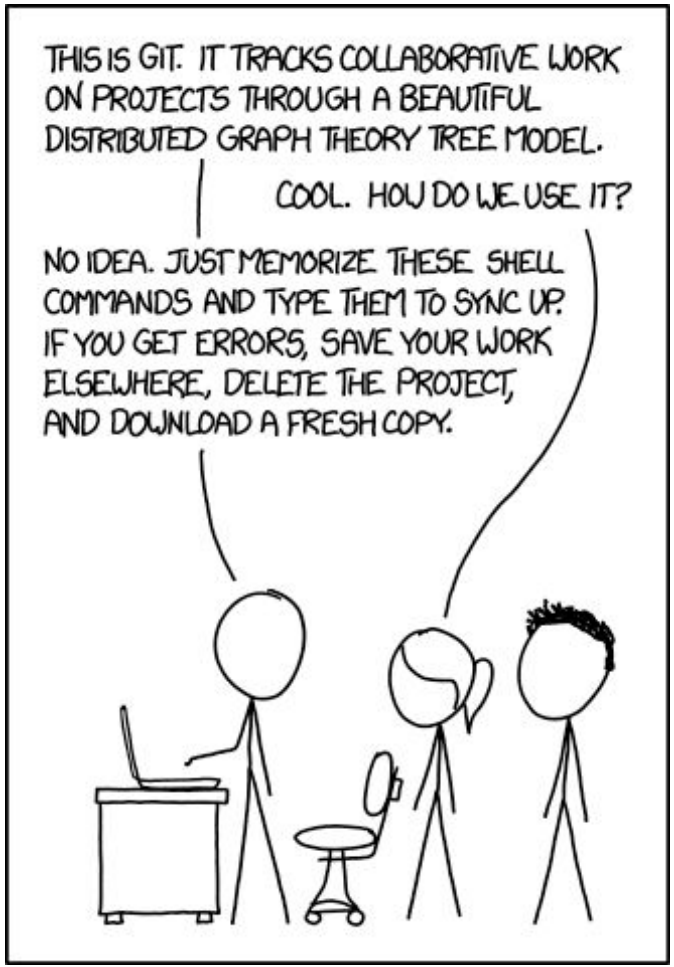
Git

Kameswari Chebrolu



https://xkcd.com/1597/

Motivation

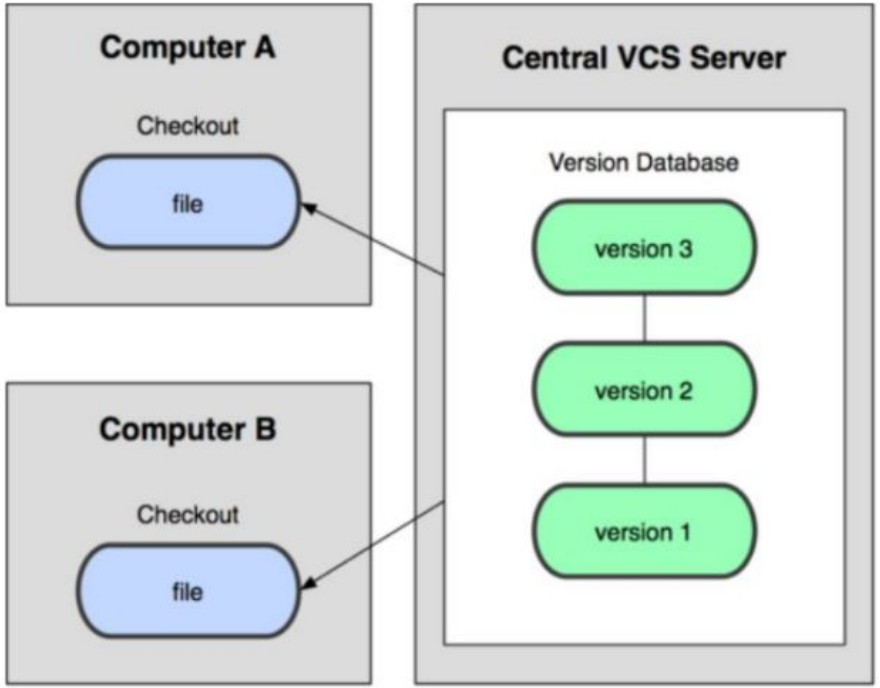
- You edit a file
- You change it some more
- And then some more…
- Darn!!! You messed up the file
- If only you know how the file changed!
  - Can revert to some older version and carry on from there

Version Management

- Version control: a system that records changes to (set of) files over time
  - Files can be code, scripts, documents, configuration files, data etc
- Roll-back functionality:
  - Mistakes happen! Can undo mistakes and go back to a working version
- Branching:
  - Can work on different issues/features in different branches (and discard branch if bad idea)
- Merging: Efficient collaboration
  - Different people can work on same code/project without interfering
- Traceability: who made the changes, and when and why the changes were made?

