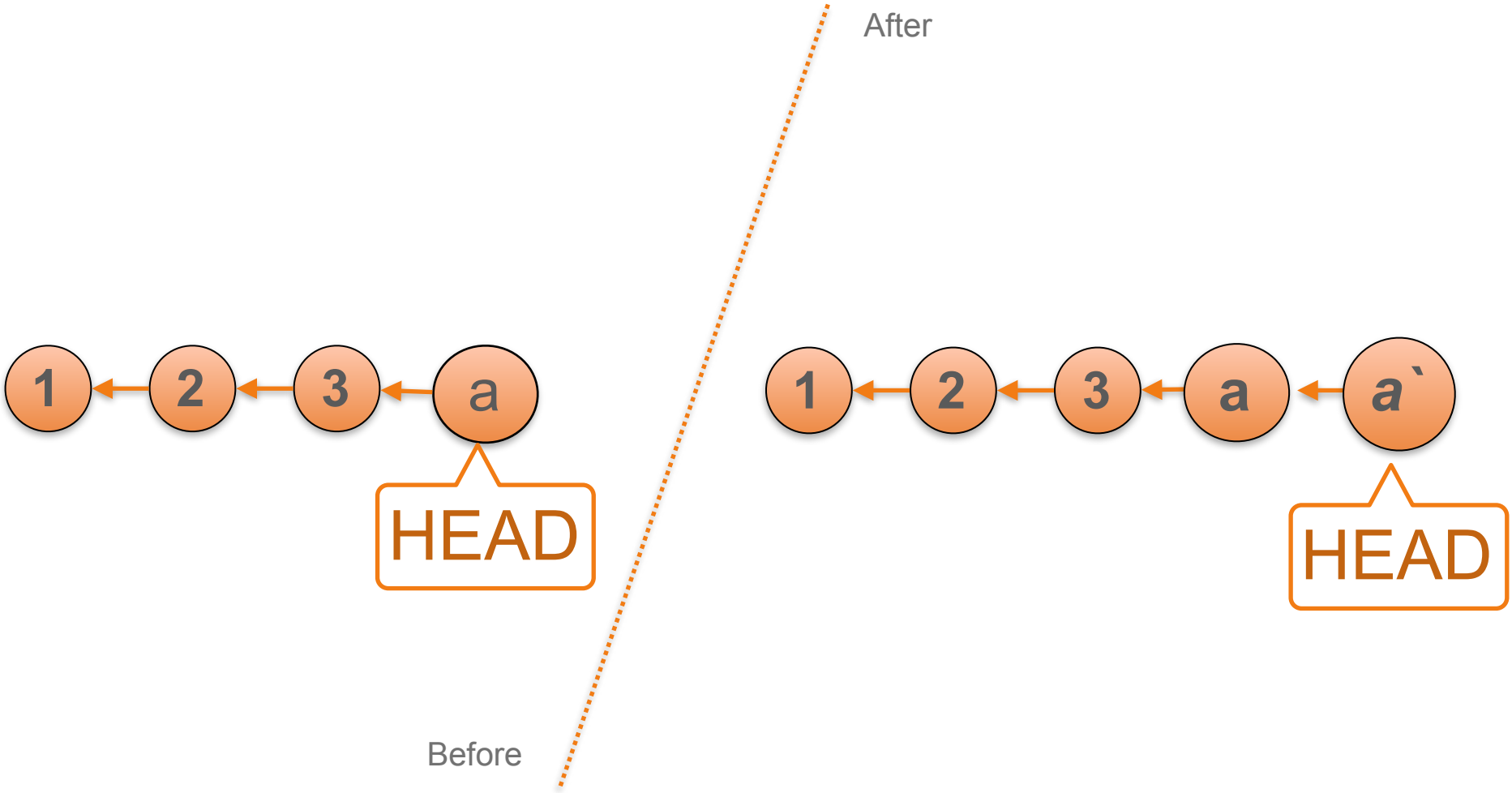
By *history* - I'm really talking about the current branch

Git revert

- Applies the ***inverse*** change set from a commit
- Good for undoing ***public*** commits

```
# undo commit ab3e230
git revert ab3e230
```

What did revert ab3e230 do?



Git clean

- Unlike checkout, only affects untracked files

```
# throw out any untracked
# files & directories
# (except ignored files...)
git clean -d
```

Recap

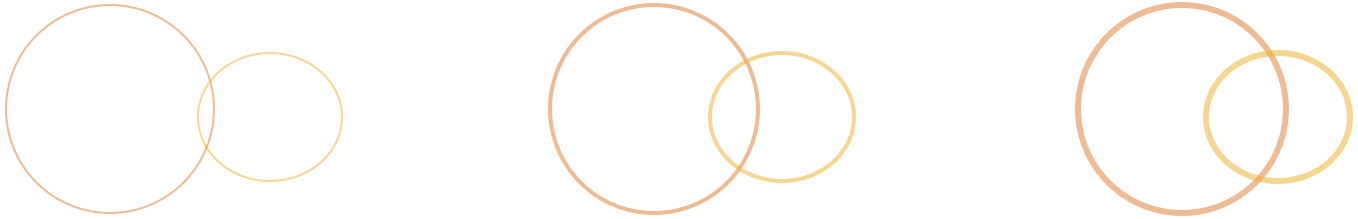
- **Un-stage** things (from **staging area**) with
  - `git reset <file>`
- **Un-change** files in **working directory** with
  - `git checkout -- <file>`
- **Modify** your **last commit** with
  - `git commit --amend`
- **Undo** the **last commit** with
  - `git reset HEAD^`
- **Reverse** commits with **revert**
- **Clean** to throw out untracked stuff

Lab: Undoing things

1. Create two new files, "junk" and "LICENSE"
2. Edit "<your-name>.txt" file, ie: add your fav animal
3. **Stage** all your changes
    1. Un-stage "junk" and "LICENSE"
4. **Commit** only the change to "<your-name>.txt"
5. **Stage** the changes to LICENSE
    1. Then **commit**
6. Stage and commit "junk"
    1. Hmm, didn't mean to do that...
    2. Undo your last commit (with "junk")
    3. Then **delete** the file, "junk".
7. Git **status** should show a clean repository
8. Finally, **amend** your last commit and edit the commit message
9. **Bonus**: use **amend** again, but this time make an additional edit to the "LICENSE" file so that the change is included in the previous commit

Toolkit

```
git add
git status
git commit
git checkout --
git reset HEAD
git commit --amend
git reset HEAD^
```



module

BRANCHING (ONLY)

What we'll learn

- What is a branch
- Creating and using branches
- Comparing branches
- View branching in the log

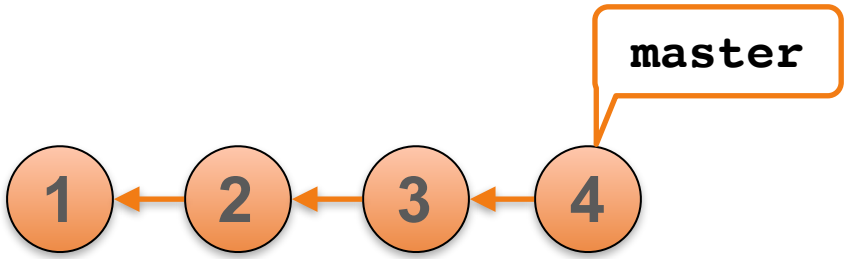
http://pcottle.github.io/learnGitBranching/?NODEMO

Branching in git

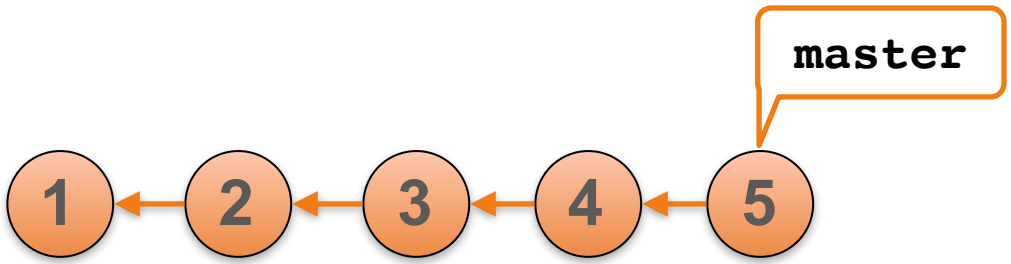
- Branches are cheap, use them frequently
  - Experimentation
  - Separate a unit of work like a ticket, feature, bug
  - Keeps related changes organized
  - Avoids noise/clutter in the mainline
- A branch is *like* a fresh copy of all your files
- **`master`** is our mainline (by convention only)

How branching works

- A branch is like a *live* bookmark for a commit



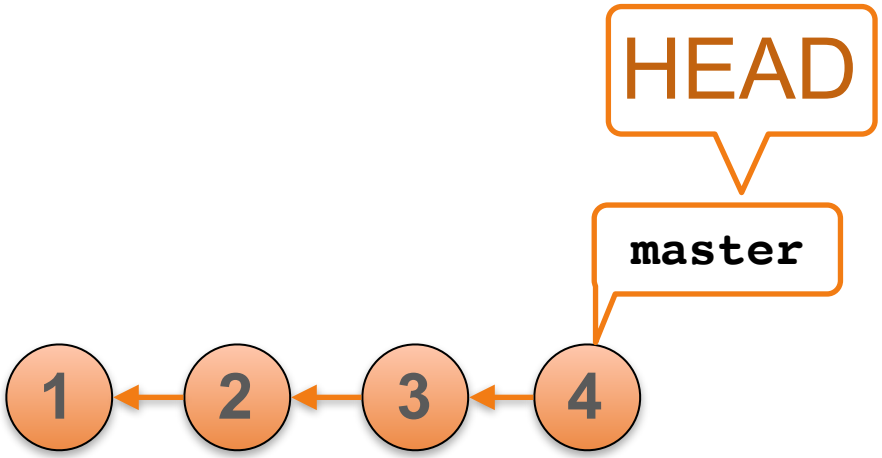
- A **commit** automatically moves the branch forward (to the new commit)



http://pcottle.github.io/learnGitBranching/?NODEMO

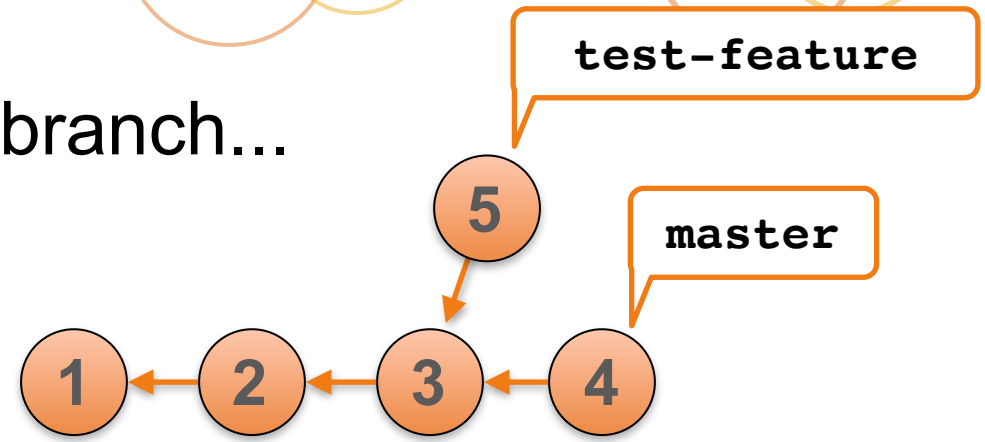
HEAD

- HEAD is a pointer that keeps track of which branch you are on...

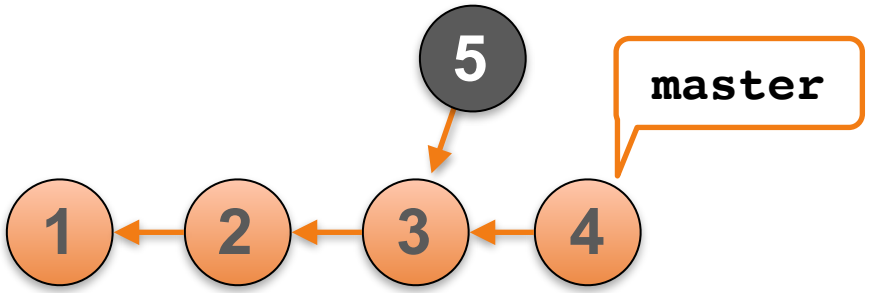


Branches make commits reachable

- Here is a branch...



- Without the branch, the commit is *unreachable*



Git branch commands

```
# list your branches
git branch

# create a branch
git branch <name>

# switch to a branch
git checkout <name>

# create and switch shortcut
git checkout -b <name>
```

Log, revisited

- Visualize the history through the log
  - `--graph` to show the tree
  - `--decorate` to show branch refs
  - `--all` to see all commits, including non-reachable

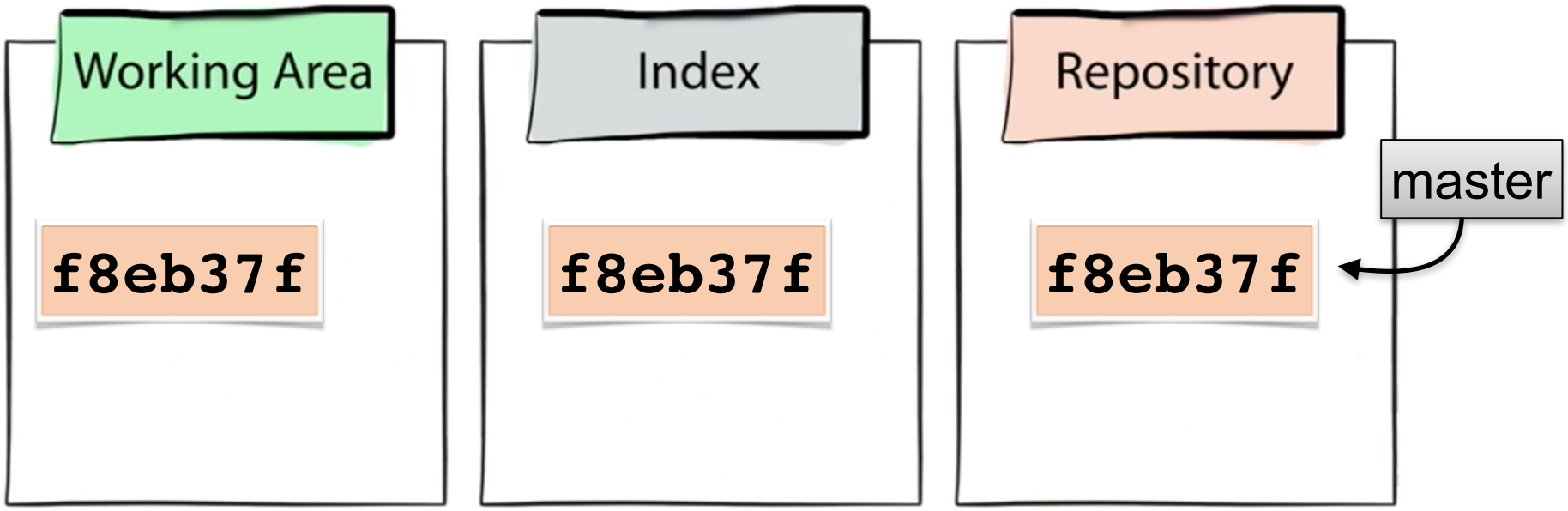
```
# show history as a graph
# with all commits displayed
# and all branches labeled
git log --oneline --decorate --graph --all
```

