Version Control with Git/GitHub

Ying Jin

February 9, 2023

Introduction

- Version Control
  - Tracking and managing changes
  - Create reproducible analysis
- Git: Free and open source **distributed version control system (DVCS)**
- GitHub: Internet hosting service of Git

Set up Git on your device

- MacOS: open terminal and run the command git −−version
- PC: Git Bash
  - Download and install Git For Windows package: `https://gitforwindows.org/`
- Additional resources
  `https://www.atlassian.com/git/tutorials/git-bash`
- Set up your GitHub account

Configuration

- Three levels of configuration: system, global (user), local (repository)
  - Check existing settings: git config −−list
  - Look for configuration files: git config −l −−show-origin
- Associate your local Git configuration with your name and Email
  - git config −−global user.name *your user name*
  - git config −−global user.email *your GitHub email*

Authentication

Protocols

- SSH: Easy, secure and free
- HTTP: Need to renew personal token often
- Git: Not secure. Rarely used alone.

Check existing SSH keys

- cd ~/.ssh: go to where git stores SSH keys
- ls: list all files in the directory
- Look for a pair of files named "id_xxx" and "id_xxx.pub"

Generate new SSH key

- Put in terminal:
  `ssh-keygen -t ed25519 -C "your_email@example.com"`
- Put in a secure passphrase (remember it!)
- Add your key to ssh-agent
  - Start ssh-agent in the background: `eval "$(ssh-agent -s)"`
  - Check if file exists in default location: `open ~/.ssh/config`
  - If doesn't exist, create file: `touch ~/.ssh/config`

Generate new SSH key

- Add your key to ssh-agent
  - Once .ssh/config is open, edit the file to include:

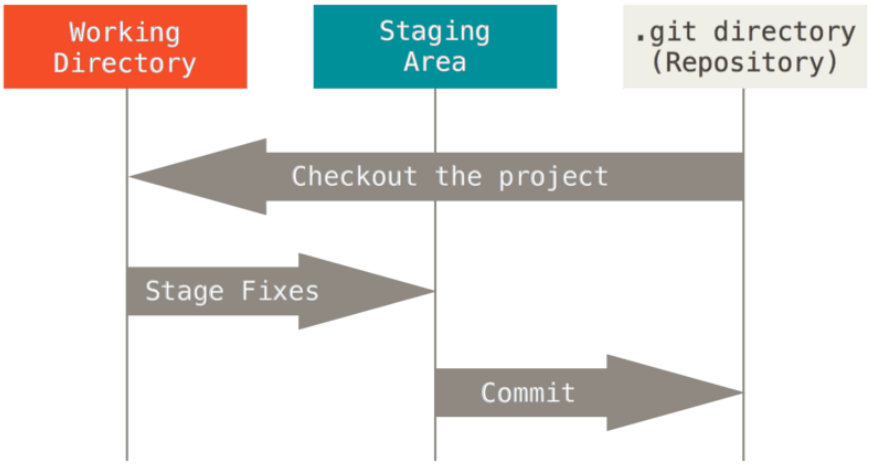
```
Host *.github.com
    AddKeysToAgent yes
    UseKeychain yes
    IdentityFile ~/.ssh/id_ed25519
```

  - Add key to agent and store password:

```
ssh-add –apple-use-keychain ~/.ssh/id_ed25519
```

- Add key to GitHub:
  - Copy key: `pbcopy < ~/.ssh/id_ed25519.pub`
  - Settings -> SSH and GPG keys

How Git works locally



- Working tree: modify files
- Staging area: selected changes (added)
- Repository: store changes permanently (committed)