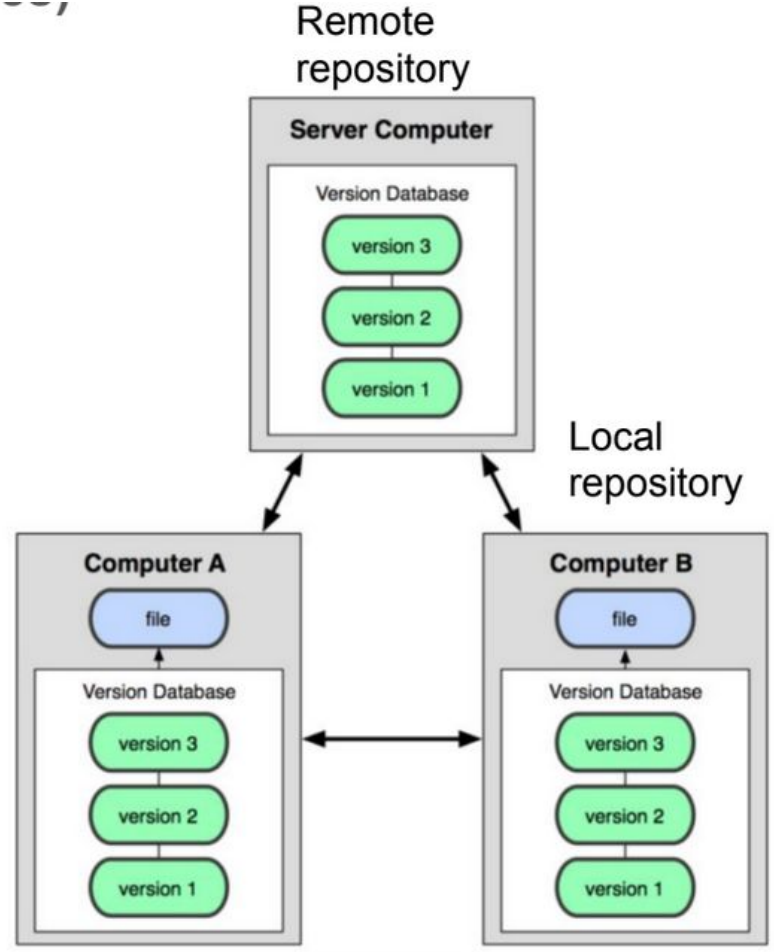
Centralized

- Example: cvs, svn
- Centralized server is vulnerable

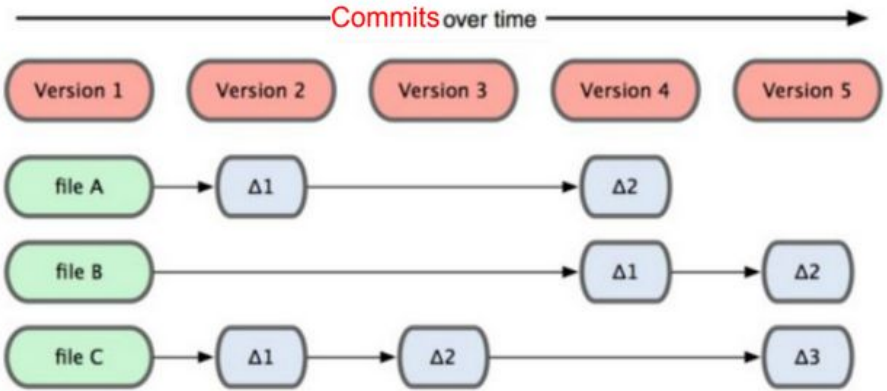


Distributed

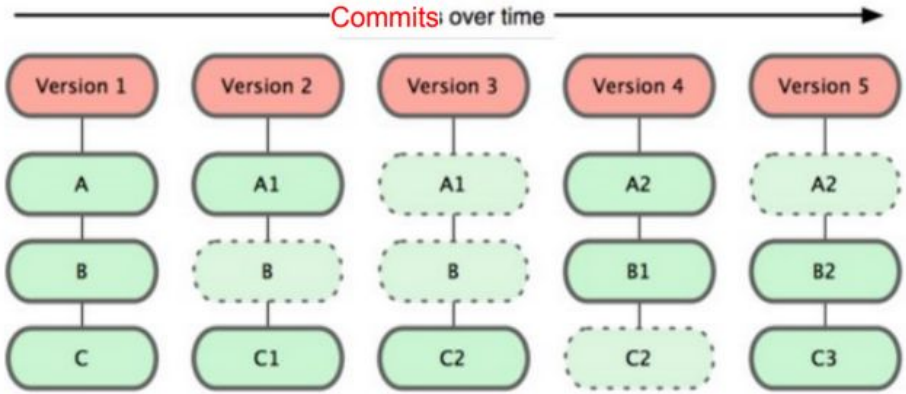
- Example: git, Darcs
- Each client fully mirrors the repository.
  - If the server dies, any of the clients can help
  - User can interact with other users independent of central repo



