PUZZLE ITC

changing IT for the better

git

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1. Introducing Git
2. Centralized vs Distributed VCS
3. Git Basics
4. Git Branches
5. Git Distributed
6. Workflow Strategies

Agenda

$ whoami

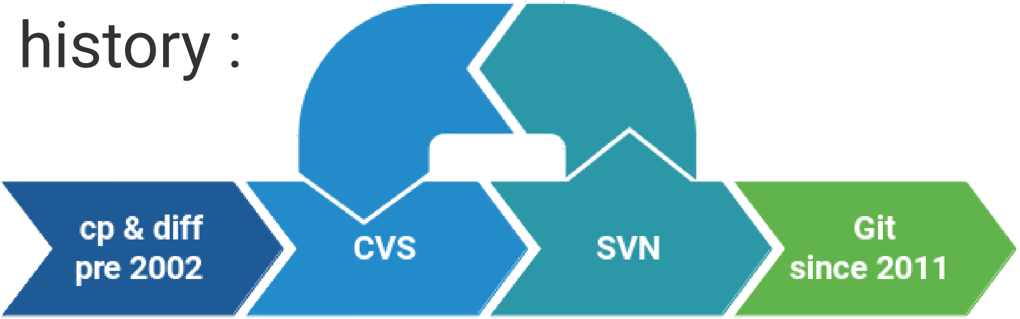
Stefan Rotman <rotman@puzzle.ch>

Puzzle ITC – since 2010 [Software Engineer, Software Architect]

Java Enthusiast – since 1997

Git Enthusiast – since 2011

My personal VCS history :



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Introducing Git

History of Git

- Developed in 2005
  - as VCS for the Linux kernal
  - by Junio Hamano and Linus Torvalds
- Fundamental requirements
  - Performance and distributed nature
  - Security and trust issues

Why the name ?

… pick and choose :

- *« I'm an egotistical bastard, and I name all my projects after myself. First 'Linux', now 'Git' » – Linus Torvalds*
- *Random three-letter combination not yet used on UNIX*
- *Slang meanings*
- *...*

What is Git ?

Git is a free and open source distributed version control system designed for speed and efficiency.

What is Git ?

Git is a free and open source **distributed** version control system **designed for speed and efficiency**.

Git is fully distributed

- (almost) everything happens local
  - it's fast !
- every clone is a full repository backup
  - … and a potential git server
- it works offline

(almost) everything happens local

No network access needed to

commit changes

generate diffs

inspect commit history

create branches

merge branches

change between branches

… and much more ☺

Security, trust and efficiency

Every commit is immutable

Every commit is a snaptshot of the entire tree, not just a patch

Data integrity is central

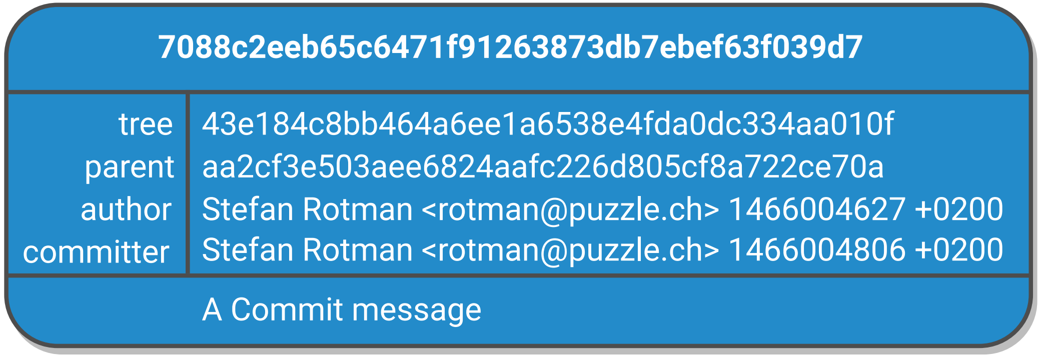
Brancing & merging is cheap, fast and easy!

Git rarely removes data (it just removes it from the working tree)

Commits are immutable

Every commit is identified by a unique SHA-1 code

Every commit points to a snapshot of the entire tree



7088c2eeb65c6471f91263873db7ebef63f039d7

tree	43e184c8bb464a6ee1a6538e4fda0dc334aa010f
parent	aa2cf3e503aee6824aafc226d805cf8a722ce70a
author	Stefan Rotman <rotman@puzzle.ch> 1466004627 +0200
committer	Stefan Rotman <rotman@puzzle.ch> 1466004806 +0200

A Commit message

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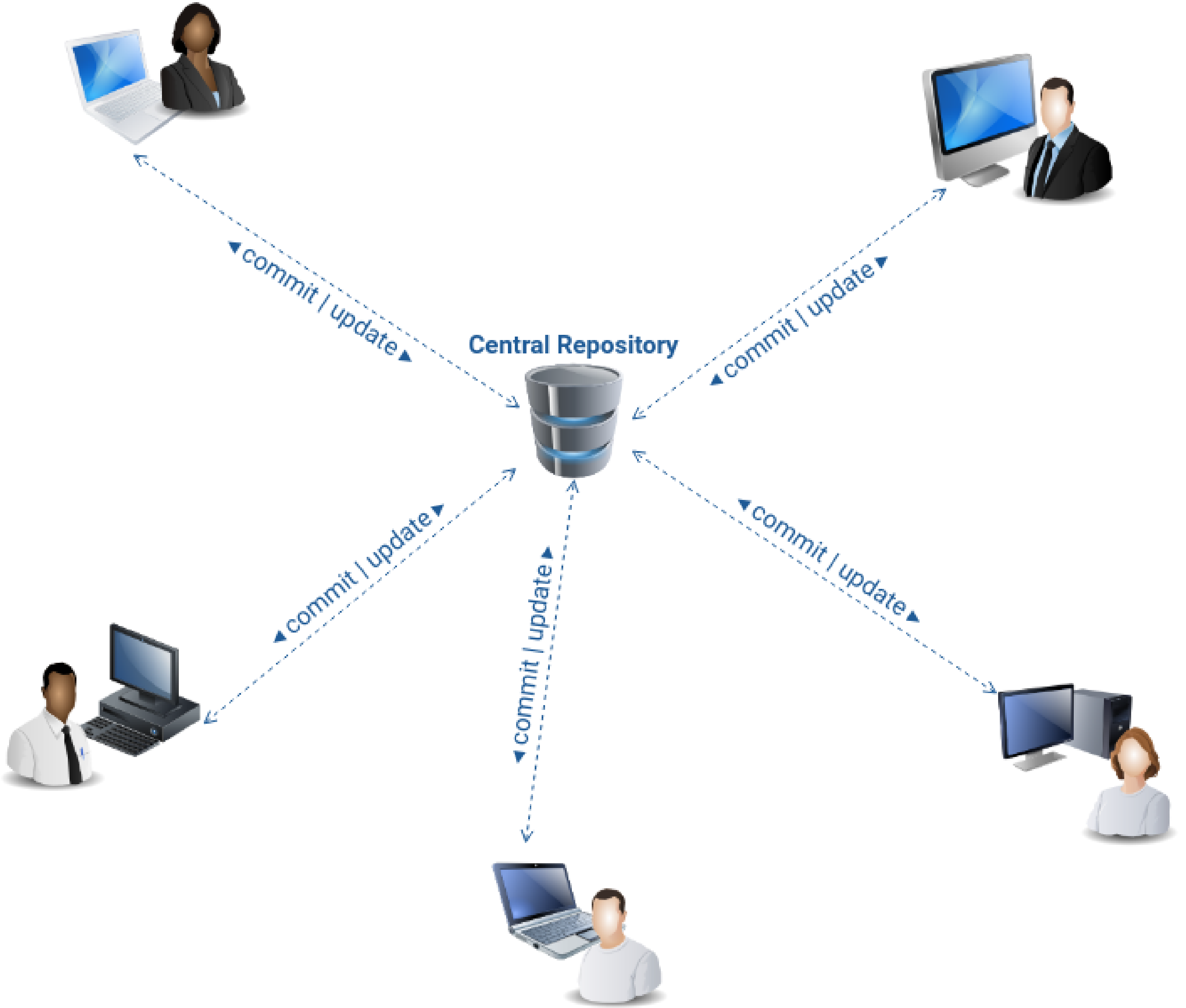
Centralized VCS
vs
Distributed VCS

