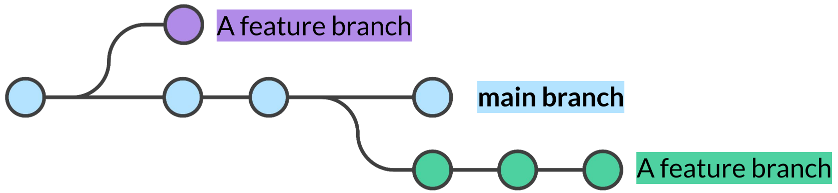
Introduction to `git` Part II

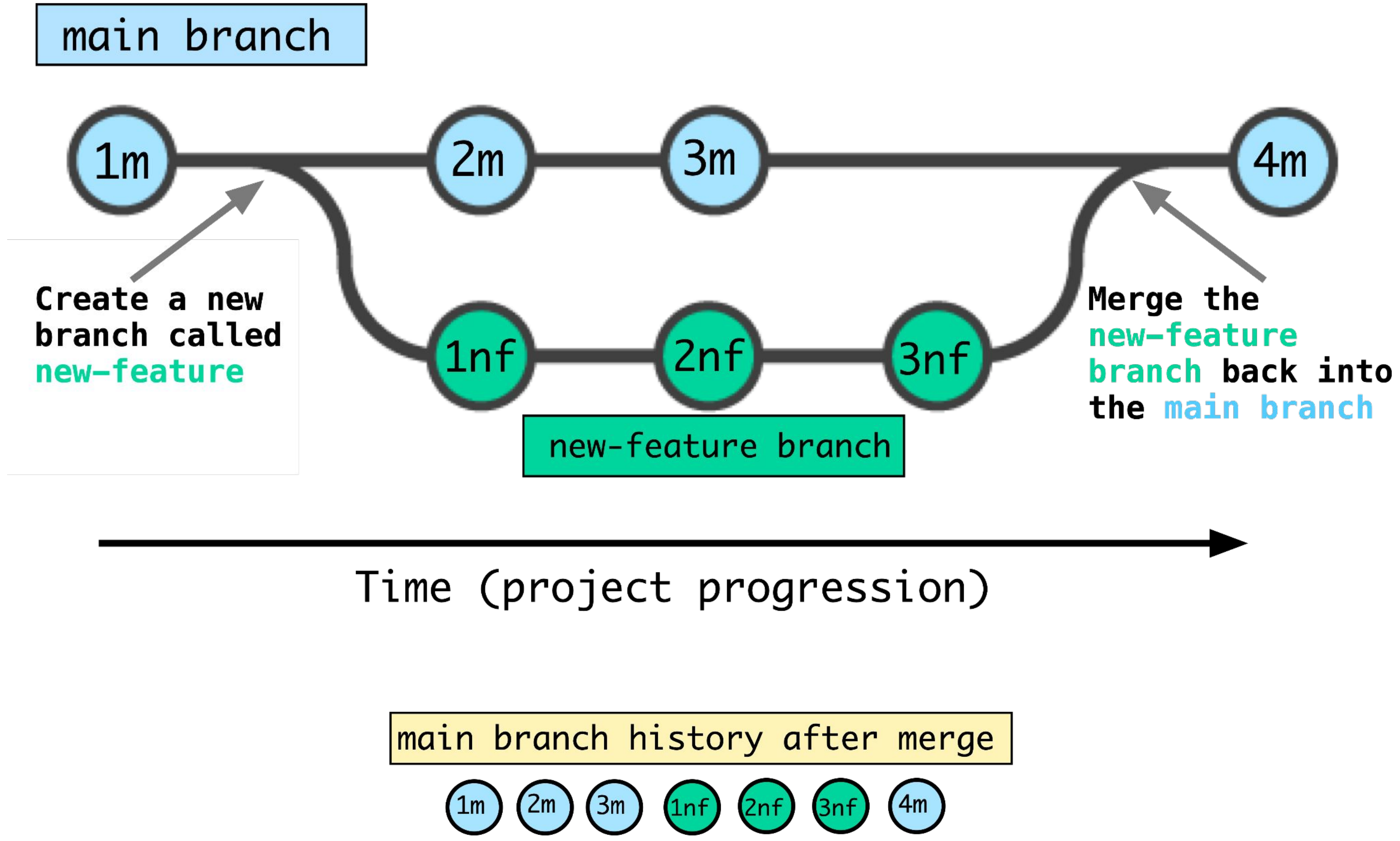
Childhood Cancer Data Lab x Alex's Lemonade Stand