other vc systems

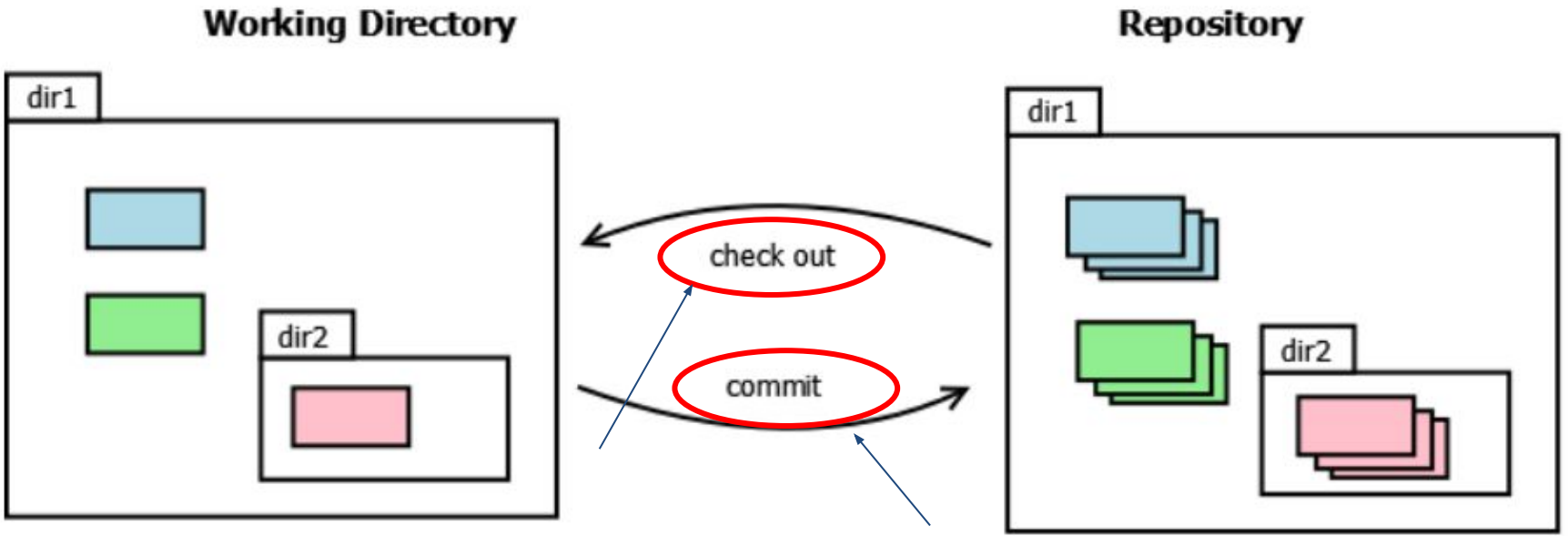


git



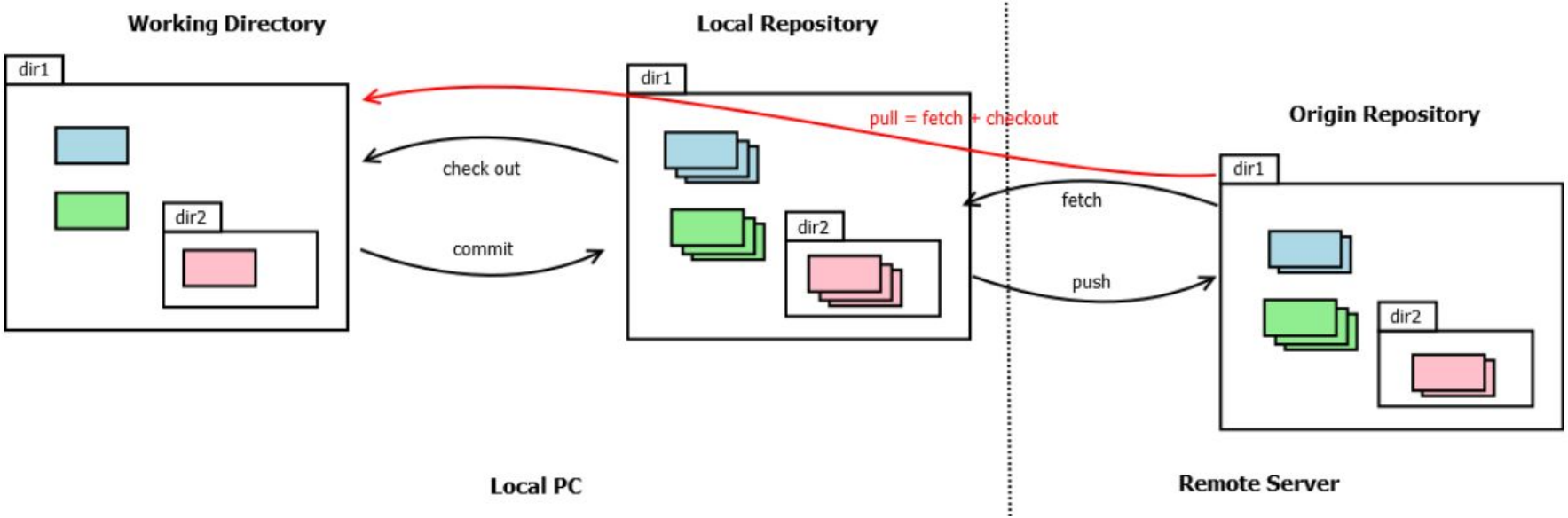
Repositories and Working Directory

- Repository: collection of versions of files
  - Tracks deleted and newly added files
  - Users do not edit or even read files in the repo
- Working Directory: Current version of files
  - Users work on a copy of the files in their working directory