Checkout

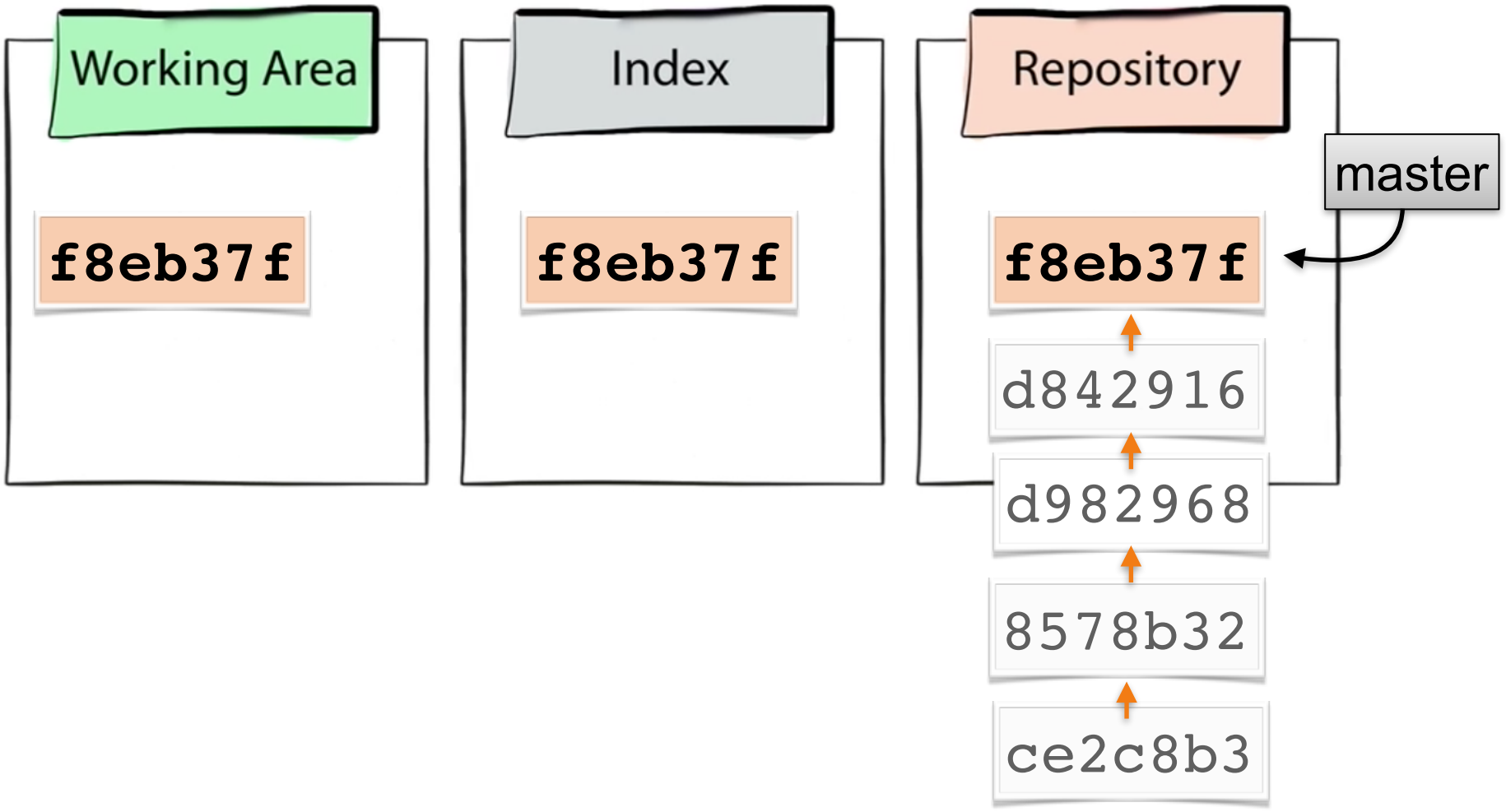
- Multi-purpose command that updates your **working directory** *(and index)* in a *non-destructive* way (overlays)

```
# undo changes to a file
git checkout -- <file>

# checking out a branch
git checkout test-branch

# checking out a specific commit
git checkout abfecf3
```

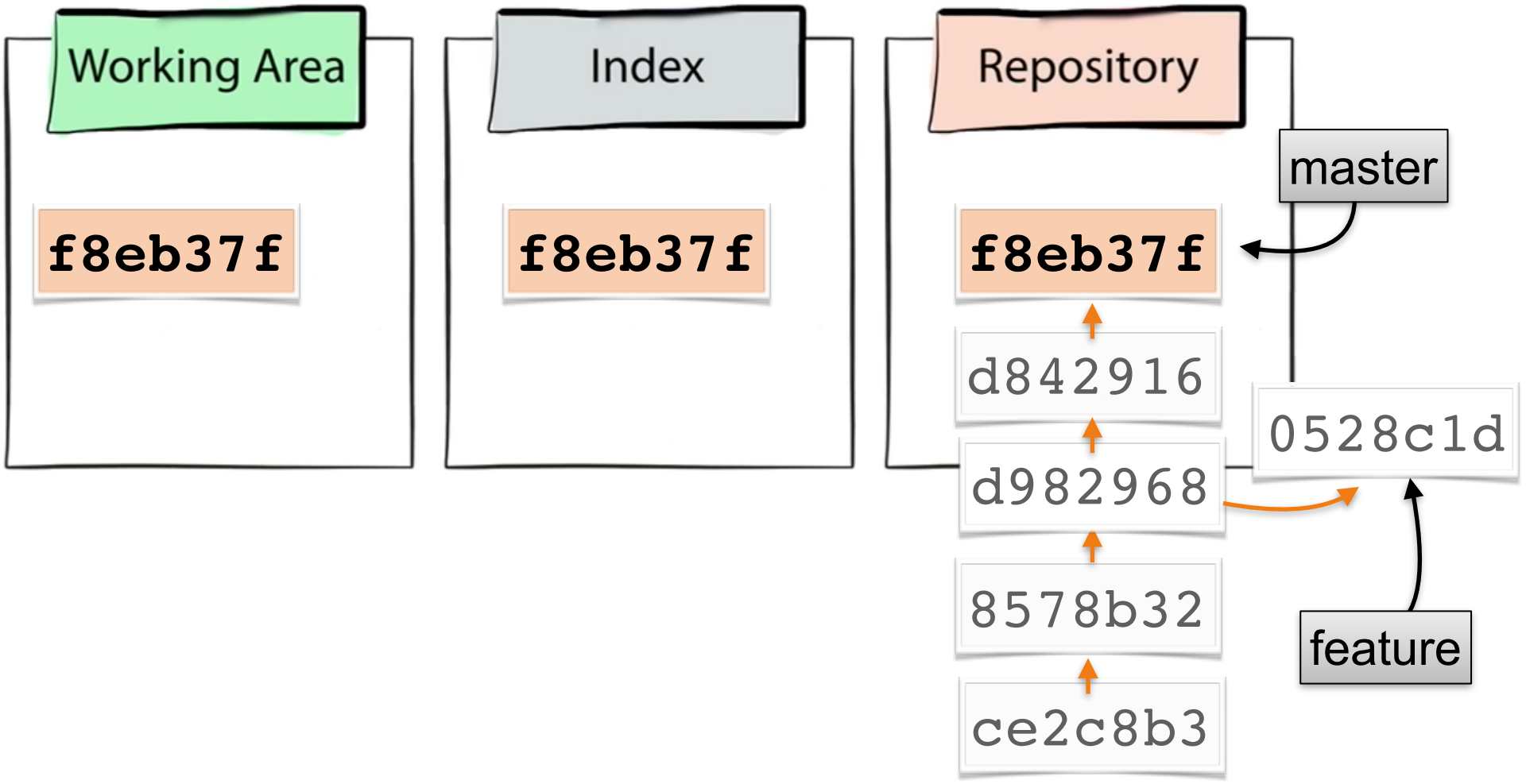
Branch, Checkout & The three trees



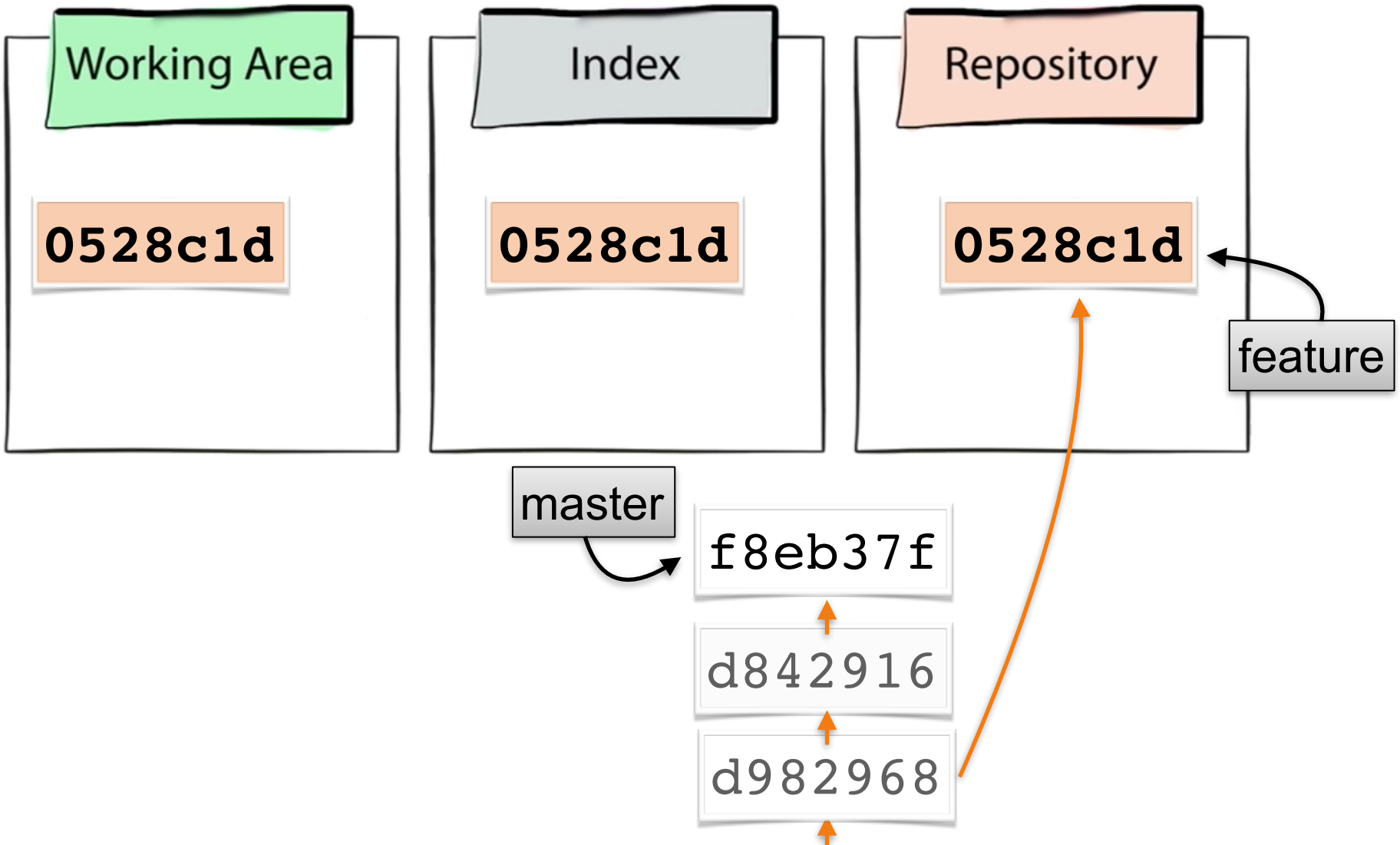
Branch, Checkout & The three trees



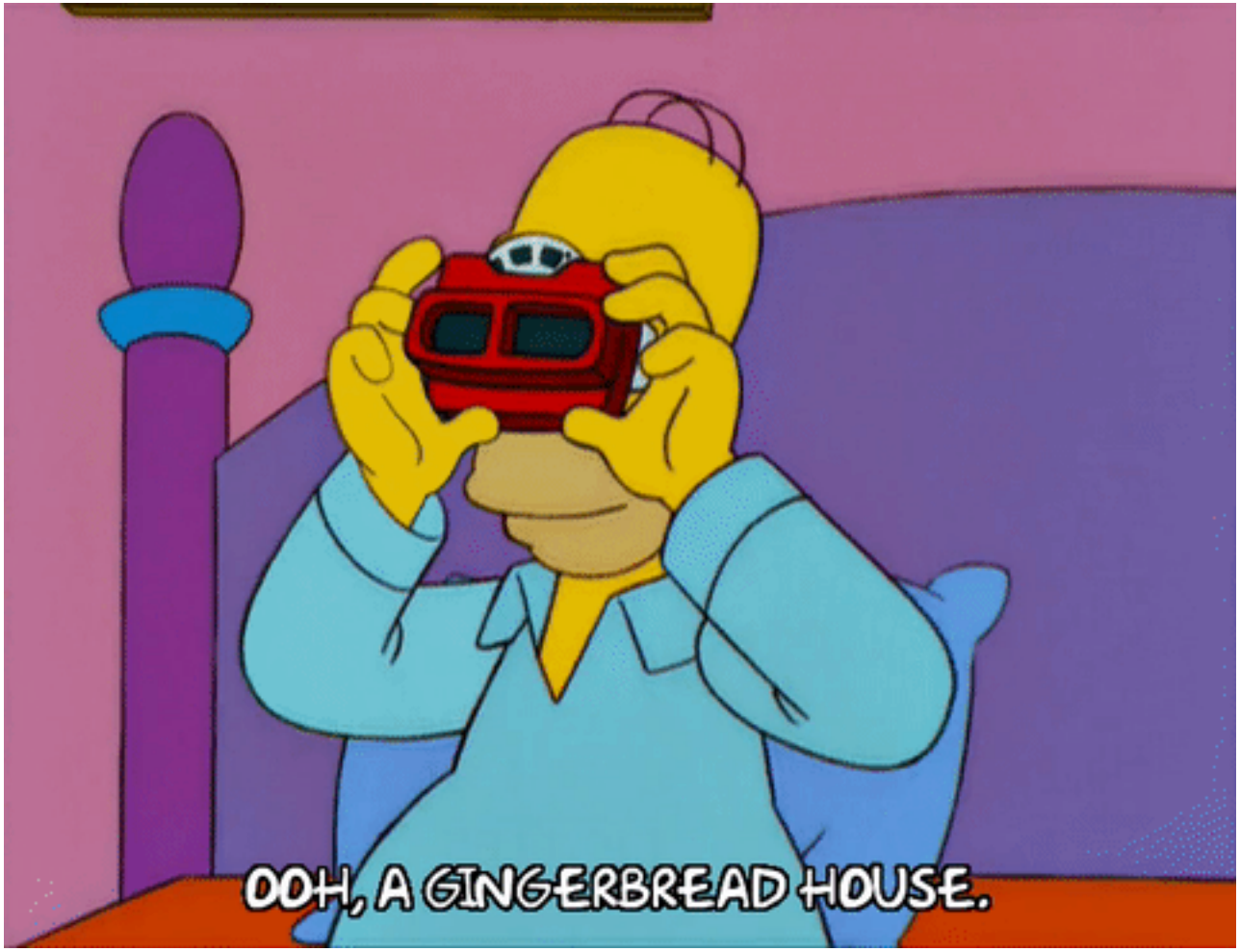
Branch, Checkout & The three trees



Branch, Checkout & The three trees

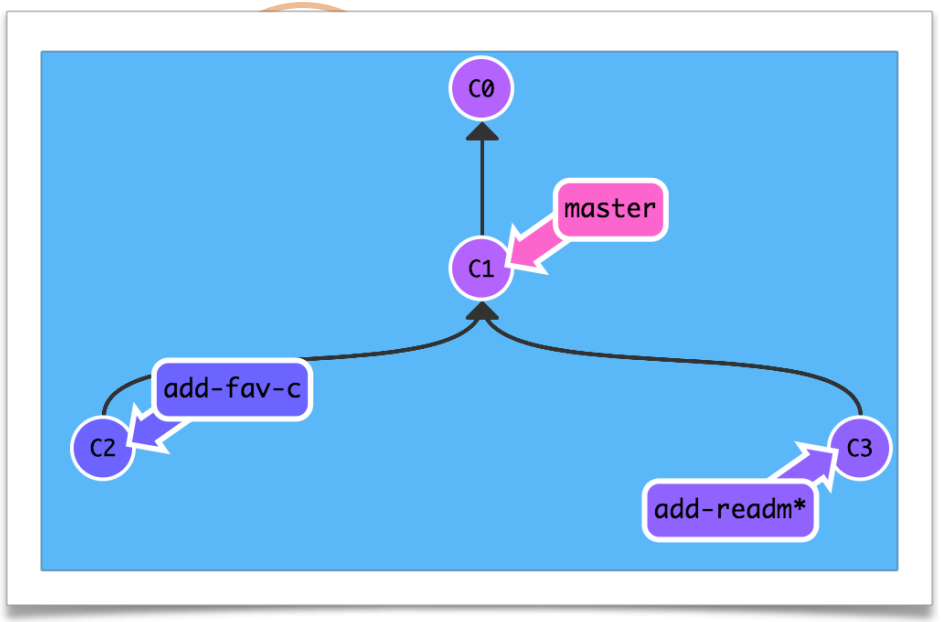


One staging area, many commits



Lab: Branching

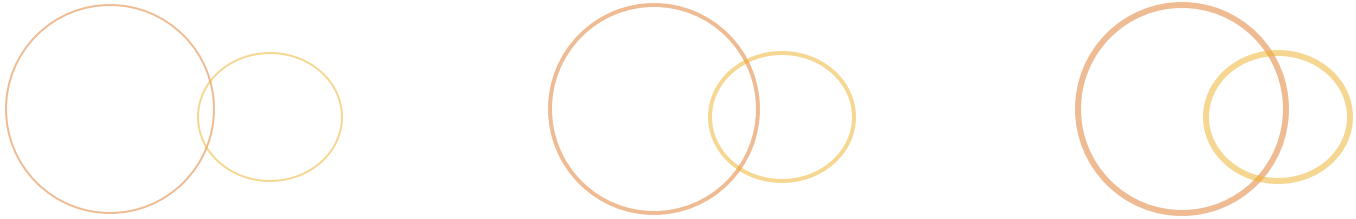
1. List your branches
2. Create a new branch off of master
   1. Label it "add-readme"
3. On the "add-readme" branch…
   1. Create a new file, "README"
   2. Stage and commit it
4. Back on "master"…
   1. Create a second branch, "add-fav-color"
5. On "add-fav-color"…
   1. Edit your `<name>.txt` file to add your favorite color to the list
   2. Stage the change and commit it
6. View the log as a graph, all commits



