Advanced Git

IVS demonstration exercise

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Red Hat

Prerequisites

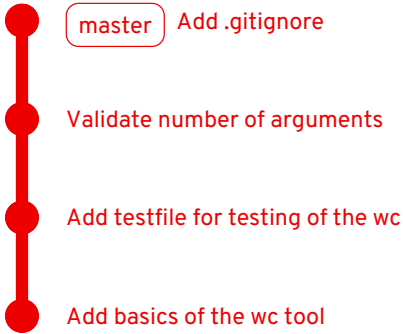
- Basic knowledge of Git commands for:
  - creating commits (`git add`, `git commit`)
  - inspecting current state (`git status`, `git diff`)
  - inspecting history (`git log`, `git show`)
  - working with remotes (`git pull`, `git push`)
  - working with branches (`git checkout`, `git branch`)

“Advanced” work with Git

Let's start

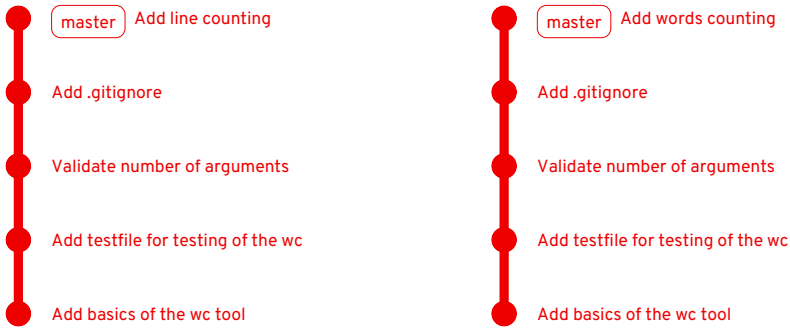
- We'll write a simple tool for counting characters, words, and lines in a file (similar to the `wc` utility)
- We start with a pre-initialized repo containing very basics of the tool: `https://github.com/viktormalik/git-workshop`
- The repo contains a source file `wc.c`, a testing file, and a `Makefile`
- We start by adding `.gitignore` and commiting it

Current status of the repo



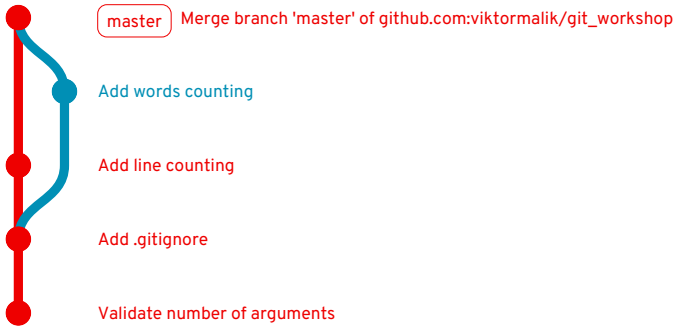
Basic team synchronisation

Every member implements a different feature in their *master*



Basic team synchronisation

The second one to push must do a merge (and resolve a merge conflict)



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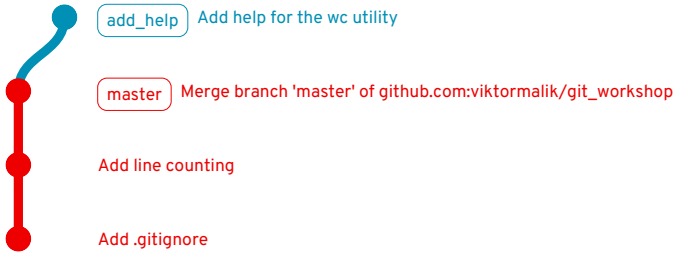
Better team synchronisation

- **This is not a good practice!**
- Always implement new features in **separate branches**.
- Potential merge conflicts should be resolved in the feature branch.
- Ideally, merging into master should be always done using **pull requests**
  - They allow other team members to comment on the changes
  - Changes can be **reviewed** before they get into master
  - Master always contains a working and approved version of the project

