Introduction to Git

Introduction to Version Control Systems

Git Fundamentals

Branching

Merging

Collaborating

Common Workflows

Git and Ansible and Kubernetes(k8)

Advanced Topics

Hands on Exercises

Version Control Systems

Why Do We Care About Version Control Systems

Enables all modern practices (Infrastructure as Code, CI/CD, 12 factor, k8)

- Revert production changes quickly (think outages)
- Creates reusable code instead of reinventing the wheel
- Provides a method for reverting to a prior state
- Tracked Changes (Who, What, When, Where, Why)
- Single Source of Truth
- High Availability and Disaster Recovery

TL;DR

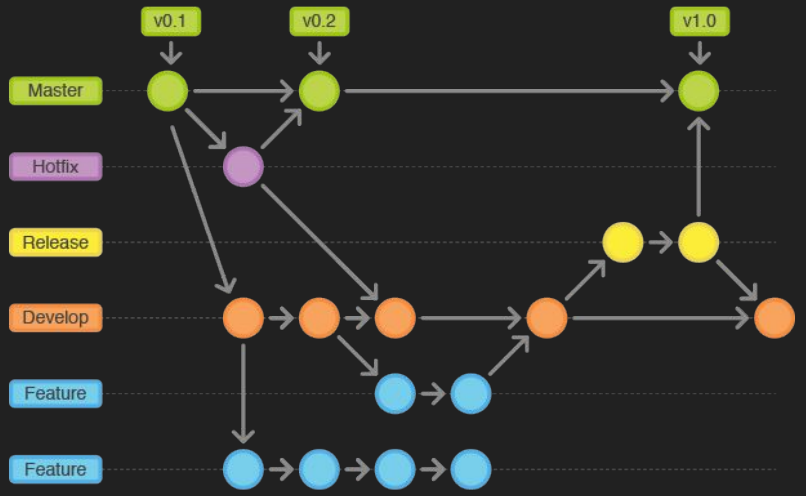
The 10 most important commands to know:

1. git clone - make a local copy of a remote repository
2. git add - adds a file to your local repository
3. git checkout - checks out a branch (“git checkout -b” creates a new branch)
4. git commit - does a local commit of changes so you can push them to remote
5. git push - pushes commit to remote repository
6. git merge - merges a branch into another (usually used to merge into main/master)
7. git stash - saves changes without a commit and reverts to last commit state
8. git log - shows log of commits (“git log --oneline --graph” makes it human readable)
9. git rebase - moves entire `feature` branch to begin on the tip of main/master branch
10. git diff - shows differences between branches

Why Version Control Systems

Management of changes to resources so they can be recalled at a later point

- Records what changed and who changed them
- Enables multiple individuals the opportunity to collaborate
- Provides a method for reverting to a prior state
- Makes code reusable
- Standard for all code storage for Automation, Kubernetes and Infrastructure as Code

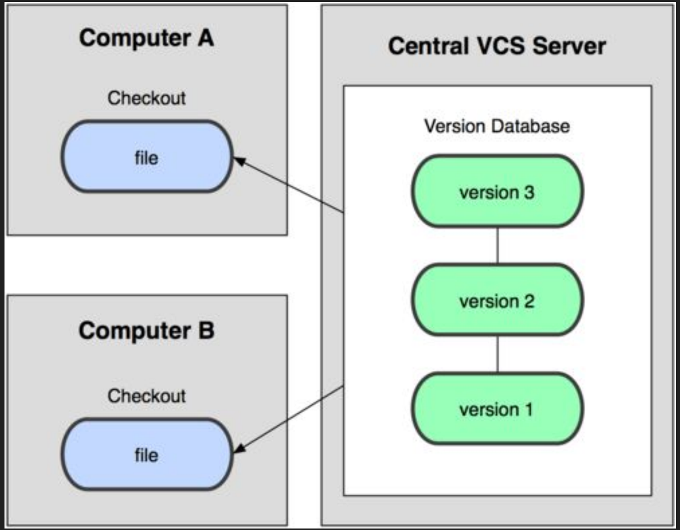


Types of Version Control Systems

Centralized Version Control

- Single copy of the project hosted on a central server
- Changes are made ("Committed") against the server
- Server contains full project
- End user never has a full copy of the project
  - Only downloads what is needed