Branches in git



- Branches are like "repositories within repositories" 🤯
- Useful when you want to make changes (maybe experimental!) but you don't want to break the rest of your code
  - You can always switch back to a "clean" branch!
- Keep related changes together
  - All commits for a given new analysis or "feature" can be made within the same branch for easier tracking
  - Helps you to identify which commits are relevant to a given analysis
- If you wreck code in a branch, you've *only wrecked that branch!* Just delete it!
- Branches provide a great framework for collaboration and team science

Source: https://www.atlassian.com/git/tutorials/using-branches


main branch
1m
2m
3m
4m
Create a new branch called new-feature
1nf
2nf
3nf
new-feature branch
Merge the new-feature branch back into the main branch
Time (project progression)
main branch history after merge
1m
2m
3m
1nf
2nf
3nf
4m

Modified from https://www.atlassian.com/git/tutorials/using-branches/git-merge

Let's begin by exploring a real life GitHub repository

https://github.com/alexsLemonade/scpca-nf

...but first, a plug: https://scpca.alexslemonade.org/

Working with multiple branches

Why and when do we use **feature branches**?

There are several different models for `git` workflows (stay tuned!), but all make use of a standard paradigm:

- The Project Truth lives in `main` (formerly `master`)
- Code is developed in different branches, which over time get *merged into* the `main` branch
- We want to avoid working directly in the `main` branch
- All of this helps us modularize project development, keep a clear project history, and avoid conflicts with our collaborators

We use the term **feature branch** because each branch should have a specific scope that is limited to a given feature

When you create a branch, it literally *branches off* the branch you are in when you create it. This is called our **base branch**.

We often work with multiple branches at a time

You might be working with more than one feature branch, and your teammates are working in their own branch(es) as well

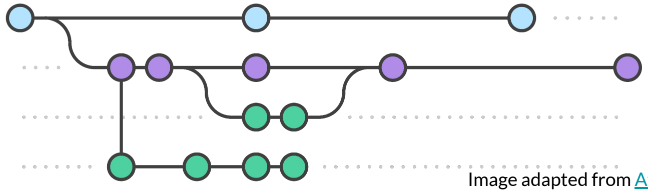


Image adapted from Atlassian

Tips for success:

- Always know what branch you're working in
- Before creating a branch, be cautious you are creating it from the correct base *and* that the base is up-to-date
- As you work, aim to keep your feature branch as up-to-date with its base as possible

… and how do you set yourself up for success? `git status`

Use an informative name for your feature branch

Informative names help **you** stay on track and organize your work, and help **your teammates** quickly get a sense of the scope of your work when reviewing your code

Let's consider a branch with code to add customization options to a histogram

- **Bad names**
  - `feature`, `options`, `patch-1`
- **A better name**
  - `add-histogram-options`
- **An even better name**
  - `<username>/add-histogram-options`
- **If you want to be very organized**
  - `<username>/<issue #>-add-histogram-options`

Creating and switching between branches

See all local branches with `git branch -a`

To switch to a different branch…

- `git checkout <different-branch>`
- `git switch <different-branch> (git >= 2.23)`

To create a new branch…

- First, make sure you are in right branch you as your base with (surprise!) `git status`, and switch as needed!
- `git branch <new-branch-name>`

