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Software Engineering Configuration Management (2)

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Adapted from materials provided by Byron DeVries, Jagadeesh Nandigam

Outline

Classic view of configuration management (Part 1)

Modern configuration management (i.e., Git) (Part 2)

- Repositories
- Tagging
- Branching
- Merging
- Sharing
- Comparison
- Git Demo

Modern source control

Git:

- The most widely used source code management tool: 42.9% of professional software developers use it as their primary source control system.
- Developed by Linus Torvalds in 2005 for use developing the Linux kernel
- GitHub was developed in 2008, and provides free (and paid) Git repository hosting
    - Currently owned by none other than Microsoft!

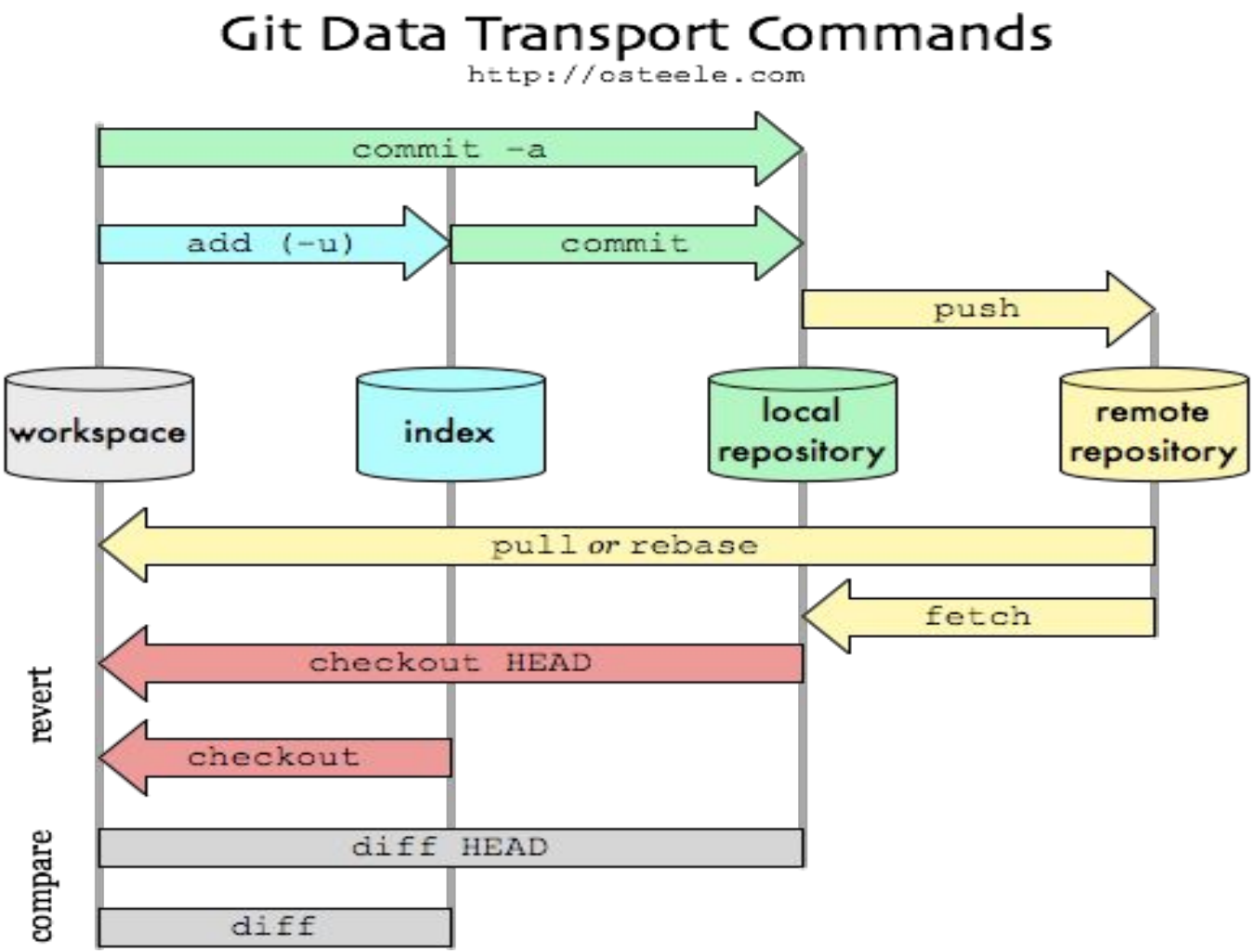


Image from http://blog.osteele.com/2008/05/my-git-workflow/

Git: Repositories

Git repositories contain:

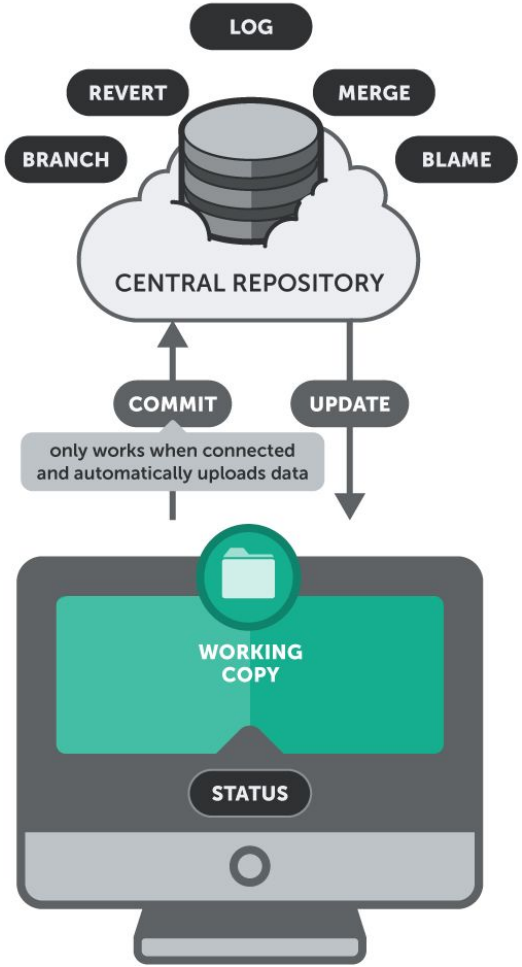
- A set of commit objects, and
- A set of references to commit objects (heads)

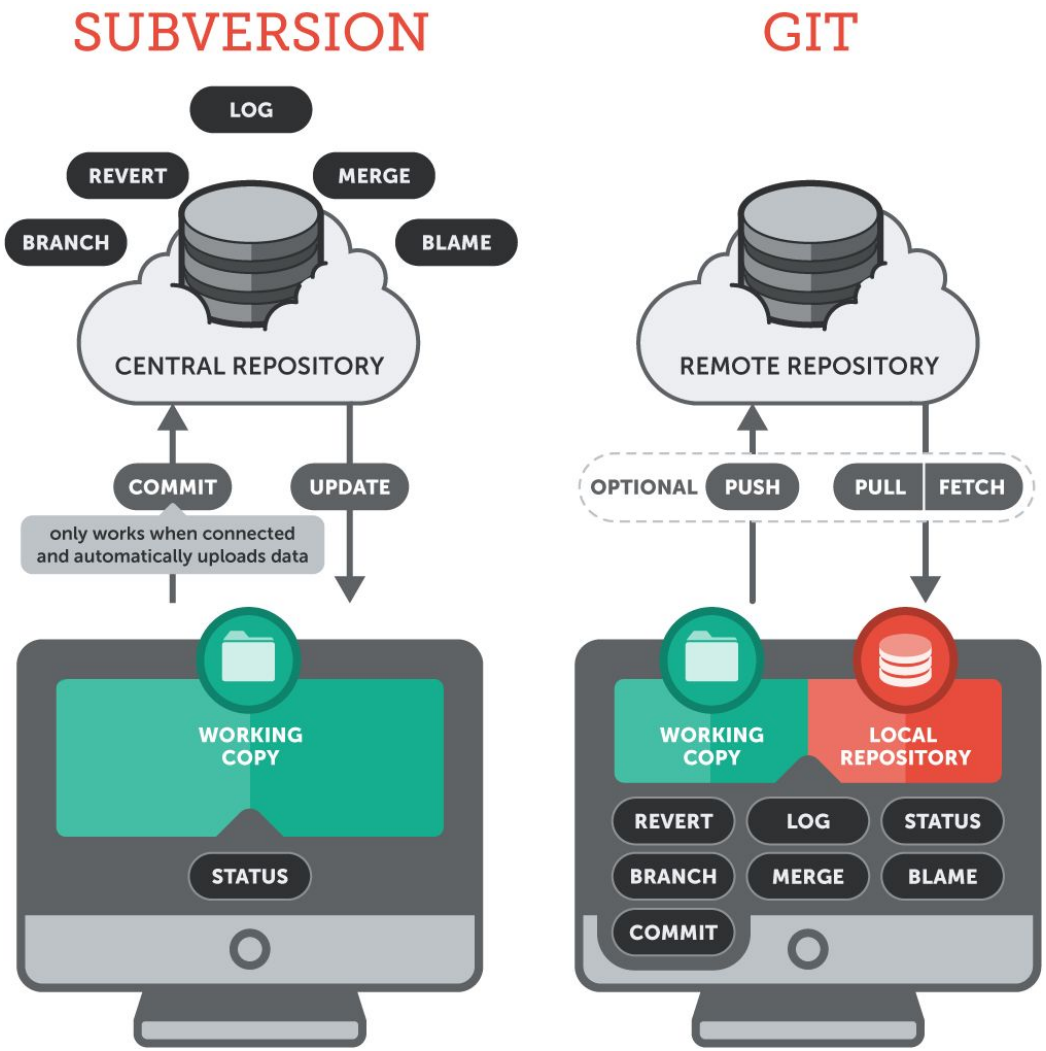
Git repositories are stored:

- In a .git sub-directory in the same directory as the project
- There is no central repository server

Git is **distributed**!

SUBVERSION


LOG
REVERT
MERGE
BRANCH
BLAME
CENTRAL REPOSITORY
COMMIT
UPDATE
only works when connected
and automatically uploads data
WORKING
COPY
STATUS


SUBVERSION
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WORKING
COPY
STATUS
GIT
REMOTE REPOSITORY
OPTIONAL
PUSH
PULL
FETCH
WORKING
COPY
LOCAL
REPOSITORY
REVERT
LOG
STATUS
BRANCH
MERGE
BLAME
COMMIT

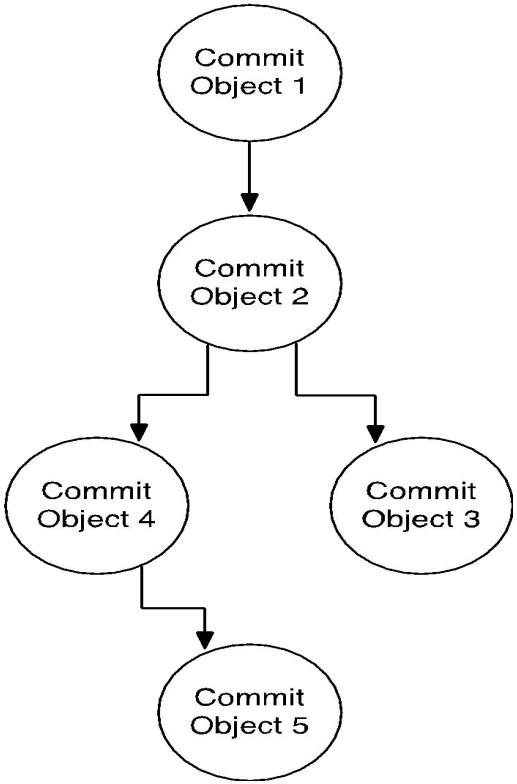
Git: Commit objects

Commit objects contain:

- A set of files (one version each),
- References to parent commit objects, and
- An SHA1 identifier that uniquely* identifies the commit

*If two commits are exactly the same, the identifier will be the same.

Git: View of commit objects in repository



Git

How do you access commit objects if you don’t know their identifier?

