Introduction to Version Control with GIT

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Overview

What is version control?

- A system that keeps records of your changes
- Allows for collaborative development
- Able to see **who** made changes and **when**
- Can revert any changes back to a previous state

Snapshots

- The way git keeps track of your code history
- Essentially records what all your files look like at a given point in time
- You decide **when** to take a snapshot and of **what** files
- Have the ability to go back to visit any snapshot

Commits

- The act of creating a snapshot
- Essentially, a project is made up of a bunch of commits
- Commits contain three pieces of information:
  1. Information about how the files changed from previously
  2. A reference to the commit that come before it (called the parent commit)
  3. A hash code name (Will look like: edfec504eb864dc557f3f5b9d3d301617036d15f3a)

Commits as small as possible or as big as necessary

Repositories

- A collection of all the files and the history of those files
  - consists of all your commits
  - place where all your hard work is stored

install git

Setup

Linux (Ubuntu) `sudo apt-get install git`

Linux (Fedora) `sudo yum install git`

Mac `https://git-scm.com/download/mac`

Windows `https://gitforwindows.org/`

Get Help

```
git --help
man git
```

git config

configure GIT

```
$ git config --global user.name "Anja Gerbes"
$ git config --global user.email
                    "gerbes@csc.uni-frankfurt.de"
```

```
# ~/.gitconfig
[user]
   name  = Anja Gerbes
   email = gerbes@csc.uni-frankfurt.de
```

```
$ git config color.ui true
$ git config format.pretty oneline
```

create repositories

```
$ mkdir myrepo
$ cd myrepo
```

- directory will be become the working tree for the repository

```
$ git init

Initialized empty Git repository in ../myrepo/.git
```

- repository is created without a working tree and it is used as a remote repository that is sharing a repository among teammates

```
$ git init --bare
```

- permanently fixing permissions on a shared git repository

```
$ git init --bare --shared=group
```

For shared repositories pay attention to the file permissions.
It is recommended to prohibit changing the history.

create a file

```
$ echo "Hello World" > doc.md
```

git status

display changed or deleted files

```
$ git status
```

```
# On branch master
#
# Initial commit
#
# Changes to be committed:
#       (use "git rm --cached <file>..." to unstage)
#
#       new file:    doc.md
#
# Changes not staged for commit:
#       (use "git add <file>..." to update what will be
    committed)
#       (use "git checkout -- <file>..." to discard
    changes in working directory)
#
#       modified: doc.md
```

git add

add files to the staging area

```
$ git add doc.md
$ git add *.md
```

create as small as possible, logically separated commits

```
$ git add --patch or git add -p
$ git add --interactive or git add -i
```

stage all changes (incl. deleted files)

```
$ git add --all
```

git commit

put files from staging area into repository and make a snapshot

a commit should contain a single, self contained idea

```
$ git commit -m "My first commit"

[master 8345967] changed
1 files changed, 1 insertions(+), 1 deletions (-)
```

---

automatically stage files that have been modified

```
$ git commit -a -m "My first commit"

[master 8345967] changed
1 files changed, 1 insertions(+), 1 deletions (-)
```

edit last commit-message

```
$ git commit --amend
```

git clone

clone remote repository

```
$ git clone git@host:/path/to/repository/testing.git
    mydir
```

```
Cloning into 'mydir'
remote: Counting objects: 3, done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Receiving objects: 100% (3/3), done.
```

git push

push all commits to remote repository

```
$ git push origin master
```

```
Counting objects: 5, done.
Writing objects: 100% (3/3), 272 bytes, done.
Total 3 (delta 0), reused 0 (delta 0)
To git@host:/path/to/repository/testing.git
    edfec50..2fc284e  master --> master
```

```
$ git push [remote-name] [remote-branch-name]
```

git pull

pull all changes from repository

```
$ git pull
```

```
remote: Counting objects: 7, done.
remote: Compressing objects: 100% (4/4), done.
remote: Total 4 (delta 2), reused 0 (delta 0)
Updating 361303d..f2cd831
Fast forward
  doc.md |    1 +
  1 files changed, 1 insertions (+), 0 deletions (-)
```

git remote

manage set of tracked repositories

```
$ git remote add origin <server>
$ git remote add origin git@host:/path/to/repository/
    testing.git
$ git push origin master
```

```
Counting objects: 3, done.
Writing objects: 100% (3/3), 231 bytes, done.
Total 3 (delta 0), reused 0 (delta 0)
To git@host:/path/to/repository/testing.git
    [new branch]  master --> master
```