- Common VCS types:
  - CVS
  - Subversion
  - Perforce

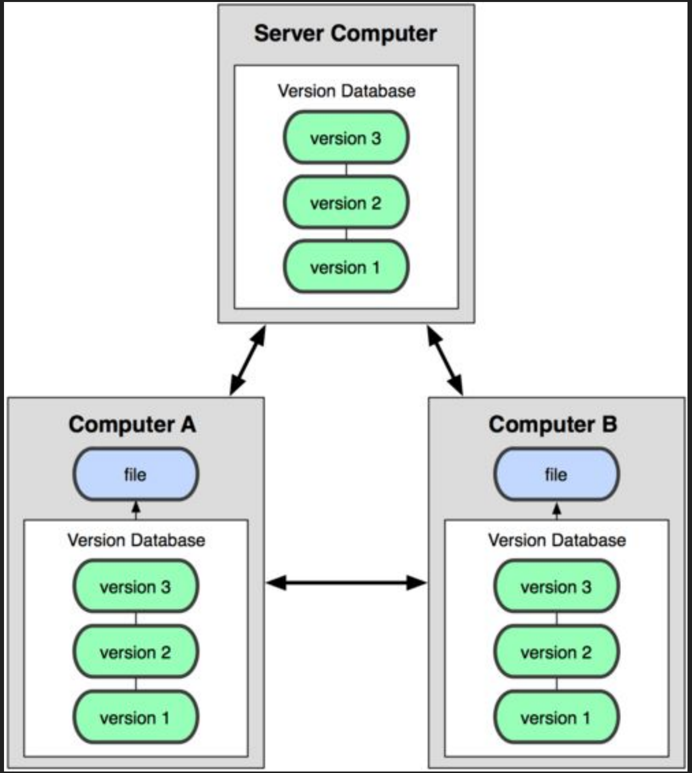


Types of Version Control Systems

Distributed Version Control

- No reliance on a centralized server
- Each user has the full copy of the entire project
- Changes are made locally
  - No network dependencies
- Users can exchange changes directly with others
  - Most common approach is to use an agreed upon location the each member can reference

- Common types:
  - Git
  - Mercurial



Git

Git is an Open Source Distributed Version Control System

- Created by Linus Torvalds (Yes…. the very same)
  - Initial use case: Managing Linux Kernel
- Written in C

Think of git as something that sits on top of the file system and manipulates files

Git

Git is a binary

- Executable file (git)

- Executable installed by:
    - yum install git
    - Direct download
        - git-scm.com
    - Ships with all official Red Hat Jupyter images

Git has online presence

- Several popular online repository managers available
- Provides a centralized git repository
- Additional features found in many providers:
  - Repository viewer
  - Issue tracking
  - Task management
  - Wiki

GitLab

GitHub

- Features provided by these services not core git functions

Git Fundamentals

Git Key Concepts

Repository

Data structure that stores the configuration of files that change over time

- Collection of files and their history organized in branches, tags, etc
- Can be either local or remote
- To work with Git, a repository must exist somewhere
- New repositories are empty by default

- Creating a new repository

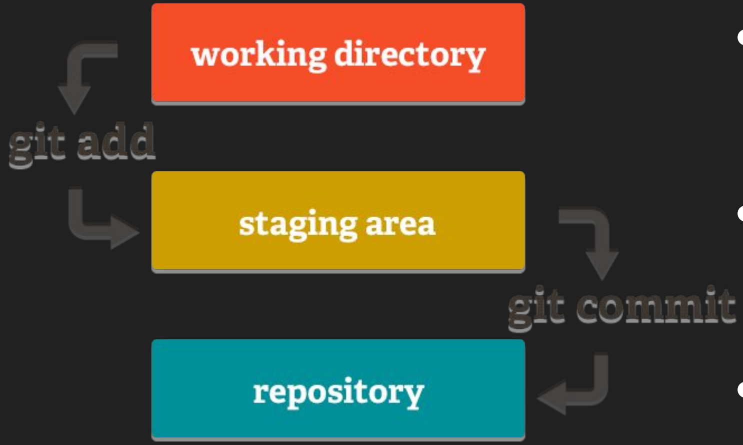
```
$ cd myproject
$ touch README
$ git init
```