What we're going for

Toolkit

```
git status
git add
git commit
git log
git branch
git checkout
git checkout -b
```



module

COMPARING BRANCHES

What we'll learn

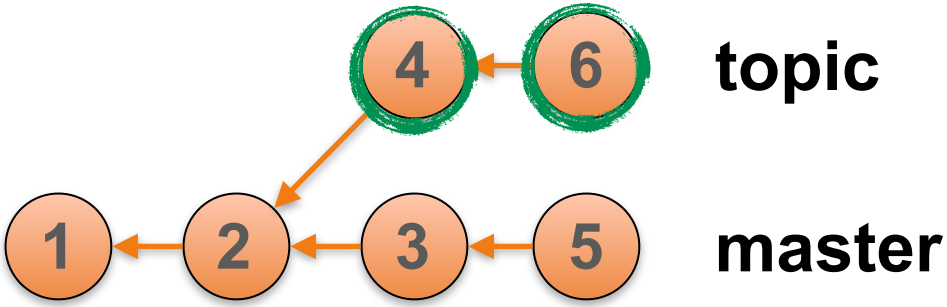
- We can compare commits & files (diffs)
  - **log**, **diff** and **range selections** (.. or ...)
- Can generate patches off these, if needed
- Generally use it to see what change you might introduce

New commits in a branch

- What are the new commits in "topic"

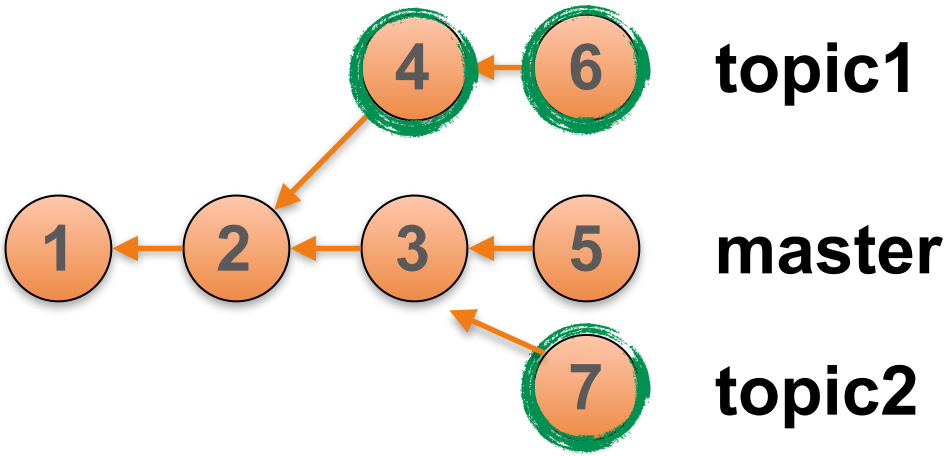
```
# reachable by topic, not master
git log master topic
git log master..topic
git log ..topic
```

HEAD is implied



Commits in one but not another...

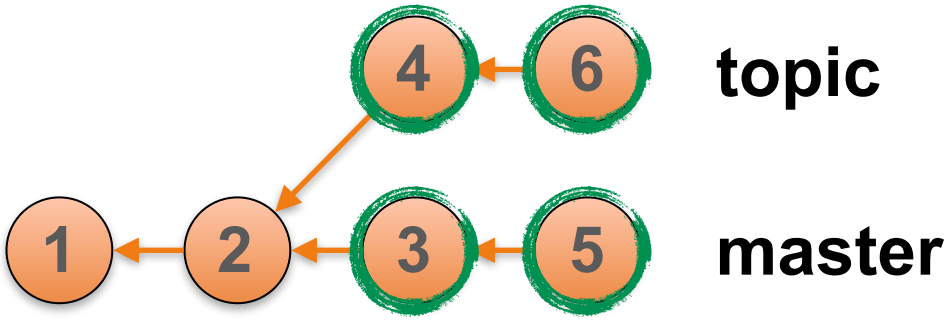
```
# reachable by topic1 and topic2
# but not master
git log topic1 topic2 --not master
```



Differing commits

- What are the unique commits across both

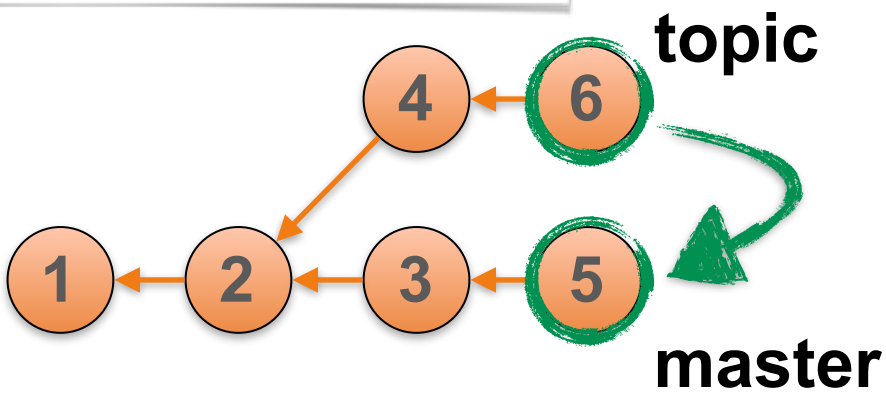
```
# commits reachable by either, but not both
git log master...topic
git log ...topic

# display branch source
git log master...topic --left-right
```



Combined file differences

- See the diffs between two branches
  - Compares between *tip* of each branch
  - "What patch can I apply to make master be like topic"

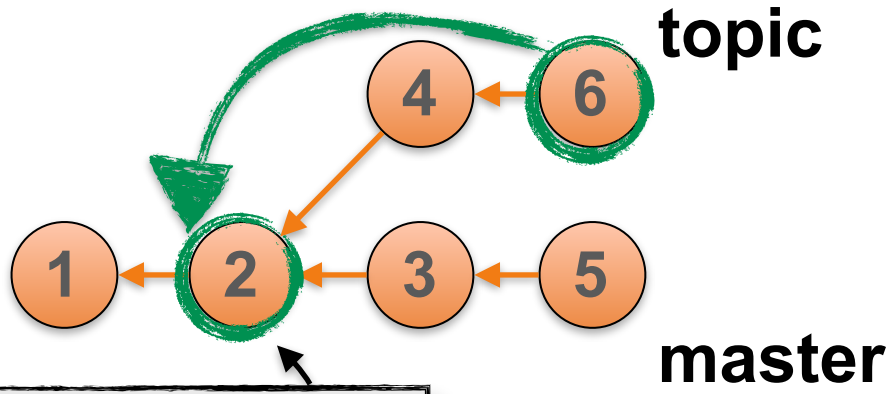
```
git diff master topic
git diff master..topic
git diff ..topic
```



Changes from a branch

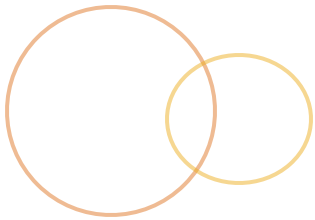
- Compares to **common ancestor (merge-base)**
  - "What change will B introduce to A"
  - *or... "What is new in B since it branched off A"*
  - Could create a patch from a branch this way

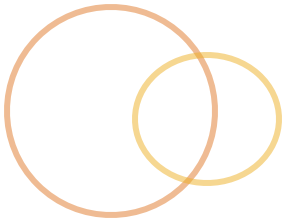
```
git diff master...topic
git diff ...topic
```



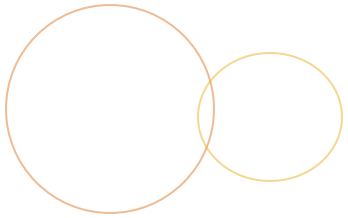
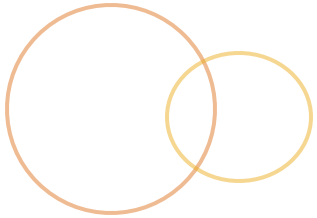
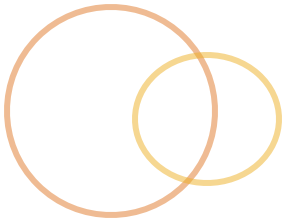

```
git merge-base master topic
```

Exercise





```
# What will these output?
git diff
git log

# What commits will I merge into master...
git ___ ___..featureA

# What file changes will my
# feature introduce to master
git ___ master__featureA
```

module

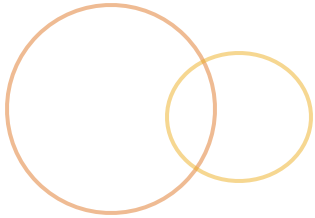
MERGING

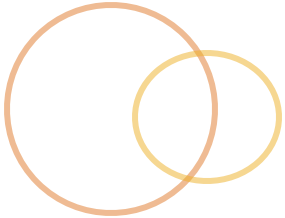
What we'll learn

- How to merge branches
- What are the basic merge strategies
- Branch management
- Our basic workflow takes form

http://pcottle.github.io/learnGitBranching/?NODEMO

Merging



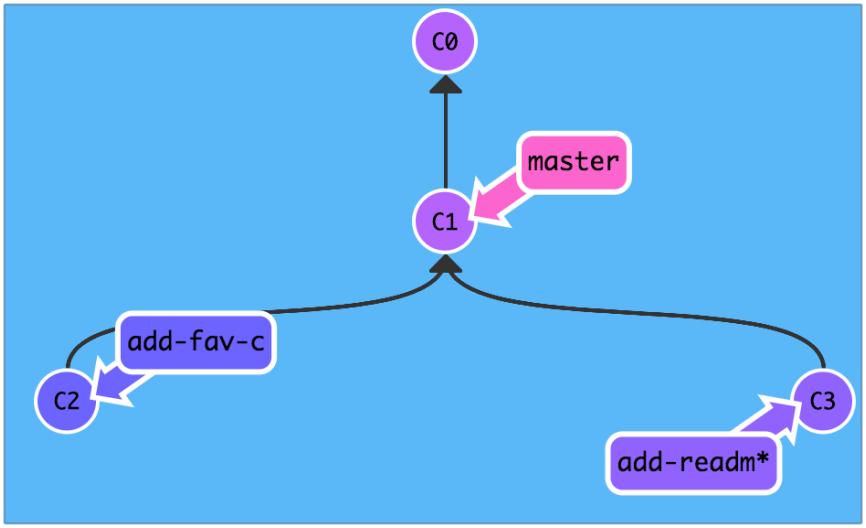


- A merge **combines the history** of two branches
  - It's how you get changes you've made in one branch into another branch (usually `master`)

```
# Applies changes from <source>
# into the branch you're on
git merge <source branch>
```

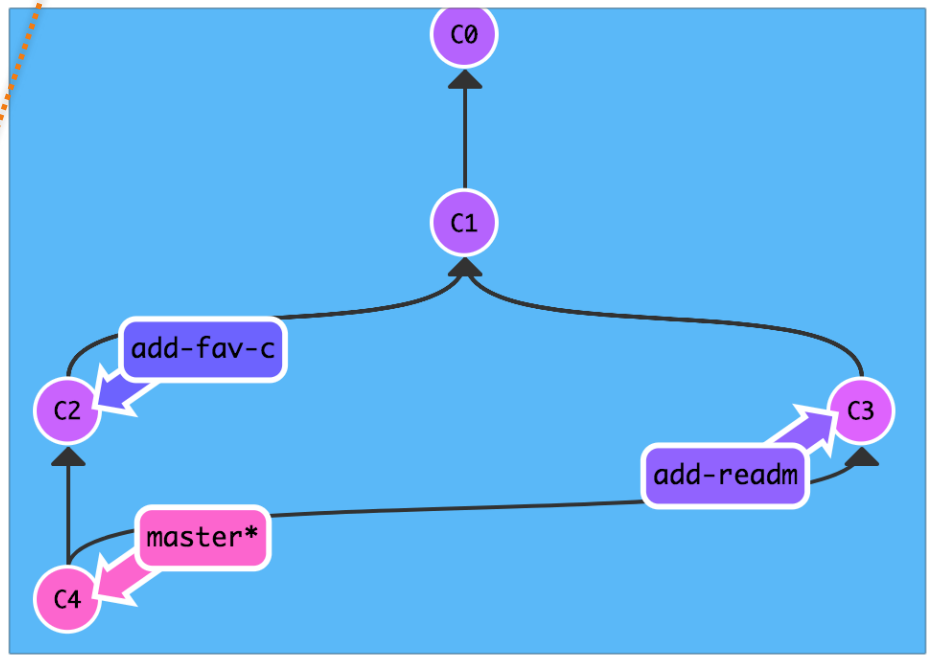
- **Does not affect** the branch you merged
  - Only affects the branch **you are on**
- Git decides on a **merge strategy** to use

Before




```
$> git checkout master
$> git merge add-fav-color
$> git merge add-readme
```

After



Merge Strategies

- **Fast-forward** merge
  - Linear history (graph) maintained
- **Recursive** / **3-way** merge
  - Merge commit created
- **Octopus** merge
  - More than 2 branches combined through a merge commit

http://pcottle.github.io/learnGitBranching/?NODEMO

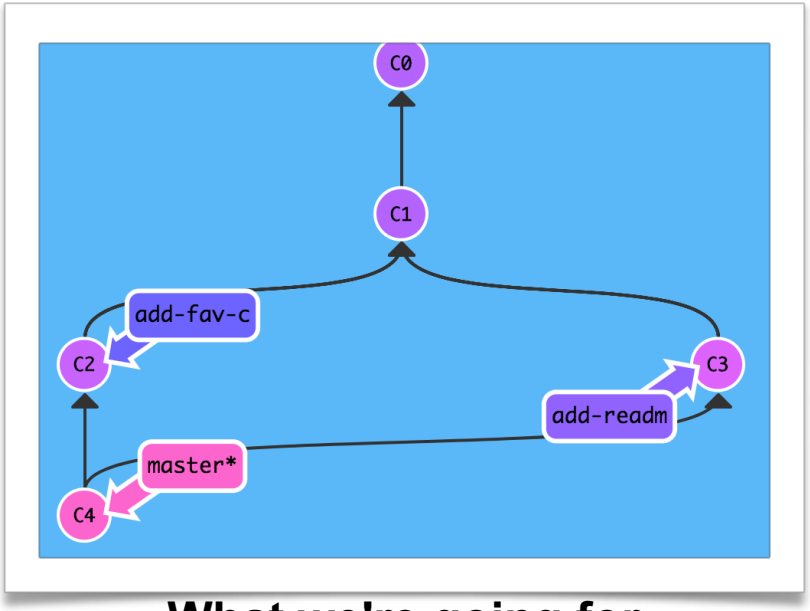
Branch Management

```
# list branches already merged
# into the branch you are on
git branch --merged

# list not-yet-merged branches
git branch --no-merged

# delete a branch
git branch -d <name>

# force delete a branch
git branch -D <name>
```

Actually:
Which branches are "in" the current branch's history

Lab: Merging

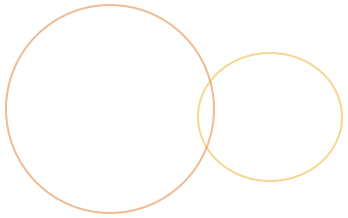
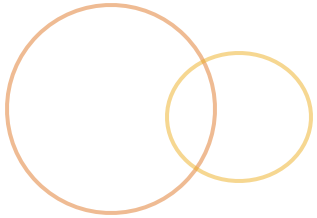
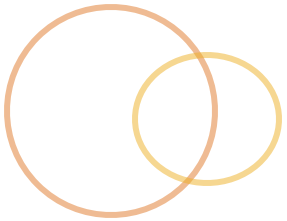
- On master
  - Merge your "add-readme" branch
    - Review your log . . .
    - What kind of merge did it perform?
  - List which branches are merged and not merged
  - Merge your "add-fav-color" branch
    - What kind of merge did it perform?
- Then create a new branch off master, "add-copyright"
- On "add-copyright"
  - Edit your `<name>.txt` file to include a copyright at the bottom
  - Stage & commit! ***I will stop saying this***
- Back on "master"
  - Merge "add-copyright"
- Review the log
- Delete your merged branches



What we're going for

Toolkit

```
git status
git add
git commit
git branch
git checkout
git log
git branch --merged
git branch --no-merged
git branch -d
git merge
```

module

MERGE ISSUES

What we'll learn

- What is a conflict
- How to abort a merge (avoiding the conflict)
- How to resolve merge conflicts
- Introduction to merge tools

Merge conflicts

- When performing a merge, if there are changes that git doesn't know how to combine you will end up in a "conflicted state".
  - Ex: The two branches contain a change to the same line of the same file

- What do I do when a conflict happens?
  - The merge is in limbo; it is not yet committed!
  - You must either:
    1. **abort the merge** or
    2. **resolve the conflict**

Abort a merge in progress

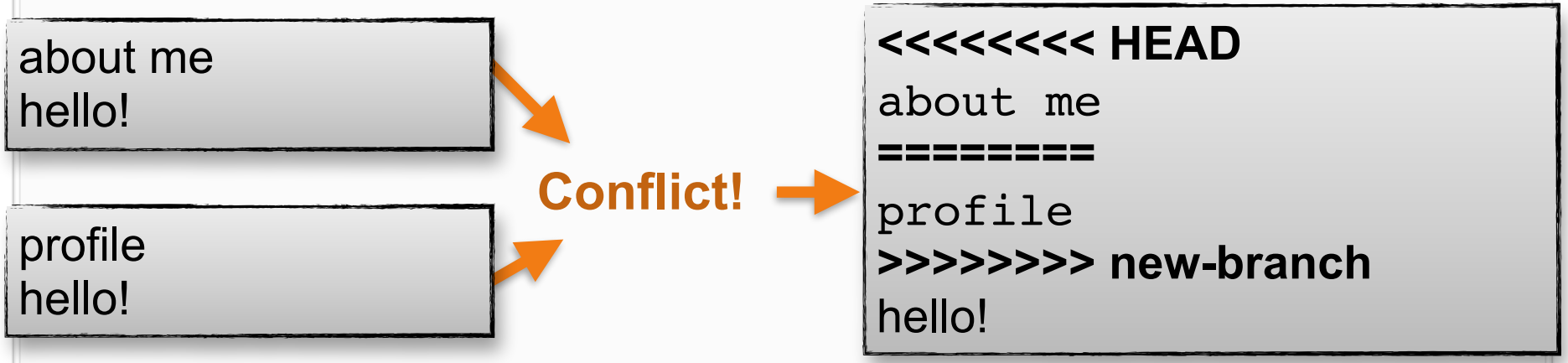
- Cancel the merge with --abort

```
# you'll remain on the branch you were on
# and it is as though the merge never began
git merge --abort
```

- But, you'll still want to merge the branch, eventually...