Start a repository

- Clone from GitHub with SSH/HTTP link

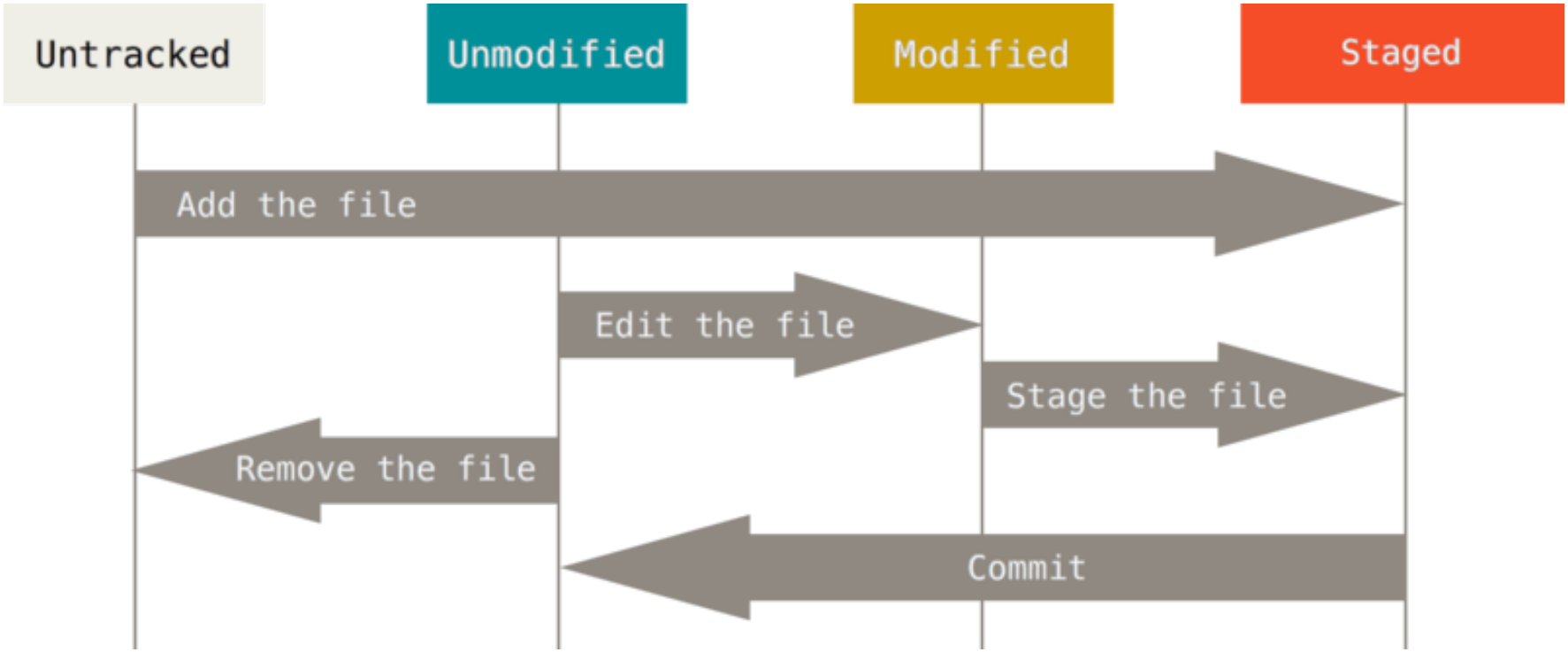
```
git clone <link>
```

- Initializing a local Repository

```
cd <link>
git init
git add .
git commit -m <message>
```

Track changes in the repository

- Make sure you are on the right working directory
- Status of files: **Tracked** or **Untracked**
- Status of **tracked** files: **Unmodified, modified, staged**



Track changes in the repository

- Check changes in your repository

  git status / git status -s

- Track new files/stage modified files

  git add *filename*

- Commit staged files to repository

  git commit -m *your message*

Ignore files

- Greate a gitignore file

```
touch .gitignore
```

- Open and edit the gitignore file

```
open .gitignore
```

Follow standard global patterns, for example:

- Ignore all .xlsx files: *.xlsx
- ignore all files in a directory: Data/

Remove files

- Remove files completely

  git rm *filename*

- Remove from Git, but not the hard drive

  git rm −−cached *filename*

Undo changes

- Modify the last commit:

```
git commit --amend
```

  - Commit message editor would fire up
  - Save message and quit: `ESC+:wq`

- Unstage/Unmodity files
  - `git status` will tell use how
  - Unstage files:

```
git restore --staged filename
```

  - Unmodify files (Careful! Any local changes will be gone!):

```
git restore filename
```