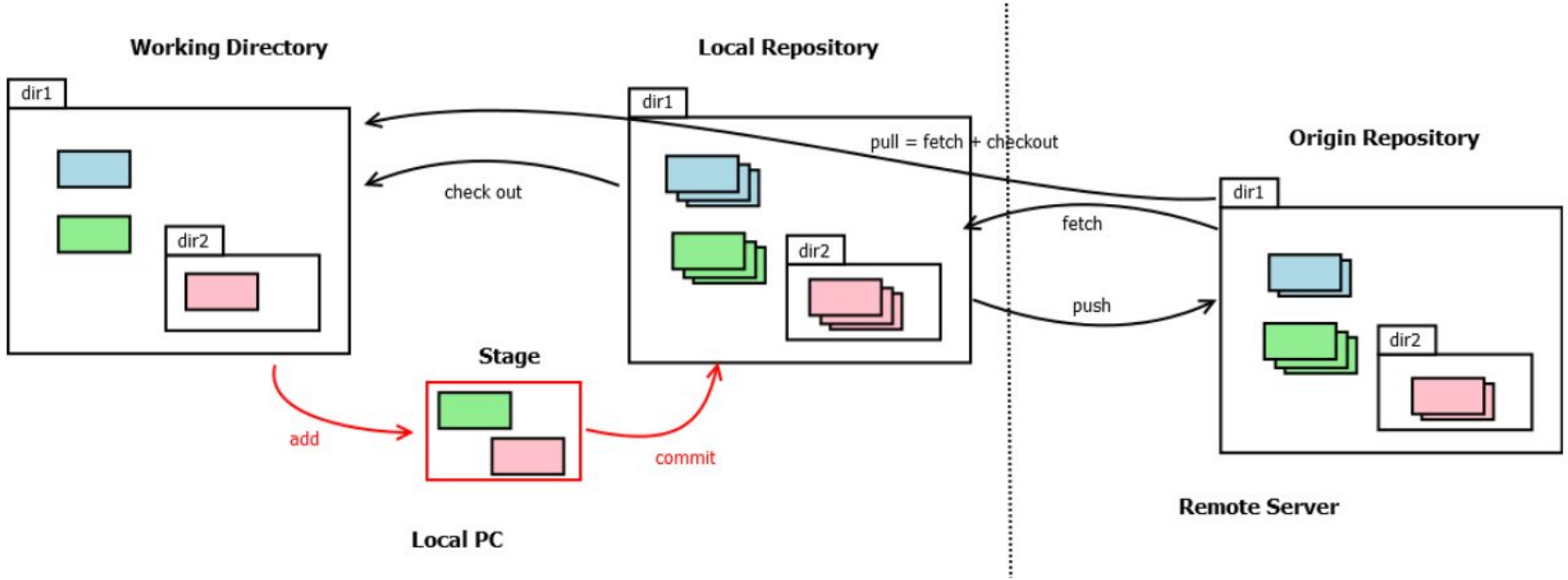
- Commit: send current contents of a file to the repository
  - current contents become a new version.
- Checkout: ask repository to give a copy of a version of a file

Git Architecture



- Local Repository: On local machine
- Origin repository: Remote for reliability
  - Many users will share origin
  - kept more or less in sync with local repository
- Push: push changes from our local repository to the origin
- Fetch: fetch changes anyone else may have made from the origin to our local repository
  - Fetching simply updates local repository
  - Need checkout for them to reflect in working directory.
- Pull: combines a fetch and a check out (most often used)
  - Changes reflect directly in working directory

Staging



- Commit/checkout/fetch/push/pull happen at directory level!
- What if we want to commit some files, not all?
- Staging: We “add” files to stage and then commit from stage instead of the working directory

Origin

- Where is the origin repository?
- Any machine which supports SSH/HTTPS will do
- Cloud Options: GitLab, GitHub, BitBucket, AWS Code Commit etc
  - A git hosting system with lots of additional features
  - E.g. project management, ticket management, bug tracking, access management etc
- Our focus: Local Repository

Creating a (local) git repository

- You can configure git via config
  - Username, email etc
  - E.g. git config --global user.name "kameswari chebrolu"
- “init” : Used to create a Git repository
  - git init
- After initialization, other files can be added

git status

- Tells current state of the repository
  - current working branch
  - what files are in staging area and not committed
  - what files are untracked etc
  - git status
- .gitignore file: helps specify files that git should ignore (even under untracked files)
  - E.g. temporary files (.o files)
  - These files won’t show in status

git add

- Add files to staging area
  - git add file1.txt file2.txt

git commit

- git commit: Commit the staged snapshot, launches a text editor for commit message
- git commit -a: Commit a snapshot of all changes in the working directory
  - But this only includes modifications to tracked files (those added with git add at some point in the past).
- git commit -m "commit message": shortcut to avoid editor
  - Use meaningful messages here, see xkcd comic :-)
  - Can also do git commit -am "commit message" (combines both)
- git commit --amend: modifies the last commit
  - Instead of creating a new commit, staged changes will be added to the previous commit

https://xkcd.com/1296/

Git log

git log
git log file1.txt (commit history of that file)