Git Key Concepts

Setting the Stage

Those with prior VCS experience may have knowledge of *committing*, but not **staging**

- In Git, we are constantly dealing with **changes** to files and we only care about the **lines** that changed



- **Untracked**
- **Staged**
- **Committed**

Git Key Concepts

Commit

Fundamental concept behind git

- A commit is just a node in a tree
- Represents a snapshot in time

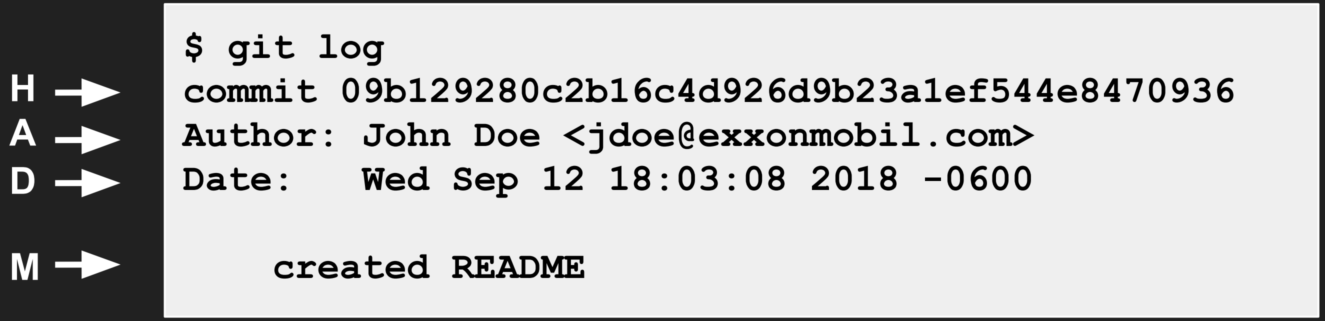
- Node contains:
  - a **H**ash of the commit -- a UUID
  - the **A**uthor
  - a **D**ate and time
  - the commit **M**essage
  - the diff of changes

```
$ git add README.md
$ git commit -m "Added README"
```

Git Key Concepts

Viewing a Commit

`git log` - Command for viewing commits

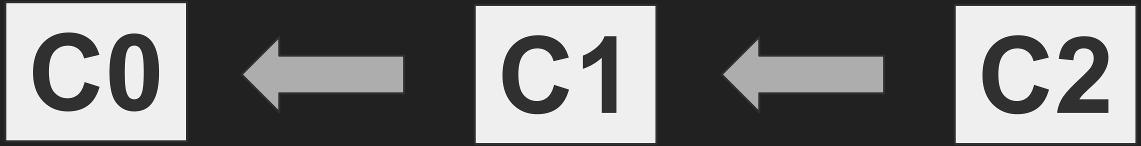


```
$ git log
commit 09b129280c2b16c4d926d9b23a1ef544e8470936
Author: John Doe <jdoe@exxonmobil.com>
Date:   Wed Sep 12 18:03:08 2018 -0600

    created README
```