Centralized VCS



Central Repository

commit | update

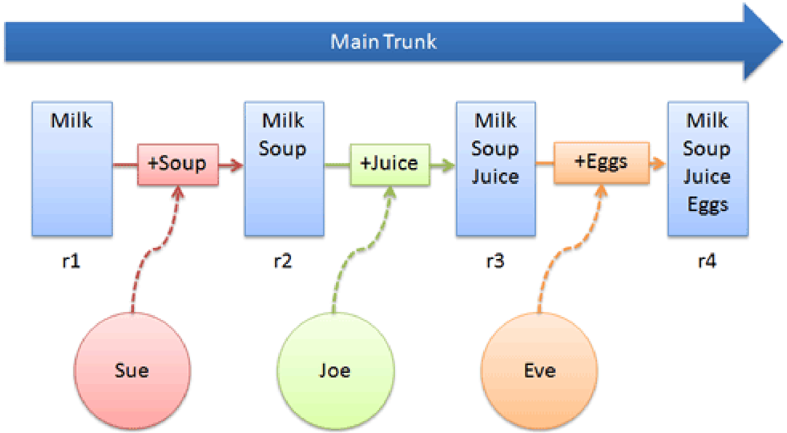
commit | update

commit | update

commit | update

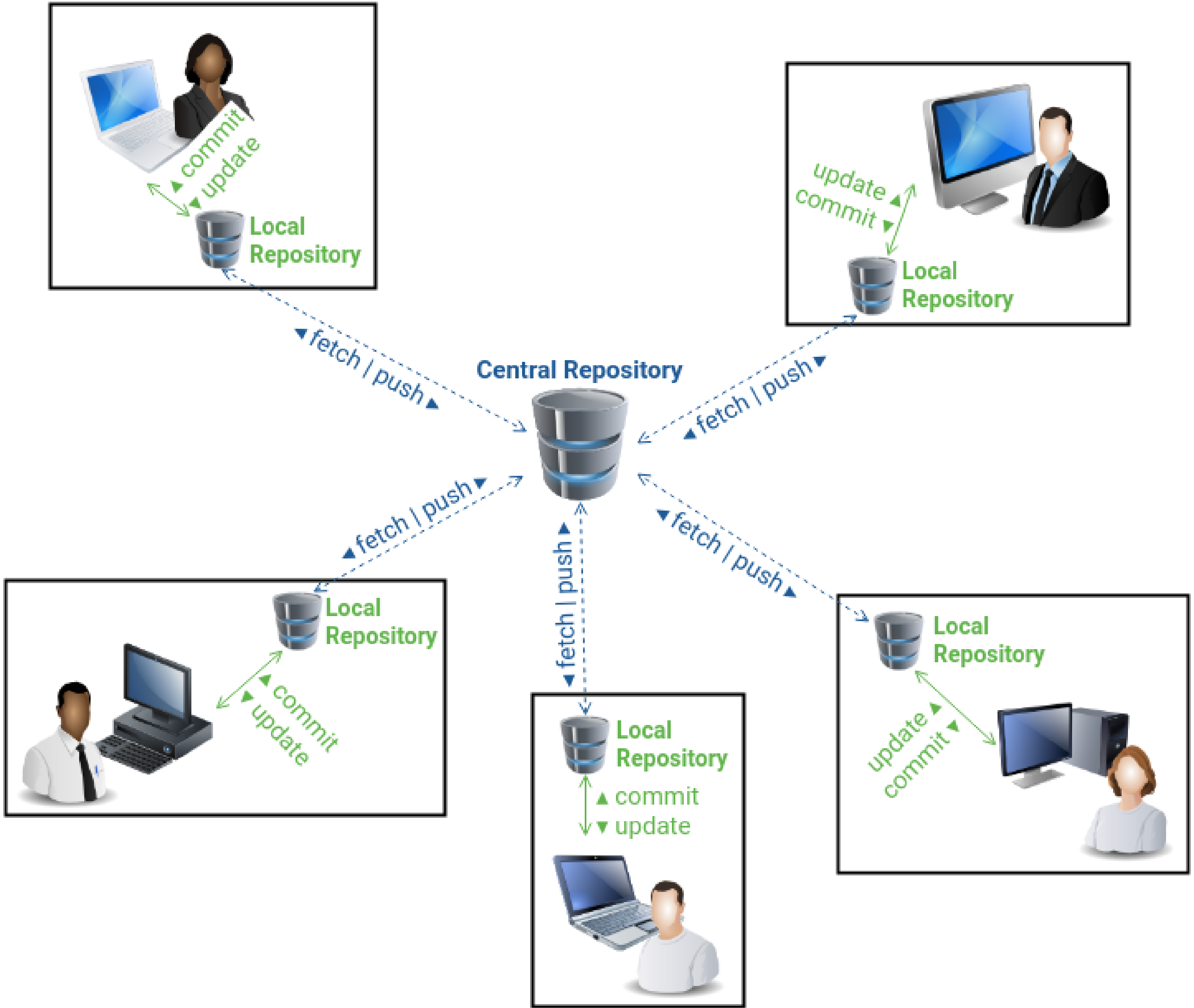
commit | update

Centralized VCS

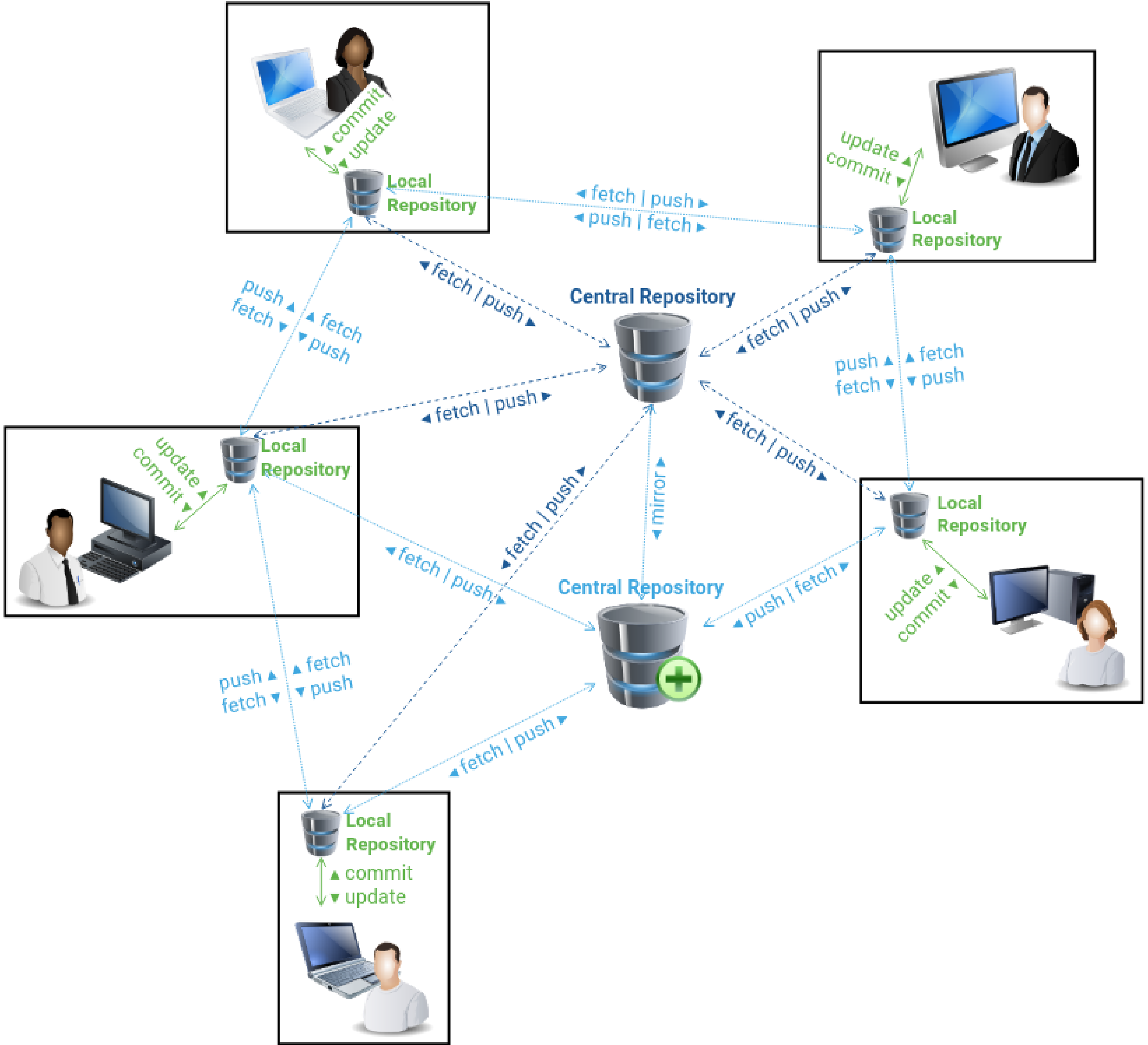


source : betterexplained.com

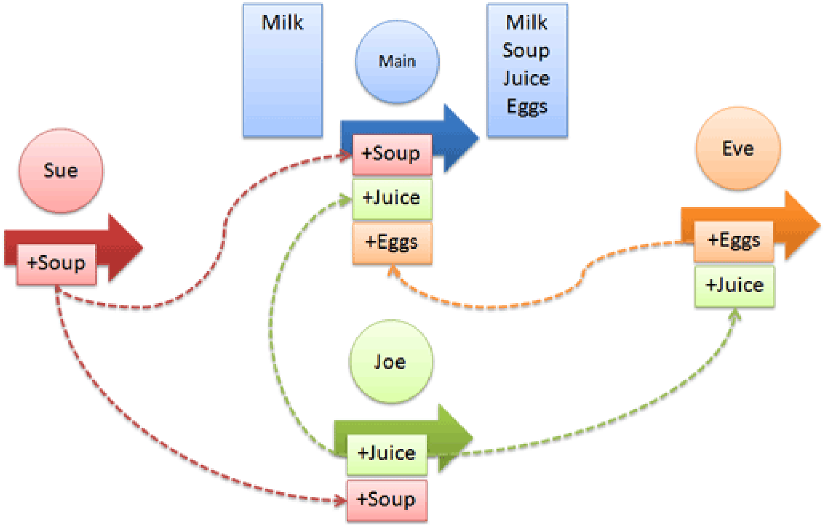
Distributed VCS



Distributed VCS



Distributed VCS



source : betterexplained.com

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Git Basics

State of the data

In 'classic' VCS, data can live in 2 places:

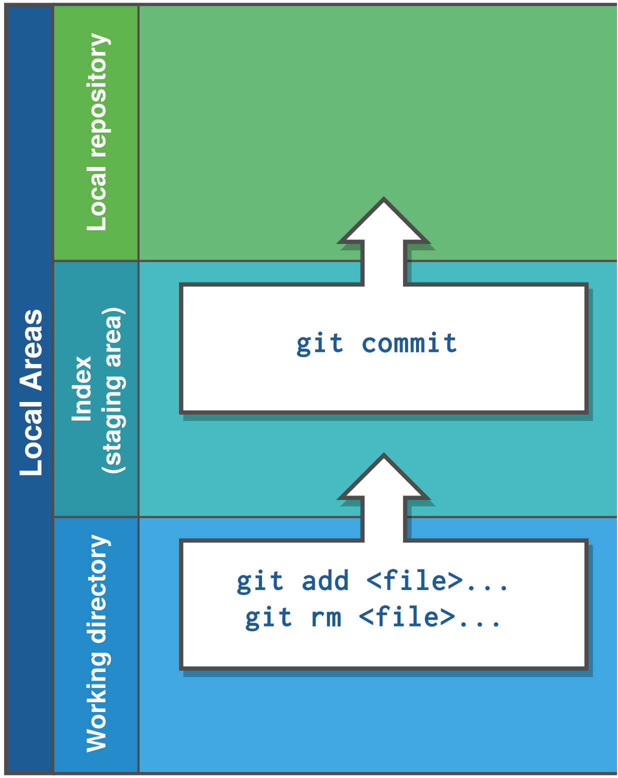
- In the datastore → for Git, that is local repository
  → HEAD references the last commit
- In the working Directory

Git adds an area between the working directory and the datastore:

- The index

From change to commit

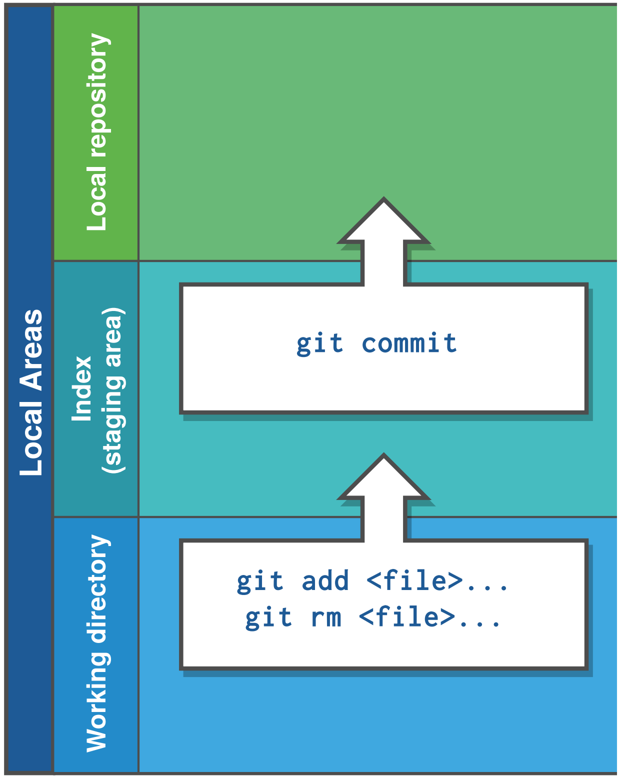
Changes are made in the Working directory



From change to commit

Changes are staged in the Index

Changes are made in the Working directory



Local Areas

Local repository

Index
(staging area)

Working directory

```
git commit
```

```
git add <file>...
git rm <file>...
```

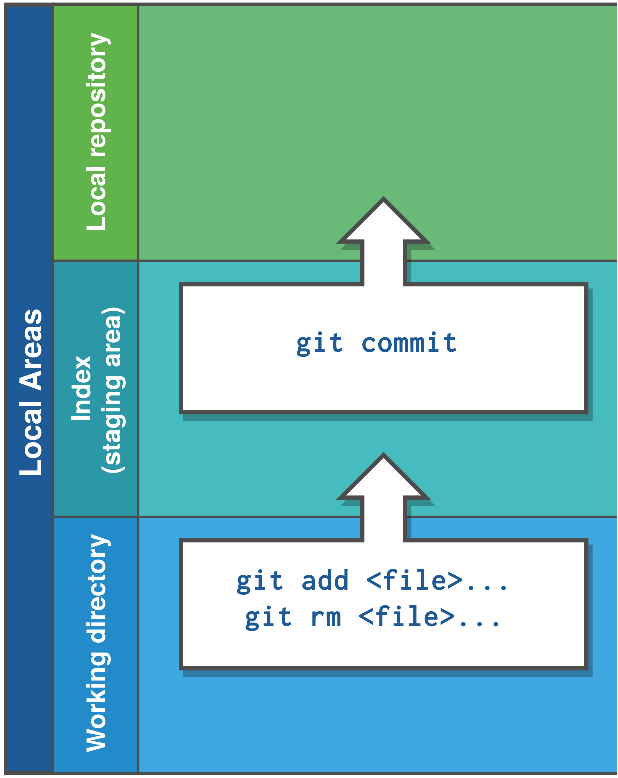
From change to commit

Changes are committed to the local repository

this updates the HEAD reference

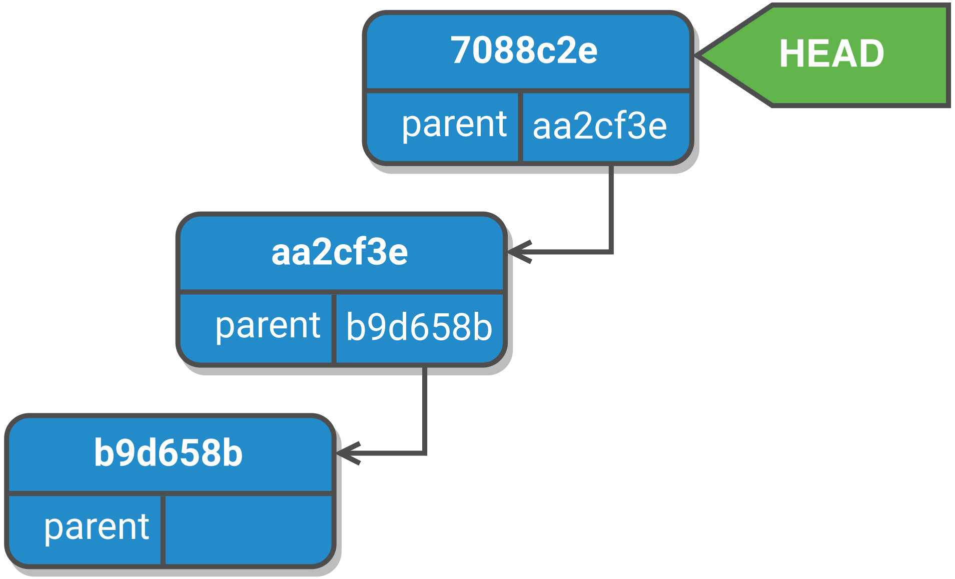
Changes are staged in the Index

Changes are made in the Working directory



Local Repository: the HEAD tree

	7088c2eeb65c6471f91263873db7ebef63f039d7
tree	43e184c8bb464a6ee1a6538e4fda0dc334aa010f
parent	**aa2cf3e503aee6824aafc226d805cf8a722ce70a**
author	Stefan Rotman <rotman@puzzle.ch> 1466004627 +0200
committer	Stefan Rotman <rotman@puzzle.ch> 1466004806 +0200
	A Commit message