- A long hexadecimal number you see is the commit's hash, helps identify a commit
  - can use just 5 digits mostly in commands

git show

git show :filename
Example: git show :file1.txt
Shows the content of file1.txt in the staging area

git show commit:filename
Example: git show HEAD:file1.txt
Shows the content of file1.txt in HEAD

Example: git show 5b80ea8:file1.txt
Shows the content of file1.txt in the commit object 5b80ea8

- `create file.txt`

Working area	Staging area	Commit
`file.txt - v1`		

- `git add file.txt`

Working area	Staging area	Commit
`file.txt - v1`	`file.txt - v1`	

- `git commit -m "msg"`

Working area	Staging area	Commit
`file.txt - v1`	`file.txt - v1`	`file.txt - v1`

- `edit file.txt`

Working area	Staging area	Commit
`file.txt - v2`	`file.txt - v1`	`file.txt - v1`

- add `file.txt`

Working area	Staging area	Commit
file.txt - v2	file.txt - v2	file.txt - v1

- edit `file.txt`

Working area	Staging area	Commit
file.txt - v3	file.txt - v2	file.txt - v1

- `git commit -m "msg"`
  `git commit file.txt -m "msg"`

Working area	Staging area	Commit
file.txt - v3	file.txt - v2	file.txt - v2
file.txt - v3	file.txt - v3	file.txt - v3

git diff

git diff <commit>: shows the diff between the current working tree and the <commit>

git diff --cached <commit>: shows the diff between your staged changes and the <commit>

Linux command: diff

- diff stands for difference
- Compares the contents of two files and display the differences between them
  - highlight changes, additions, and deletions in a clear and readable format
- Tells us which lines in one file have to be changed to make the two files identical

Example

- diff a.txt b.txt
  - Output:
    - Line numbers corresponding to the first file
    - A special symbol
    - Line numbers corresponding to the second file
    - E.g. 2,3c3
      - line 2 to line 3 in the first file needs to be changed to match line number 3 in the second file
    - Lines preceded by a < are lines from the first file.
    - Lines preceded by > are lines from the second file.
    - The three dashes (“—“) merely separate the lines of file 1 and file 2

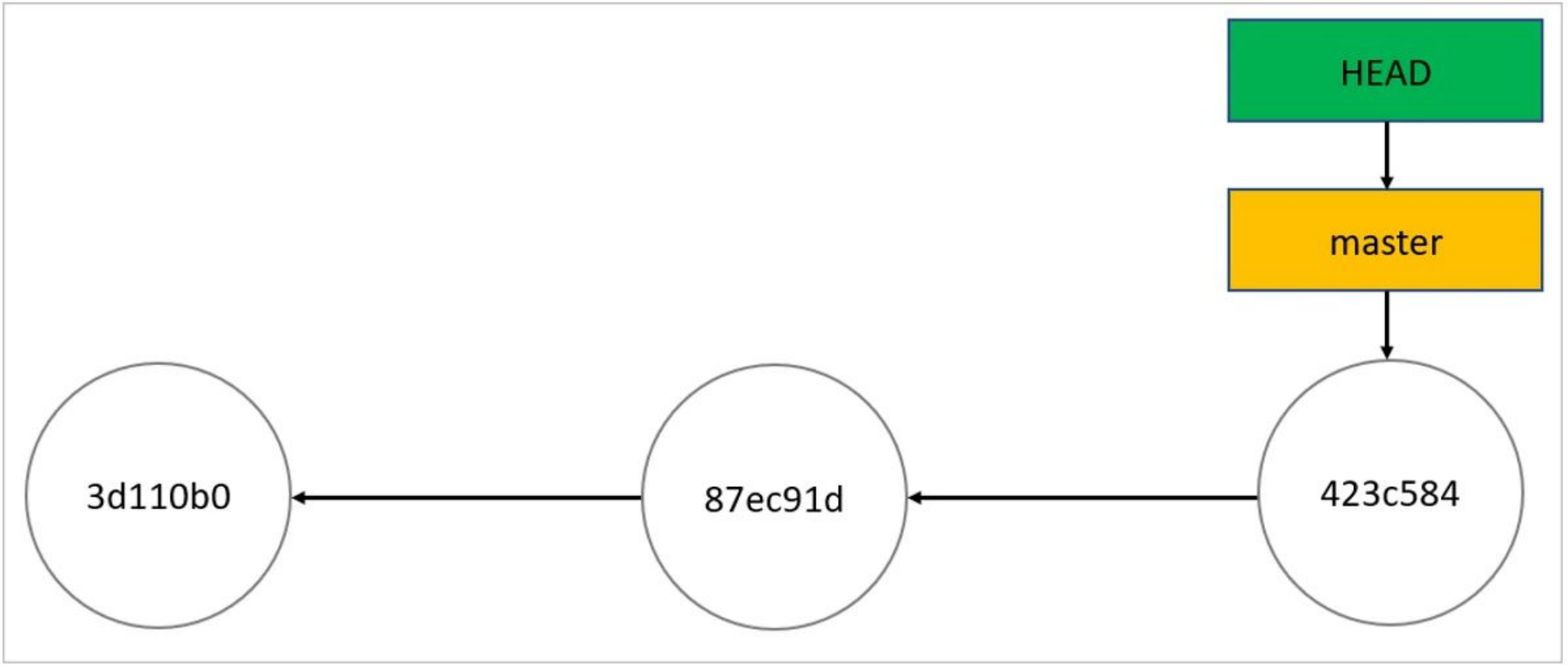
- diff -u a.txt b.txt (unified mode)
  - Output:
    - The first file is indicated by `---`, and the second file is indicated by `+++`.
    - The first two lines provide information about file 1 and file 2, including the modification date and time
    - @@ -1,5 +1,5 @@ denote the line range for both files
      - In this example, both files are 5 lines each
    - Subsequent lines represent the contents of the files with specific indicator
      - Unchanged lines are displayed without any prefix
      - Lines in the first file to be deleted are prefixed with -
      - Lines in the second file to be added are prefixed with +.