Branching

create branch `my-feature`

```
$ git branch my-feature
```

rename branch `my-oldfeature` to `my-newfeature`

```
$ git branch -m my-oldfeature my-newfeature
```

delete branch `my-feature`

```
$ git branch -d my-feature
```

create & switch to new branch

```
$ git checkout -b my-feature
```

```
$ git checkout master
```

```
Switched to branch 'my-feature'
```

```
$ echo "My Branch is different" > doc.md
$ git commit -a -m "changed content to my branch"
```

List Branches

list all local branches

```
$ git branch
```

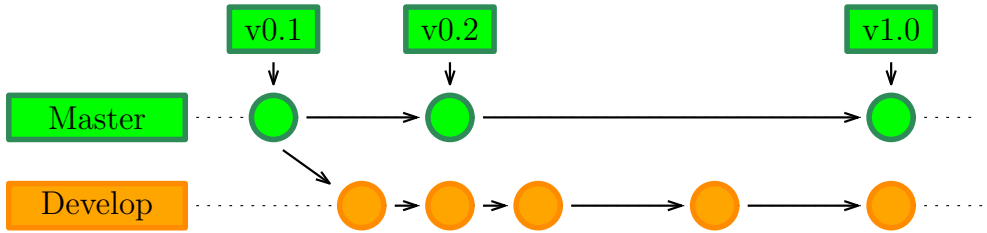
```
  master
* my-feature
```

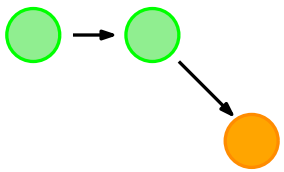
list all branches (local + remote)

```
$ git branch -a
```

```
  master
* my-feature
  remotes/origin/HEAD -> origin/master
  remotes/origin/master
```

Branch Workflow





Developer creates an empty develop branch locally & pushes in to server

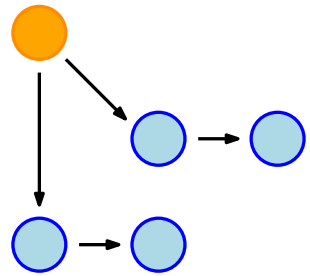
```
git branch develop
git push -u origin develop
```

Other developers should now clone central repository & create a tracking branch for develop branch:

```
git clonessh://user@host/path/to/repo.git
git checkout -b develop origin/develop
```

Now everyone has a local copy of historical branches set up.

Branch Workflow



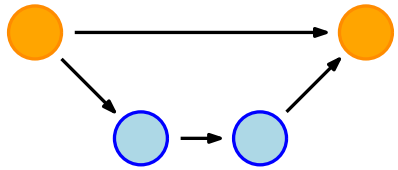
eg. 2 developers: Both require separate branches that are based on develop branch instead of master branch

```
git checkout -b some-feature develop
```

Both of them add commits to the feature branches according to the usual procedure: Edit, stage, commit.

```
git status
git add
git commit
```

Branch Workflow

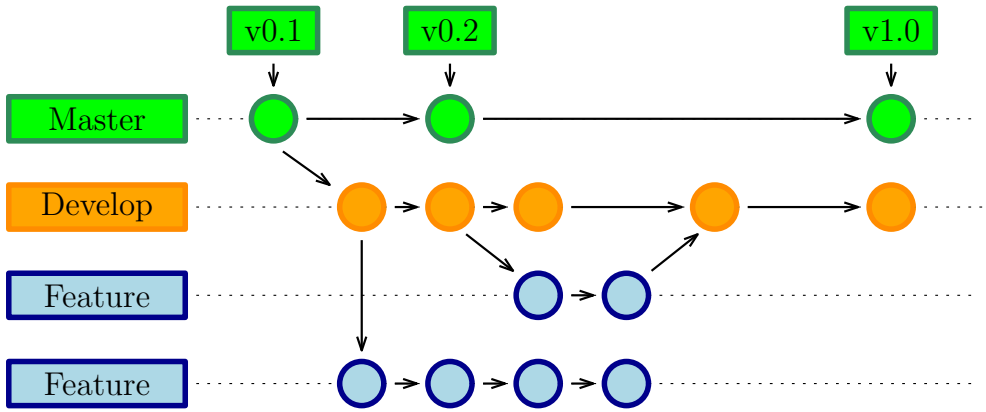


- after several commits, a developer feels that feature is ready
- he can merge it into his local develop branch & push it into central repository as follows:

```
git pull origin develop
git checkout develop
git merge some-feature
git push
git branch -d some-feature
```