Configuration: making yourself known

git config is used to configure git repositories

with **user.name** and **user.email** values identify a user

The **--global** flag makes the setting a user default

```
$ git config --global user.name ”Stefan Rotman”
$ git config --global user.email rotman@puzzle.ch
$ git config -l | grep user.
user.name Stefan Rotman
user.email rotman@puzzle.ch
```

Creating a clean repository

git init initializes a new repository

No files are added yet, no commits are made yet

The 'administration' for a git repository is located in the ***.git*** *folder*

```
$ mkdir foo
$ cd foo
$ git init
Initialized empty Git repository in
/home/srotman/foo/.git/
$ ls -A
.git
```

Cloning a remote repository

git clone clones a remote repository into a local repository

*The default name git uses for a remote repository is **origin***

```
$ git clone git://foo.com/bar.git
Cloning into 'bar'...
remote: Counting objects: 13, done.
remote: Total 13 (delta 0), reused 0
(delta 0), pack-reused 13
Receiving objects: 100% (13/13), done.
Receiving deltas: 100% (2/2), done.
Checking connectivity... done.
$ cd bar
$ ls -A
.git src README
```

Check for changes

git status checks for uncommitted changes in the working directory and index

```
$ git status
On branch master
nothing to commit, working directory clean
$ echo ’new file’ > file.txt
$ git status
On branch master
Untracked files:
  (use ”git add <file>...” to include in what will be committed)

        file.txt

nothing added to commit but untracked files present (use ”git add” to track)
```

Staging changes

git add <file>... adds files or changes and stage in the index

git rm <file>... removes files and stage the removal in the index

*alternatively, you can also use **git add -p <file>...***

```
$ git add README file.txt; git rm dummy
$ git status
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        modified:   README
        deleted:    dummy
        new file:   file.txt
```

Unstaging changes

git reset HEAD unstages all changes

git reset HEAD <file>... unstages changes made to specific files

```
$ git reset HEAD
$ git status
On branch master
Changes not staged for commit:
  (use "git add/rm <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   README
        deleted:    dummy

...
```

Commit staged changes

git commit commits the changes in the index into the local repository

```
$ git status
On branch master
Changes to be committed:
  (use ”git reset HEAD <file>...” to unstage)

        modified:   README
        deleted:    dummy
        new file:   file.txt

$ git commit -m ’Important changes’
[master 3c4bb4d] Important changes
3 files changed, 2 insertions(+), 1 deletion(-)
 delete mode 100644 dummy
 create mode 100644 file.txt
```

Inspect the commit history

git log shows the commit history of the HEAD

- **git log <reference>** shows the commit history for a specified reference
- **git log <file>** shows the commit history for a spedified file
  - by adding **--follow**, path changes are also considered

git show <commit> shows the changes made in a certain commit

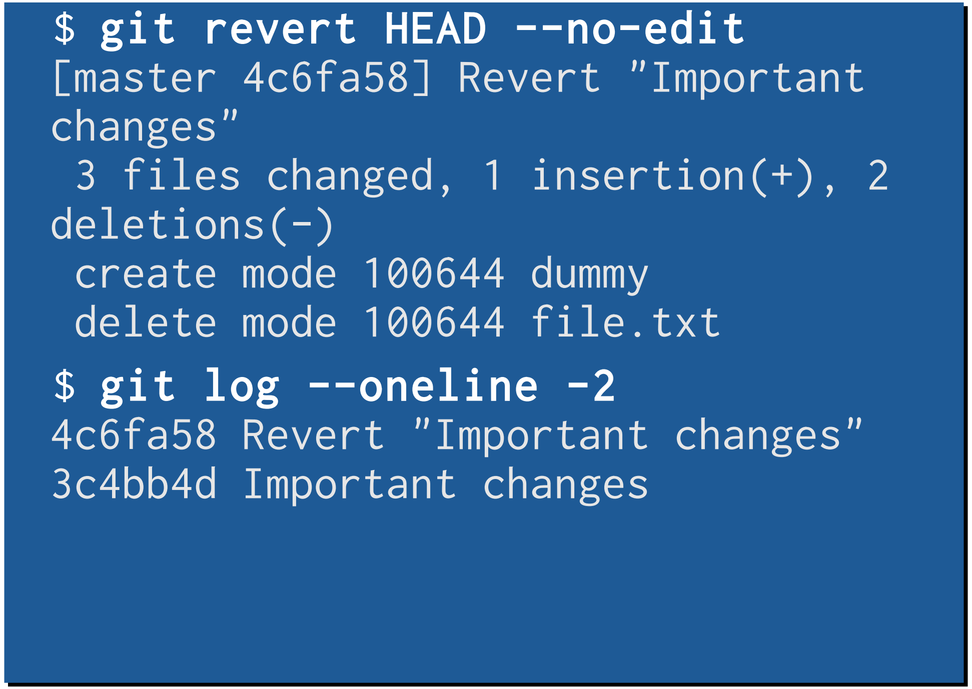
ℹ *__git log --oneline --decorate --graph__ shows a visual graph of the commit history, including branches, tags, merges, ...*

Revert a commit

git revert <commit>

creates a new commit that undoes the changes from the specified commit

The commit can be specified by it's has, or by a reference to it.



```
$ git revert HEAD --no-edit
[master 4c6fa58] Revert "Important
changes"
 3 files changed, 1 insertion(+), 2
deletions(-)
 create mode 100644 dummy
 delete mode 100644 file.txt
$ git log --oneline -2
4c6fa58 Revert "Important changes"
3c4bb4d Important changes
```

Reset the HEAD

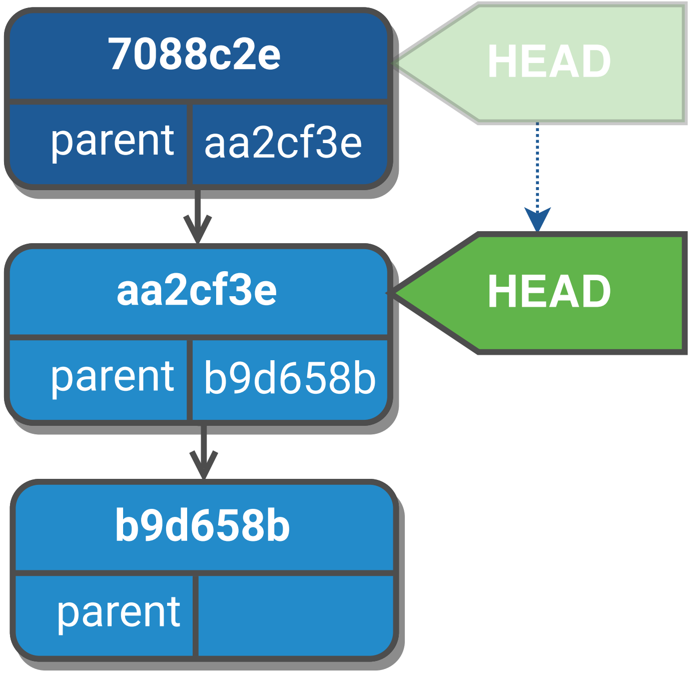
git reset <reference>

resets the HEAD to the specified reference (default with --mixed behaviour)

--soft loose the commits, but keep the changes in the index

--mixed loose the commits, but keep the changes in the working directory

--hard loose the commits and loose the changes



Undo changes in the working directory

git checkout -- <path>

resets the file (or files) on the specified path to the HEAD version.

If the file is in the index, it will be reset to the version in the Index instead.

The 'time machine'

git checkout <commit>

check out the repository tree as stored under the specified commit. This will land you in a 'detached HEAD' state, meaning that any *new* commit you will make here will not be referenced by a branch or tag

git checkout <commit> <file>

checks out the specified file in the state it has under the specified commit, and places it in the index.

Clean the working directory

git clean

deletes files that are not under Version Control from the working directory. Usually required one of the following flags:

- **-i** interactive mode. Show what would be done and clean interactively
- **-f** force. Do what needs to be done
- **-n** dry run. Doesn't clean anything, just shows what would be cleaned.

If the **-d** flag is specified, git also cleans up untracked directories.

Configuration: aliases

Git aliases can be used to make your life easier 😉

git config --global alias.<name> <command>

Some examples:

```
[alias]
        f = fetch
        s = status -sb
        co = checkout
        ci = commit
        lol = log --graph --oneline --decorate
        amend = commit –amend –no-edit
        unstage = reset HEAD --
        up = !git fetch --all --prune && git rebase --autostash
        sprint = log --pretty=format:'%an commited %h [%s] on %ai' --since '2 weeks ago'
```

Configuration: color your life

color.ui is the 'master switch' for colors

```
$ git config --global color.branch auto
$ git config --global color.diff auto
$ git config --global color.interactive auto
$ git config --global color.status auto
```

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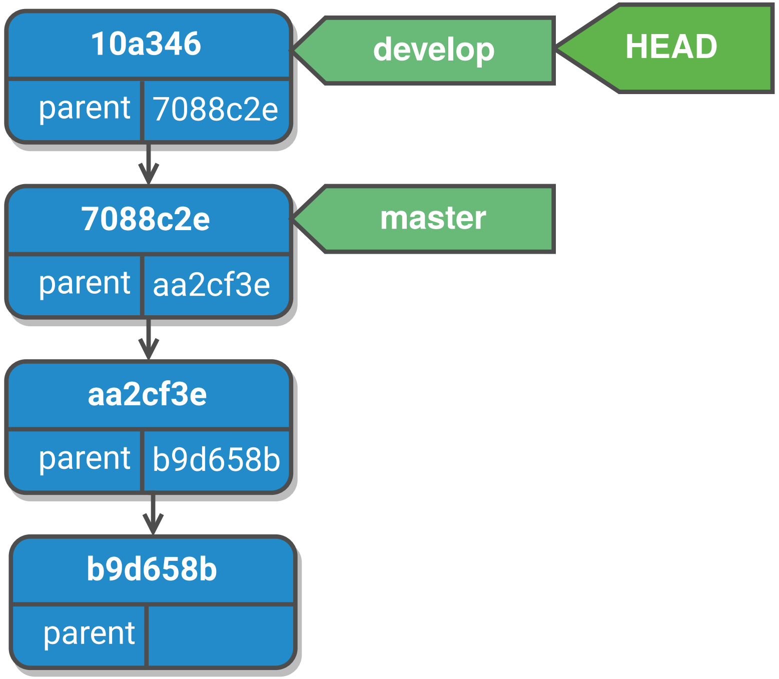
Git Branches