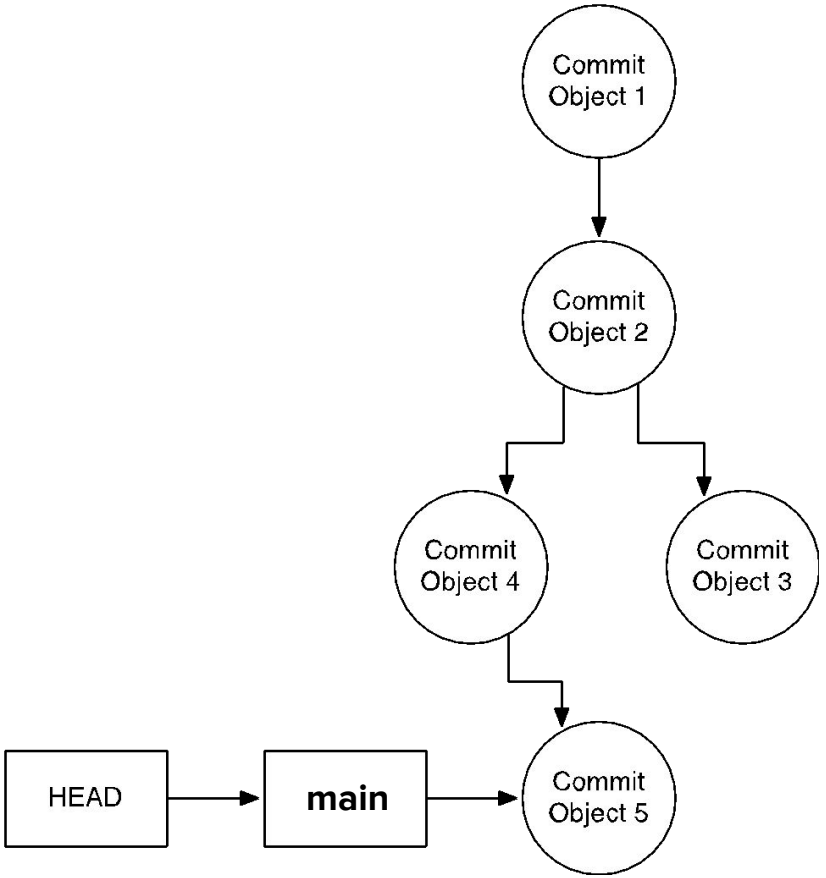
Git: Head(s)

Git heads:

Reference a commit object

Repositories always include:

- "main"
- “HEAD”



Git: Referring to a commit object

How do you reference a specific commit object?

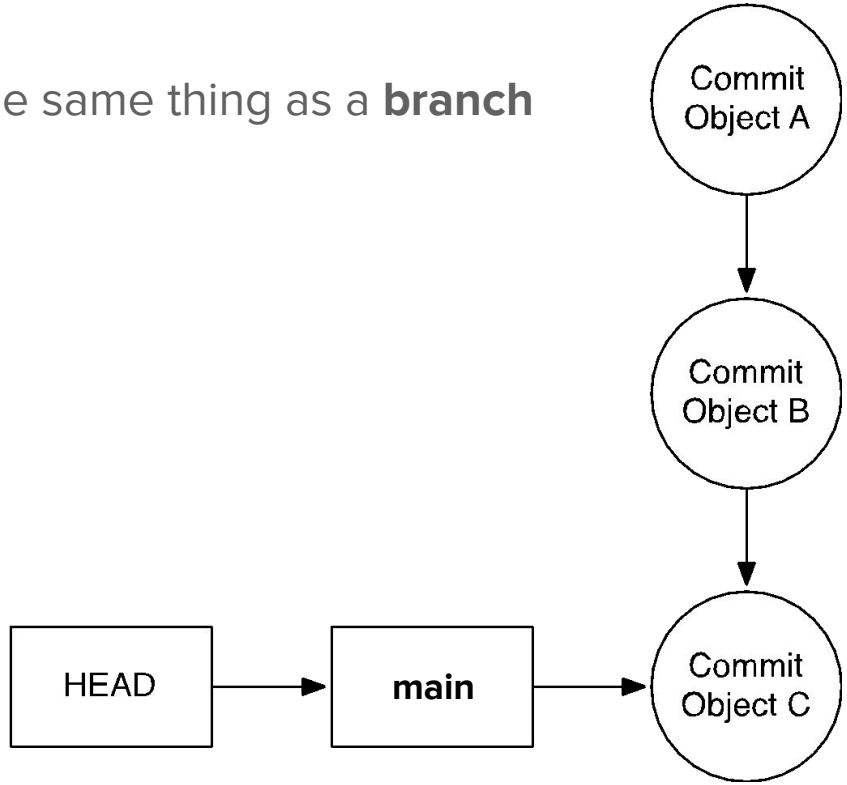
- Its identifier (i.e., the SHA1 calculated for the commit object)
- The first few characters of the identifier
- A head that references it (e.g., HEAD or main)

Git: Branching

Why would you branch?