Git Key Concepts

Making More Commits



1. make changes
2. git add [files]
3. git commit

1. make changes
2. git add [files]
3. git commit

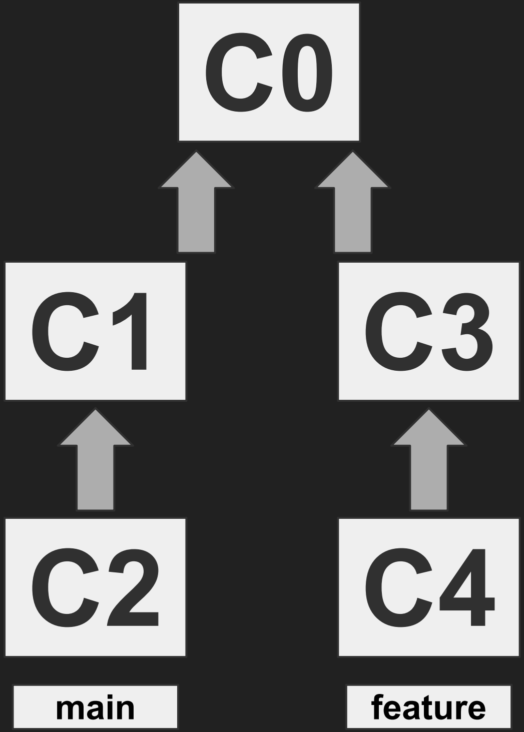
Branching and Merging

Branching and Merging

Branches

Lightweight movable pointer on a commit

- Branching model is one of the best capabilities of git
- In Git, you are **always** working on a branch
  - **main** is the default branch (typically long-term stable)
  - Each branch is given a name
- Only **one** branch can be active at a given time
  - Signified by HEAD
- Allows for features to be created

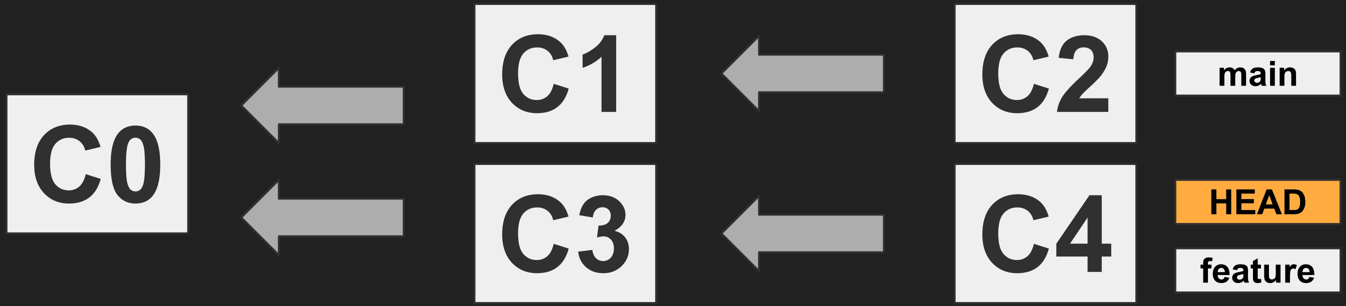


Branching and Merging

Branch Operations

Commands for managing branches

- `git branch` - List branches
- `git branch <branch name>` - Creates a new branch
- `git checkout <branch name>` - Switches to new branch



Branching and Merging

Merging

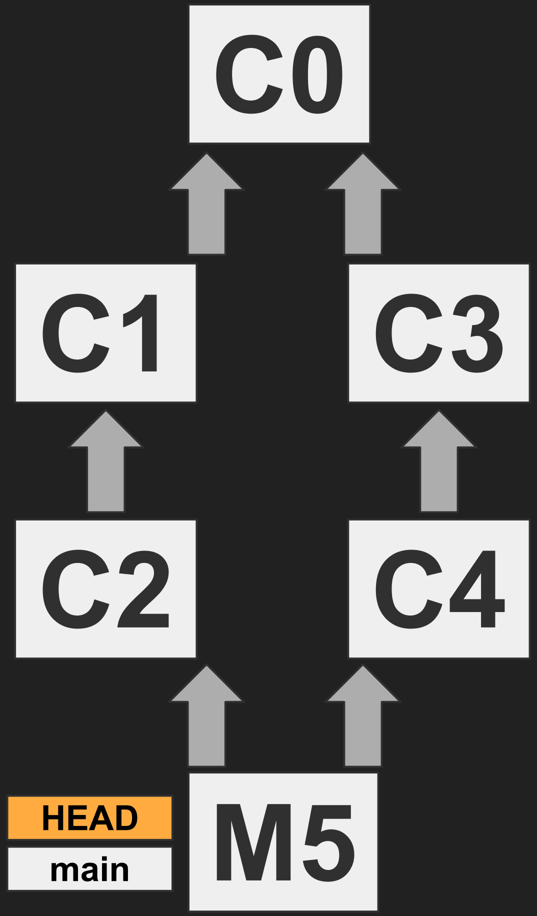
Integrates all commits from a specific branch into the current branch (HEAD)

- `git merge` command

```
# Checkout main branch
$ git checkout main

# Merge feature branch into main branch
$ git merge feature
```

- M5 is a **merge commit**



Collaborating

Showcasing the true power of Distributed Version Control Systems(DVCS)