What is a Git Branch

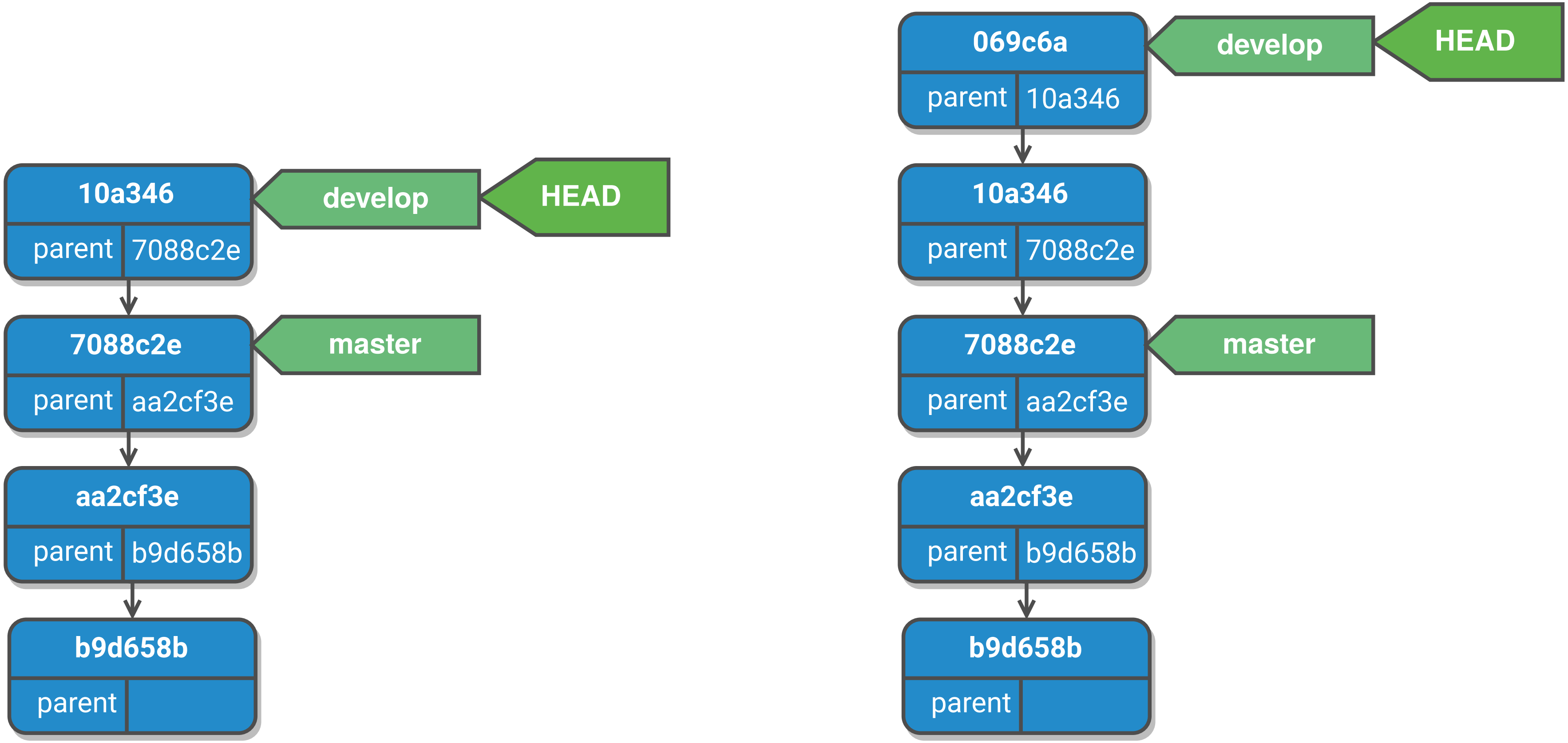
A Branch is a commit marker

(the same is true for tags)

```
$ cat .git/refs/heads/master
7088c2eeb65c6471f91263873db7ebef63f039
d7
$ cat .git/HEAD
ref: refs/heads/develop
```



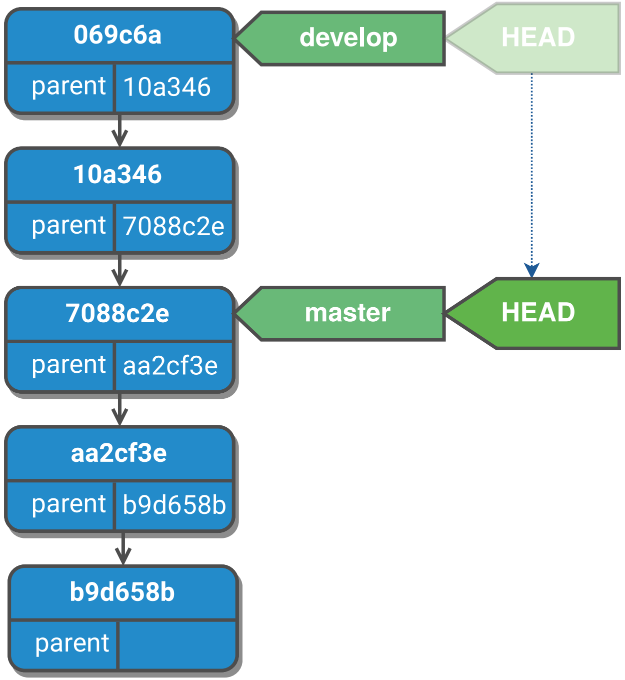
Commit on active branch



Change between branches

git checkout <branchname>

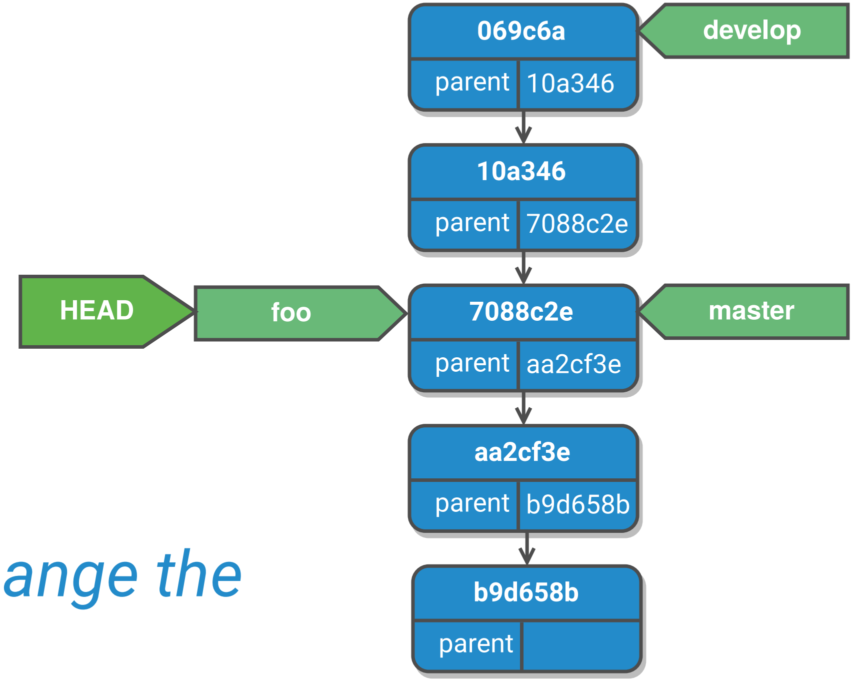
```
$ git branch
* develop
  master
$ git checkout master
Switched to branch 'master'
$ git branch
  develop
* master
$ cat .git/HEAD
ref: refs/heads/master
```



Create branch

git branch <branchname>
creates a branch on the current HEAD

git branch <branchname> <ref>
creates a branch on the specified reference



*Creating a branch does **NOT** change the HEAD reference !*
*Use **git checkout -b <branchname>** to create a branch and check it out right away*

Delete branch

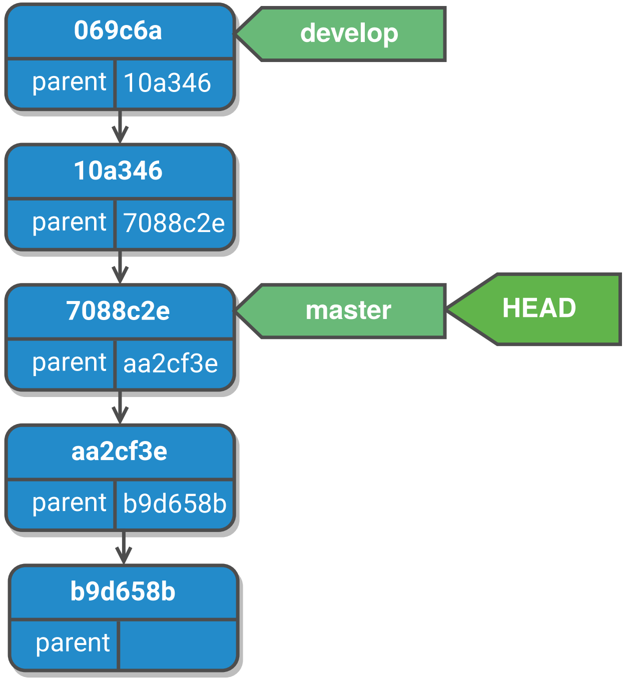
git branch -d will delete a branch that is fully merged in it's upstream or in HEAD

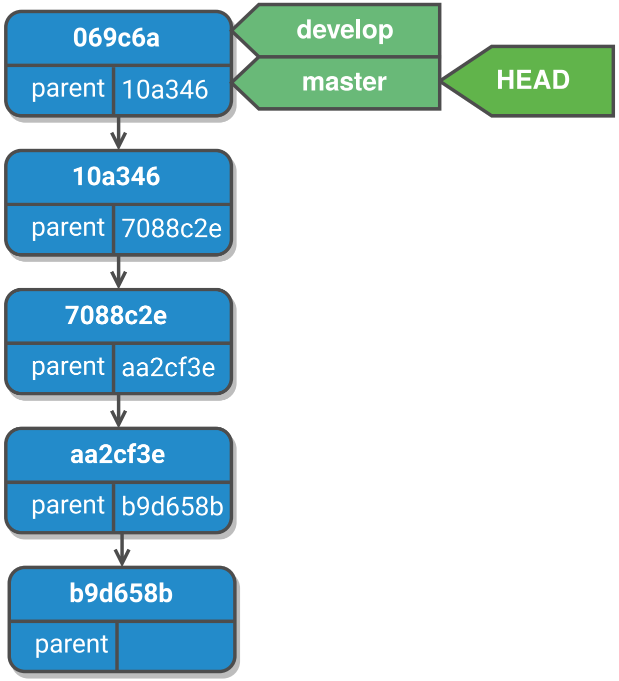
git branch -D will delete a branch without it being merged

You can not delete the branch you're currently on

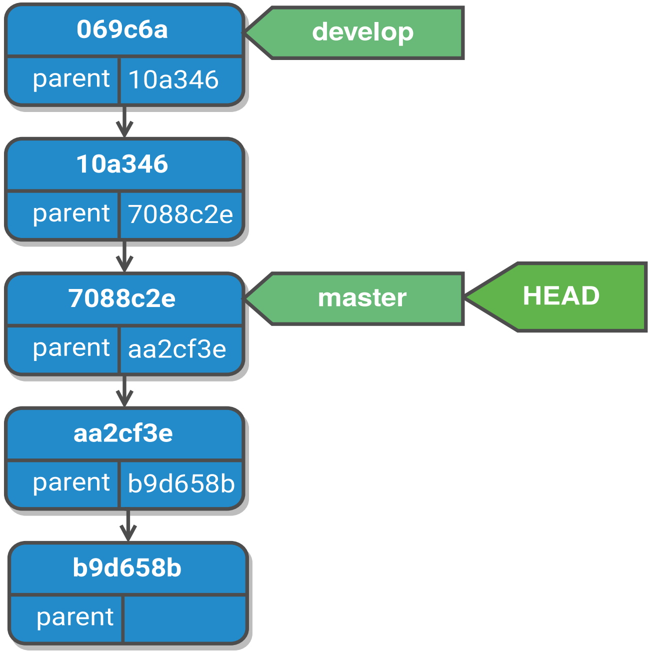
```
$ git branch -D foo
error: Cannot delete the branch 'foo'
which you are currently on.
$ git checkout master
Switched to branch 'master'
$ git branch -d foo
error: The branch 'foo' is not fully
merged.
If you are sure you want to delete it,
run 'git branch -D foo'.
$ git branch -D foo
Deleted branch foo (was e31e45f).
```

Merging (Fast-forward merge)





Merging (non-Fast-forward merge)



