Git – distributed version-control system

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Series of Corona seminars

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Motivation

1. I need order in my source files.
2. I need to collaborate with my colleagues.
3. I need to back up my files.
4. I need to fix a broken code which was working a long time ago.

What is Git?

- Initial release 7 April 2005.
- Current version 2.26.0 (22 March 2020).
- Initially developed by Linus Torvalds.
- Developed for Linux kernel versioning[1].
- Originally only low level commands.
- Since version 1.6 reference implementation.

FigureLinus Torvalds

[1] https://github.com/torvalds/linux

Distributed vs centralized version control

Distributed:

- Each repository contains complete history.

Centralized:

- One ground truth.

Distributed vs centralized version control

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- Each repository contains complete history.
- Allows private work (fast operations).

Centralized:

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- Needs internet connection.

Distributed vs centralized version control

Distributed:

- Each repository contains complete history.
- Allows private work (fast operations).
- Git, Mercurial, BitKeeper

Centralized:

- One ground truth.
- Needs internet connection.
- Apache Subversion (SVN), Autodesk Vault

Where to get Git

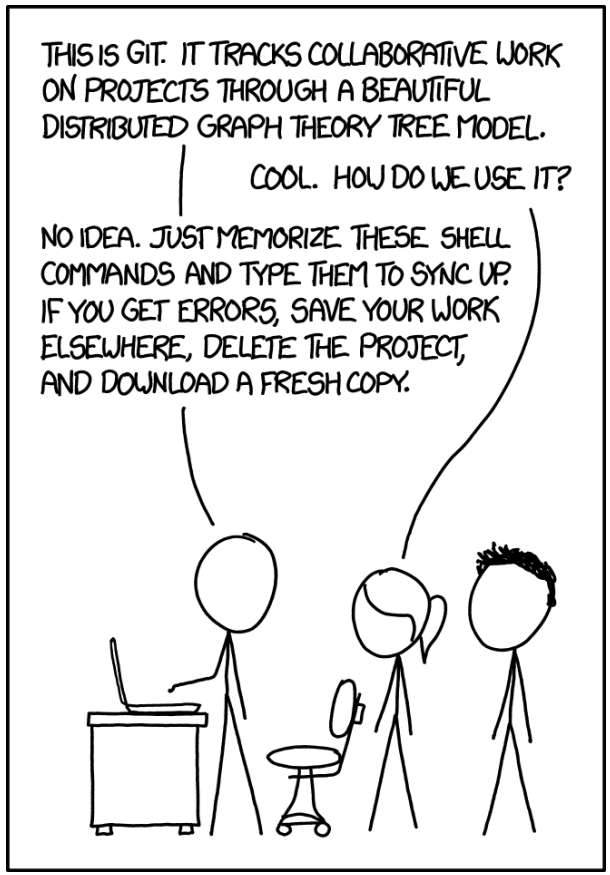
- Windows: download from `https://git-scm.com/downloads`
- macOS: `brew`
- Linux: `apt-get`, `zypper`, etc.

Local repository

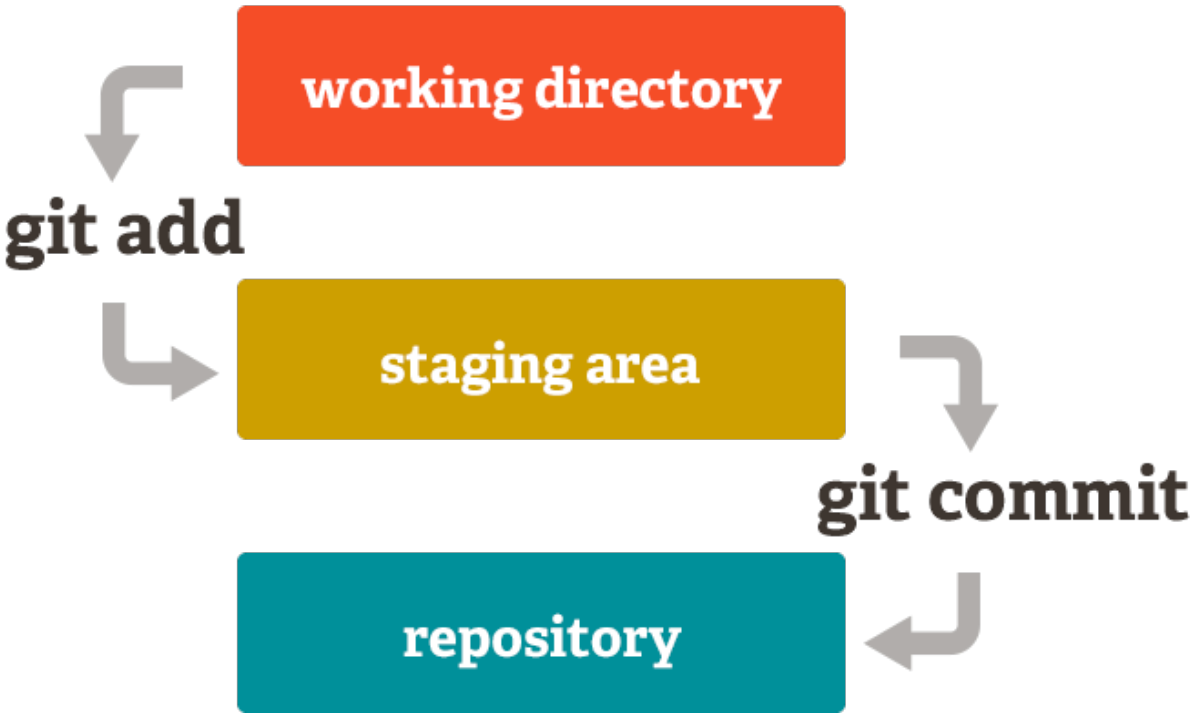
- Contains git metadata in .git folder.
- New tracked files can be added via `git commit`.