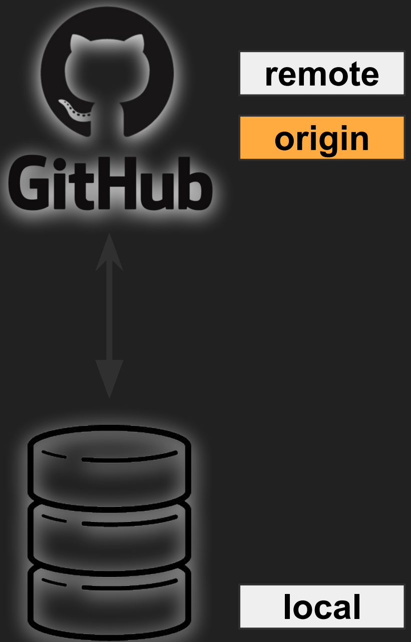
Collaborating

Remotes

Enables sharing code with other locations

- Versions of the project hosted on the internet or somewhere else
- Enabled through the `git remote` command

```
# Adding a remote
$ git remote add origin git@github.com:ansible/ansible.git
```



remote

origin

local

Collaborating

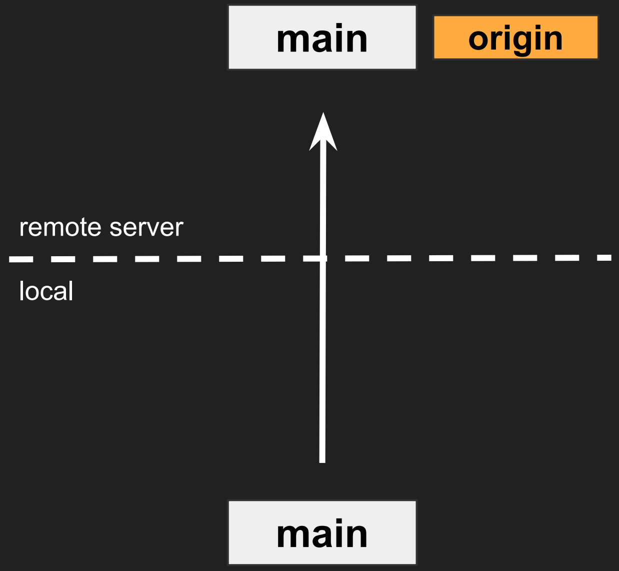
Pushing

Upload code from local repository to remote repository

- Merge local changes into the remote branch
- An existing remote must be defined

```
$ git push <remote> <branch>
```

- **branch** is **main**



Collaborating

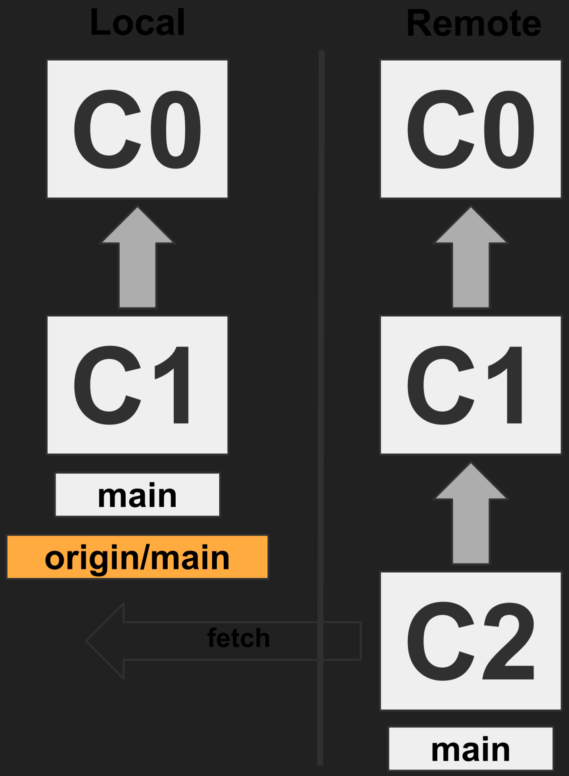
Fetching

Retrieve changes from remote repositories

- Brings in changes from other contributors
- Changes are retrieved, but does not modify local workspace
- Creates new branch locally (**<remote>/<branch>**)
- Afterward, a merge needs to occur to integrate