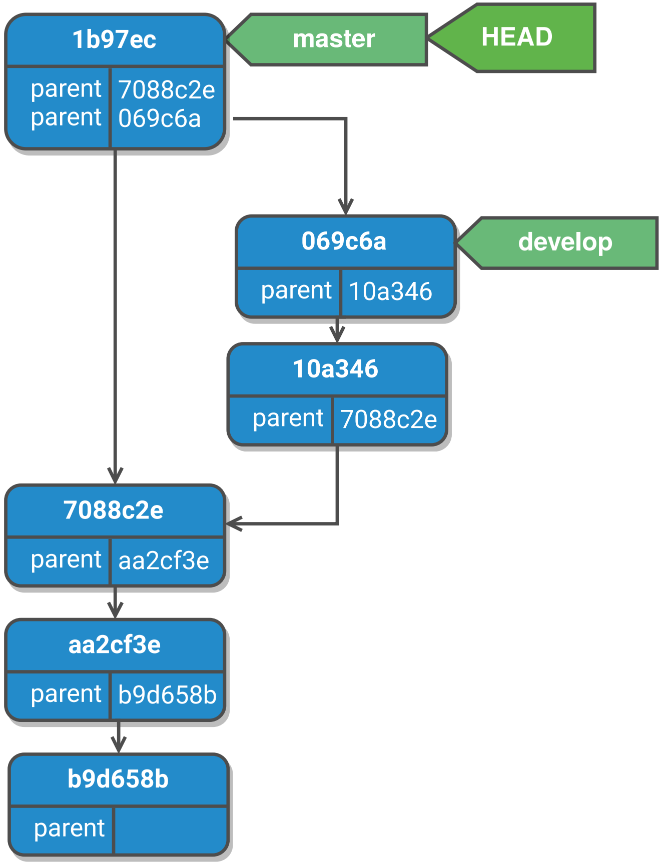
069c6a
parent 10a346
develop

10a346
parent 7088c2e

7088c2e
parent aa2cf3e
master
HEAD

aa2cf3e
parent b9d658b

b9d658b
parent



1b97ec
parent 7088c2e
parent 069c6a
master
HEAD

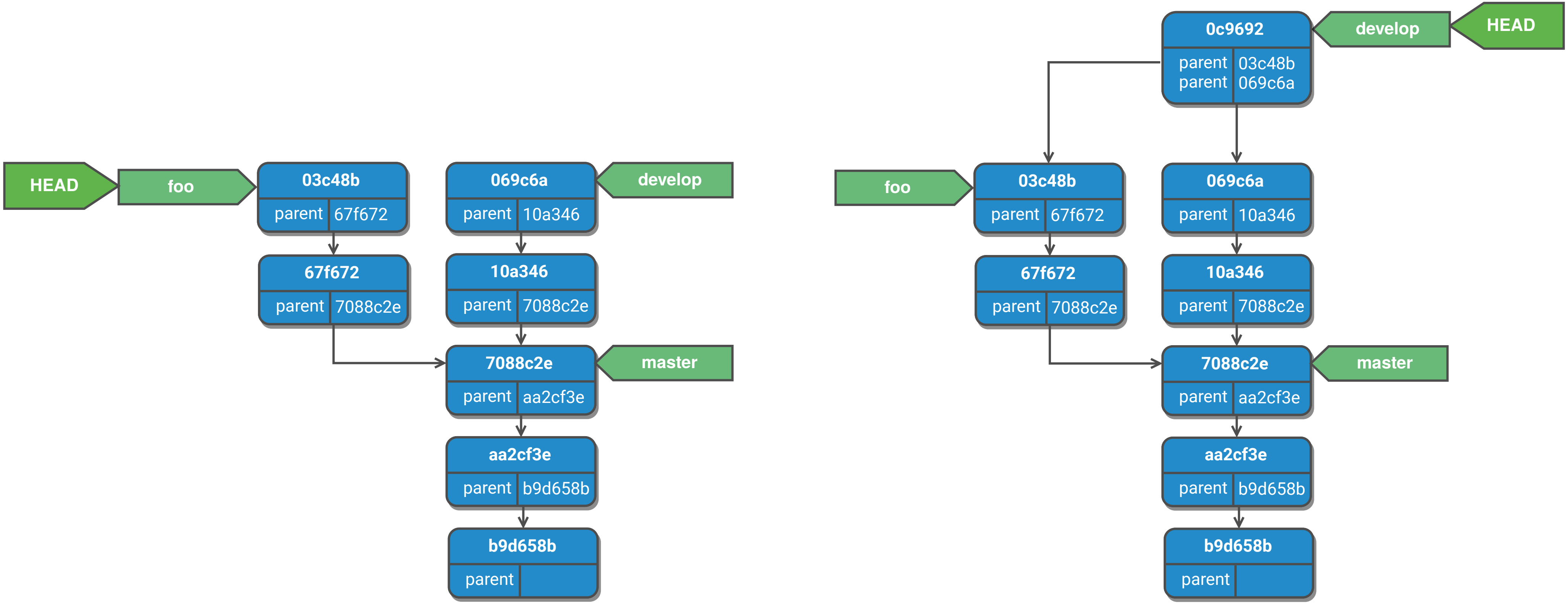
069c6a
parent 10a346
develop

10a346
parent 7088c2e

7088c2e
parent aa2cf3e

aa2cf3e
parent b9d658b

b9d658b
parent


HEAD
foo
03c48b
parent 67f672
67f672
parent 7088c2e
069c6a
parent 10a346
develop
10a346
parent 7088c2e
7088c2e
parent aa2cf3e
master
aa2cf3e
parent b9d658b
b9d658b
parent
0c9692
parent 03c48b
parent 069c6a
develop
HEAD
foo
03c48b
parent 67f672
67f672
parent 7088c2e
069c6a
parent 10a346
10a346
parent 7088c2e
7088c2e
parent aa2cf3e
master
aa2cf3e
parent b9d658b
b9d658b
parent

Merging branches

git merge <branchname>

merges the specified branch in the active branch.

```
$ git merge develop
Updating 7088c2e..069c6a
Fast-forward
...
```

git merge <to_merge> <target>

merges the specified branch into the specified target branch.

```
$ git merge --no-ff master
Merge made by the 'recursive'
strategy.
...
```

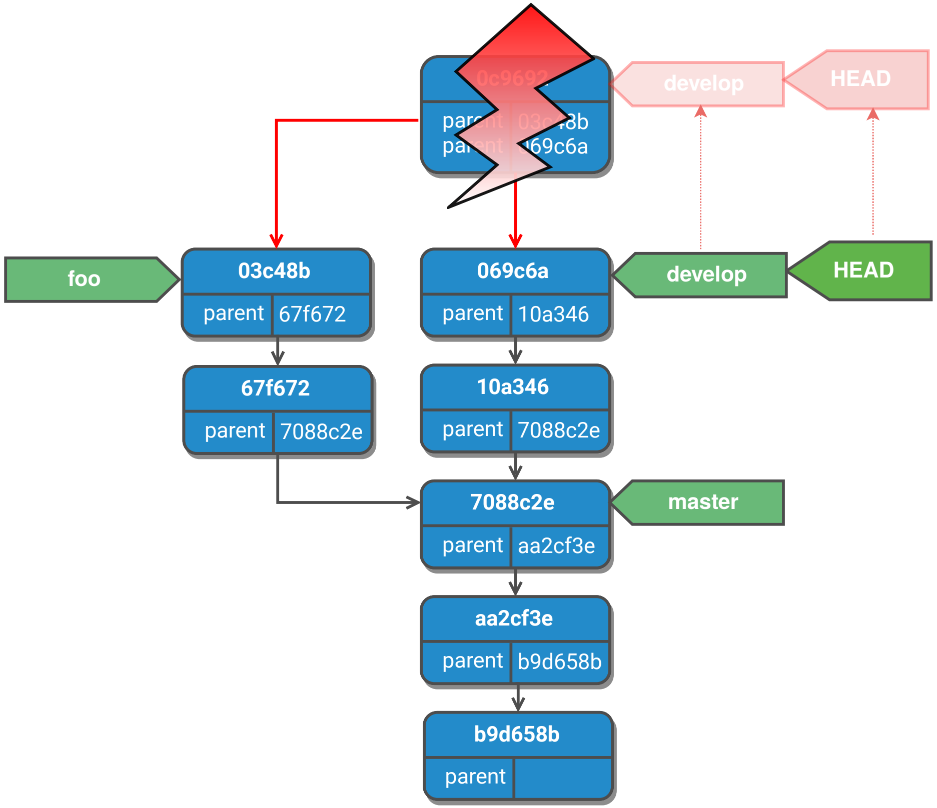
*By default Git will attempt to use fast-forward merges. Using the **--no-ff** flag enforces a merge commit*

*Use the **--no-edit** flag to use the default commit message*

Conflicting merge

Changes on non-conflicting files are placed in the index

Files with conflicts are marked as conflicted stay in the working directory



git merge --abort

Reset the HEAD to where it was before the merge

Resolving merge conflicts

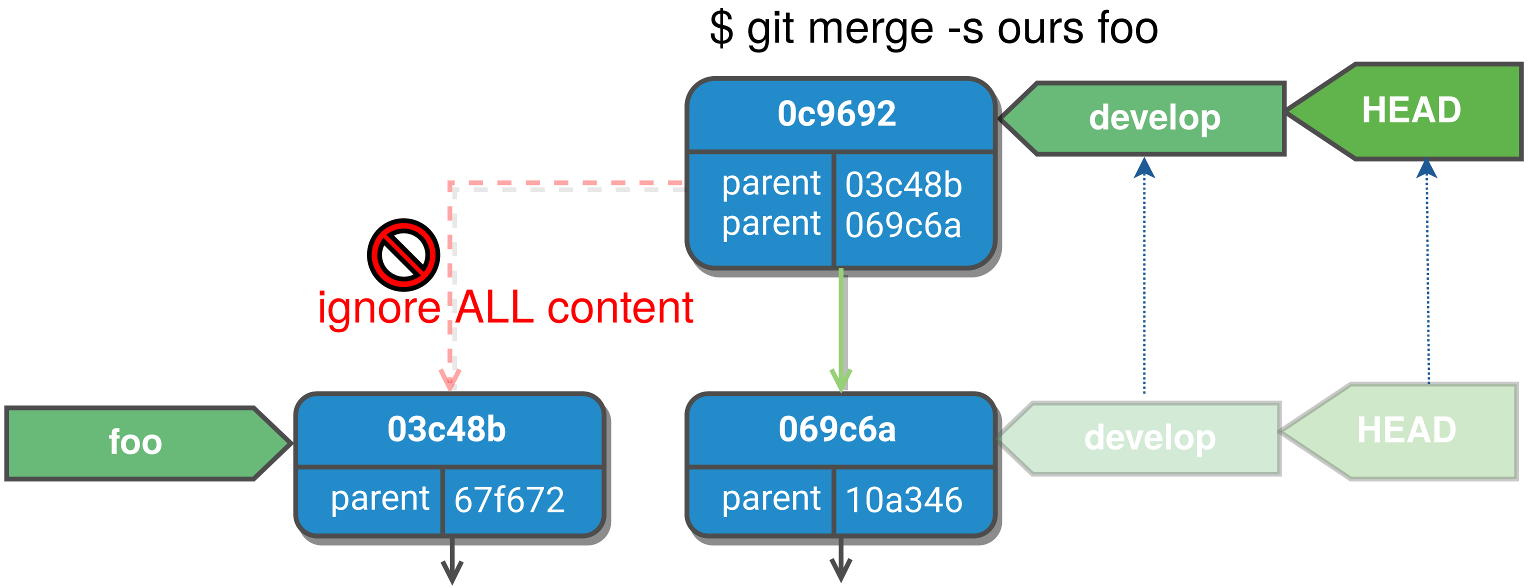
git mergetool

Presents the conflicts in the specified mergetool, and stages them after saving and closing the mergetool

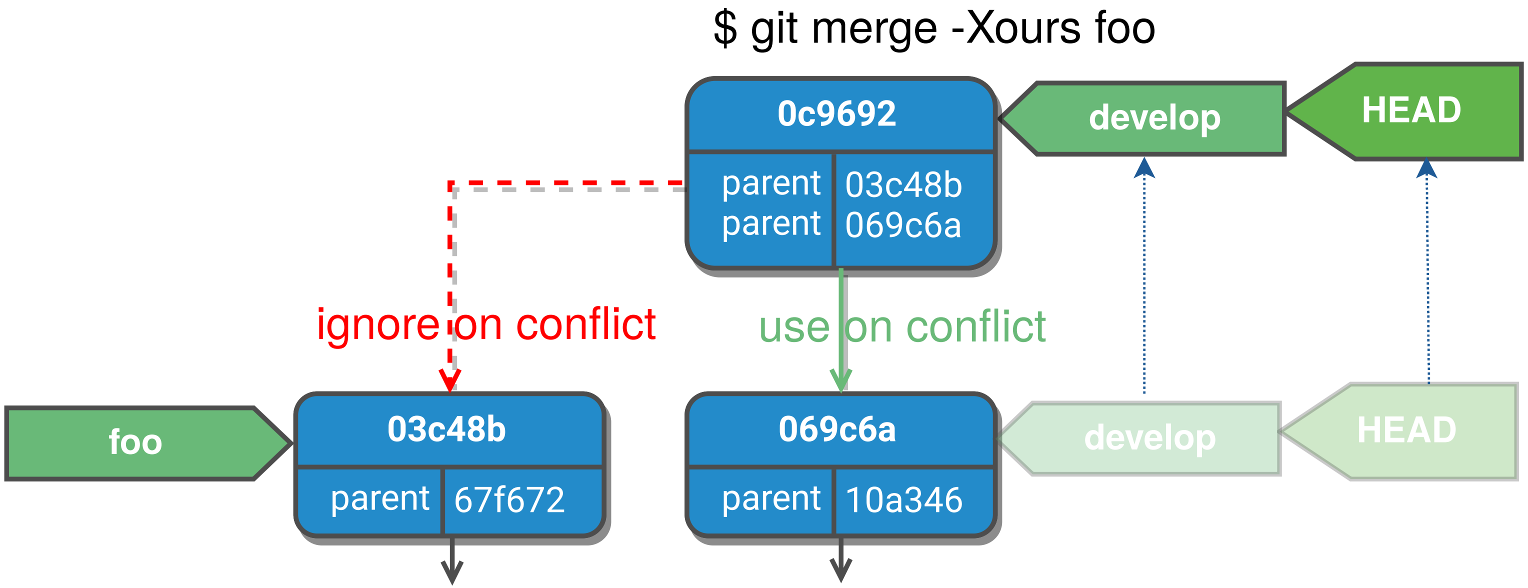
Don't forget to commit the index after the conflicts are resolved

```
[merge]
        tool = meld
        conflictstyle = diff3
[mergetool ”meld”]
        cmd = <path/to/meld> $LOCAL $BASE $REMOTE -o $MERGED \
                        --diff $BASE $LOCAL \
                        --diff $BASE $REMOTE \
                        --auto-merge
```