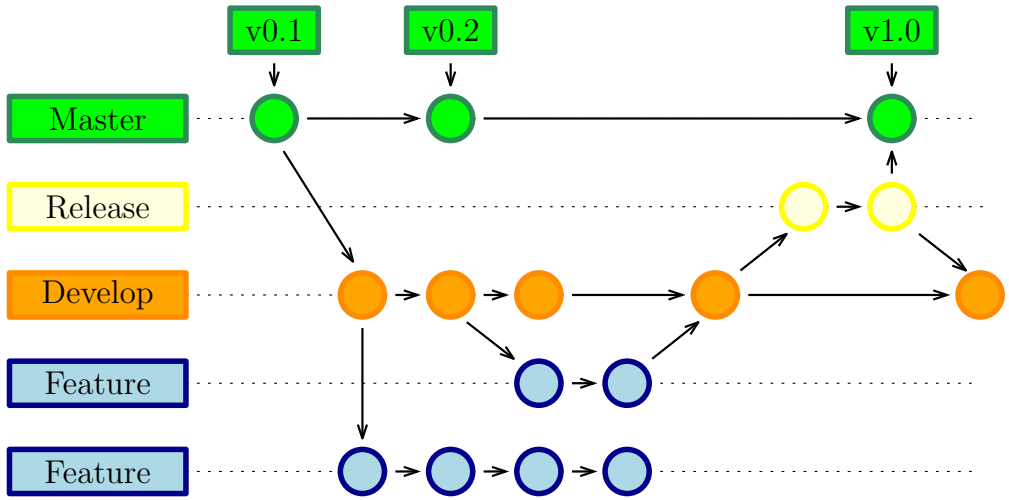
The first command ensures that the develop branch is up to date before attempting to merge the feature into it.

Feature Branch Workflow



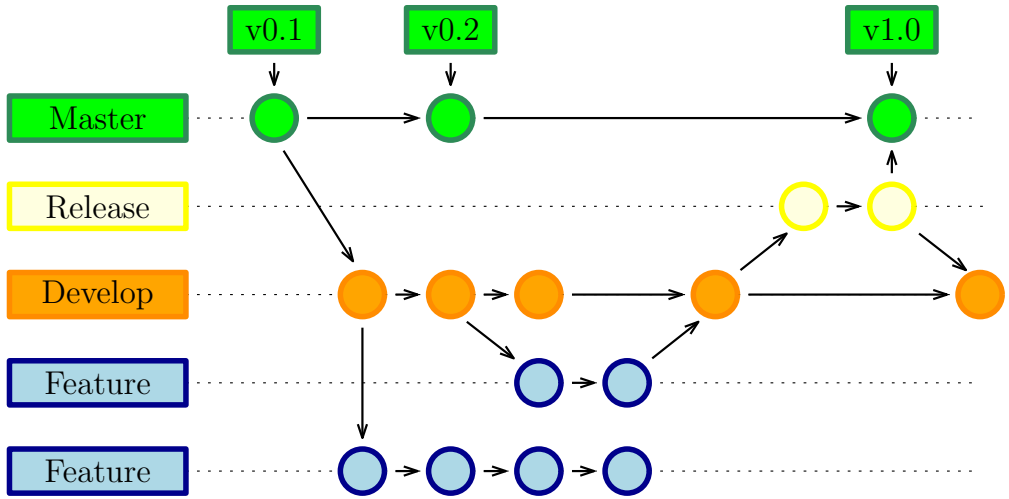
- each new feature should be developed in its own branch
- branch can be pushed into central repository for backup and collaboration purposes
- develop branch is used as a source and branches are created here not on the master branch
- once new features are completed they are merged back into the develop branch
- new features never interact directly with master branch

Release Branch Workflow



- If develop branch contains enough features for a release, develop branch suspends a release branch
- this starts next release cycle; new features should not be added, only bugfixes & similar release-oriented changes
- release is ready for delivery, it is merged into master branch & tagged with a version number

Release Branch Workflow



- using a dedicated release preparation branch allows one team to fine-tune current release while other team continues to work on features for next release
- certain stages of development can be defined very well; e.g "Prepare this week like version 4.0" & see it in the structure of the repository