- Single branch of all branches can be retrieved

```
$ git fetch <remote> <branch>
```



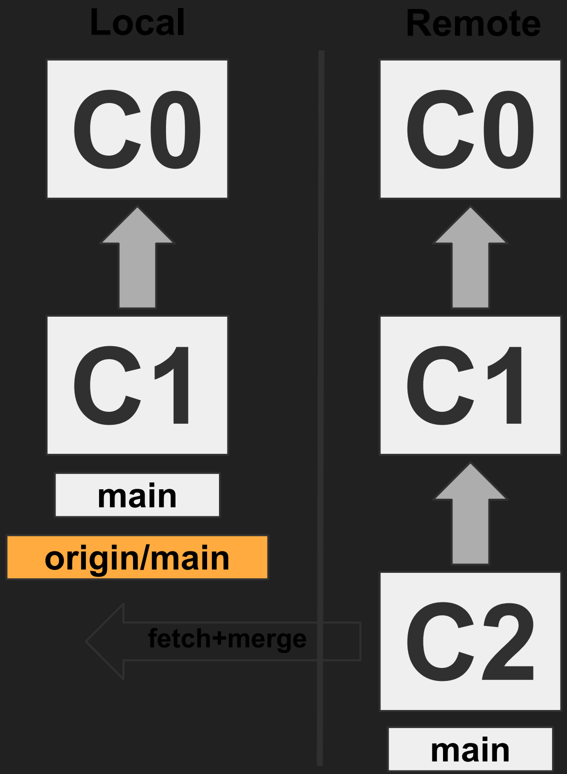
Collaborating

Pulling

Streamlined method of retrieving changes from remote repositories

- Performs a fetch and merge

```
$ git pull <remote> <branch>
```



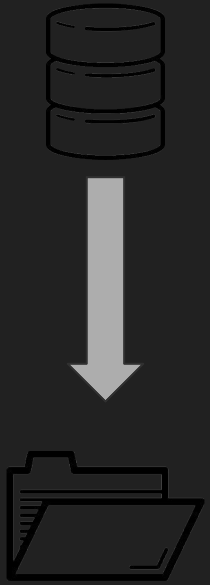
Collaborating

Cloning

Retrieves a full copy of a remote repository

- Unlike other VCS tools, the entire content is retrieved

```
$ git clone <url>
```



Git Workflows

Git Workflows

Workflows in Git are guidelines and not structured rules

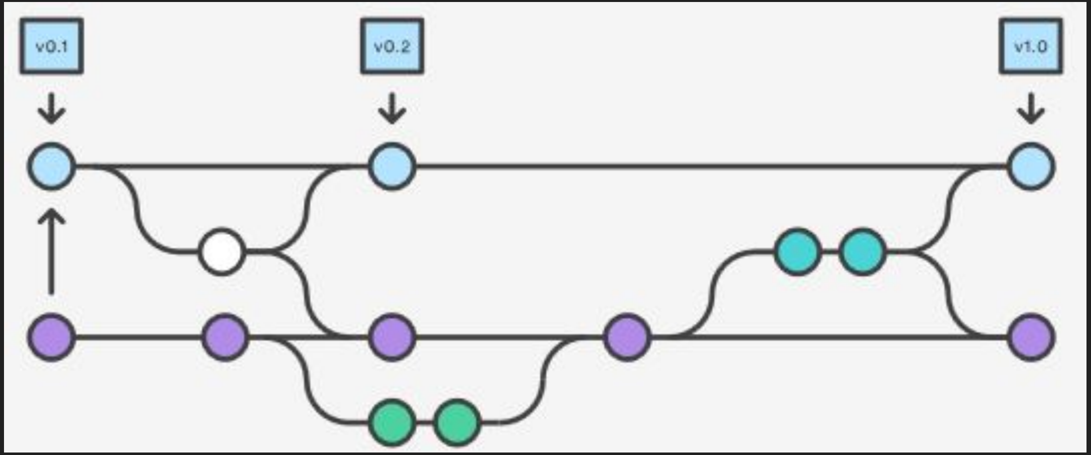
Git Workflows

Types of Workflows

Methods for working and collaborating with git

- **Basic/Centralized**
- **Feature Branch**
- **Pull/Fork**

Plus several others:
[Martin Fowler Blog]