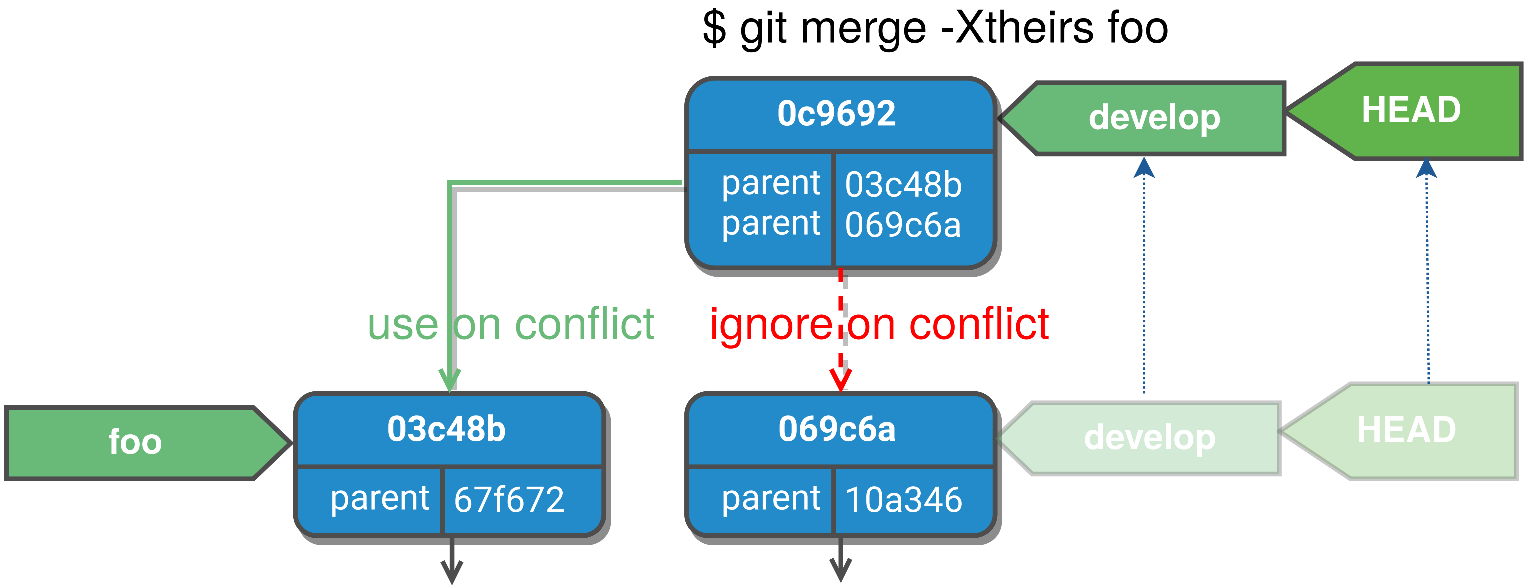
Merge strategy **ours** (-s flag)



Merge strategy **ours** (-X flag)

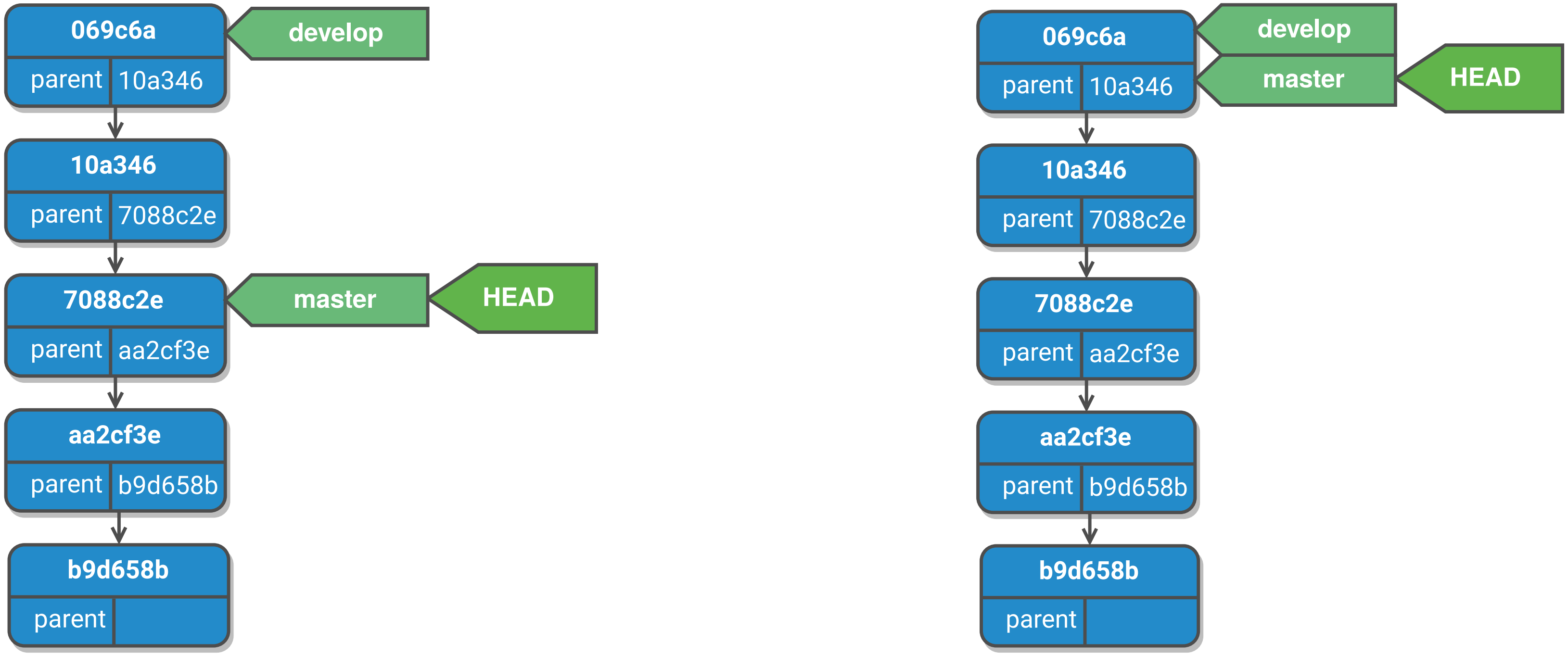


Merge strategy **theirs** (-X flag)

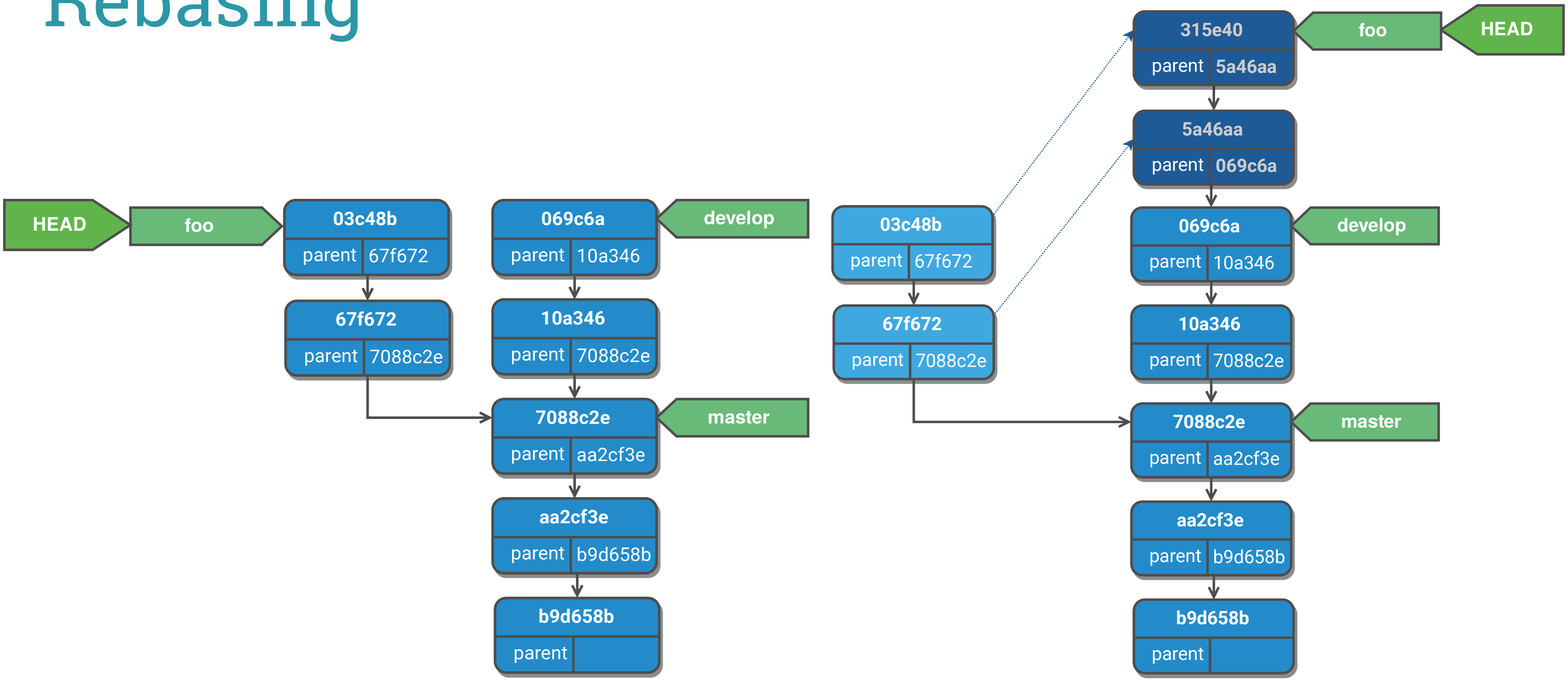


```
$ git merge -Xtheirs foo
```

Rebasing (Fast-forward)



Rebasing



HEAD
foo
03c48b
parent 67f672
67f672
parent 7088c2e
069c6a
parent 10a346
develop
10a346
parent 7088c2e
7088c2e
parent aa2cf3e
master
aa2cf3e
parent b9d658b
b9d658b
parent
315e40
parent 5a46aa
foo
HEAD
5a46aa
parent 069c6a
03c48b
parent 67f672
67f672
parent 7088c2e
069c6a
parent 10a346
develop
10a346
parent 7088c2e
7088c2e
parent aa2cf3e
master
aa2cf3e
parent b9d658b
b9d658b
parent

Rebasing branches

git rebase <branch>

rebases the active branch onto the specified branch

git rebase <newbase> <branch>

rebases the specified branch onto the specified base

```
$ git checkout master
$ git rebase develop
First, rewinding head to replay your
work on top of it…
Fast-forwarded master to develop.
$ git checkout foo
$ git rebase develop
First, rewinding head to replay your
work on top of it…
Applying: Some Commit message
Applying: Another commit
```

Rebasing branches (with merge-commits)