More fun with branches

🔥 To simultaneously create and switch into a new branch…

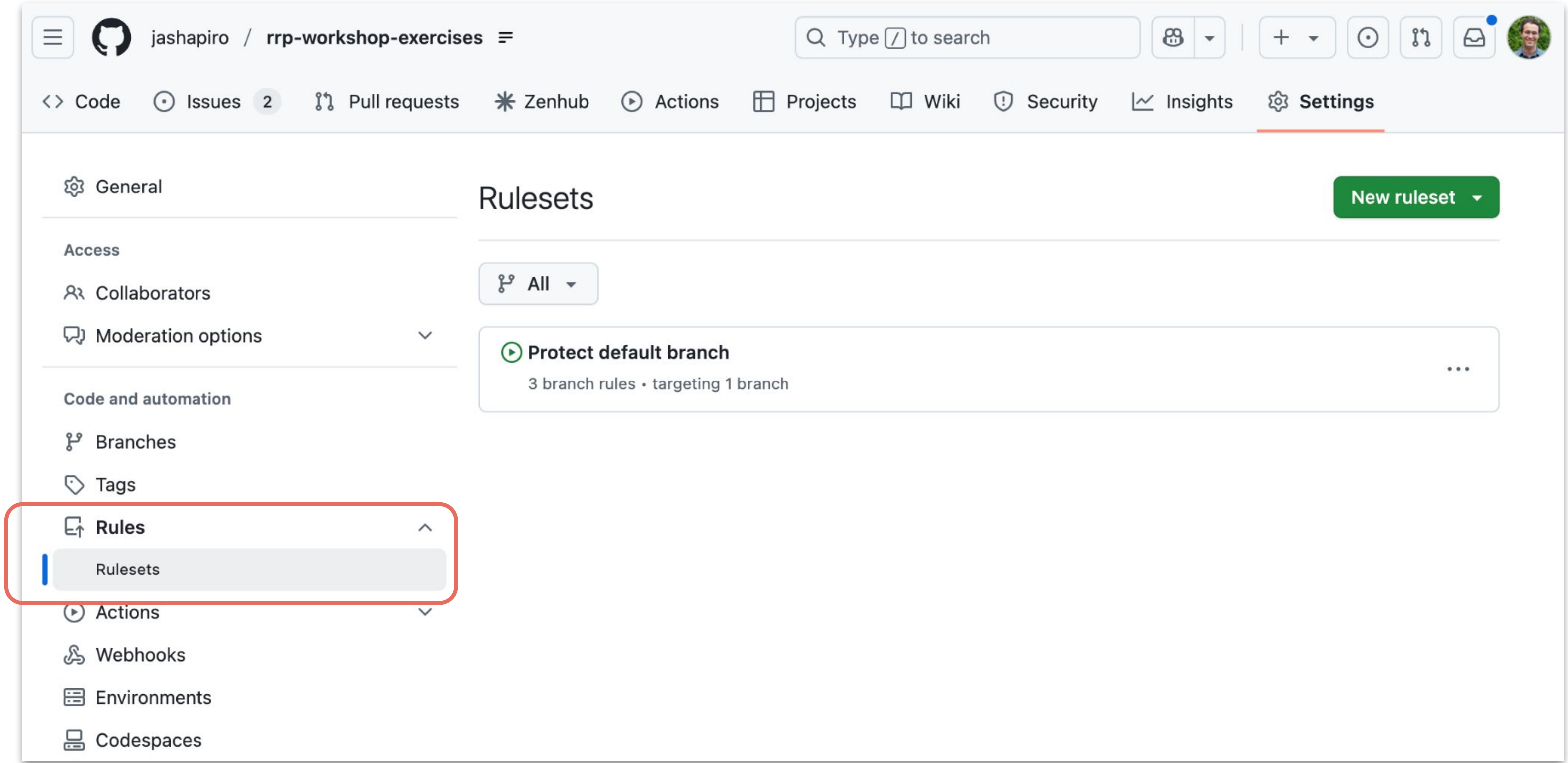
- `git checkout -b <new-branch-name>`
- `git switch -c <new-branch-name> (git >= 2.23)`

Change your branch name: `git branch -m <updated-branch-name>`

⚠️ *Caution!* If you've already pushed your branch, this will *not rename the remote branch*. You'll also need something like…

```
git push origin -u <updated-branch-name>         # change your remote target branch
git push origin --delete <original-branch-name> # delete original remote branch
```

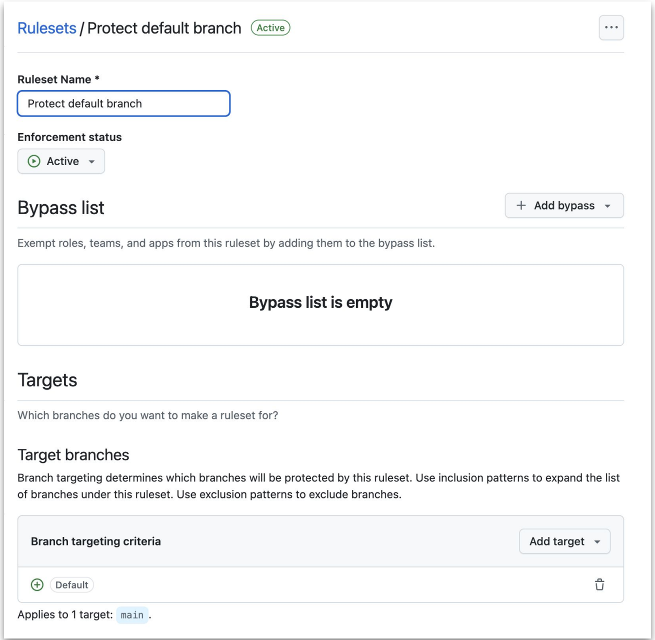
Help GitHub help you: Protect your `main` branch