Using a feature branch

Let us add help into the tool using a separate branch *add_help*



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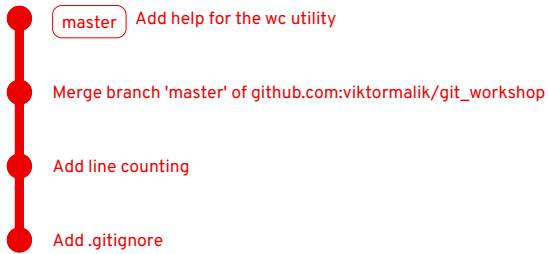
Using a feature branch

The state of *master* after **rebase**:



Moving branches

We have 2 branches pointing to the same commit and we want to move one backwards.

own-separator, option-opt Add counting by custom separator

master Add help for the wc utility

Merge branch 'master' of github.com:viktormalik/git_workshop

Moving branches

This can be done using `git reset HEAD^`

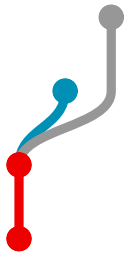
own-separator Add counting by custom separator

master, option-opt Add help for the wc utility

Merge branch 'master' of github.com:viktormalik/git_workshop

Moving branches

After adding a new commit to *options-opt*:



option-opt Optimise getting CLI options

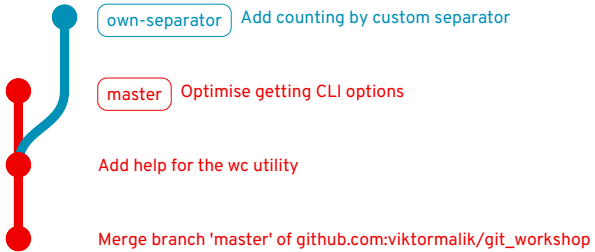
own-separator Add counting by custom separator

master Add help for the wc utility

Merge branch 'master' of github.com:viktormalik/git_workshop

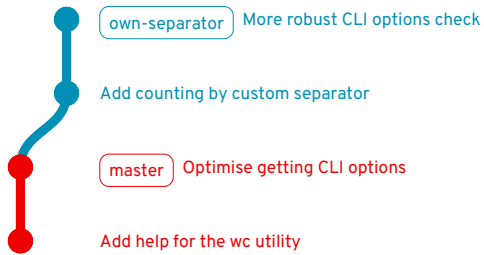
Moving branches

options-opt can be now merged into master while *own-separator* remains a feature branch in development.



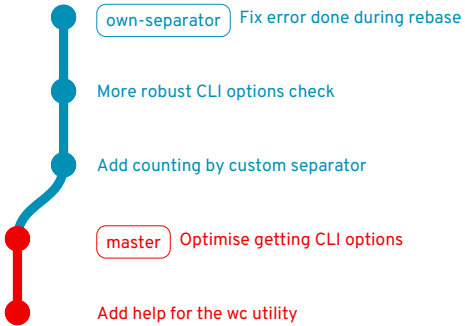
Rebasing feature branches

We add more commits to the feature branch and then **rebase** it onto *master* (to avoid creation of a merge commit).



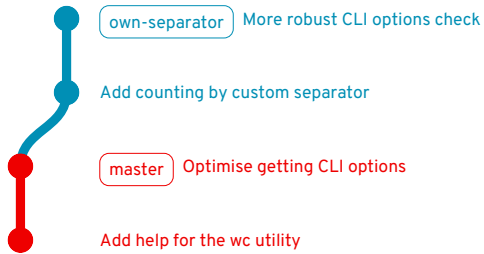
Rebasing feature branches

We made a mistake during rebase, which we had to fix with an additional commit.



Rebasing feature branches

It is possible to merge the “fix commit” into one of the previous commits using **interactive rebase** (`git rebase -i`).

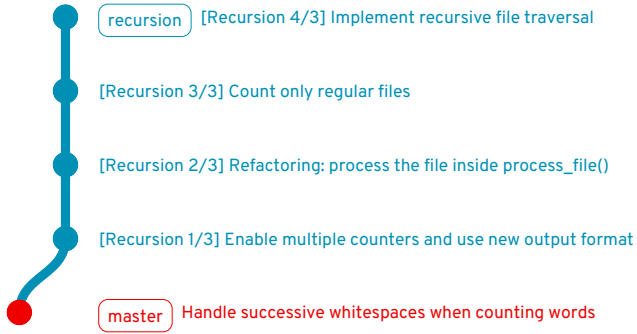


Interactive rebase

- One of the most important Git features in the modern pull request-based workflow.
- Allows to **edit**, **reorder**, **merge**, or **drop** commits.
- **Rewrites history** – should be only used on feature branches.
- **Never rewrite history of master!**
  - Other developers would not be able to do `git pull`.