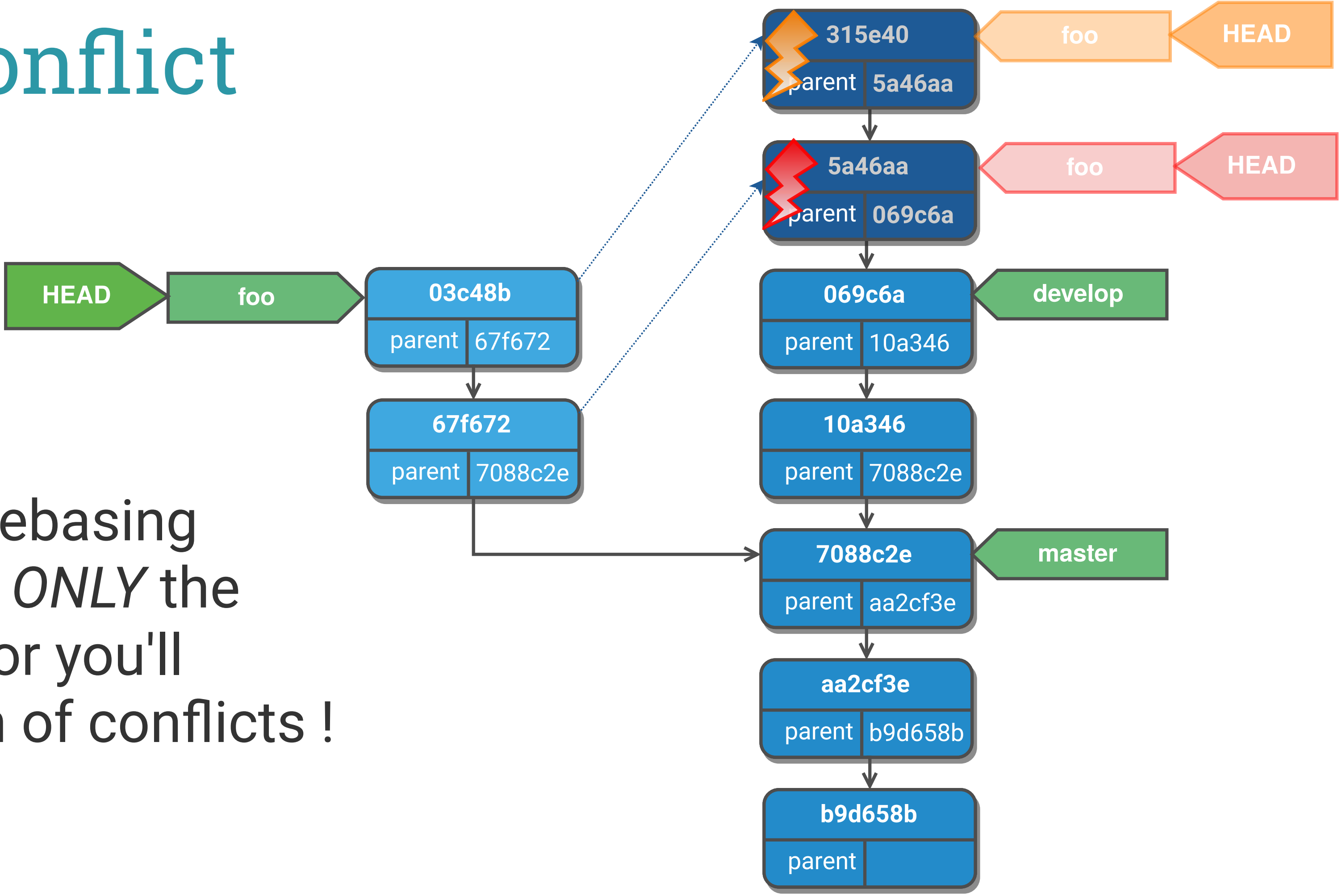
By default, rebase will flatten out no-ff merges, making them appear as ff merges.

git rebase -p <branch>

rebases the active branch onto the specified branch while preserving (re-creating) merge-commits

```
$ git checkout master
$ git rebase -p develop
Rebasing (1/5) → will clear
Successfully rebased and updated
refs/heads/develop
```

Rebasing conflict



When resolving rebasing conflicts, resolve *ONLY* the conflict at hand, or you'll introduce a chain of conflicts !

HELP !! I broke my branch !!

git reflog

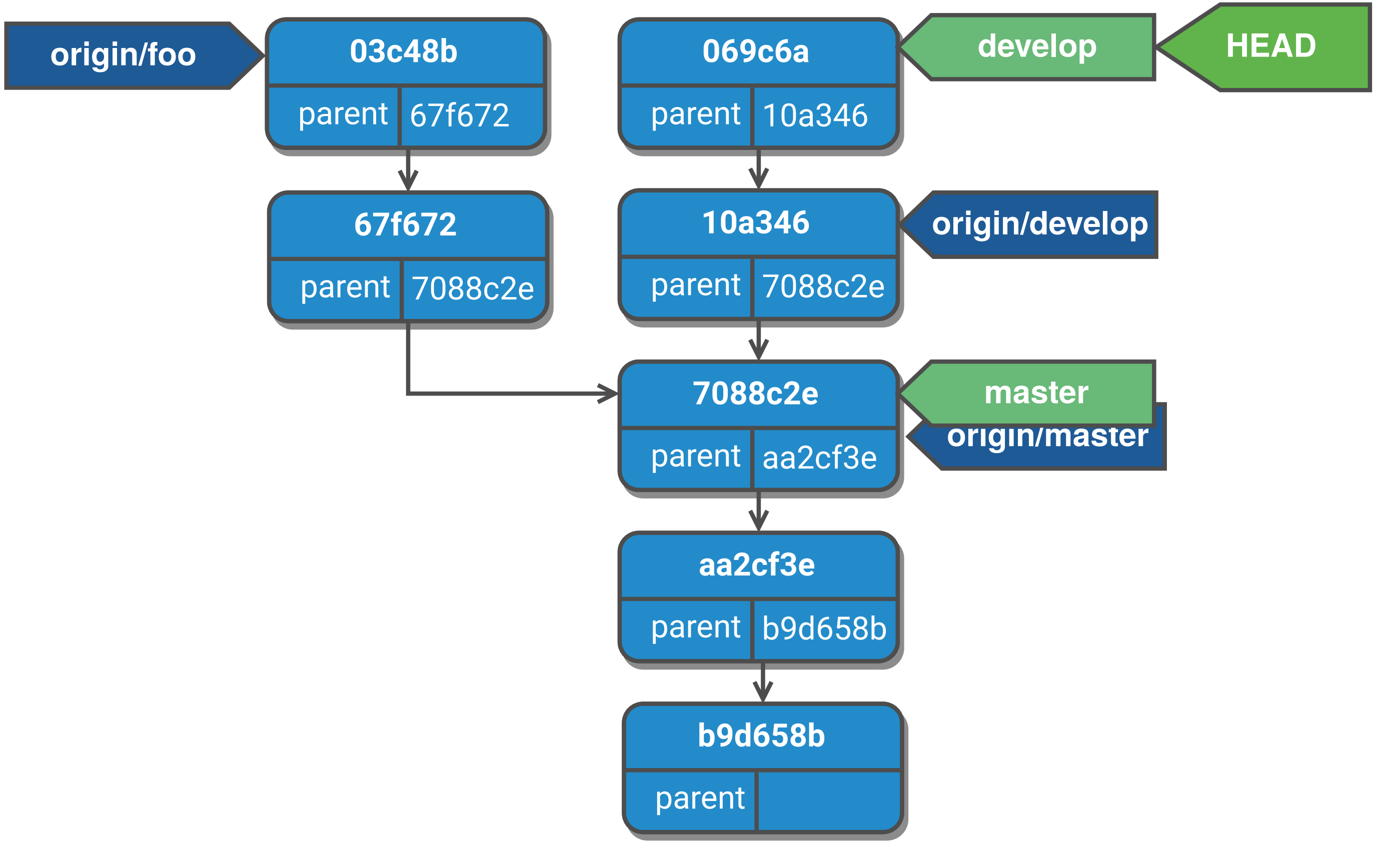
The reflog keeps a neat record of all previous HEAD references of your repository.

Per default, it rememers the last 30 days.

```
$ git reflog
315e40   HEAD@{1}: rebase -i (finish): returning to refs/heads/develop
315e40   HEAD@{2}: rebase -i (pick): Added foo
5a46aa   HEAD@{3}: rebase -i (pick): Foo magic
069c6a   HEAD@{4}: rebase -i (start): checkout develop
03c48b   HEAD@{5}: commit: Added foo
67f672   HEAD@{6}: checkout: moving from master to foo
7088c2e  HEAD@{7}: commit: Some more content
aa2cf3e  HEAD@{8}: commit: Added content
b9db658b HEAD@{9}: commit (initial) : Initial commit
```

4

Git Distributed


origin/foo
03c48b
parent 67f672
67f672
parent 7088c2e
069c6a
parent 10a346
develop
HEAD
10a346
parent 7088c2e
origin/develop
7088c2e
parent aa2cf3e
master
origin/master
aa2cf3e
parent b9d658b
b9d658b
parent

Add a remote repository

git remote add <name> <url>

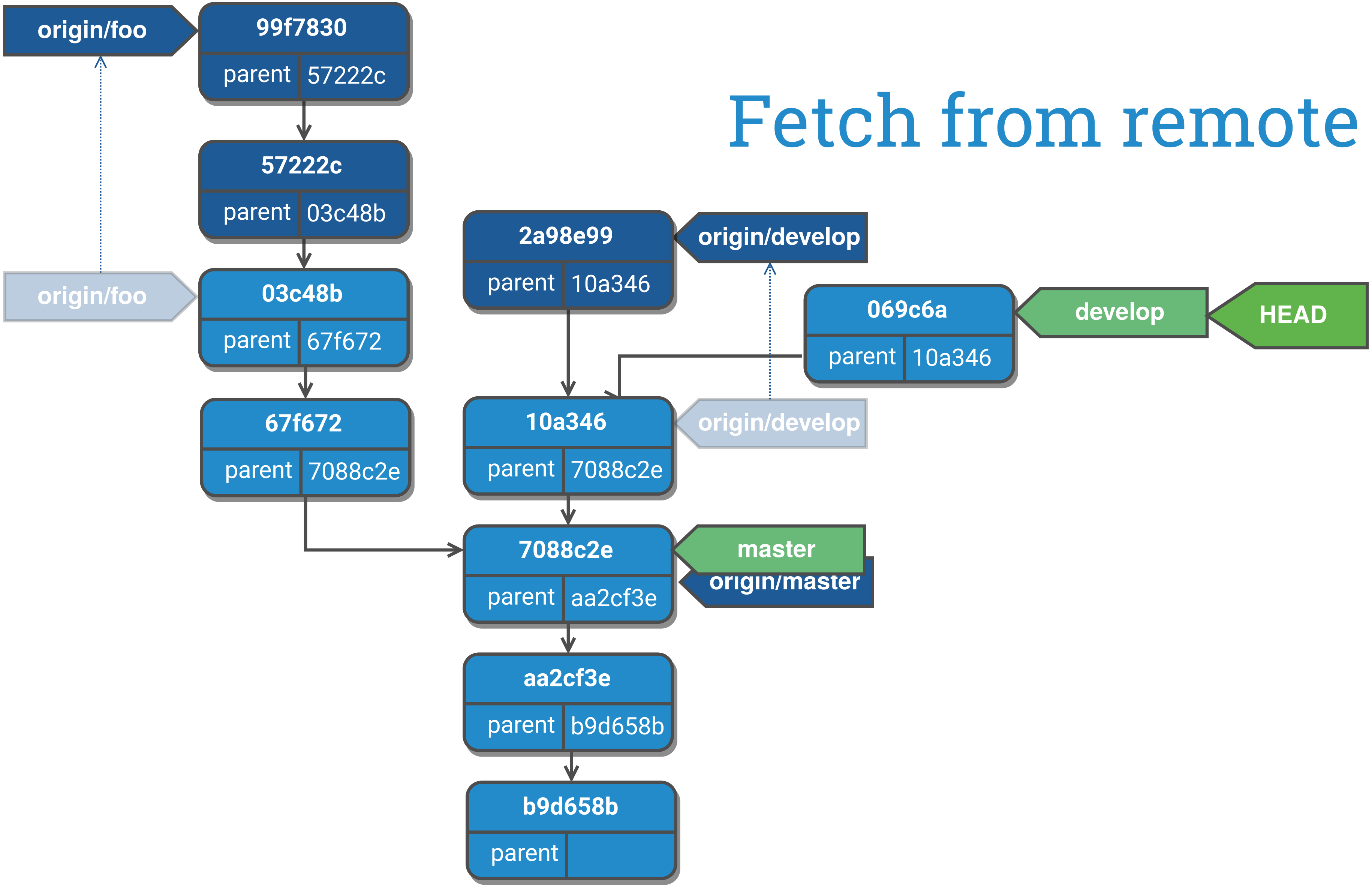
Adds the remote repository on the specified url under the given name.

If this is the first remote, **origin** is a good default for the name.

git remote show <name>

Show information about the remote repository (URL, tracked branches, stale branches, ...)