Undoing Changes: checkout and commit

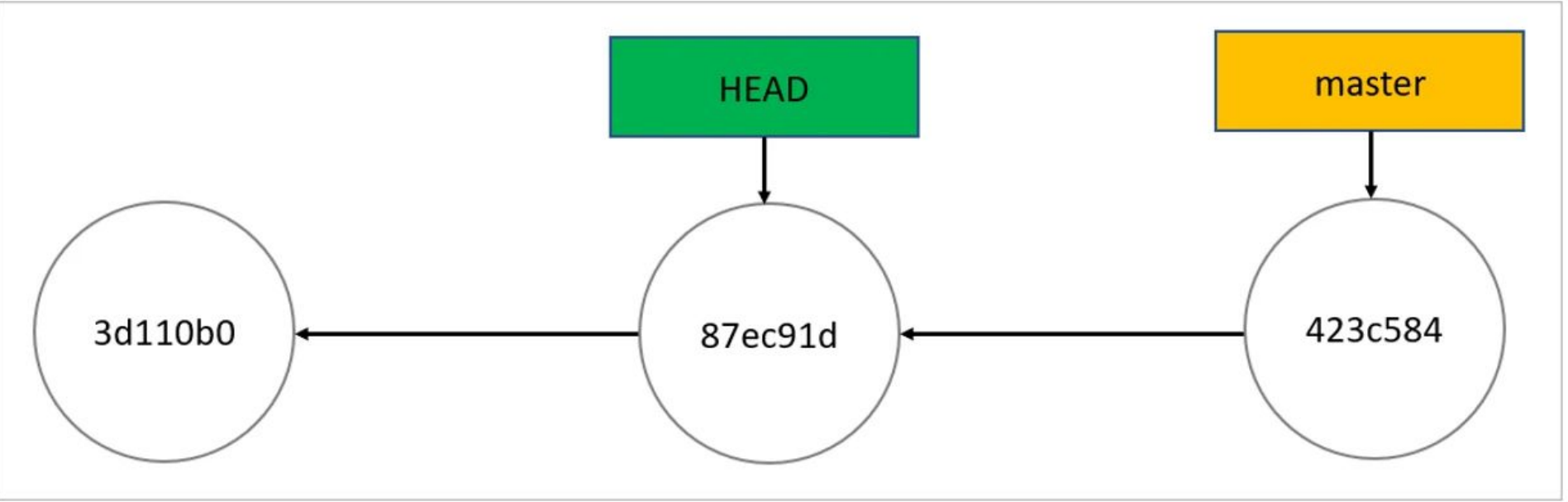
- You can move backwards in time by checking out an older commit.
  - git checkout commit-id
  - Will replace the contents of working directory by the contents of that older commit
  - Useful for “look but don’t touch” way to explore the older code
  - Get back to most recent commit via git checkout master
- Ability to rollback individual files to old versions: git checkout commit-id path-to-a-file
  - Then can use git commit if you want everything else to use current and this file to be some older version

HEAD

- HEAD answers the question: “Where am I right now?”
- Most of the time, HEAD points to a branch name
  - So far we have seen only one branch, master!
  - HEAD is synonymous with “the last commit in the current branch.”
    - This is the normal state
- In a detached HEAD state; HEAD is pointing directly to a commit instead of a branch