Initialize empty repository

```
git init
```



Working areas



History and changes

Status of all working areas

```
git status
```

Changes in working area

```
git diff
```

Changes in stage area

```
git diff --cached
```

History of commits

```
git log [REV]
```

Commit

- Good commit is one logical part of your work.
- Commit message should be in English. It's an imperative sentence which ends with a dot.
- No tests should be broken.

Add changes to stage area

```
git add PATH
```

Create revision

```
git commit
```

Create revision with a message

```
git commit -m "commit message"
```

Revision specification (REV)

Absolute:

- Hash
- Branch name
- Tag name
- HEAD (symbolic reference)

Relative:

- REV^ parent of revision
- REV^^ parent of parent of revision
- REV~NUM - NUM commits before REV

Branches

- Branch is a pointer to a commit.
- One branch always exists (implicitly `master`)

Create a branch

```
git branch NAME [REV]
```

List of existing branches

```
git branch [-v]
```

Change a branch

```
git checkout NAME
```

Create and checkout a branch

```
git checkout -b NAME [REV]
```

Merge

Merge another branch to the current branch

```
git merge NAME
```

Three possible outcomes:

- Fast-forward

Merge

Merge another branch to the current branch

```
git merge NAME
```

Three possible outcomes:

- Fast-forward
- Merge without conflicts

Merge

Merge another branch to the current branch

```
git merge NAME
```

Three possible outcomes:

- Fast-forward
- Merge without conflicts
- Merge with conflicts

Reset

Reset changes

```
git reset [ --hard | --mixed | --soft ] REV
```

1. Rewinds HEAD reference
2. Updates content

- soft - discards commits, changes remain in stage area
- mixed - discards commits, changes are moved to working area (default)
- hard - discards commits and changes (including uncommitted changes)

Rebase

Initial history

```
      A---B---C topic
     /
D---E---F---G master
```

Rebase command

```
git rebase master
```

or

```
git rebase master topic
```

Altered history

```
              A---B---C topic
             /
D---E---F---G master
```

Rebase

Initial history

```
                      H---I---J topicB
                      /
              E---F---G topicA
              /
A---B---C---D master
```

Rebase command

```
git rebase --onto master topicA topicB
```

Altered history

```
              H'--I'--J' topicB
              /
              | E---F---G topicA
              |/
A---B---C---D master
```

Cherry-pick

Useful for moving changes from one branch to another.

Cherry-pick command

```
git cherry-pick [--edit] REV
```

`--edit` lets you modify commit message

Stash

It is a special branch for stashing changes from working directory away. Works as a stack.

Stash changes

```
git stash
```

Stash changes only from working area

```
git stash --keep-index
```

Apply changes from the last stash

```
git stash apply
```

Apply changes from the last stash and discard the stash

```
git stash pop
```

Solving conflicts

Conflicts can happen during any operation which moves changes (`merge`, `rebase`, `cherry-pick`, `stash`, ...).

Solve situation with a conflict

Select correct variant of the code

```
git add
git OPERATION --continue
```

Abort operation with a conflict

```
git OPERATION --abort
```

Tags

Simple tag

```
git tag NAME [REV]
```

Anotated tags

```
git tag -a NAME [REV]
```

Local tags must be pushed to remote repository with option `--tags`

.gitconfig

Configuration can be specified in a global (`--global`) or a local (`--local`) configuration file.