Fetch from remote



Fetch from remote

git fetch

fetches the changes from the remote repository, without applying the changes

git fetch --prune

prunes the branch markers for branches that have been removed remotely

```
$ git fetch
remote: Counting objects: 3, done.
remote: Compressing objects: 100% (3/3),
done.
Receiving objects ...
...
From git://example.com/foo.git
 10a346..7088c2e  develop -> origin/develop
 7288c2e..7088abd foo -> origin/foo
```

Pull the changes from remote

git pull

Short-hand command for **git fetch** followed by **git merge**

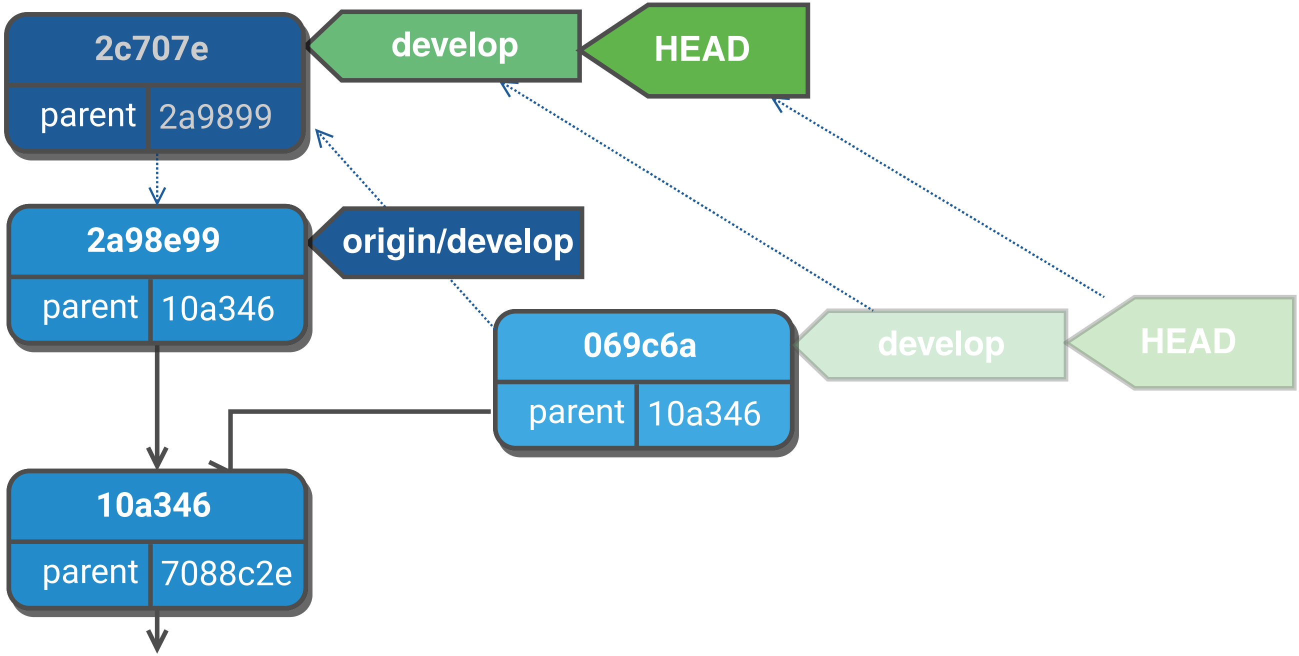
This will try to merge the remote tracking branch into the active HEAD.

If both branches have commits, a merge-commit will be created

git pull --rebase

Short-hand command for **git fetch** followed by **git rebase**
This will rebase the active HEAD onto it's remote tracking branch

git rebase [origin/develop [develop]]

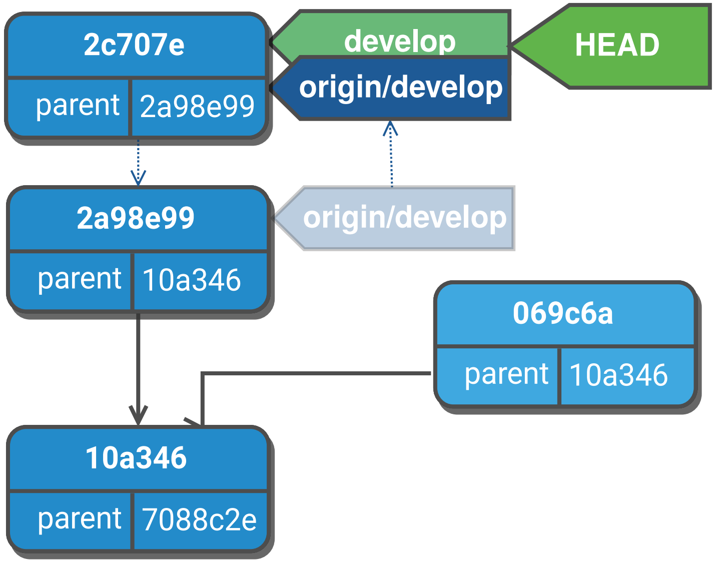


Push the changes

git push

pushes the commits from the local repostitory to the remote repository.

If you didn't push, your commits are just with you!



Find a remote branch

git branch

- **-r** shows all remote branches
- **-a** shows all local and remote branches

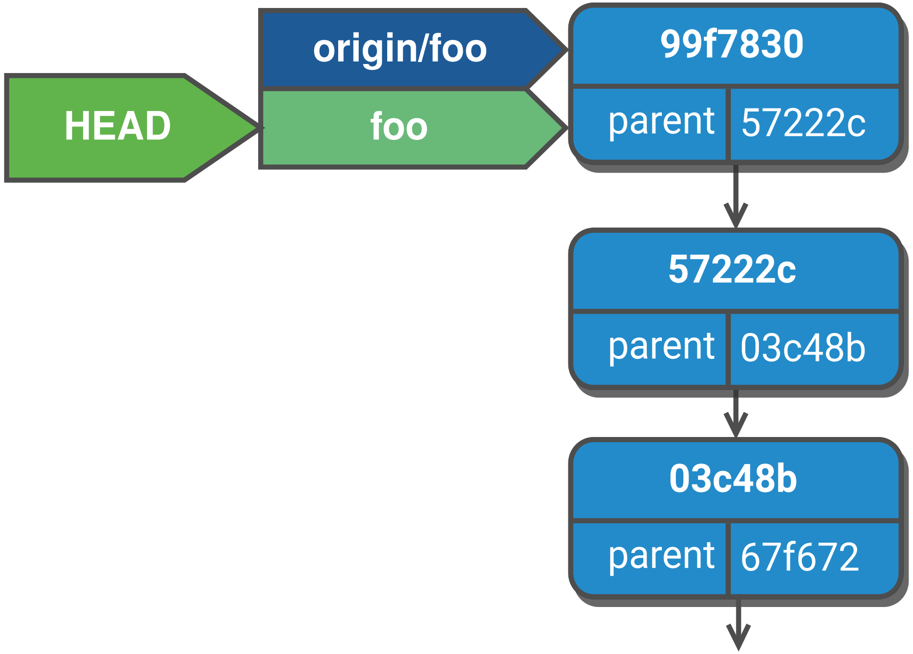
```
$ git branch -r
  origin/HEAD -> origin/master
  origin/develop
  origin/foo

$ git branch -a
* develop
  master
  remotes/origin/HEAD -> origin/master
  remotes/origin/develop
  remotes/origin/foo
```

Checkout remote branch

git checkout <branch>

If a remote branch with the given name exists, a local tracking branch will be created and activated.



Create a remote branch

git push origin <branch>

creates a new remote branch with the specified name and the content of HEAD

git push origin <ref>:<branch>

creates a new remote branch with the specified name and the content of the specified reference

When using the **-u** flag, the new branch will also be configured as a tracking branch

Delete remote branch

git push --delete origin <branch>

git push origin :<branch>

Deletes the remote branch. Note that if a local branch exists, this local branch will not be deleted.

… « But what about the force flag » ?

« With great power comes great responsibility »

~ Voltaire, uncle Ben, or whoever … ;-)

Once it's pushed, don't change it ! → *the golden rule* *but sometimes rules can be broken*

And always remember: There's a dark side to the force !

source : disneyinfinity.wikia.com/wiki/Darth_Vader

5

Workflow Strategies

Centralized Workflow

Everybody synchronizes with a single centralized branch.

– Compareable to a Centralized-VCS workflow

Detailed description:

https://www.atlassian.com/git/tutorials/comparing-workflows/centralized-workflow

Feature Branches

For every 'Story', a feature branch is created. This is where the work is done.
After the Story is completed, the feature branch can be merged into the master

- This can be merged directly
- This can also be merged using pull requests

Detailed description:

https://www.atlassian.com/git/tutorials/comparing-workflows/feature-branch-workflow

Gitflow

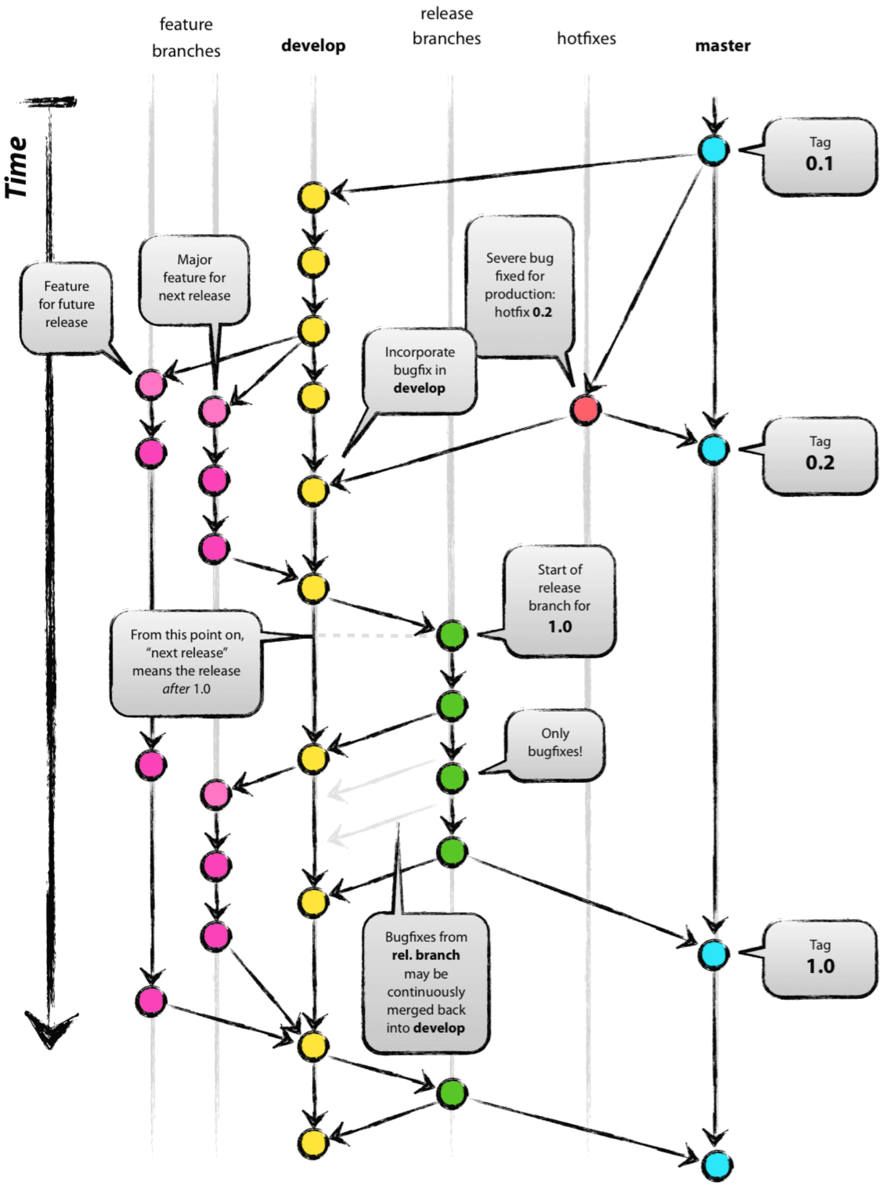
Refinement of Feature Branch workflow

1 dedicated branched for production state and development code

2 feature branches, release branches and hotfix branches

Detailed description:

http://nvie.com/posts/a-successful-git-branching-model/
https://www.atlassian.com/git/tutorials/comparing-workflows/gitflow-workflow


feature branches
develop
release branches
hotfixes
master
Time
Tag 0.1
Feature for future release
Major feature for next release
Severe bug fixed for production: hotfix 0.2
Incorporate bugfix in develop
Tag 0.2
Start of release branch for 1.0
From this point on, "next release" means the release after 1.0
Only bugfixes!
Tag 1.0
Bugfixes from rel. branch may be continuously merged back into develop

source : nvie.com/posts/a-successful-git-branching-model

Resources

References & Cheatsheet

Official Git documentation : https://git-scm.com/doc

Git Reference : http://gitref.org/

GitHub Git Cheatsheet :

https://services.github.com/kit/downloads/github-git-cheat-sheet.pdf

Visual Git Cheatsheet : http://ndpsoftware.com/git-cheatsheet.html

Learn Git Branching : http://learngitbranching.js.org/

Git SCM Wiki : https://git.wiki.kernel.org/

Video Resources

Official Git documentation : https://git-scm.com/videos

Knowledge is Power: Getting out of trouble by understanding Git

Steve Tarka : https://www.youtube.com/watch?v=sevc6668cQ0

Introductioni to Git with Scott Chacon of GitHub

https://www.youtube.com/watch?v=ZDR433b0HJY

Google Tech Talks :

Randal Schwartz on git (12.10.07) :https://www.youtube.com/watch?v=8dhZ9BXQgc4

Linus Torvalds on git (May 3, 2007)

https://www.youtube.com/watch?v=4XpnKHJAok8

Thank you!

CHANGING IT FOR THE BETTER

PUZZLE ITC