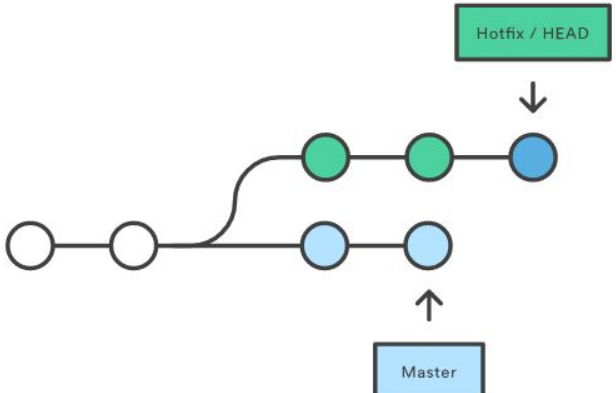

HEAD
master
3d110b0
87ec91d
423c584

After running git checkout 87ec91d, the repo looks like this



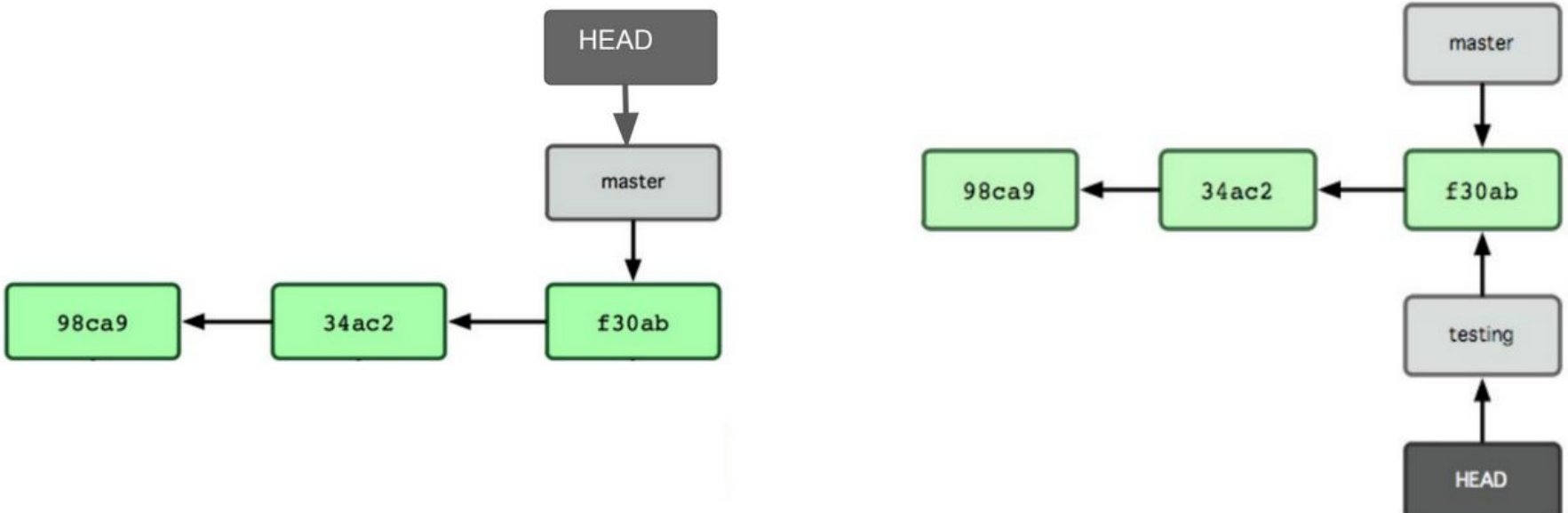
Branching

- Useful in solo projects, but critical in team projects
- So far, linear development; can move forward and backward
- What if you want to fix a bug (or try a feature), but don’t want to mess up the master?