Branch → Remote

store branch in remote

```
$ git push origin <branch>
$ git push origin my-feature
```

```
Counting objects: 6, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (6/6), 482 bytes, done.
Total 6 (delta 0), reused 0 (delta 0)
To git@host:/path/to/repository/testing.git
  * [new branch]     my-feature -> my-feature
```

Update & Merge a Branch

```
$ git pull
$ git merge <branch>
$ git add <dateiname>
$ git diff <branch> <branch>
```

Merging Branches

```
# the working tree is in the same state as git HEAD
$ git checkout master
```

```
Switched to branch 'master'
```

```
$ git merge my-feature
```

```
Updating edfec50..2bc1785
Fast-forward
  doc.md |  2+-
  1 files changed, 1 insertions (+), 0 deletions (-)
```

changes can be enacted at the remote server by typing

```
git push origin master
```

Dealing with Merge Conflicts

- Handling a `git pull` request with merge conflict
- When working with git, the relatively complex tasks are issuing a pull request & then merging with conflicts

Step 1 Verify your local repository

```
git checkout pinc
```

```
git pull origin pinc
```

Ensure that the files on local repository are in-sync with your remote git repository

Step 2 Switch to branch

```
git checkout feature-1
```

```
git pull origin feature-1
```

Switch to the branch that you want to merge
Ensure that you pull the latest files from your remote server

Step 3 Try to merge

```
git merge pinc
```

Step 4 Resolve the merge conflict If you get the message, that there is a merge conflict & it cannot automatically merge the change, you can resolve the conflict manually. Open the file & you'll need to fix this.

Step 5 Check in changes
Commit the fixes to the branch

```
git add file.py
```

```
git commit -m "some comment"
```

```
git push origin feature-1
```

Step 6 Merge the branch

Restore

restore deleted files

```
$ git checkout -- <filename>
$ git checkout -- doc.md

$ git fetch origin
$ git reset --hard origin/master
```

git stash

`git stash | git stash save` will actually create a git commit object with some name and then save it in your repository

Syntax:

```
$ git stash <command>
```

`save "Your message"`	stashes with a message
`save -u | save --include-untracked`	stashes untracked files
`list`	view list of stashes you made at any time
`apply [stash@{stash\_id}]`	apply specific stash
`pop [stash@{stash\_id}]`	deletes stash from stack after it is applied
`show`	shows summary of stash diffs
`show -p`	shows full diffs
`show stash@{stash\_id}`	use stash_id to get diff summary
`branch <name>`	creates new branch then deletes latest stash
`branch <name> stash@{stash\_id}`	useful, conflicts after you've applied stash to latest version of your branch
`clear`	deletes all stashes made in repository impossible to revert
`drop stash@{stash\_id}`	deletes latest stashes from stack use it with caution, difficult to revert

git log

display repository log

```
$ git log
```

```
commit edfec504eb864dc557f3f5b9d3d301617036d15f3a
Author: Anja Gerbes <gerbes@csc.uni-frankfurt.de>
Date:   Thu Oct 18 14:00:20 2018 +0200

    My First Commit
```

search in history

```
$ git log --pretty=short --since=2weeks
$ git log --pretty=short --author="Anja Gerbes"
          --grep="comment"
```

Regular expression for git repository

```
git@github.com:someone/someproject.git
```

```
[user]@[server]:[project].git
```

Git accepts a large range of repository URL expressions:

```
ssh://user@host.xz:port/path/to/repo.git/
file:///path/to/repo.git/
```

```
(1)  '(\w+://)(.+@)*([\w\d\.]+)(:[\d]+){0,1}/*(.*)'
(2)  'file://(.*)'
(3)  '(.+@)*([\w\d\.]+):(.*)'
(4)  '((git|ssh|http(s)?)|(git@[\w\.]+))(://)?)
      ([\w\.@\:/\-~]+)(\.git)(/)?'
```

look at https://www.debuggex.com

gitignore

ignore specific informations

```
$ cat .gitignore
```

e.g. LaTeX-generated files:

```
*.aux
*.log
*.nav
*.out
*.pdf
*.snm
*.toc
*.vrb
```

global .gitignore

```
$ git config --global core.excludesfile ~/.gitignore
```

git worktree

- A worktree gives you an extra working copy of your repository for parallel development

```
git worktree add ../new-worktree-dir some-existing
    -branch
```

- `../new-worktree-dir` is a clone of your repository
- it should be somewhere outside of your main repository!
- You can then proceed to use the worktree directory as usual, checking out branches, pushing upstream, etc.
- You are finished with a worktree, just delete its directory then run `git worktree prune` from main repository directory