Git: Branching

In Git, a **head** is almost the same thing as a **branch**



Git: Branching

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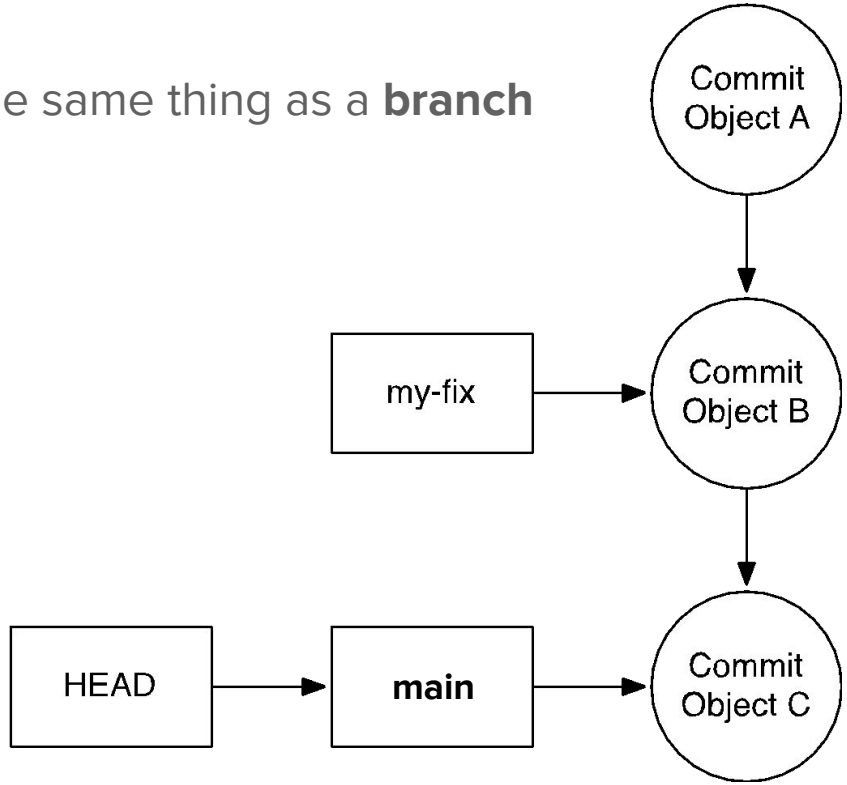
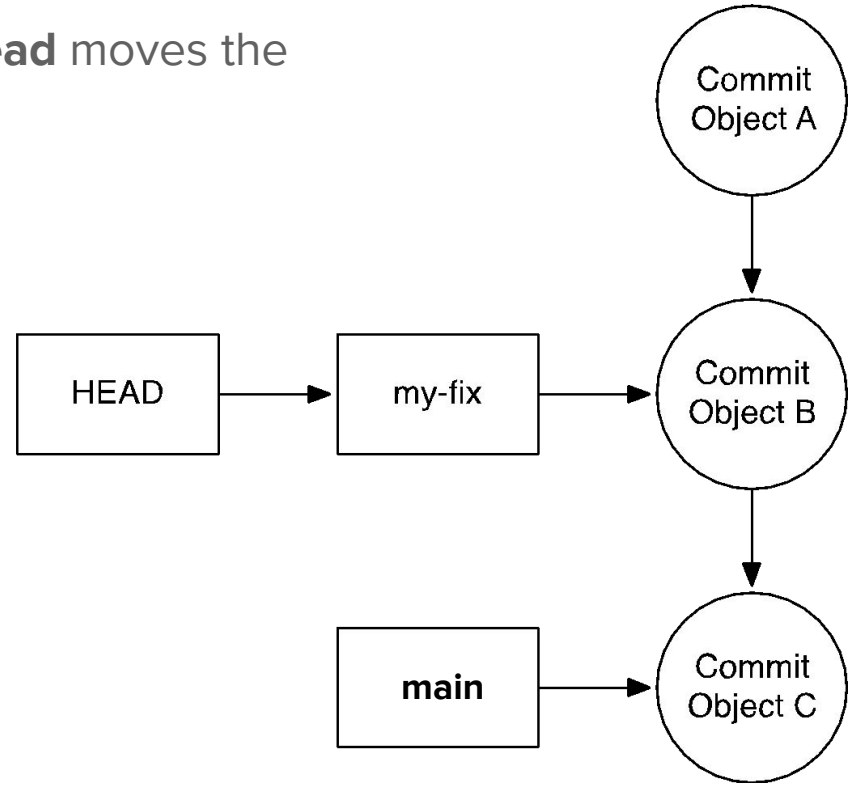