Resolving the conflict

```
# first, check which files are in conflict
git status
# then, fix the files in your editor
```




```
# then...
git add .
# finally, tell git to complete the merge
git commit
```

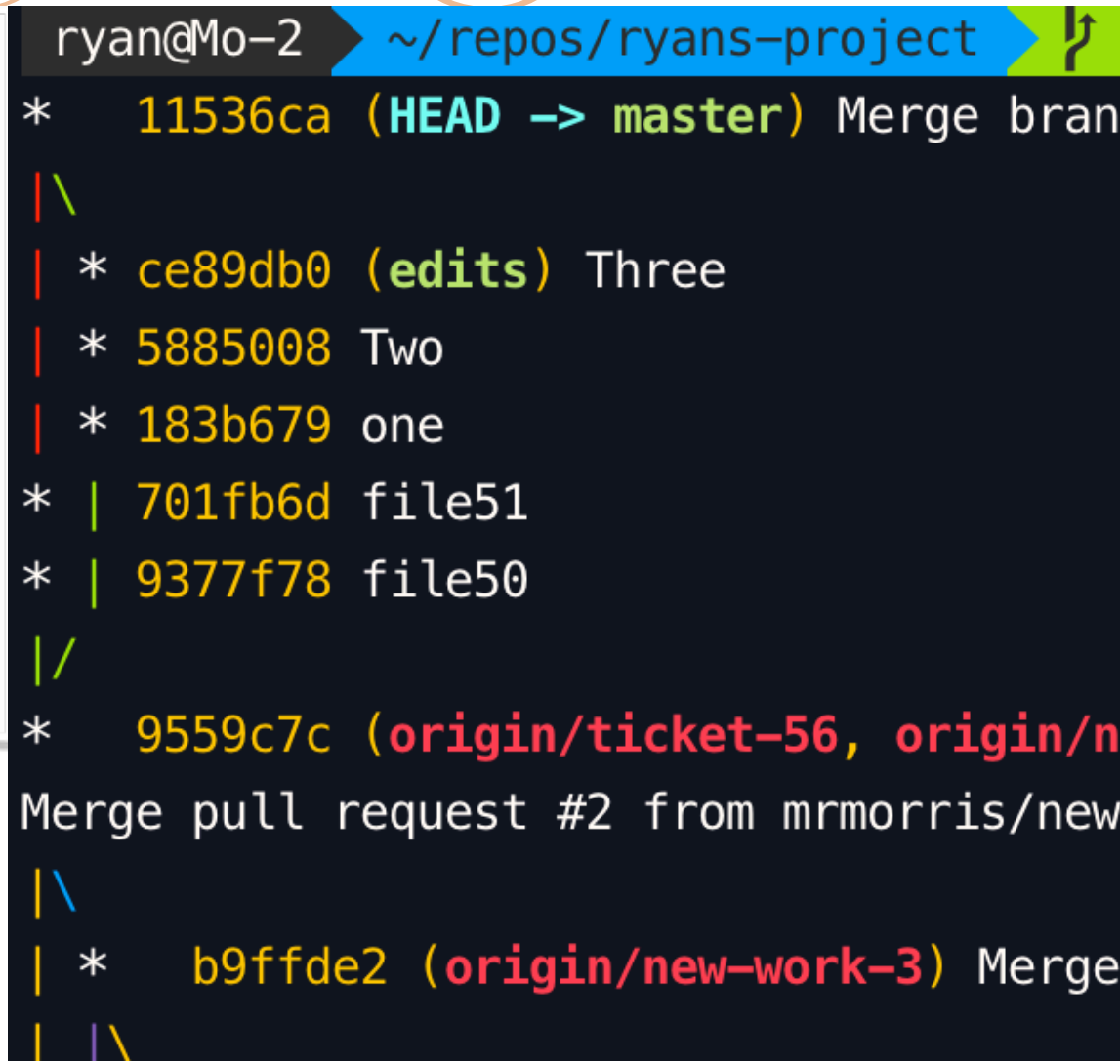
Undoing a merge

- How can I undo a merge that I just did?
  - If you haven't done anything else
  - And you haven't left the target branch yet

```
# puts your branch back to where it was
# before the merge happened
git reset --hard ORIG_HEAD

# back to... first parent
git reset HEAD^

# back to... second parent
git reset HEAD^2
```

Undoing a merge

```
# this won't work
# how you expect
# every time...
git reset HEAD^

# there is a
# second parent,
# too!
git reset HEAD^2
```



Merge tool

- Conflicts can be tedious, a GUI can help

```
# opens your default GUI
git mergetool

# check which tools you have
git mergetool --tool-help

# run a specific tool
git mergetool -t <tool>

# configure it to always use one tool
git config --global merge.tool <tool>
```

Some great tools
- sublime merge
- kaleidoscope

Common issues when resolving

- You commit the conflict-resolution markers
- You commit extra files created by your editor

```
$> ls -la
filename
filename.ORIG_B
filename.ORIG_A
```

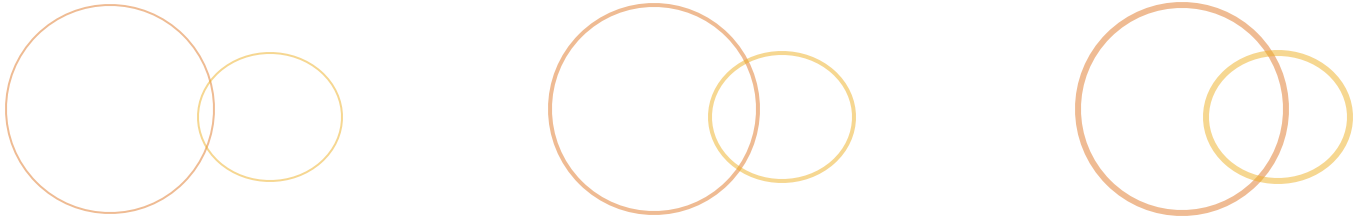
Lab: Resolve a conflict

Filenames different?
Create a conflict by editing the same line of the same file in two different branches.

- Let's create a conflict!
  - Create two branches off of master
  - First branch will be called "red"
    - In this branch, edit your favorite color to be "Red!"
  - Go back to master
  - Create and checkout a second branch called "blue"
    - Edit favorite color to be "No, Blue!"
- Back on "master"
  - Merge "red" then "blue"
  - You should get a conflict
- Abort the merge!
  - Then merge "blue" again
- Resolve the conflict
  - When done, stage and commit

Toolkit

```
git status
git add
git commit
git branch
git checkout
git log
git merge
git merge --abort
git mergetool
```



module

CORE ODDS & ENDS

TAGS, ALIASES, STASHING AND IGNORE

What we'll learn

- Parent References
- Tags
- Aliases
- Stashing
- Ignoring

Tags

- A static bookmark for a special commit
- **Lightweight**, Annotated and **Signed**
- What should I tag?
  - Releases
  - Each x.x.x version
  - Important commits you may want to come back to

```
# add a new (lightweight) tag
git tag <name> <optional-commit>

# add an annotated tag
git tag -a <name> -m "Message"

# list tags
git tag
```

You can **`checkout`** a tag just like a branch, *but*...

Aliases

- Command shortcuts *you* configure

```
git config --global alias.co checkout
```

- What would you alias?
  - Maybe make "co" an alias to "checkout"
  - Or make "stage" an alias of "add"
  - Any command you want to simplify
- Reference non-git commands with "**!**" prefix

```
git config --global alias.visual '!gitk'
```

Set up some aliases

```
# co
git config --global alias.co checkout

# unstage
git config --global alias.unstage 'reset HEAD --'

# undo-merge
git config --global alias.undo-merge 'reset --hard
ORIG_HEAD'

# graph
git config --global alias.graph 'log --oneline --graph --
decorate'
```

Stashing

- Quickly stores work in progress without committing -- local only

```
# saves changes in your stash
git stash

# applies your most recently stashed work
git stash pop

# list what is in your stash
git stash list

# git stash apply <name>
# git stash drop <name>
# git stash pop <name>
```

Ignoring files

- You can tell git to ignore certain files and folders
  - Set up a `.gitignore` file in the root of your project
  - List files or patterns to ignore

```
*.tmp
*.log

# directories
tmp/
logs/*.log

# negate a pattern
!main.log
```

- Github has a lot of prefab gitignores

https://git-scm.com/docs/gitignore#_pattern_format

Empty folders

- Add a `empty`, `.gitkeep`, `.keep file`
- Optionally ignore it

```
# ignore files in logs folder
logs/*

# but keep the folder
!logs/.keep
```

Other special ignores

- Ignore a local file without sharing the "ignore"

```
#edit this file like .gitignore
.git/info/exclude
```

- Global ignores (all your repos)

```
git config --global core.excludesfile ~/.gitignore_global
```

Lab: Day 1 (Stashing)

- Make sure you're on master
- Make some edits to your profile
  - Add your favorite city?
- Stage the changes

Shifting gears: You have to go fix the copyright ASAP

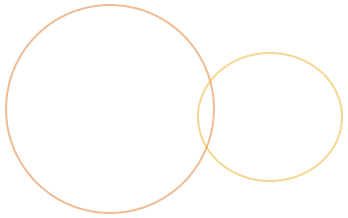
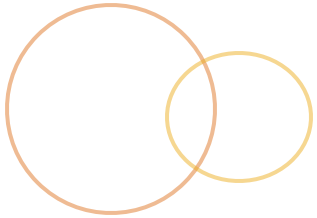
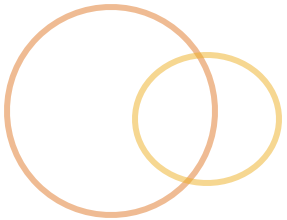
- Stash those changes
- Create a new branch off master, "fix-copyright"
  - On "fix-copyright", edit your copyright year to be 1901-2079
  - Stage & commit

Let's get back to what we were doing...

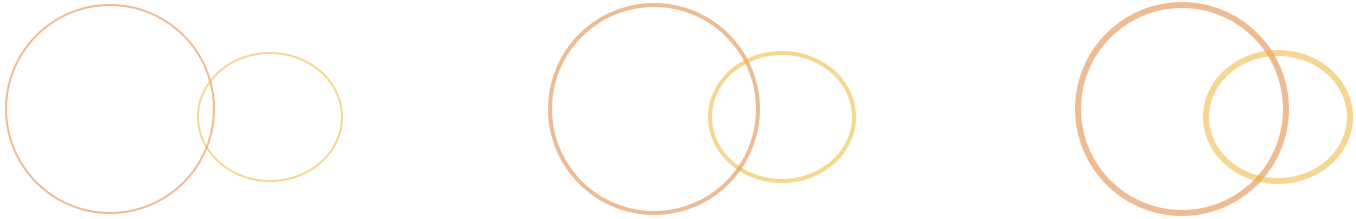
- Back on master...
- List your stash
- Un-stash the changes you were working on
- Make any further edits you want to your profile
- Create a new branch, "fav-city"
  - On "fav-city", stage and commit your profile edits
- Merge both "fav-city" and "fix-copyright" into master...
- View your log and delete merged branches

Toolkit

```
git status
git stash
git stash pop
git stash list
```

End day 1



optional...

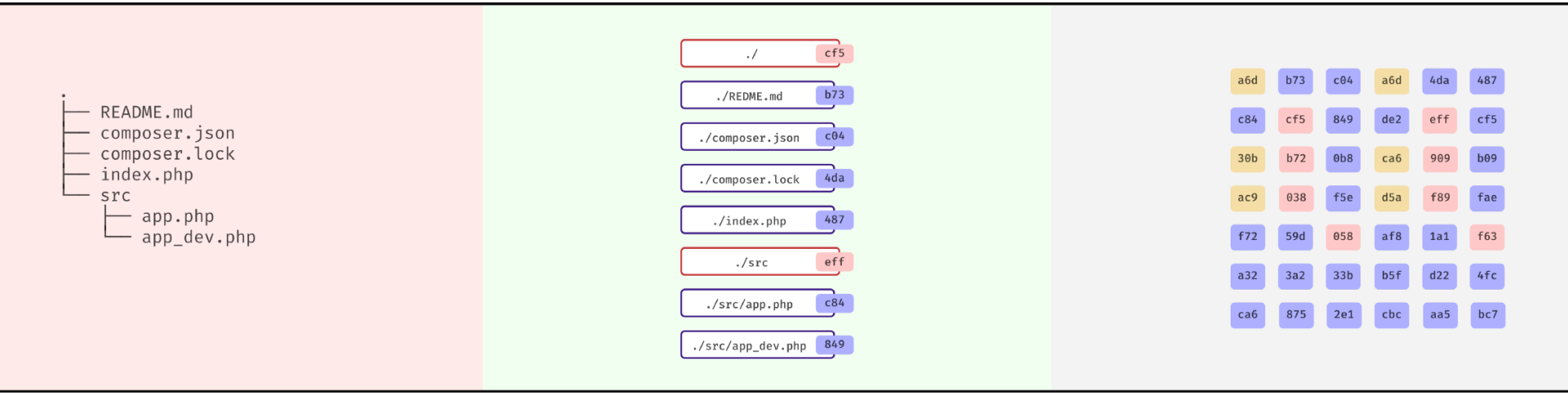
DEEP DIVE ON GIT

The trees (more detail)

Working Directory
Your filesystem
one "version" at
a time...