Remote command lines

- Check existing remote settings: `git remote` or `git remote -v`
- Clone a remote repository to your local device: `git clone` *url*
- Connect local repository to remote repository:

  `git remote add` *shortname url*

  - Specify a name for your remote server
  - Use the name (string) on the command line in lieu of the whole URL
- Remove remote repository: `git remote remove shortname`

Remote command lines

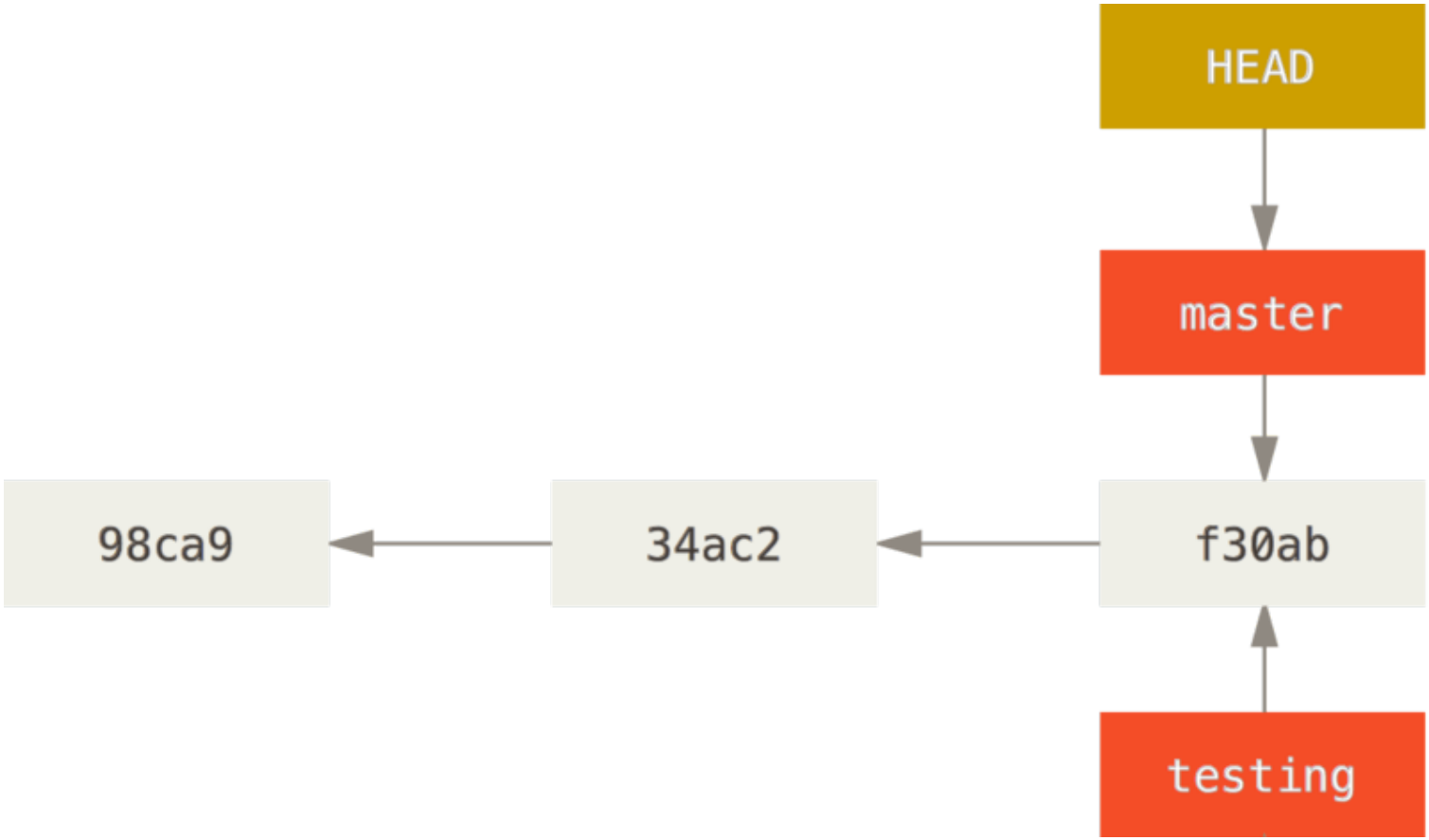
- Download data: git fetch *remote*
  - Only download. Does not change local repository
  - Need to merge manually
- Download and merge: git pull
- Update remote repository git push *remote branch*
- Upstream setting:

  git push −−set-upstream *remote branch*

  - Set a default remote branch for a local branch
  - fetch/push/pull can be used with no additional arguments
- Inspect remote settings: git remote show *remote*