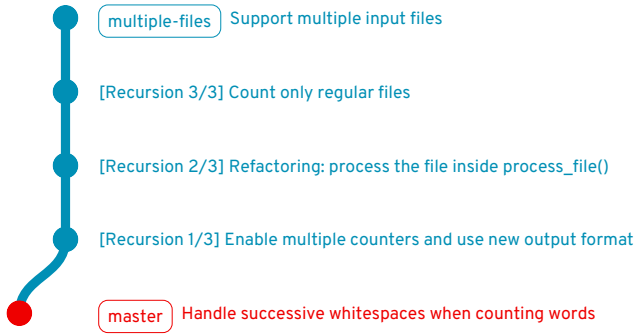
Copying commits from other branches

It is possible to copy commits from other branches (e.g. commits implementing useful features from co-workers feature branches) using `git cherry-pick`.



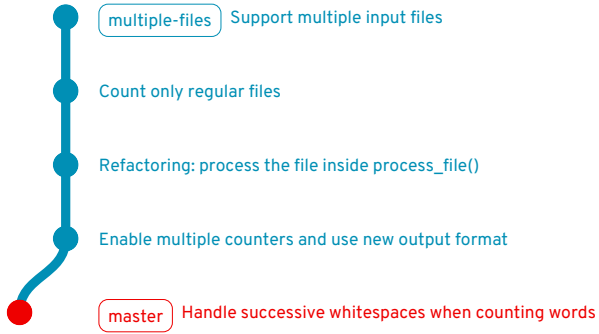
Copying commits from other branches

After moving 3 commits from *recursion* into *multiple-files*:



Copying commits from other branches

If the commits are altered in *multiple-files*, it may be needed to use `skip` when rebasing *recursion* onto *multiple-files*.



Hunting bugs in Git history

- We often discover a bug that was certainly introduced **somewhere in the Git history**.
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- Git offers `git bisect` that uses **binary search** to localise the commit that caused the bug.
  - `git bisect start` starts bisecting.
  - `git bisect good` marks a commit that does not contain the bug.
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- The process can be **automated** using a script that returns 0 on success and a non-zero result on failure.

Git tips and tricks

Cloning repositories with a long history

- If a repo has a long history, it may take long time to clone it.
- If the entire history is no needed, it is possible to use a **shallow copy**:
  `git clone --max-depth N`
- Try it with the Linux kernel:
  `git clone --max-depth 1 https://github.com/torvalds/linux`

Default push and pull into different remotes

- When using pull requests, it may be useful to pull from the **upstream** repo but push into own **fork**.
- A different remote for push can be configured using:
  `git config remote.pushdefault <remote>`
- Alternatively, this can be configured per-branch:
  `git config branch.<branch>.pushremote <remote>`

Signing commits

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- To resolve this problem, Git offers **signing commits** using GPG keys.
- GitHub offers a nice tutorial on how to setup commit signing: `https://help.github.com/en/github/authenticating-to-github/signing-commits`

Setup your environment

There are various possibilities on how to ease your life with Git:

- **Git prompt**
  - It is possible to setup Bash prompt such that it shows the current branch, state of the directory, etc.
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- **Use tools for history inspection**
  - There is a number of tools for an easier history traversal
  - E.g. **tig**, gitk, ...

Setup your environment

- **Command aliases**
  - Many Git commands are quite long (or have many options).
  - It is possible to setup short aliases for most commonly used commands.
  - Git offers a way to set aliases:

```
git config --global alias.co checkout
...
```

    or edit `$HOME/.gitconfig`:

```
[alias]
 co = checkout
 ...
```

  - An alternative is to setup aliases via shell

Useful links

- https://www.atlassian.com/git/tutorials/advanced-overview
- https://guides.github.com
- https://help.github.com/en/github