Protect default branch

3 branch rules • targeting 1 branch

Help GitHub help you: Protect your `main` branch



Rulesets / Protect default branch Active

Ruleset Name *

Protect default branch

Enforcement status

Active

Bypass list

+ Add bypass

Exempt roles, teams, and apps from this ruleset by adding them to the bypass list.

Bypass list is empty

Targets

Which branches do you want to make a ruleset for?

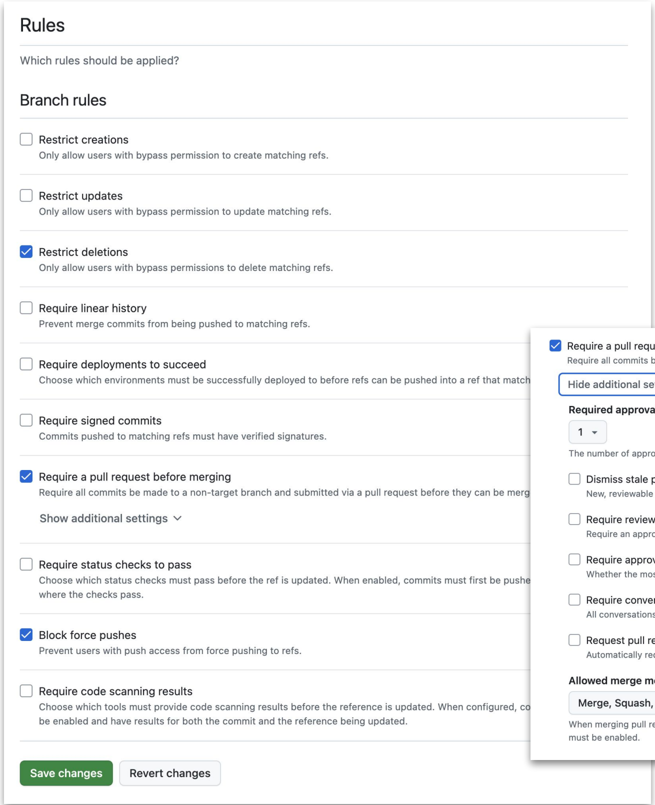
Target branches

Branch targeting determines which branches will be protected by this ruleset. Use inclusion patterns to expand the list of branches under this ruleset. Use exclusion patterns to exclude branches.

Branch targeting criteria Add target

Default

Applies to 1 target: `main`.



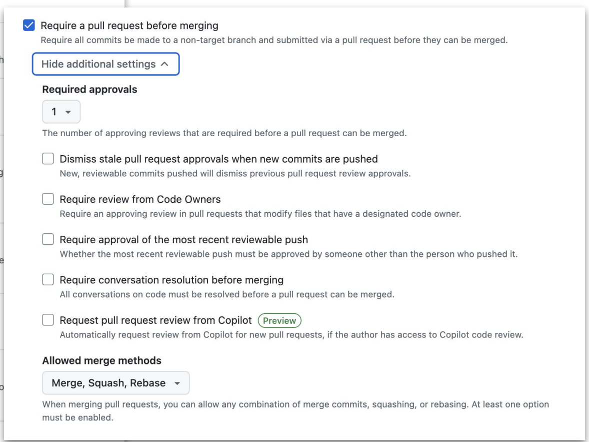
Rules

Which rules should be applied?

Branch rules

- [ ] Restrict creations
  Only allow users with bypass permission to create matching refs.
- [ ] Restrict updates
  Only allow users with bypass permission to update matching refs.
- [✓] Restrict deletions
  Only allow users with bypass permissions to delete matching refs.
- [ ] Require linear history
  Prevent merge commits from being pushed to matching refs.
- [ ] Require deployments to succeed
  Choose which environments must be successfully deployed to before refs can be pushed into a ref that match
- [ ] Require signed commits
  Commits pushed to matching refs must have verified signatures.
- [✓] Require a pull request before merging
  Require all commits be made to a non-target branch and submitted via a pull request before they can be merg
  Show additional settings
- [ ] Require status checks to pass
  Choose which status checks must pass before the ref is updated. When enabled, commits must first be pushe where the checks pass.
- [✓] Block force pushes
  Prevent users with push access from force pushing to refs.
- [ ] Require code scanning results
  Choose which tools must provide code scanning results before the reference is updated. When configured, co be enabled and have results for both the commit and the reference being updated.