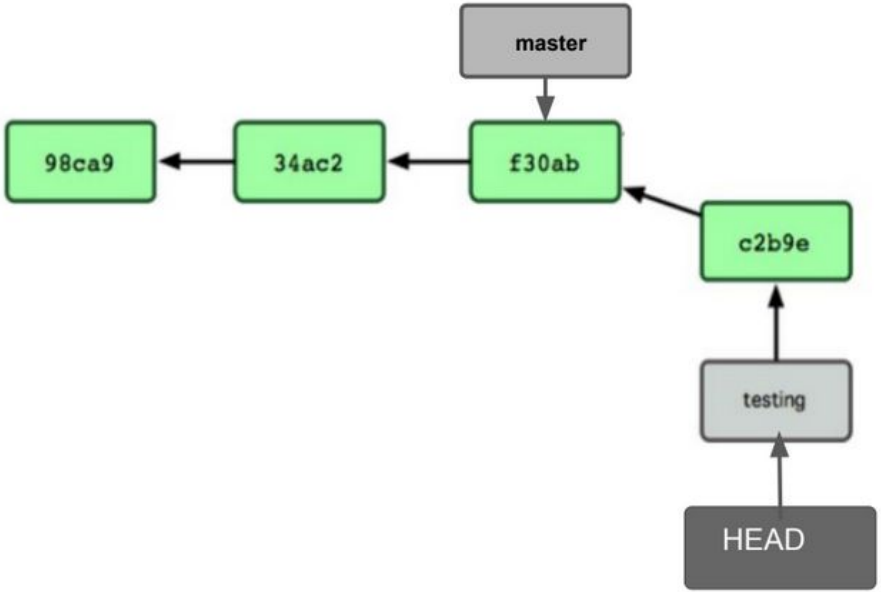


git branch/switch

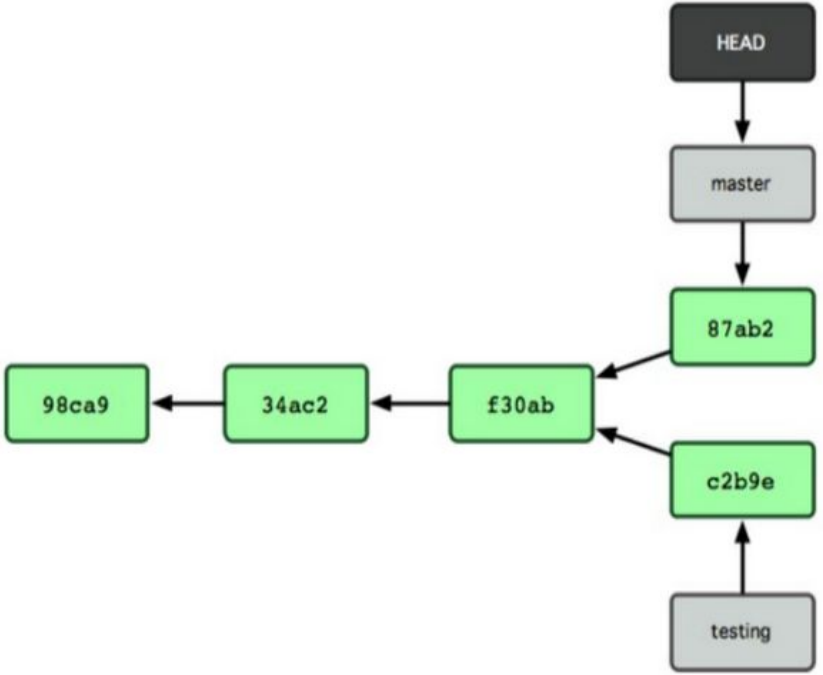
- git branch: List the branches
- git switch -c testing: create a new branch
  - “testing” is the name of this new branch



Development along testing

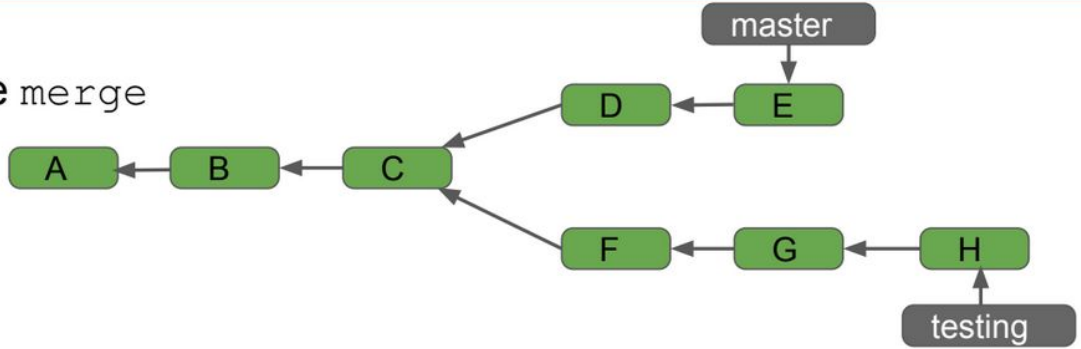


Separate development along master

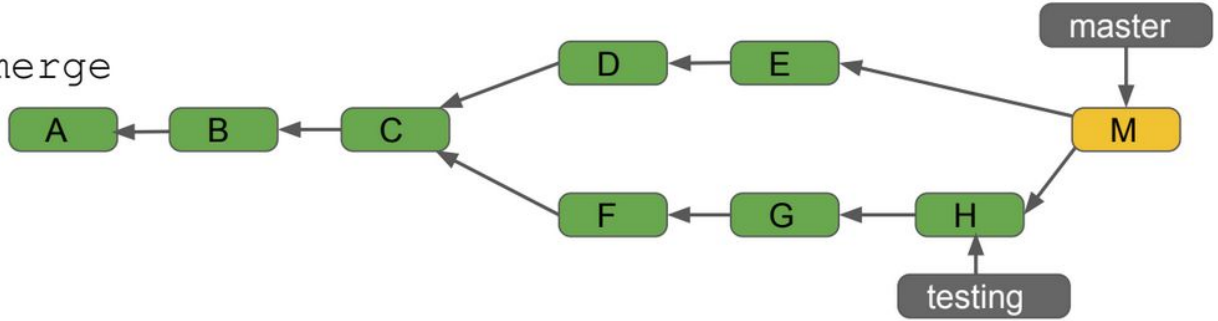


git merge

- Before `merge`



- After `merge`



- git checkout master (ensure you are in master branch; you want to merge testing into this)
- git merge -m "merging" testing (merge testing into master)
- Often this may result in a conflict, which you need to resolve.
  - After you resolve, you need to add and commit the files with conflict into master
- Note testing still exists and not affected by merge
  - git checkout testing

Reference

https://www.cs.odu.edu/~zeil/cs252/latest/Public/git/index.html

https://sillevl.gitbooks.io/git/content/advanced/reset-checkout-revert/ (advanced-reverting changes, not in syllabus)

https://www.geeksforgeeks.org/diff-command-linux-examples/