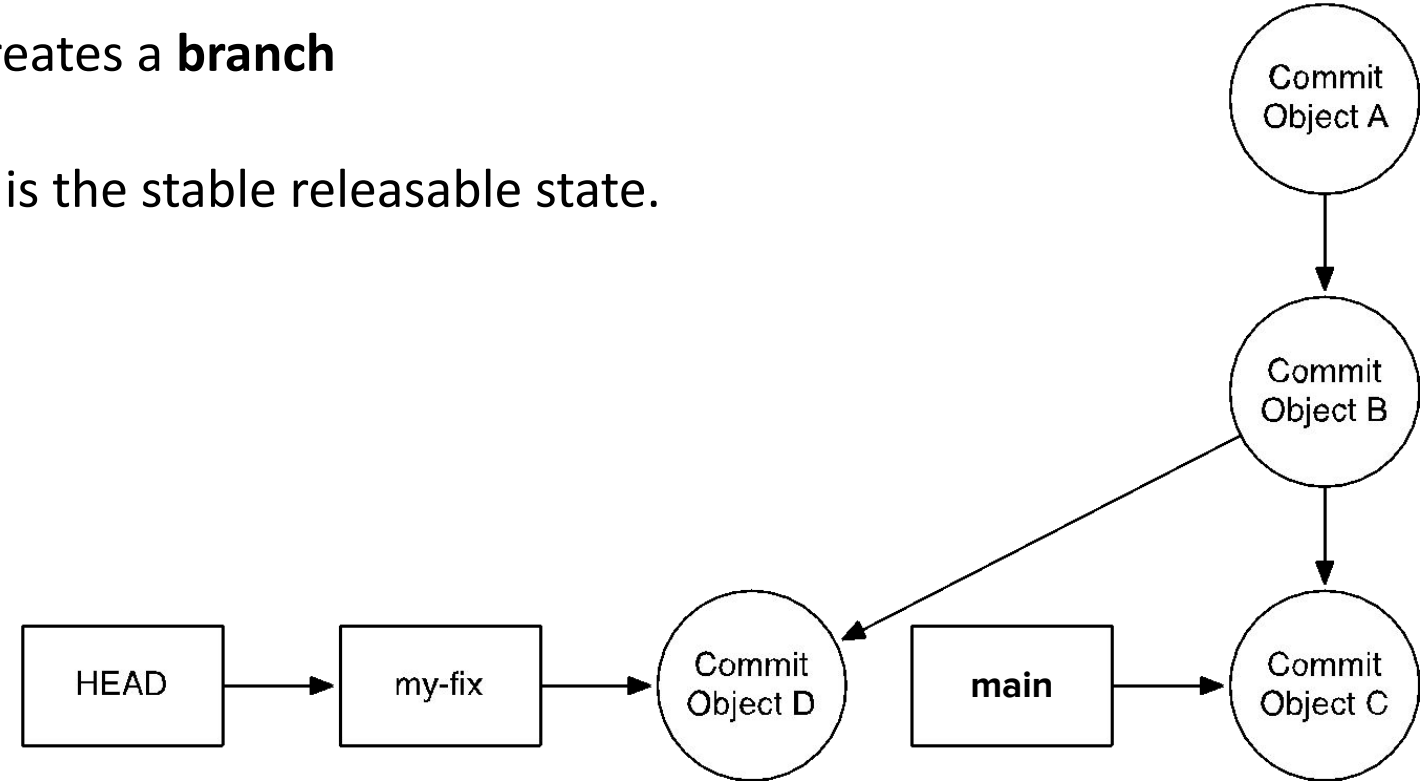
Git: Branching

Switching between **heads**, or **checkout** a **head** moves the current HEAD



A new **commit** creates a **branch**

Ideally, the **main** is the stable releasable state.