Git Branches

- Remember Git stores data in a series of commit
- Every branch has a pointer to a specific commit in this chain
- A "head" point indicates the branch you are currently on



Branch operations

- Create a branch

  git branch *branchname*

- Switch to a branch

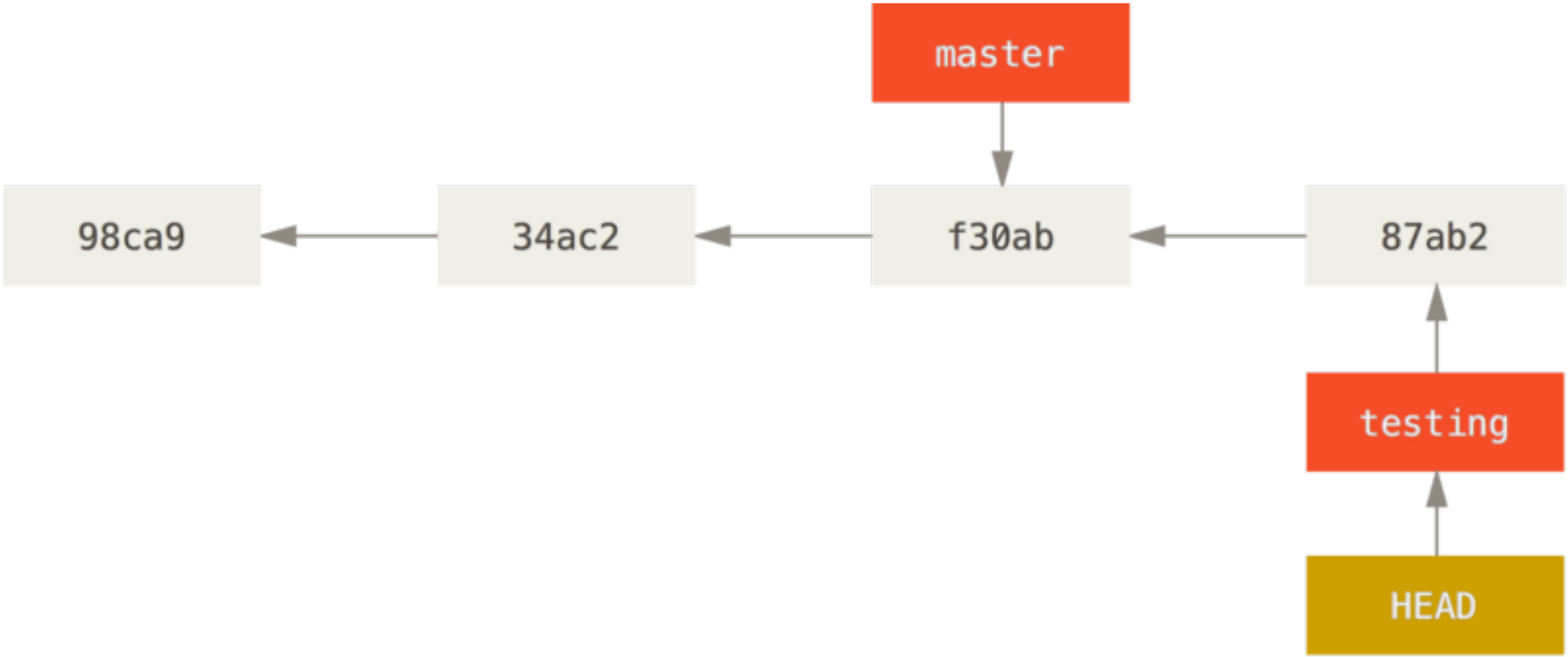
  git checkout *branchname*

- See current branch

  git branch
  git log −−oneline −−decorate

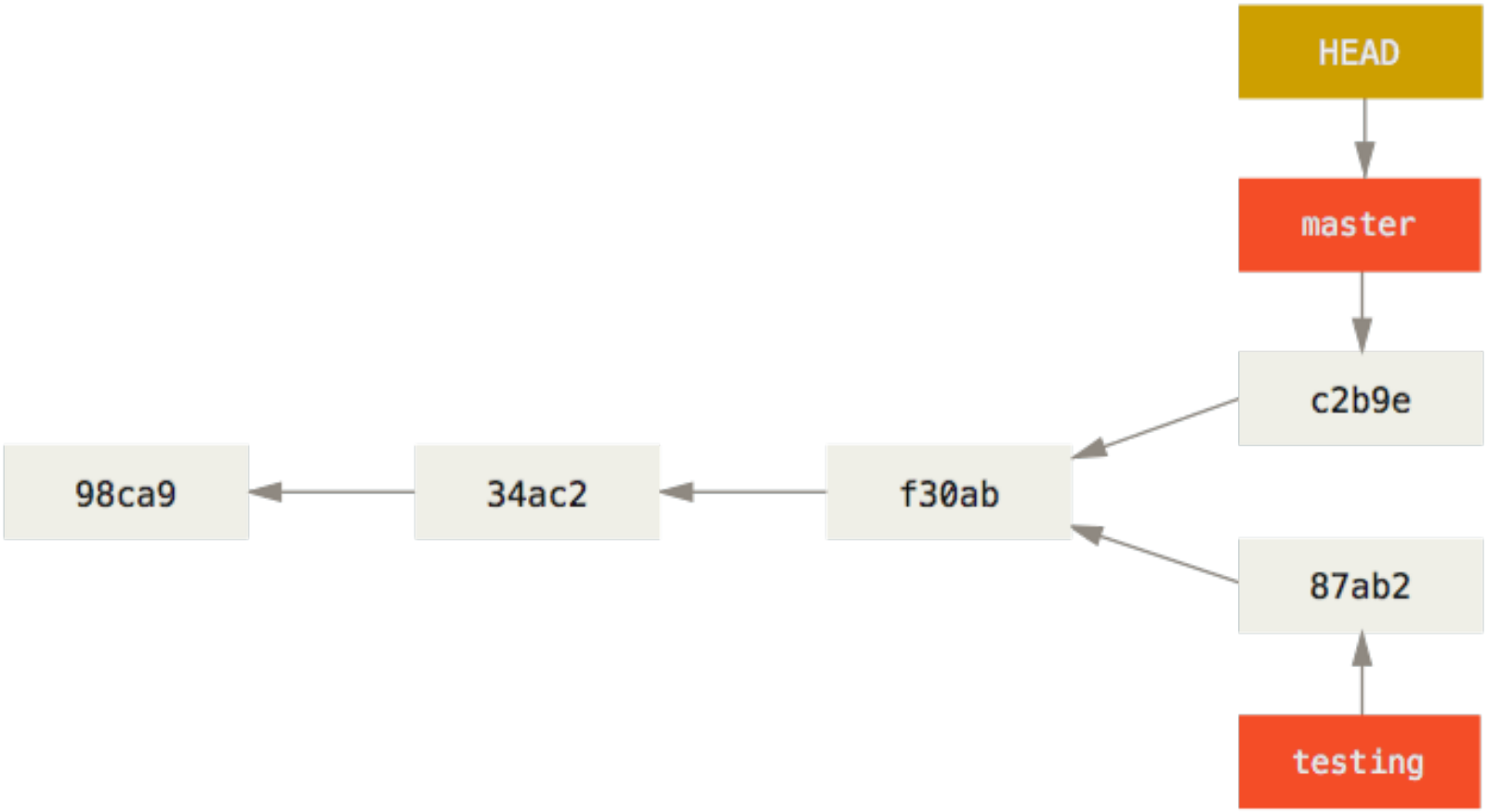
Branch operations

When commits are made, the "head" pointer moves forward.