The Index/Staging
"Next commit"
and..
Tracks changes
across the two
< ---------- >

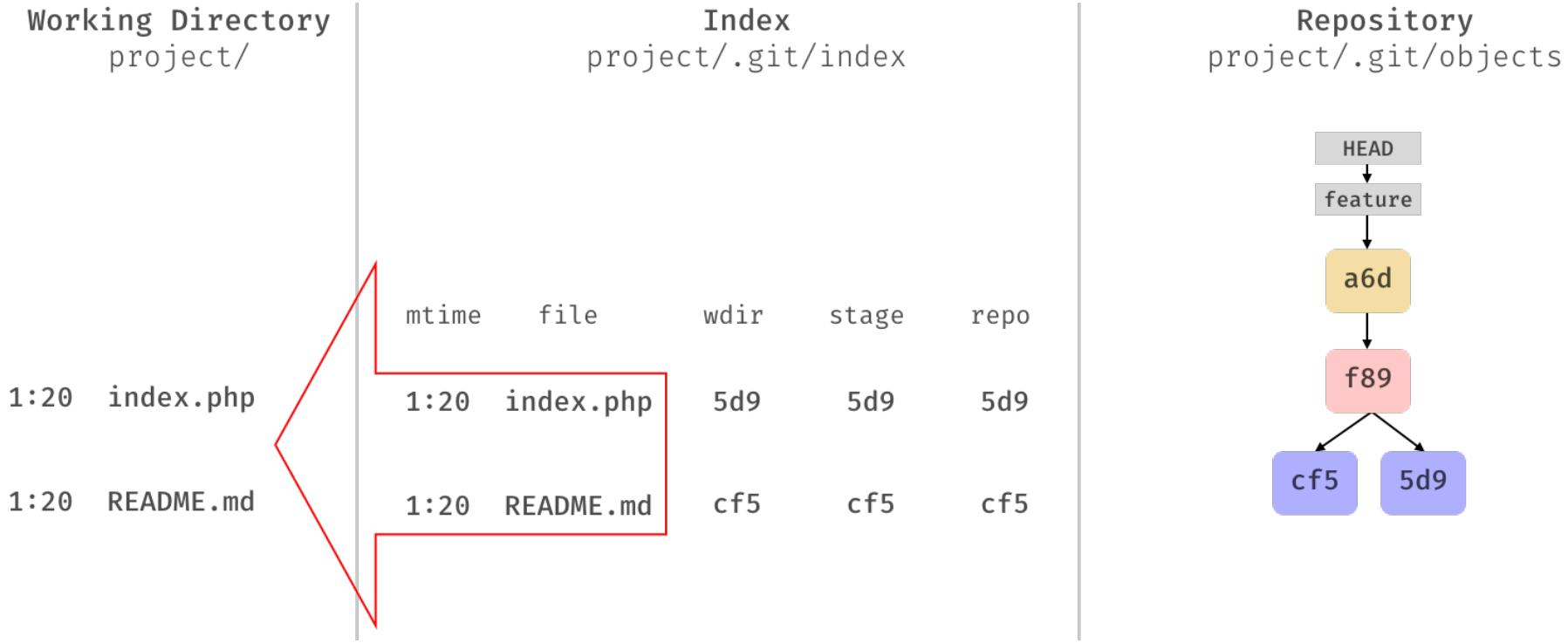
The repository
a mess of objects:
- commits
- trees
- blobs
- tags



Source: https://hackernoon.com/understanding-git-index-4821a0765cf

The index

- Git keeps track of the three trees within .git/index
- Checkout updates the index and wd to match

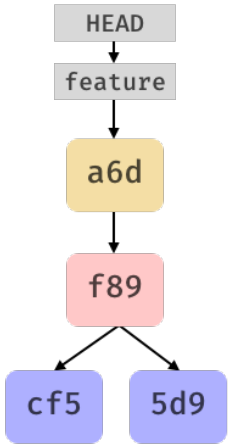


Source: https://hackernoon.com/understanding-git-index-4821a0765cf

Modifications

- Changes are recognized by git once you run `git status` -- which updates `.git/index`

Working Directory project/		Index project/.git/index				Repository project/.git/objects
		mtime	file	wdir	stage	repo
1:21	index.php	1:21	index.php	9f5	5d9	5d9
1:20	README.md	1:20	README.md	cf5	cf5	cf5



Source: https://hackernoon.com/understanding-git-index-4821a0765cf

Add

- Once you `git add` the change
  - Git creates an object for it in `.git/objects`
  - And update the `.git/index`

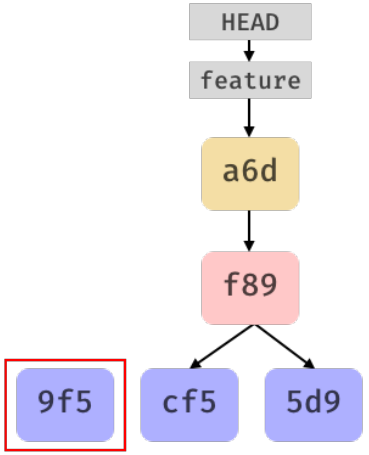
Working Directory
project/

1:21	index.php
1:20	README.md

Index
project/.git/index

mtime	file	wdir	stage	repo
1:21	index.php	9f5	9f5	5d9
1:20	README.md	cf5	cf5	cf5

Repository
project/.git/objects



Commit

- Once you `` `git commit` ``, git
  - creates the commit and tree object
  - updates the branch pointer
  - updates the .git/index

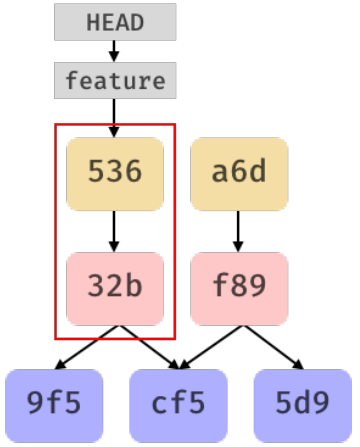
Working Directory
project/

1:21	index.php
1:20	README.md

Index
project/.git/index

mtime	file	wdir	stage	repo
1:21	index.php	9f5	9f5	9f5
1:20	README.md	cf5	cf5	cf5

Repository
project/.git/objects



Go deeper

- Follow the trail
- The format of index per git docs
- What I just ran through: Understanding Git Index
- Introduction to Git (Internals)
  - Great video!

review

TEST YOUR BRAINS

Test: What does each command do?

Explain what each command does in context and how it affects the "three trees"

- git init
- git commit
- git add me.html
- git status
- git reset me.html
- git checkout feature234
- git checkout
- git checkout -- profile.txt
- git checkout -b hotfix10
- git branch
- git diff master..feature234

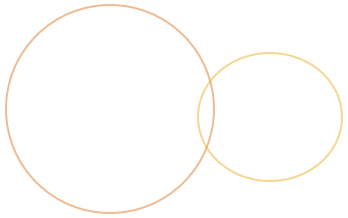
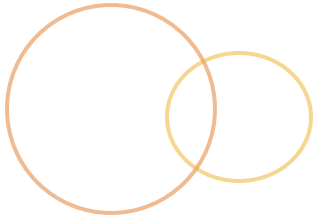
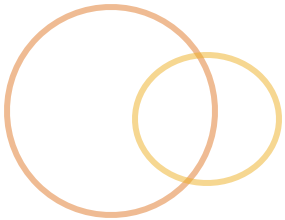
Test: What does each command do?

- git branch ticket55
- git show ticket55
- git checkout 5d23ef
- git show 5d23ef
- git tag -a v1.5
- git rm debug.log
- git show HEAD
- git show HEAD^
- git show HEAD^^
- git reset HEAD^
- git merge ticket55

Test: Map the repository graph

- In a brand new repository...
- We create three commits
- We're on… the master branch
- Make a "bug-5" branch
- Where is HEAD
- Checkout bug-5
- Where is HEAD now
- Add a commit to bug-5
- Where is HEAD, master and bug-5?
- Can we undo it all and go back to the first commit?

Map the commits, label the branches and HEAD

module

SHARING THROUGH A REMOTE

What we'll learn

- Repository hosting options / git servers
- What are remotes and how to use them
- Uploading our repository

Remotes

- **Remotes** are *local references* to *clones* of the repository
  - GitHub.com / GitLab.com / Bitbucket
  - Your own git server (Phabricator, Gerrit)
  - Your local system (git init --bare)
- And might include...
  - Workflow for introducing changes
  - Ticketing, automation integrations
- **This is how we collaborate and contribute**

Sharing our repository

- Created an empty repository on a host
- Added a **remote reference** to the hosted repository and labeled it: **`origin`**

```
git remote add <name> <url>
```

- Pushed local repository to the remote repository

```
git push <remote-name> <branch-name>
```

- Optionally, told git to "*track*" remote branches by using the **`--set-upstream`** (-u) flag

Lab: Sharing our repository

Uploading our repositories to a hosting platform

- On our hosting service (github.com)
  - Make sure you have an account!
- Create a new repository
  - Call it "**about-me**"
  - Don't *initialize* it, it is already initialized...
- Follow the directions they give or…
  - Copy the remote repository **url**
  - Then add a **remote** in our local git repository

Issues with pushing? Try:

- moving `--set-upstream` after "`origin master`"
- disable 2-factor auth
- set up your ssh keys and use the ssh uri

```
git remote add origin <remote-url>
git push origin master --set-upstream
```

- **List** your remotes
- **View** *all* your branches (including remote branches)
- Finally, **view** the repository on the hosting platform

Lab: Pushing Local

Uploading our repositories to a bare repository

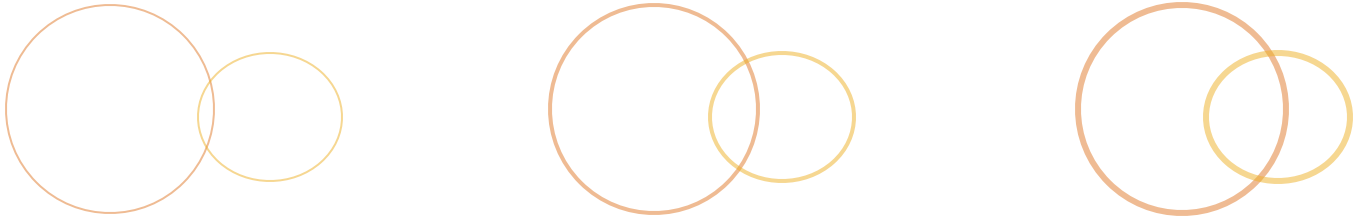
- Create a bare repository

```
cd ..
git init --bare ./about-me-bare
```

- Push your local 'about-me' to your local bare
  - Copy the remote repository **url**
  - Then add a **remote** in our local git repository

```
cd about-me
git remote add origin ../about-me-bare
git push origin master --set-upstream
```

- **List** your remotes
- **View** *all* your branches (including remote branches)
- Finally, **view** the repository on the hosting platform



module

WORKING WITH REMOTES

What we'll learn

- Share work through branches
- Keeping up to date
- Fetch vs Pull
- Sharing tags you've created
- Setting up tracking branches
- General remote management

I'll run through pushing, pulling & staying up to date with a remote

Push to share (or upload)

- **`push`** to send branches to our remote(s)
  - *Typically* one branch at a time
  - We keep branch names in sync by convention
  - Sends *data* necessary to recreate branch ref

```
git push <remote-name> <branch-name>

# examples
git push origin bug-1
git push upstream master
git push origin ryan-fix:bug-25
git push origin :bug-1
```

Pull to sync (or download)

- **`pull`** updates HEAD (local branch) & repo data
  - One branch at a time
  - Fetches all the latest data & remote refs
  - **Merges** to **the branch you are on**
    - **ie: "update my local branch with latest version of a remote branch"**

```
git pull <remote-name> <branch-name>

# for example
git checkout master
git pull origin master
```

Make sure you're on the right branch, it will merge into HEAD

Fetch to update data w/out merging

- **Fetch** updates remote references
  - *It does NOT automatically merge anything*

```
git fetch <remote-name>

# then maybe update your
# local branches manually...
# (pull would have done this)
git checkout master
git merge origin/master
```

This is a *remote branch reference*

Remote branches

- When we reference a remote git will also become aware of all the branches in the remote repository

```
git branch --remote
git branch --all
```

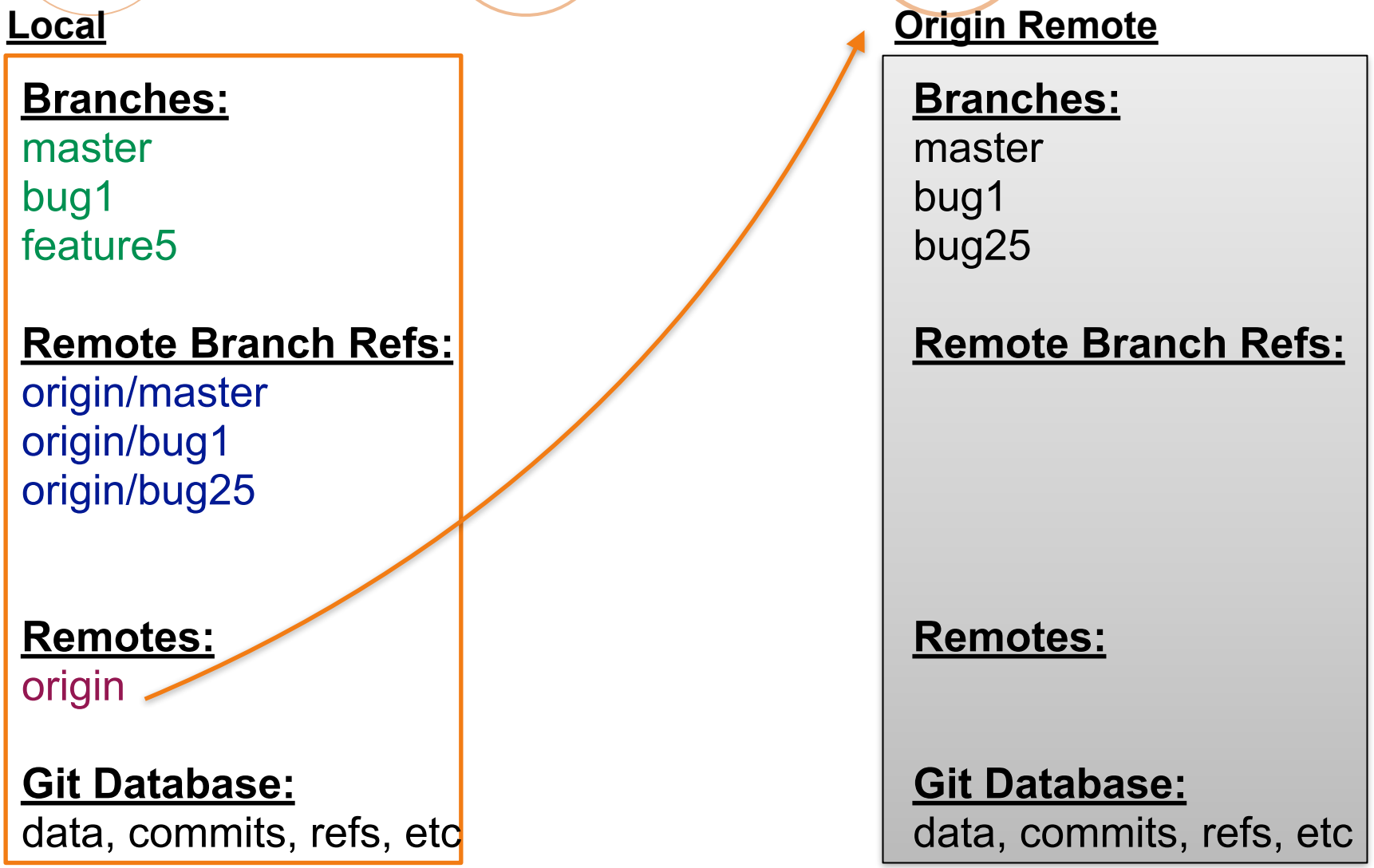
- Remote refs behave like tags, they are not for work

```
git checkout origin/feature-5
# also OK to merge these...
git merge origin/feature-5
```

- Checking out a remote branch by name only will auto-create a local copy with tracking

```
git checkout feature-5
```

Remote branch references



Tracking branches

- Relate a local branch to a specific remote branch
  - Pull, push (and a few other commands) will automatically fill in the branch name(s) for you

```
git checkout bug1

# before tracking
git pull origin bug1

# add tracking relationship
git branch --track bug1 origin/bug1

# after tracking
git pull
```

Set up tracking

- Set up a local branch to track to a remote branch

```
git branch --track <branch> <remote>/<branch>
git push --set-upstream <remote> <branch>
git push -u <remote> <branch>
git branch --set-upstream-to <remote>/<branch>
```

- Shortcut; create local branch that tracks

```
# if origin/bug-22 exists
git checkout bug-22
```

- You can view tracking branch info

```
git branch -vv
```

Sharing tags

- **Tags** need to be explicitly pushed

```
git push <remote-name> <tag-name>
git push <remote-name> --tags

# you can also ask git
# to push "reachable", annotated tags
git push origin --follow-tags

# and config git to always do this
git config push.followTags true
```

Tending remotes

- Deleting remote branches (affects remote)

```
git push origin :master
# or
git push origin --delete master
```

- Prune remote branch references (affects local)

```
git fetch origin --prune

# you can also config it
git config fetch.prune true
```

To summarize

- Share changes

```
git push origin branch-name
```

- Update your master

```
git checkout master
git pull origin master
```

- Update any branch

```
git checkout branch-name
git pull origin branch-name
```

To summarize (pt 2)

- (more) update any branch with master's changes

```
git checkout branch-name
git pull origin master
```

```
git checkout branch-name
git fetch origin
git merge origin/master
```

```
# update local master, then...
git checkout branch-name
git merge master
```

Optional

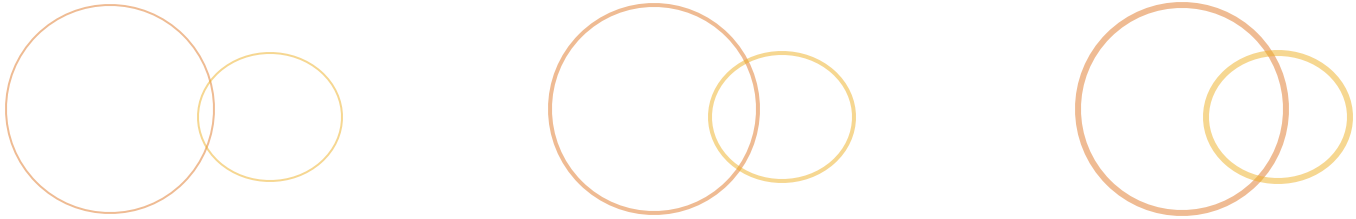
Lab: Pushing & Pulling (Team of 1)

1. Sharing your work
   - In your local **about-me** repository
     - Create a new branch off **`master`**, call it **`upper-name`**
     - Edit your <name> file so your name in the file is UPPERCASED
     - Stage, commit, then **`push`** your branch to the remote

```
git push origin upper-name
```

2. Integrating your work
   - Create a pull/merge request on Github/Gitlab
     - To the remote's **`master`** branch
   - Merge the PR
3. Keeping up to date
   - Update your local master using **`git pull`**

This is a typical workflow…



step-by-step

REMOTE VS LOCAL

Remotes and branches

LOCAL

master

"remote add origin <uri>"

Remotes and branches

LOCAL

master

origin

Remotes and branches

LOCAL

master

origin

now "git push origin master"