Git Workflows

Basic/Centralized Workflow

Simplified method where all changes are made against the same branch

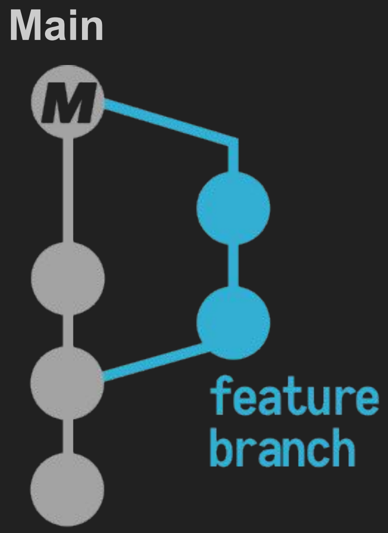
- Similar structure as a Subversion repository
- All changes made against the **main** branch
  - SVN equivalent to *trunk*
- Ideal for small teams

Git Workflows

Feature Branch

Separate branches created for each enhancement

- **main** branch represent stable state of repository
- Each developer works on their own separate feature
- Features can be shared without disrupting **main**
- Code review through pull request mechanism prior to integration



Git Workflows

Pull/Fork

Each developer has their own copy (fork) of the repository that they work on

- No centralized repository for pushing changes
- Only project maintainers have access to push to official repository
- Maintainers accept changes from contributors to official repository
  - Pull/Merge request
- Embraces security and distributed nature of Git

This is a common type in GitLab and GitHub based repositories

Advanced Git

Pull/Merge Requests

This is how most modern development collaborates on code.

- Fork code to your own namespace
  - Update code and commit back to your branch
  - Perform a pull request to the upstream repository

Links to each type of repository server documentation on how to do a PR:

- Azure Devops
- Bitbucket
- **Github**
- Gitlab

Git Ansible and K8

Git and Ansible

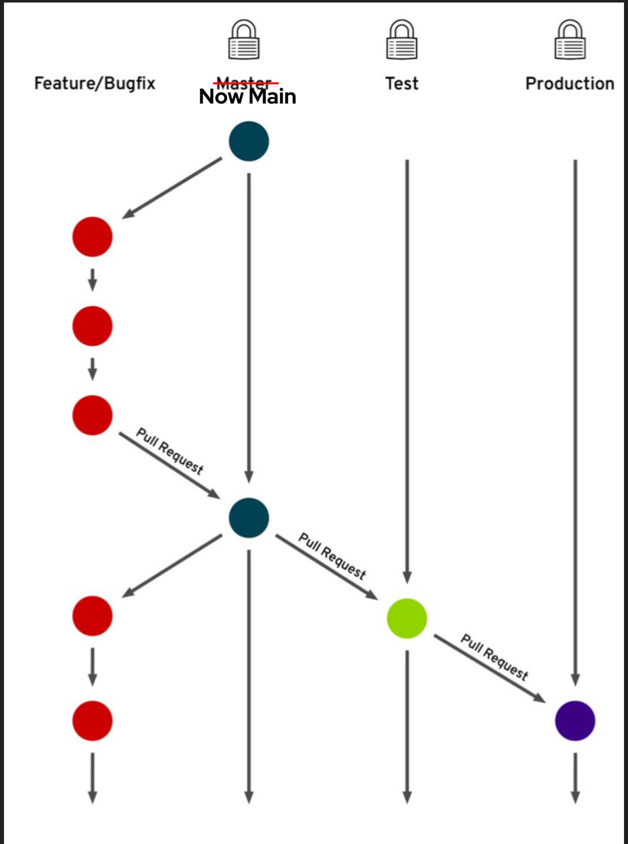
Branches by Environment

Each branch within a repository represents a deployment environment

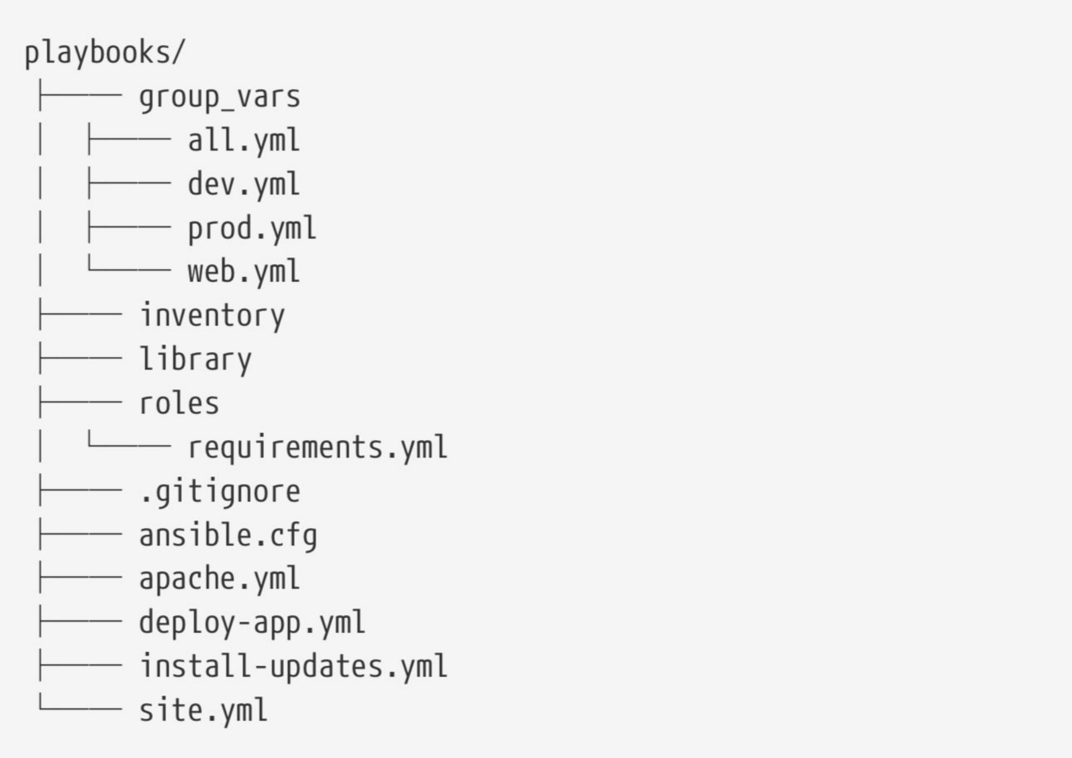
- Branches such as dev, test, prod in addition to main
- main branch is starting point. Changes are promoted to upper level environments
  - Bug fixes can be made against each branch as necessary
- Extends concepts emphasized by multiple git workflows
  - Feature branch
  - Pull/Fork
- Example: Ansible Tower projects created per branch. Job templates target each project

Git Ansible and k8

Branches by Environment

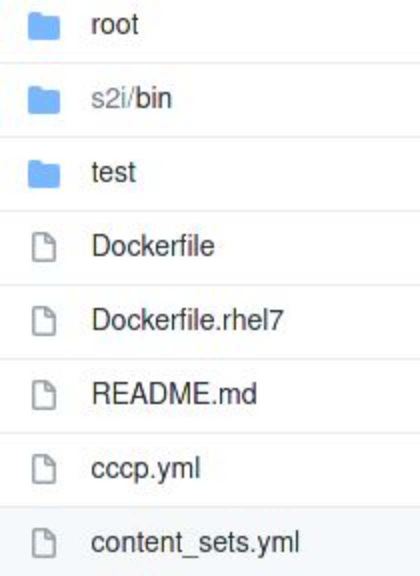


Git and Ansible
Typical Repository Structure



```
playbooks/
├─── group_vars
│   ├─── all.yml
│   ├─── dev.yml
│   ├─── prod.yml
│   └─── web.yml
├─── inventory
├─── library
├─── roles
│   └─── requirements.yml
├─── .gitignore
├─── ansible.cfg
├─── apache.yml
├─── deploy-app.yml
├─── install-updates.yml
└─── site.yml
```

Git and Kubernetes
Typical S2I (source to image) Repository Structure



root
s2i/bin
test
Dockerfile
Dockerfile.rhel7
README.md
cccp.yml
content_sets.yml