Setup user

```
git config --global user.name "John Doe"
git config --global user.email
johndoe@example.com
```

Setup default text editor

```
git config --global core.editor vim
```

Create aliases for commands

```
git config --global alias.st status
```

.gitignore

- defines files which are intentionally untracked
- each line defines a pattern
- global vs local (local versioned with the repository)
- * any
- ! negation
- # comment
- \ escape symbol

Remote repositories

Hosted repositories:

- providers like: `github.com`, `gitlab.com`, etc.
- self-hosted: `http://atom2.feld.cvut.cz:3000`

Repository can be connected either via http/https or interactively via SSH. You can have multiple remotes to one repository. Default remote is called *origin*.

Clone repository from a remote server

```
git clone URL [DIRECTORY]
```

List all remotes

```
git remote -v
```

Push/Pull

Push changes to a server

```
git push
```

Push changes to a server and set upstream branch

```
git push -u REMOTE BRANCH[:REMOTE_BRANCH]
```

Pull changes from a remote

```
git pull [REMOTE [REMOTE_BRANCH[:BRANCH]]]
```

`git pull` does `git fetch` and `git merge` of a remote branch to the local one.

Force push to remote (changes history)

```
git push --force
```

Useful commands

Pretty print of history

```
git log --oneline --graph --decorate --all
```

Find a breaking commit

```
git bisect start
git bisect bad
git bisect good REV
```

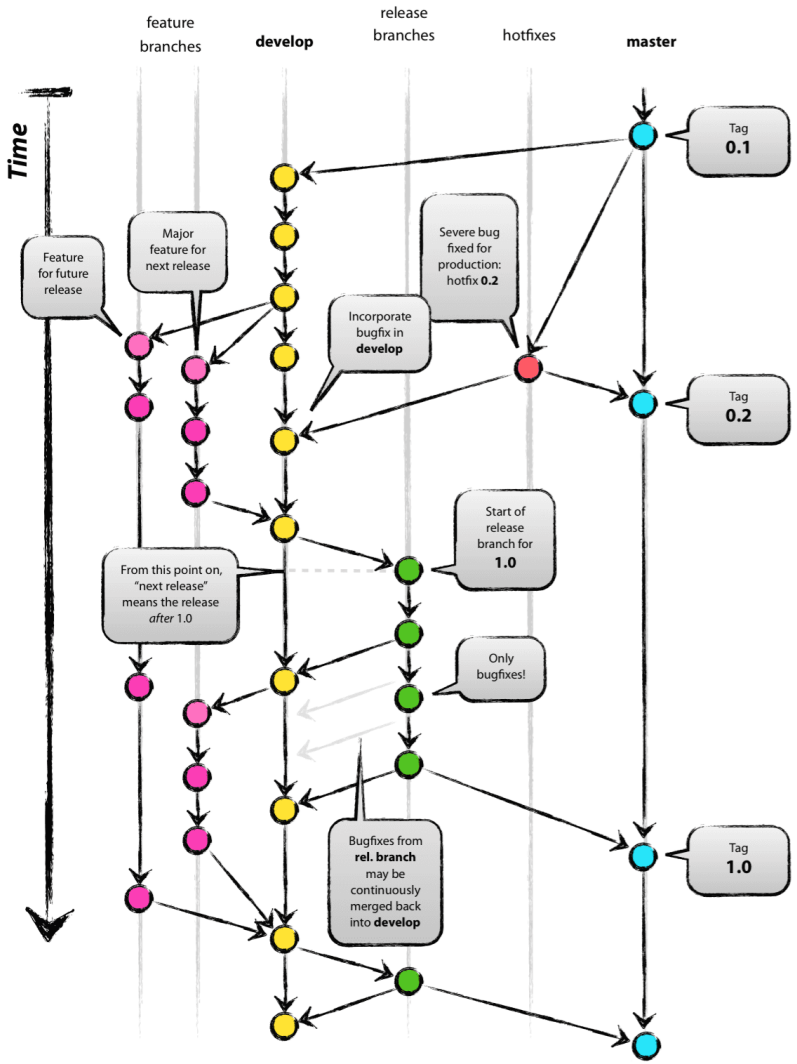
Add patch interactively

```
git add -p [PATH]
```

Interactive rebase

```
git rebase -i REV
```

Workflows


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!
Bugfixes from rel. branch may be continuously merged back into develop
Tag 1.0

Questions?

?

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