Save changes Revert changes



- [✓] Require a pull request before merging
  Require all commits be made to a non-target branch and submitted via a pull request before they can be merged.

Hide additional settings

Required approvals

1

The number of approving reviews that are required before a pull request can be merged.

- [ ] Dismiss stale pull request approvals when new commits are pushed
  New, reviewable commits pushed will dismiss previous pull request review approvals.
- [ ] Require review from Code Owners
  Require an approving review in pull requests that modify files that have a designated code owner.
- [ ] Require approval of the most recent reviewable push
  Whether the most recent reviewable push must be approved by someone other than the person who pushed it.
- [ ] Require conversation resolution before merging
  All conversations on code must be resolved before a pull request can be merged.
- [ ] Request pull request review from Copilot Preview
  Automatically request review from Copilot for new pull requests, if the author has access to Copilot code review.

Allowed merge methods

Merge, Squash, Rebase

When merging pull requests, you can allow any combination of merge commits, squashing, or rebasing. At least one option must be enabled.

Merging feature branch changes back into `main`

Merging itself creates a "merge commit" within the `main` branch (or, in whichever branch you are merging into)

If the feature branch is as up-to-date as possible with `main`, merge conflicts will be much less likely!

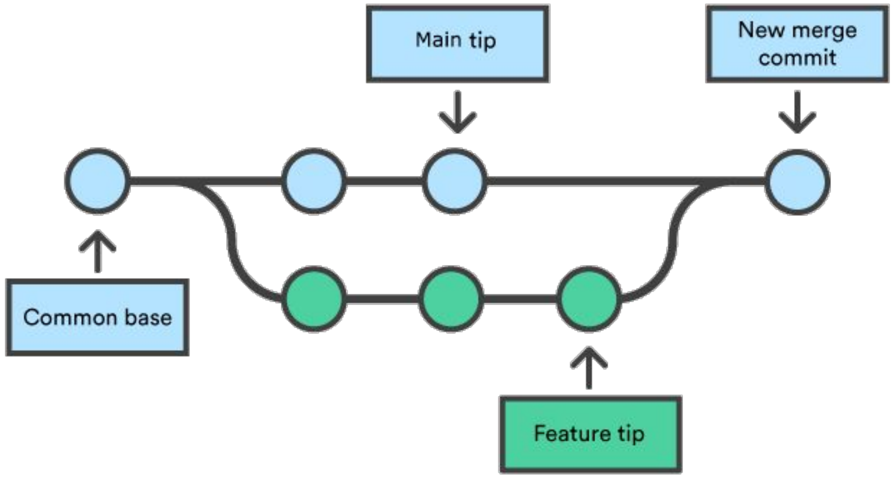


Image from Atlassian

Keeping your feature branch up-to-date with `main`

1. Locally, switch back to the main branch `git switch main`

2. Pull down `main` branch changes: `git pull main`
   - This will update your local `main` branch to match the remote `main` branch

3. Switch back to your feature branch: `git switch <feature-branch>`

4. Merge in the `main` branch updates: `git merge main`
   - Note that you specify the name of the branch you want to merge changes *from*; the branch you are merging *to* is your current branch.
   - You may enter **`vi`** as part of the commit that this command creates! Use **`:wq`** to get out.

Some caveats to the previous slide!

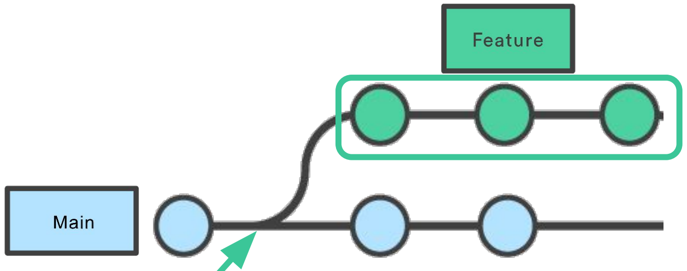
We assumed that the base branch is always `main`, but this is not always the case! We'll see later a couple scenarios where your base branch is not `main`, but the same concepts will apply.