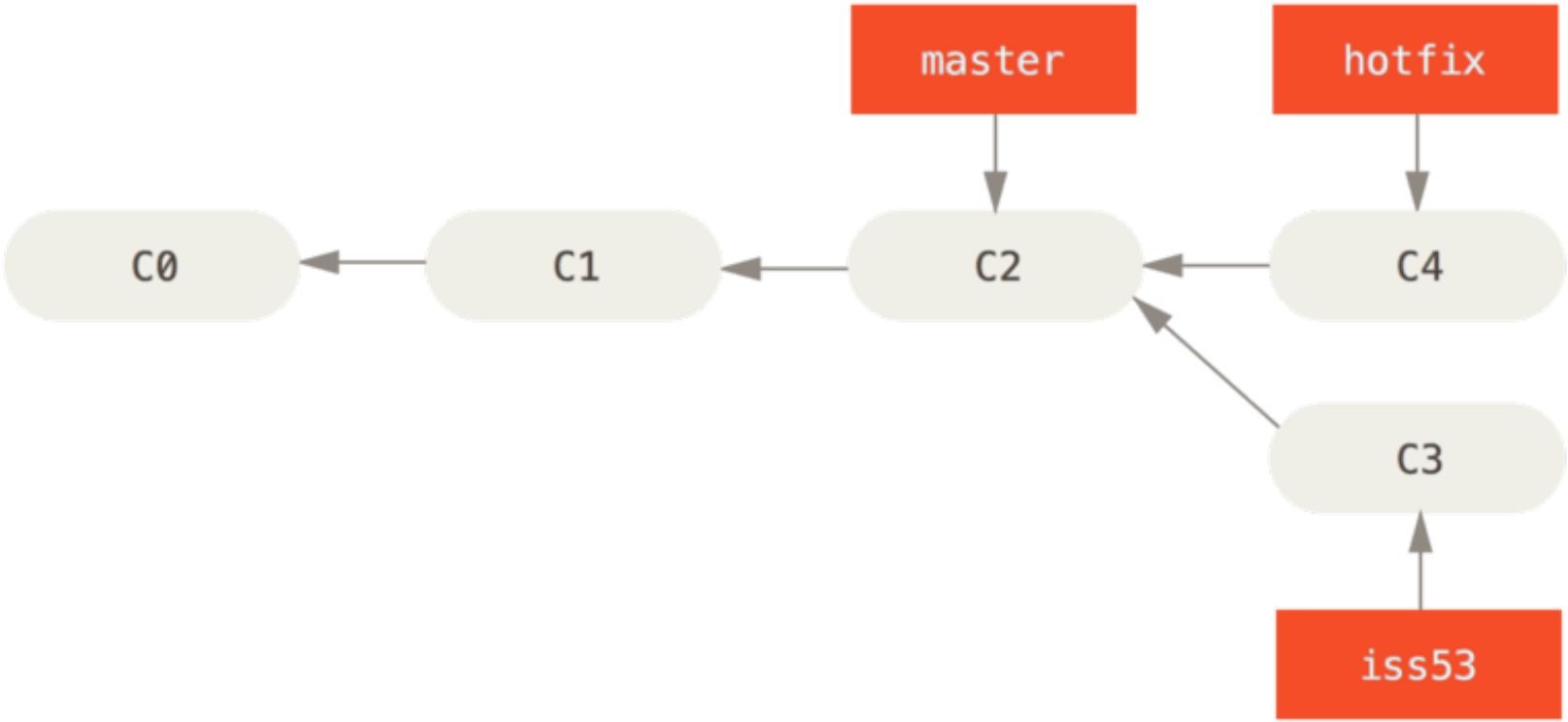
Branch operations

Your Git repository can accommodate divergent history



Basic merge

- Make sure you are currently on the branch to merge into
- Run command `git merge` *branchname*
- Fast-forward recursive merging



Merge conflicts

- When conflicts happen, Git where tell you where to find them
- Open the file and look for the following section

```
<<<<<<<
Current branch version
=======
Merged-in branch version
>>>>>>>
```

- Resolve manually, then add, commit and push

Branch management

Example:

- A long-running branch that is clean and "ready for publication"
- A long-running branch that is messy with all your mess around code
- Occasionally, create "topic" branches for particular fixes

git branch -d *branchname*
git push *remote* −−delete *branchname*