Remotes and branches

LOCAL

master

origin/master

Origin (server)

master

Remotes and branches

LOCAL

master

origin/master

Origin (server)

master

create branch topic-1

Remotes and branches

LOCAL

master

topic-1

origin/master

Origin (server)

master

Remotes and branches

LOCAL

master

topic-1

origin/master

Origin (server)

master

git push origin topic-1

Remotes and branches

LOCAL

master

topic-1

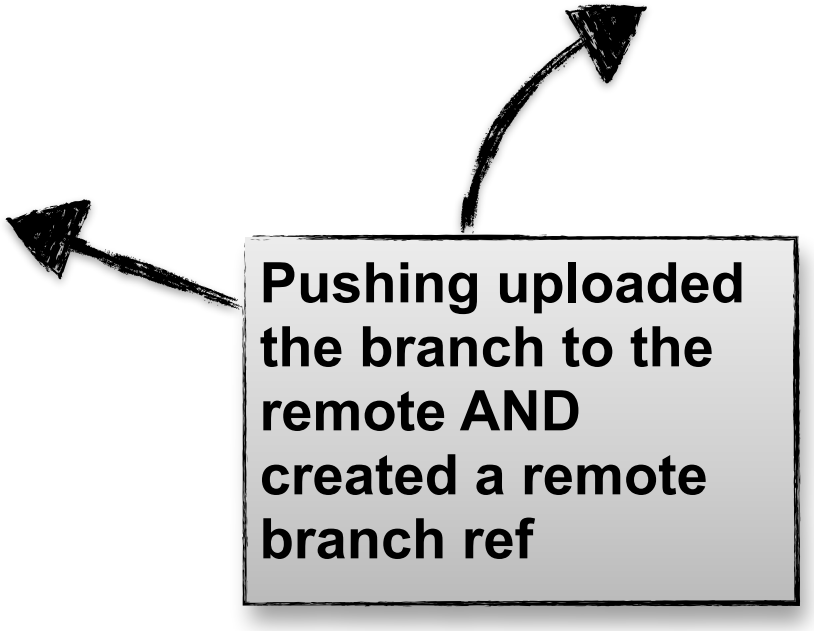
origin/master

origin/topic-1

Origin (server)

master

topic-1



Remotes and branches

LOCAL

master

topic-1

origin/master

origin/topic-1

Origin (server)

master

topic-1

Someone else pushes a branch to origin

Remotes and branches

LOCAL

master

topic-1

origin/master

origin/topic-1

Origin (server)

master

topic-1

topic-20

Remotes and branches

LOCAL

master

topic-1

origin/master

origin/topic-1

Origin (server)

master

topic-1

topic-20

Then I fetch origin (again)

Remotes and branches

LOCAL

master

topic-1

origin/master

origin/topic-1

origin/topic-20

Origin (server)

master

topic-1

topic-20

Remotes and branches

LOCAL

master

topic-1

origin/master

origin/topic-1

origin/topic-20

Origin (server)

master

topic-1

topic-20

To work on a branch locally, just check it out…

```
git checkout topic-20
```

Remotes and branches

LOCAL

master

topic-1

topic-20

origin/master

origin/topic-1

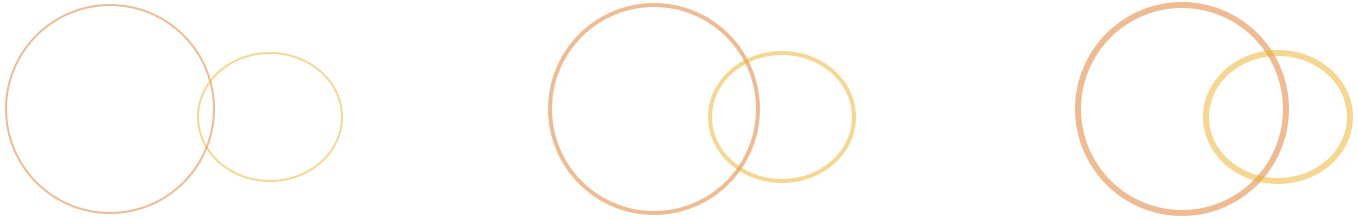
origin/topic-20

Origin (server)

master

topic-1

topic-20



module

COLLABORATION IN A SINGLE REPO

What we'll learn

- Intro to a git workflow with a single repository
  - Join - How to clone a repo
  - Do work - What are topic branches
  - Share work - Get it reviewed
  - Stay up to date (next module)
- Keeping up to date

I'll set up a single repo for us to work on as a team (& push my profile)

Join - Cloning

- **`clone`** copies a repository
  - Initializes the repo
  - Pulls all data and remote branches
  - Sets up an initial remote, called **`origin`**
  - Sets up "master" with tracking

```
# copy the repo
git clone <remote-url>

# copy into a specific dir
git clone <remote-url> <dir>
```

Do work - Topic Branches

- **`master`** should be stable and production ready
- All **new work** should be done in a **new branch**
- Sometimes referred to **topic branches**, or "working" branch, or "feature" or "bug" or "hotfix" branch.

Share work - Get Reviewed

- Push your branch to the remote to share
- Get it reviewed
  - merge or pull request (hosted reviews)
  - or another review process / platform
- Get it merged
- Share early
- Your team should define:
  - review expectations; who does it?
  - merge expectations; who does it?
  - any tests/CI?
- Delete branches when done (local and remote)

Lab: Share your work

Start in a fresh directory - not in a previous repository!

- **The task**: Add your profile page to the project
  - Just a file w/ a list of your favorite things, name the file after you
- **Clone** the **about-us** repository

```
git clone <git:url>
```

- Create a new **topic branch** off master
  - Add your profile, stage, commit, etc...
- Share your branch by **pushing** it to the remote repository
- On GitHub/Lab, open a **pull/merge request** to request that your new branch be merged into **`master`**

Don't merge...

We'll review & merge pull requests together

Keep up to date

- Keep `master` up to date (typically)

```
# make sure you're on master
git checkout master
git pull
# or, being explicit
git pull origin master
```

- Starting new work off `master`

```
git checkout master
git checkout -b feature-25
```

Now I'll add an index page for us to all collaborate on...

Keep topic branches up to date

- Occasionally you'll want to update your topic branches
  - Grab the latest changes/fixes
  - Incorporate a teammates changes

```
# always make sure you're on the branch
git checkout feature-5

# incorporate changes
# from master
git pull origin master

# or incorporate changes from your teammate?
git pull origin feature-5
```

```
# or do the merge manually
git fetch origin
git merge origin/master
```

Lab: Update & Collaborate

- **The Task**: Add your name to the list in the **`index.html`** file

- First: Make sure **`master`** is up to date

```
# use either
git pull
# or
git fetch origin
git merge origin/master
```

- Then: Do the work
  - Branch off **`master`**, *use a branch name that won't collide with your team*
- *Finally:* Share your work
  - Push your branch
  - Create a pull/merge request (DO NOT MERGE)

We'll merge later... I'll also add one more pull request to the mix...

Dealing with conflicts

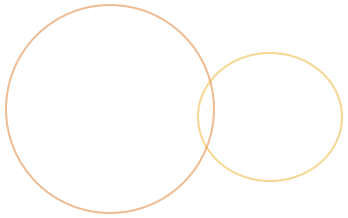
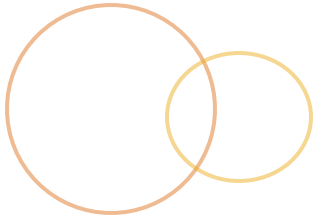
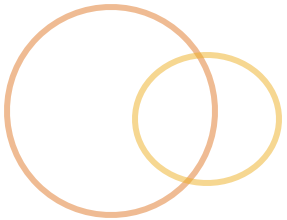
- When you get a conflict
  - ie: you can't merge your pull/merge request
- **Merge** the target branch into your topic branch
  - This will cause the conflict locally
- **Resolve** the conflict
  - Stage, commit (to complete the merge, per normal)
- **Push** your updated topic branch
- Now the request should merge cleanly

I'll create a conflict by being the first to edit the index ;)

Lab: Remote Conflicts

- **The Task**: Fix the conflict so your branch will merge cleanly

1. Make sure `master` is up to date
2. Cause the conflict
   - Merge `master` into your local topic branch
   - We are merging in the conflicting changes to cause the conflict locally
3. Resolve the conflict
   - Fix, stage, commit
4. Share your updated branch
   - Push your branch
   - View your original pull/merge request, the conflict should be resolved

module

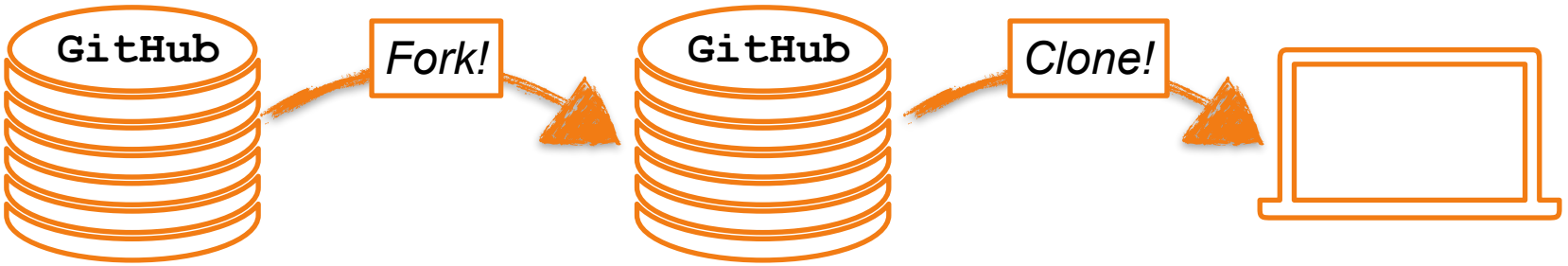
COLLABORATION ACROSS MULTIPLE REPOS

What we'll learn

- What is a fork and when would you use it
- What does upstream mean
- How to collaborate with forked repositories
- Potential repository fork strategies

Fork a repository

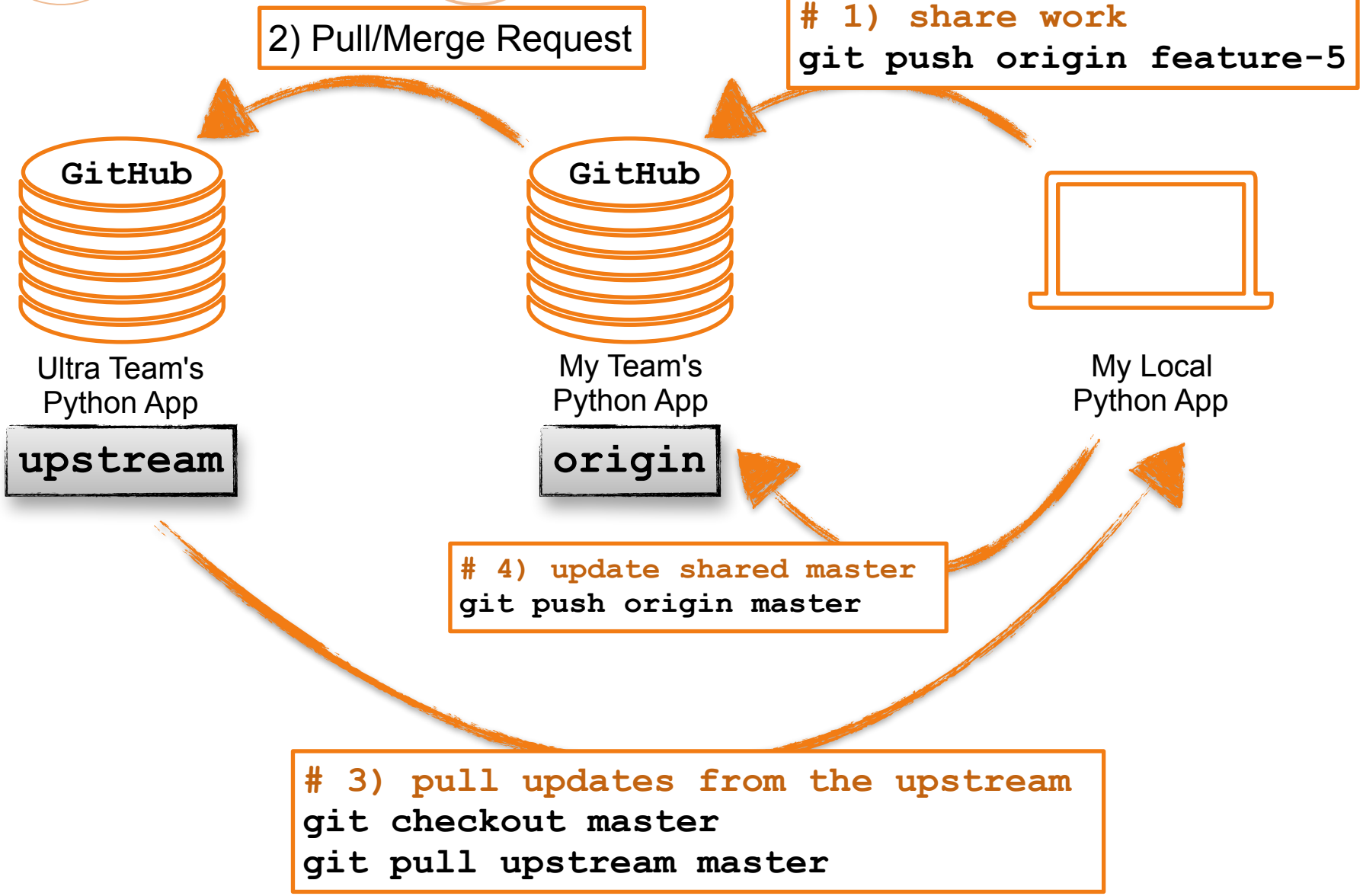
- A **fork** is a **copy** of a repository that remains within your hosting account
  - You can fork any public project in GitHub/Lab
  - It's a copy you own
- Why fork?
  - To submit changes to a public/open source project
  - Organizational safety net for larger teams
  - To split up a project or codebase amongst smaller teams



Fork Workflows

- The main repo is referred to as the **`upstream`**
- While your personal fork is the **`origin`**
- You **push** branches into your **`origin`**
- **Pull request** into the **`upstream`**
- And **pull** updates from the **`upstream`**

Fork Workflows



Optional

Lab: Working with forks

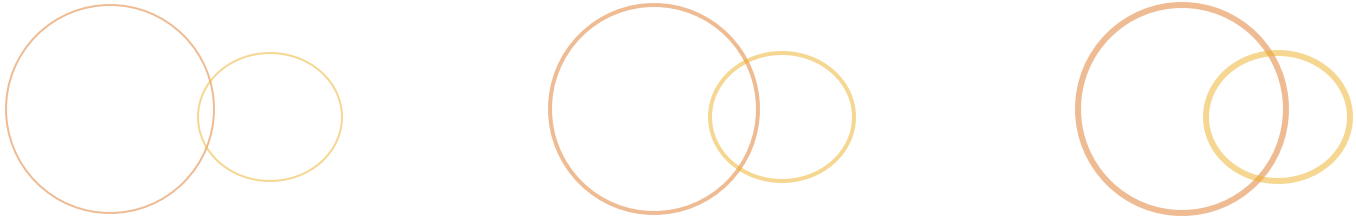
github: https://github.com/rm-training/tag-wall
gitlab: https://gitlab.com/rm-training/tag-wall

- **Share work**
  - Fork my repository
  - Clone **your fork** to your local
  - Submit a change
    - Branch off master
    - Make your edit(s) locally, stage, commit, etc...
    - Push to your **`origin`**
  - Create a pull/merge request *into the main repository (mine)*

I'll begin merging...

- **Stay up to date with the fork**
  - Add a new remote for the main repo, call it **`upstream`**
  - Update your local master

```
git remote add upstream <url>
git checkout master
git pull upstream master
```



module

WORKFLOWS

Team Workflows

- Centralized Repository
  - + trunk-based
- Feature Branch
- GitFlow
- Forking
- Mix & Match...