Git: Commands

`git branch` – with no arguments lists the existing heads

`git branch [new head] [location]` – creates a new head a the location

`git diff [head 1]..[head 2]` – shows the difference between the commit objects referenced by head 1 and head 2

`git log` – shows the change log

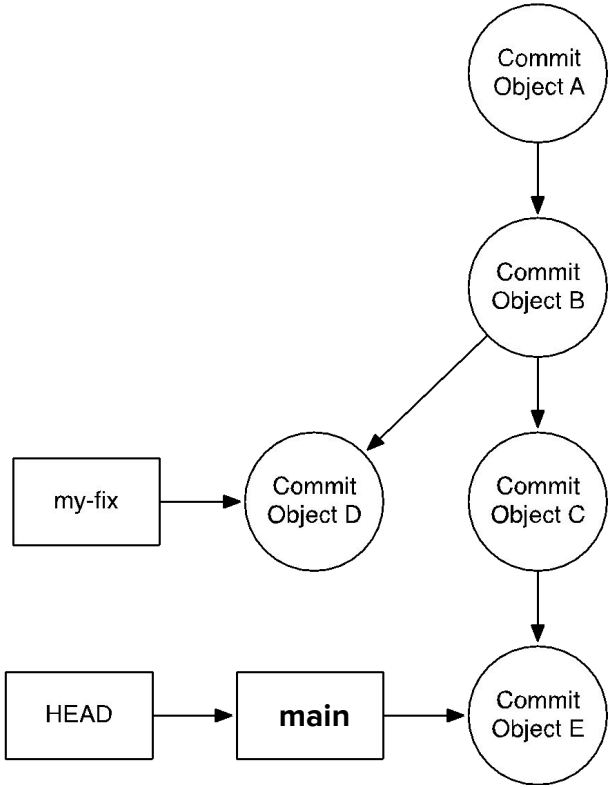
`git log[head 1]..[head 2]` – shows the change log between head 2 and the common ancestor of head 1 and head 2

`git checkout [head]` – points HEAD to the commit object referenced by head & writes all files in directory to match new reference

Git: Merge

`git merge [head]`:

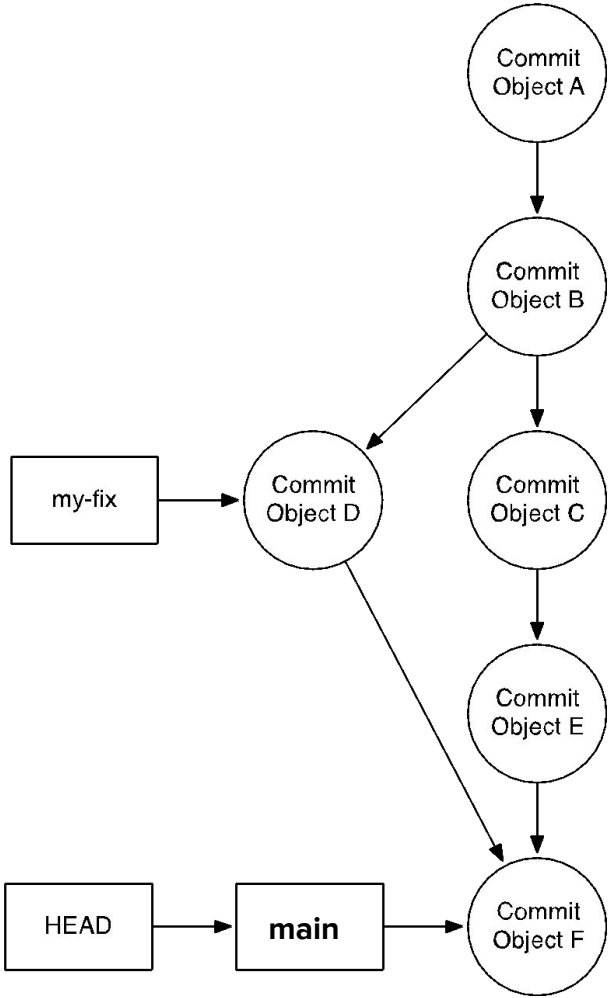
- Identify the common ancestor of HEAD and head
- If the same, do nothing.
- If ancestor is HEAD, head=HEAD
- Otherwise...



Git: Merge

`git merge [head]`:

- Identify changes between head and ancestor
- If no conflicts, create a new commit object with two parent objects (HEAD and head)
- If a conflict, inform user and don't commit



Git

But all this happens on my own computer!

- How do I share?

Git: Sharing

Make a copy of a repository:

- `git clone [remote] (e.g., ~/friend/termproject/)`

Branch from the remote repository:

- `git branch --track [new-local-branch] [remote-branch]`

Receive changes from the remote repository:

- `git fetch [remote-repository-reference]`
- `git pull [remote-repository-reference] [remote-head-name]`

Send changes to the remote repository

- `git push [remote-repository-reference] [remote-head-name]`

A refresher:

What is the difference between Git and conventional source code repositories?