This process will differ a little if you are working in a fork! You first have to keep your `main` branch up-to-date with the **upstream** `main` branch:

```
git switch main              # switch to your main branch
git merge upstream/main      # merge the upstream main into your local main branch
git push                     # update your fork's remote main

# Now, you can sync your feature branch with your main branch
```

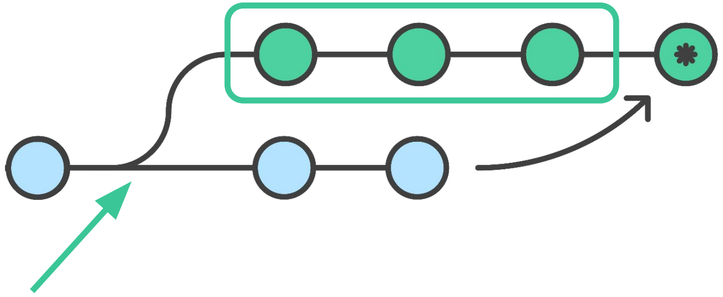
Merging and *rebasing* can be used to combine branch histories



Feature branch created here

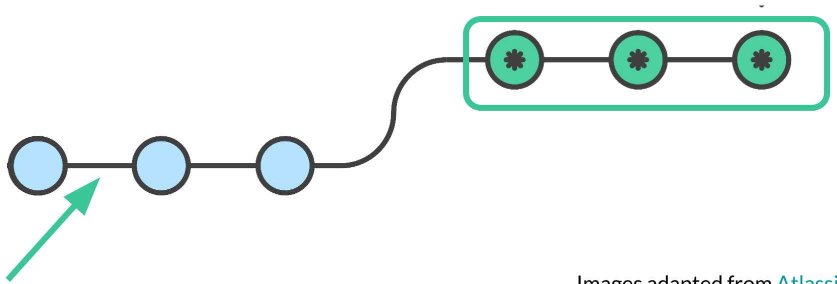
`git merge`

Retains full project history



`git rebase`

Overwrites project history



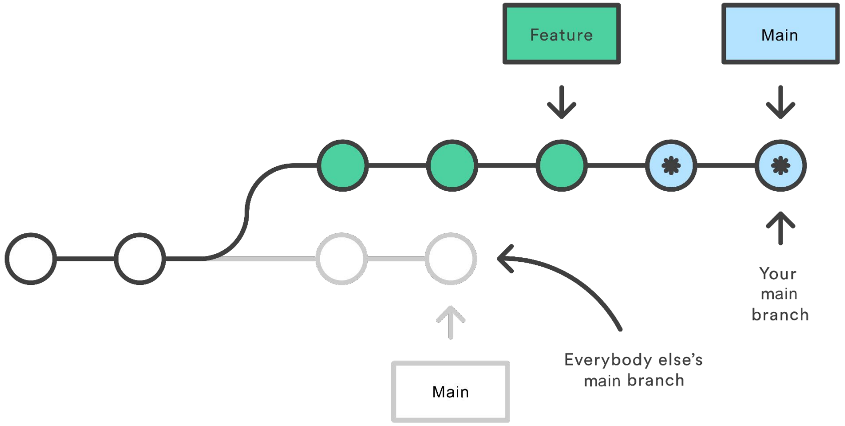
Images adapted from [Atlassian]()

Remember Atlassian's golden rule of rebasing

So, before you run git rebase, always ask yourself, "Is anyone else looking at this branch?"

AKA, never* use `git rebase` on a shared branch

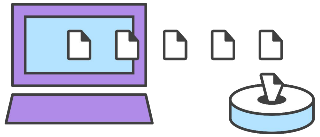
- Public repositories with potential for open contribution
- Private repositories within your organization, even if not meant for external use or consumption



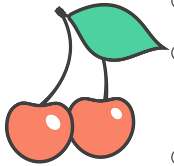
*unless the project maintainers tell you to

Image & quote from [Atlassian]()

Helpful commands when working in multiple branches



- `git stash`
  - Use this to save "work in progress" code for later *without committing*
  - This commands adds changes since the last commit to the stash, which you can "apply" when you are ready



- `git cherry-pick`
  - This command will *copy* (not move!) commit(s) from one branch to another
  - The same commit(s) will now exist in *both branches*, meaning this command results in duplicate history
  - But, you can clean up after yourself if you absolutely need to (we'll see an example...now!)

Image from Atlassian

Demo: Working with multiple branches