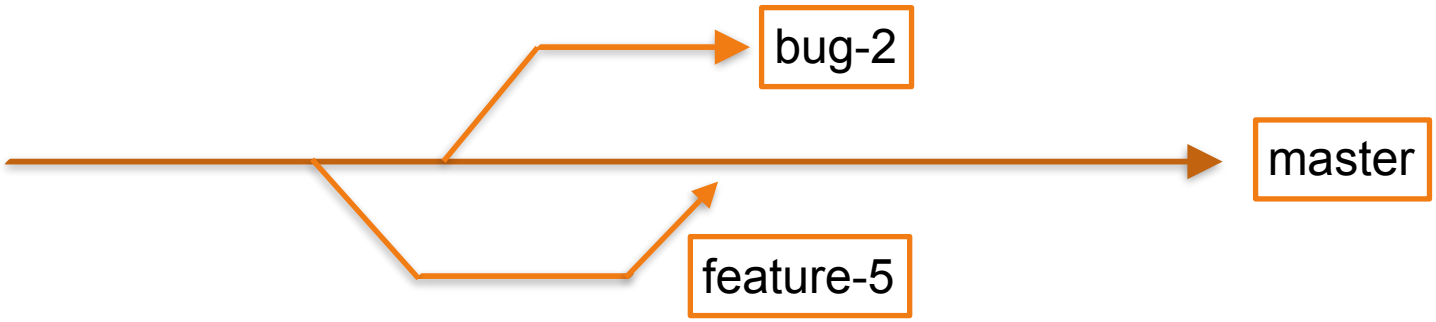
Centralized

- Remote: One, primary
- Branches: One, master
- Everyone works on and pushes to master

- Might be rebasing to get updates
- Deal with conflicts frequently
- Might be sharing changes in singular "commits"
  - ex: Gerrit

Feature Branches

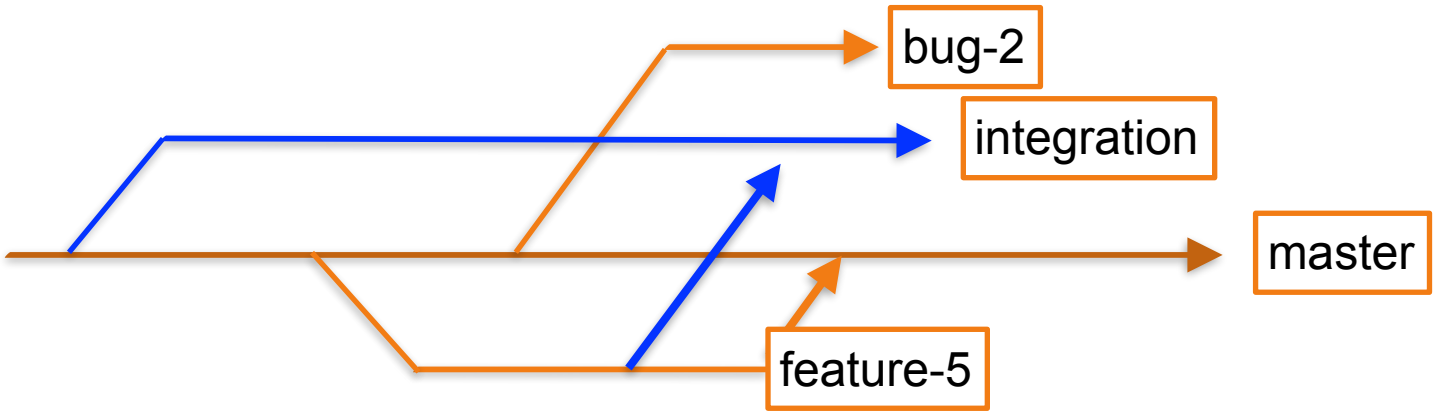
- Remote: One, primary
- Branches: master and many feature branches
- Everyone branches off master and works to get branches merged back into master



- Try to keep feature branches small, short-lived
- Might use "pull/merge requests" to get work back into master

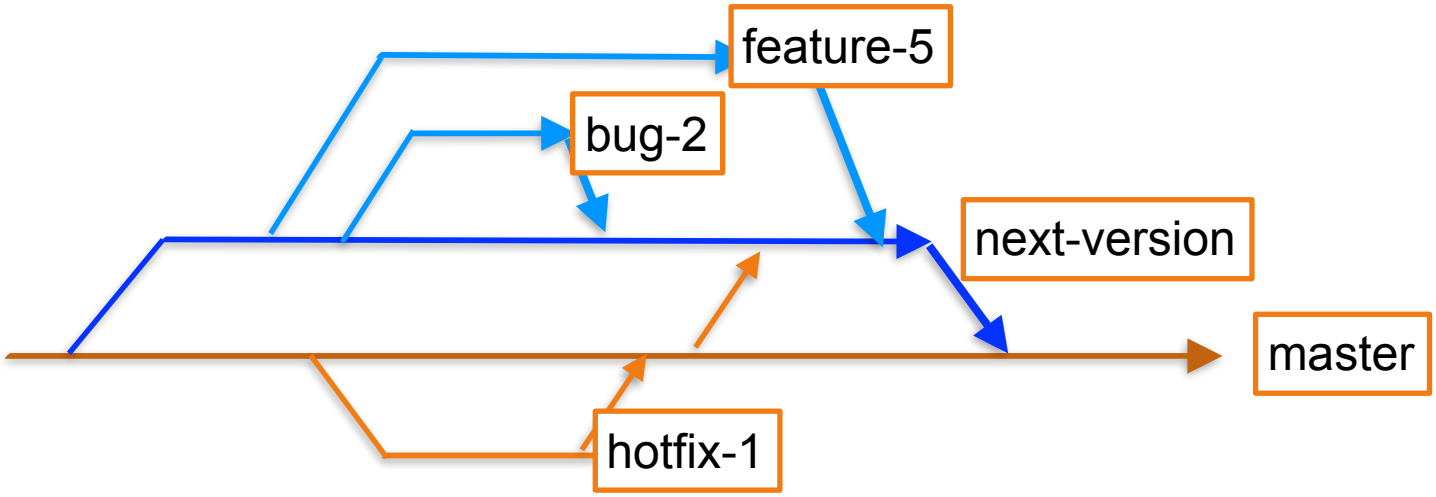
Testing-focused branch

- Branch off master, merge and test on integration, then merge topic branches into master once they pass tests, deploy master



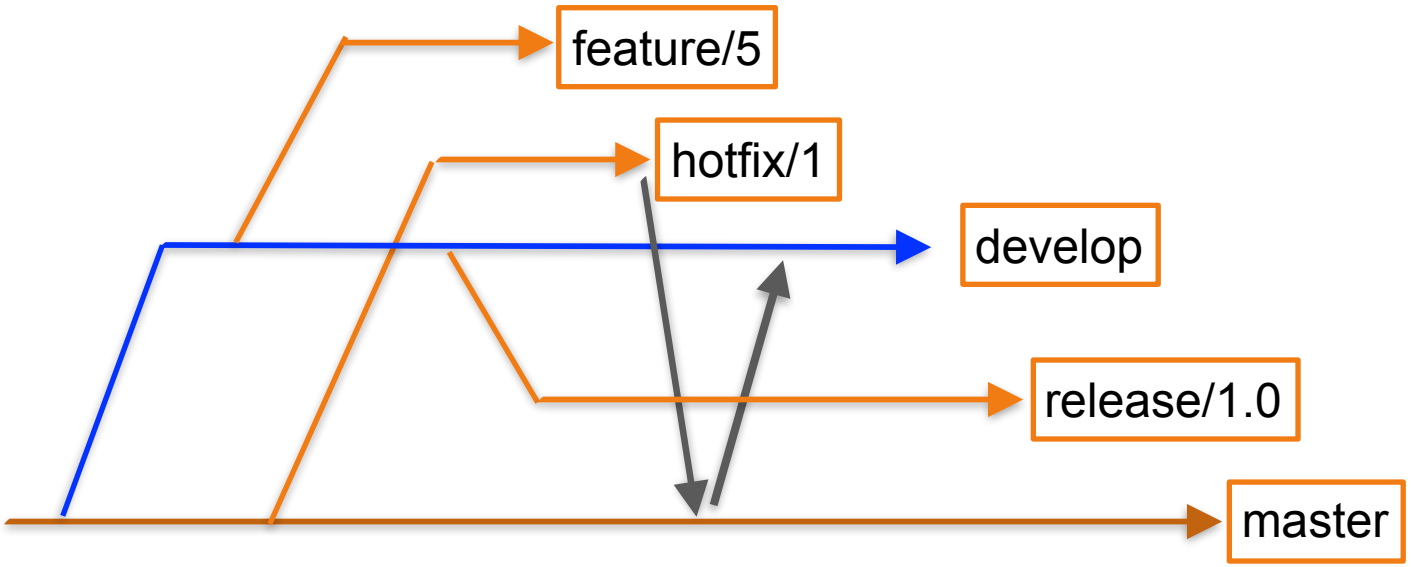
Next-version/release focused branch

- Branch off version branch, merge into version branch, merge full version branch into master once complete and deploy master.



"Git Flow"

- Remote: One, primary
- Branches: master, develop, features, hotfixes, releases
- Very rigid approach to branch naming, synchronization and merging

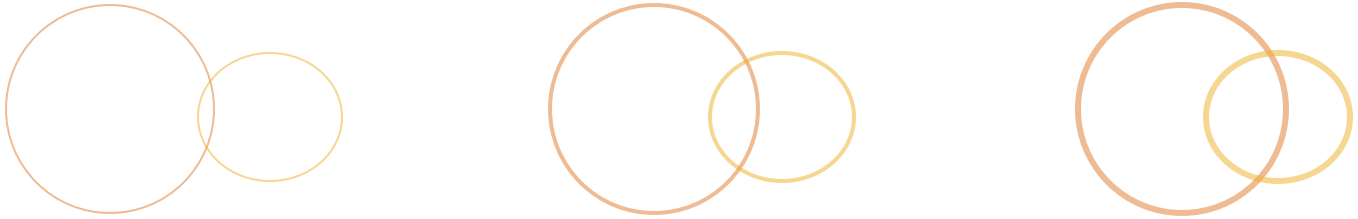


Forks

- Remotes: Many, with one primary everyone is working to get changes into
- Branches: variable; can work with many workflows
- Remotes could represent:
  - One per engineer
  - One per team within a larger team
  - One per module within a large project
  - One per contributor to an open source project

The choice depends on

- The need for stability
  - Does master need to be green?
- Deploy schedule / frequency
  - Continuous, each sprint, quarterly, etc...
- The environments you support
  - QA, Build, Integration, platform-focused, etc..
- How you want to leverage your history
  - Need it super clean/easy to debug?



module

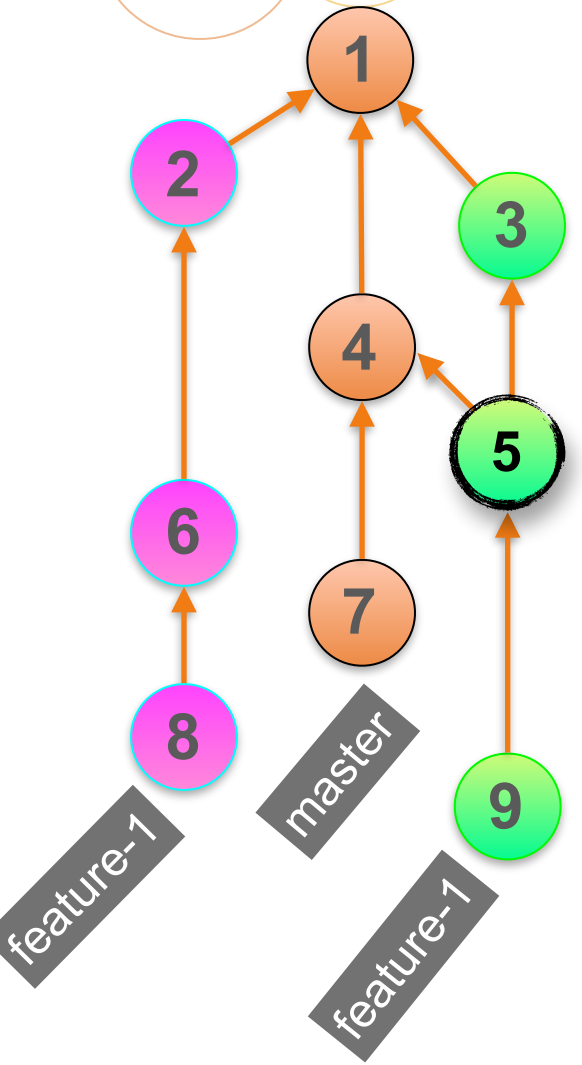
MANAGING HISTORY

What you'll learn

- Why bother *managing your repository history*
- How to **rebase** to stay up to date
- How to **squash** many commits into one
- How to **cherry picking** one or more commits

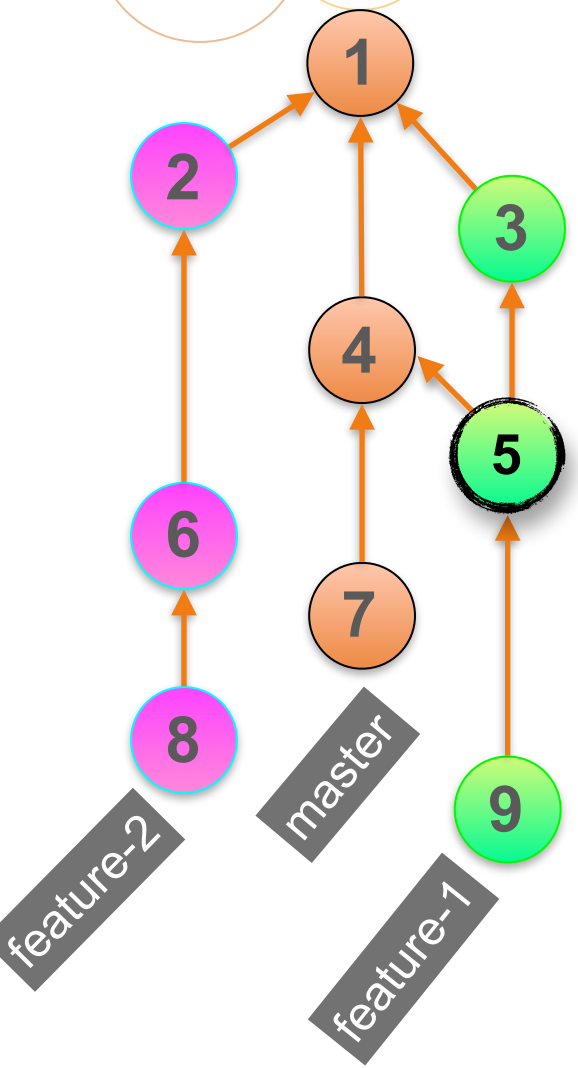
Manage History?

- Some teams want control over their graph
  - Keep commits in sequence
  - Reduce "merge noise"
    - Such as merges when someone is keeping up to date
  - Reduce number of commits
- Makes it easier:
  - to **debug** when looking at the log
  - easier to **hunt down bugs**, potentially
  - to **see related work** happening in sequence
  - to **see only *meaningful* work** (not mistakes)

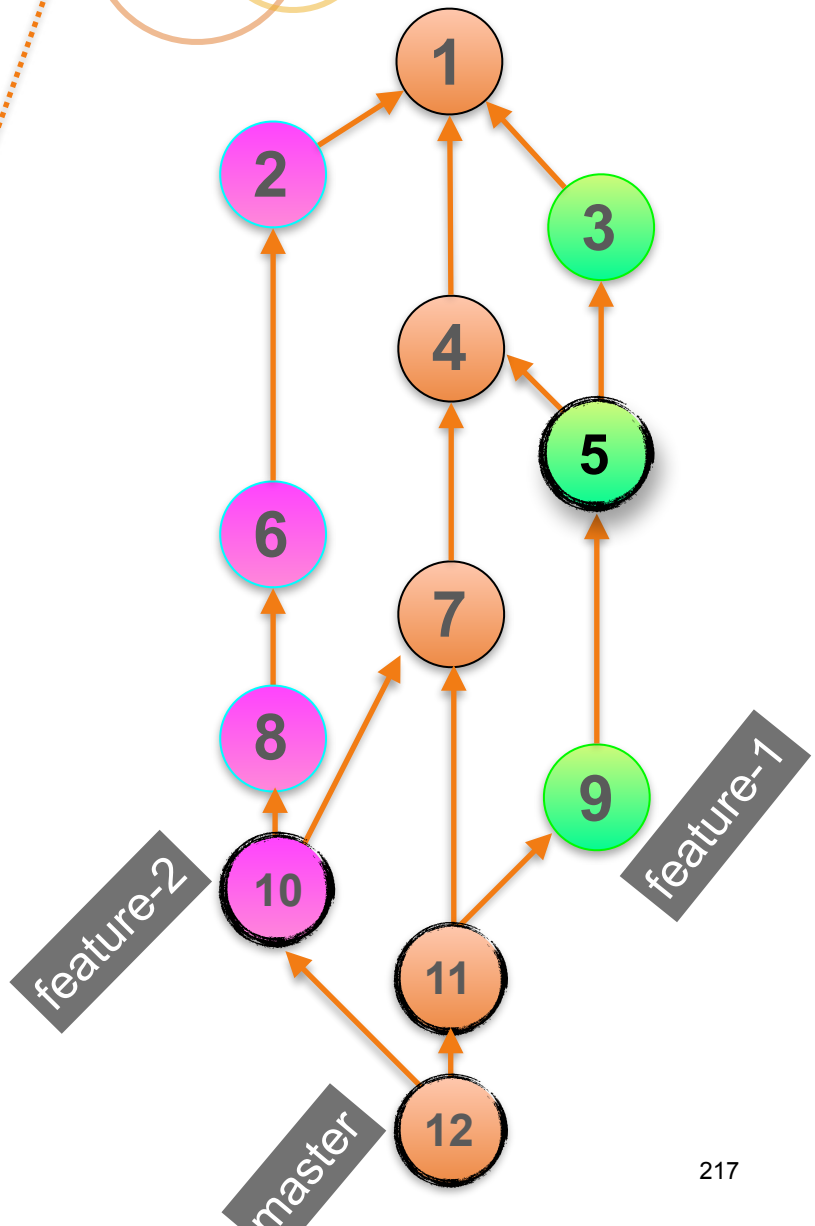


Three branches
A merge commit...

Confetti Graph

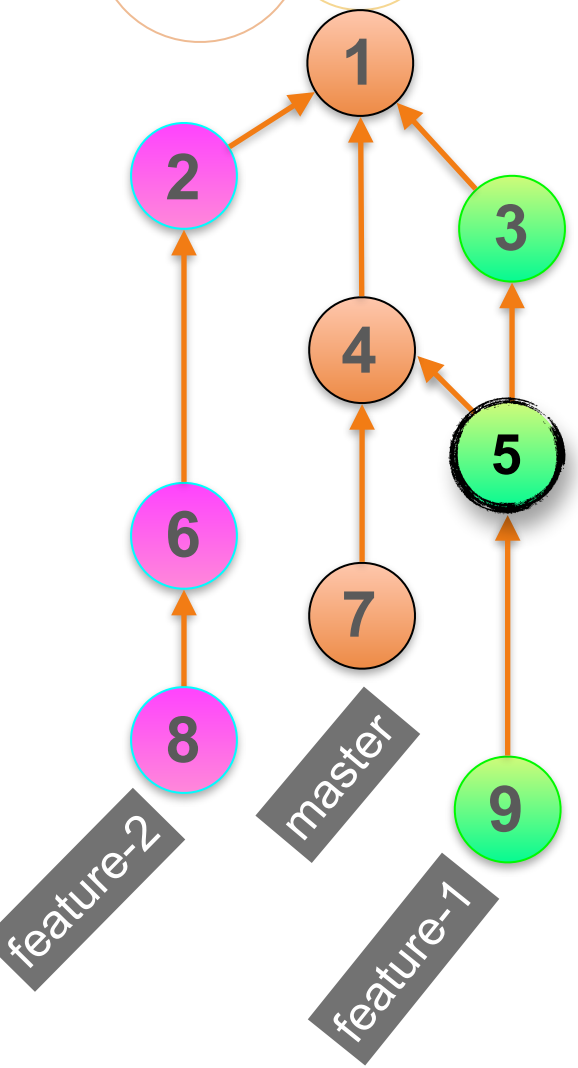


Three branches
A merge commit...



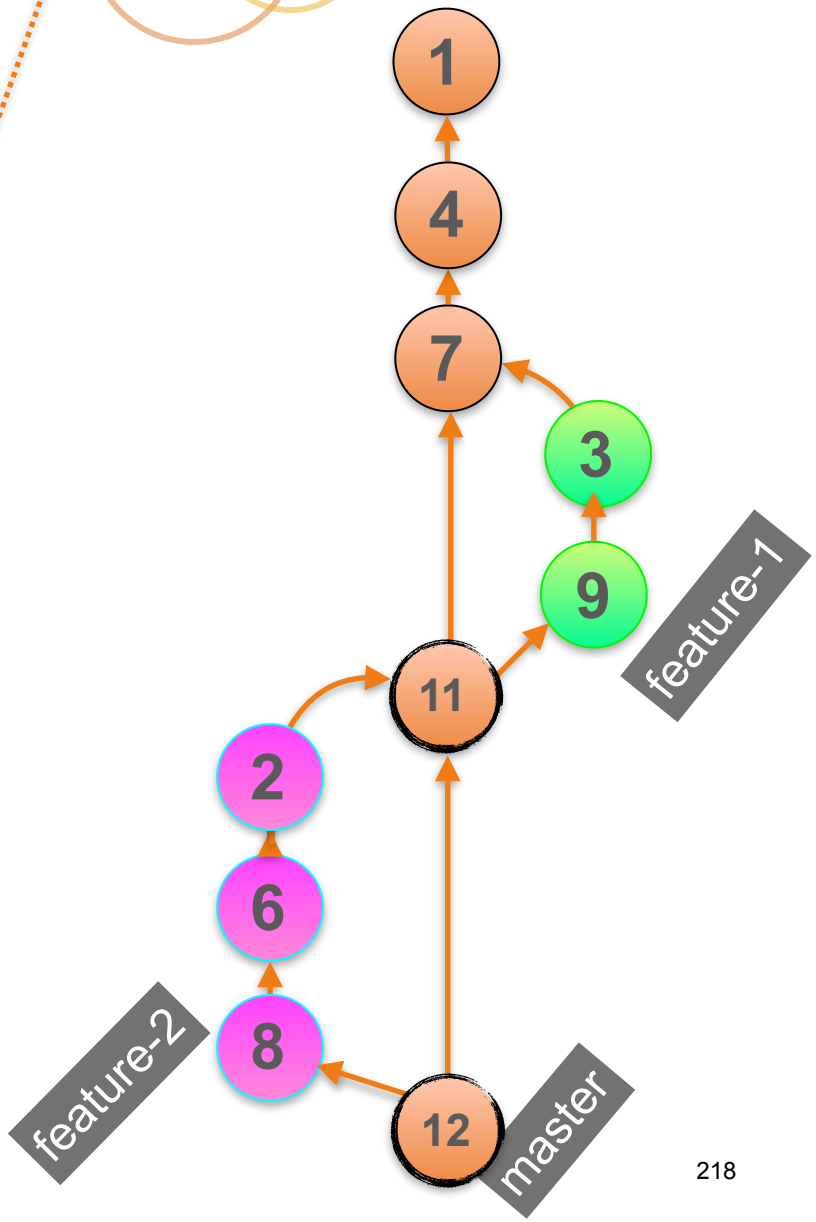
Confetti graph

Rebasing



Three branches
A merge commit...

Rebased



Ways we control history

- Control the **merge type** that happens

```
git merge --no-ff <branch>
```

- Avoid merges altogether by **rebasing** on to master when keeping up to date

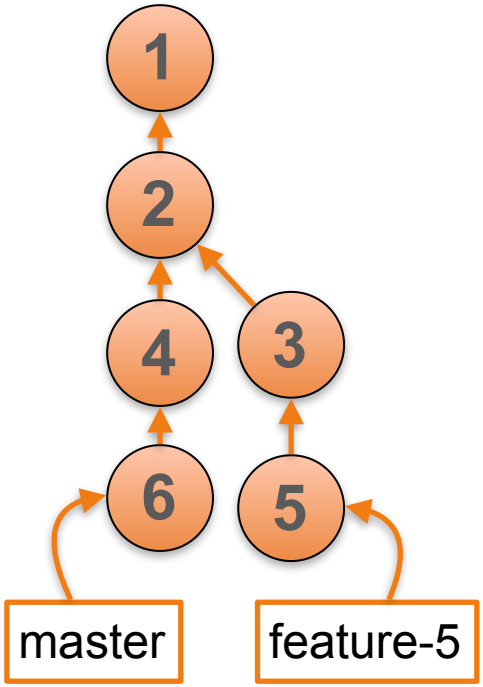
```
git rebase origin/master
git pull origin master --rebase
```

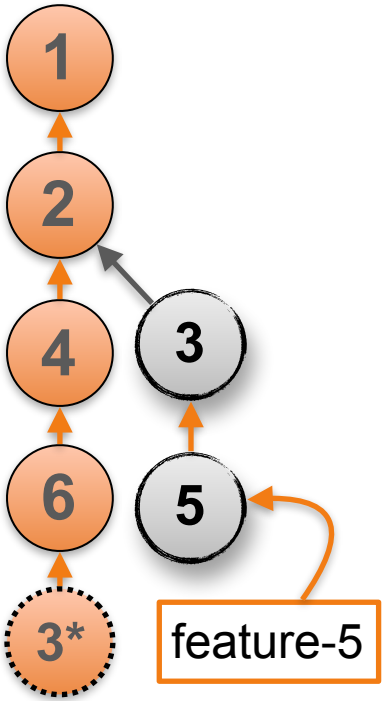
- **Squash** many commits into one when merging into master/releasing

```
git rebase origin/master -i
git merge feature-1 --squash
```

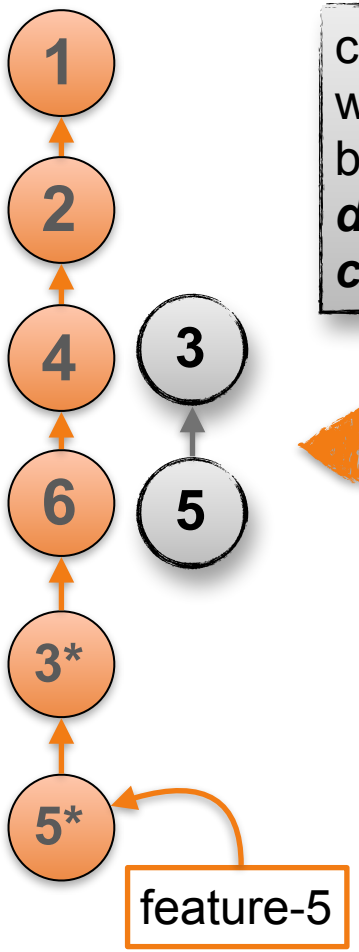
What a rebase looks like

```
git checkout feature-5
git rebase master
```





replays the branch on the ***new base***



commits w/out a branch... ***dangling commits***

Squash many commits into one

- Combining many commits into fewer/one
  - Squashes into a new commit(s)

```
git rebase -i origin/master
```

- During the rebase we can tell git to
  - "s" squash commits
  - throw away commits
  - stop and let me edit the commit itself
  - stop and let me edit the commit message

Cherry-pick a single commit

- Apply (copy) changes from one commit

```
git cherry-pick 2629dbe
```

- You can cherry pick without auto-committing

```
git cherry-pick 2629dbe --no-commit
```

Don't alter shared history

- All these operations create new commit objects
  - Changes the HEAD of a branch
  - Duplicate changes, different commit
- Pushing to previously shared branch will fail
  - You can force push it but it will cause conflicts for your team if they are using your previous commits

```
# the semi-nuclear option
git push origin feature-5 --force
git push origin feature-5 -f
```

Conflicts

- **`rebase`** and **`cherry-pick`** can get conflicts
- Fix & stage the resolution then continue...

```
git rebase --continue
git cherry-pick --continue
```

- Otherwise abort the whole operation

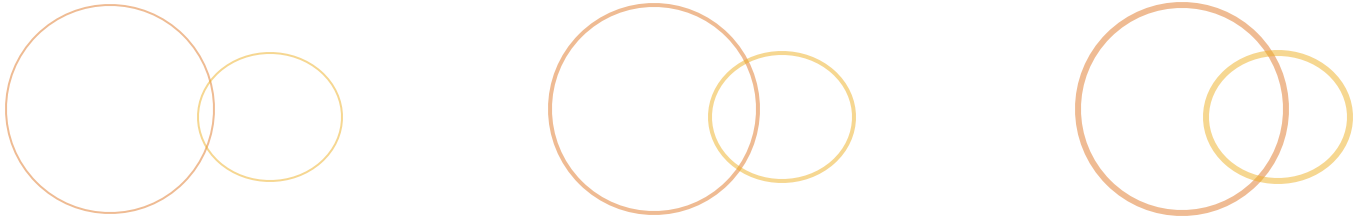
```
git rebase --abort
git cherry-pick --abort
```

Optional

Lab: Changing history

- Clone my repository:
  - https://github.com/rm-training/history-changer
  - Check the log (`--all --graph --decorate`)

1. Using rebase to bring in updates
   - Update the `topic-behind-1` branch with changes from master by using `rebase`
2. Using rebase to squash commits
   - `checkout` the `messy-branch` and view the log
   - Use `rebase -i` to squash it into one commit
   - Give it a more meaningful commit message
3. Cherry pick a commit
   - `checkout` the `diamond` branch
   - Use `git log` to find the commit with the "super important patch"
   - Create a new branch, `diamond-only`, off master and use `git cherry-pick` to bring that *important* "super important patch" commit into the new branch



module

FIXING ISSUES

Reset - The utility knife

- Wheras **checkout** moves **HEAD**
- **Reset** can be used to move branch pointers
  - **C**hanges which commit a branch points to

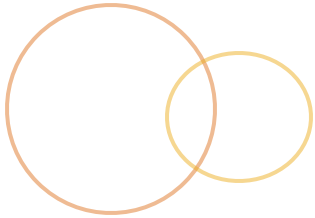
```
# reset the current BRANCH to...
git reset HEAD~2
git reset 55d932f

# reset or checkout file to...
git reset 55d932f -- readme.txt
git checkout 55d932f -- readme.txt
```

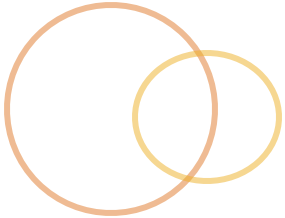
Reset modes

- Soft
  - Changes the branch pointer only
- Mixed (default)
  - Same as above, and also resets the staging area
  - When you "reset a file" it will only do a "mixed"
- Hard
  - Same as above, and also resets the working directory. This is the nuclear option.

```
git checkout master
git reset fd2930c --hard
```

The reflog





- Git keeps a log of where **HEAD** and **branch refs** have been over the past few months
  - `git reflog`
- You can use these references
  - `git show HEAD@{3}`
  - "Where HEAD was three moves ago"
- Branches also have ref logs
  - `git reflog master`
- And you can reference by date
  - `git show master@{yesterday}`
  - `git show master@{one.week.ago}`
- View by date
  - `git reflog --date=iso`

Blame & Revert

- Blame will show who did what at the line-level

```
git blame some/file.txt
```

- Revert is appropriate for fixing released commits

```
git revert <some commit>
```

What should you do if...

1. Your master is all kinds of messed up
2. You want to work on your teammate's branch
3. Your branch won't merge cleanly into master
4. Your teammate has a change that you want to use in your branch
5. You start your day; working on a feature you've been building for several days
6. Your branch has work you want to keep, but it also has lots of other junk commits or changes...

Any other common scenarios, gotchas or questions?

What should you do if...

1. Your master is all kinds of messed up

   Delete it and checkout a fresh copy
   or...
   Use the reflow to find the "correct" commit and "reset" master back to that commit id.

What should you do if...

1. You want to work on your teammate's branch

   Make sure you're all up to date
   git fetch origin
   Then checkout their branch by name
   git checkout feature-12

   You can share by pushing
   And Get their updates by pulling

What should you do if...

1. Your branch won't merge cleanly into master

   You'll need to resolve the conflict.
   Get up to date
     git fetch origin
   Then merge master into your branch
     git checkout feature-12
     git merge origin/master

What should you do if...

1. Your teammate has a change that you want to use in your branch

   You could cherry-pick their commit(s)
   Or if their branch is well isolated, you could merge their branch into yours.

What should you do if...

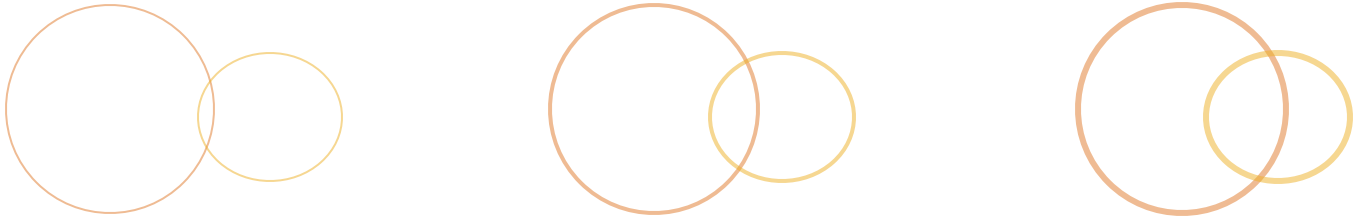
1. You start your day; working on a feature you've been building for several days

   Get up to date!
   Check out the branch if you weren't already on it.
   ```
   git checkout feature-12
   ```
   And get all the updates from the team...
   ```
   git pull origin master
   ```

What should you do if...

1. Your branch has work you want to keep, but it also has lots of other junk commits or changes...

   You could hand-pick commits and cherry pick them out
   Or...
   Use rebase -i to re-do your history...



module

MORE WITH GIT

or: The stuff we didn't cover....

Other commands

- git blame
- git gui
- gitk
- git bisect
- git mergetool & difftool
- hooks
- commit message templates
- .gitattributes
- submodules & subtrees
- ReReRe (Reuse Recorded Resolution)

Commit Message Templates

- Agree on what is expected in a commit message

./gitmessage

```
# 50-char summary

# detailed explanation:

Resolves:
See also:
```

- Set up a template file and tell git about it

```
git config --local commit.template ~/.gitmessage
```

.gitattributes

- Configuration file in a directory or subdirectory
  - Specifies behaviors for files/paths
- Such as dealing with binary files

```
# tell git to consider *.pbxproj as binaries
*.pbxproj binary

# tell git to use the "word" filter to diff
# this requires additional set up...
*.docx diff=word

# show exif data when diffing images
*.png diff=exif
```

Hooks

- Trigger functionality during different git events
  - Pre/post commit, push, pull, etc

```
# take a look at the samples
ls -la .git/hooks
```

- Local or Server-side hooks
- Our hosted repos can be set up to respond to branch updates, triggering a build, test suite, CI, etc...

Sharing hooks with your team

- `.git/hooks` directory is not version controlled
- So... we have two options:
  1. Add a setup script that copies from `./githooks` into `.git/hooks`
  2. Define `hooksPath` in your local config (2.9+)

```
git config --local core.hooksPath .githooks
```

Don't forget to make newly added hooks executable