# Version Control with git

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## Outline

- Introduction to git
  - What is git
  - Features of git
- Tutorial
  - Standalone developer
  - Participating developer
  - git-svn

## Part I:
## Introduction to Git

# What is Git?

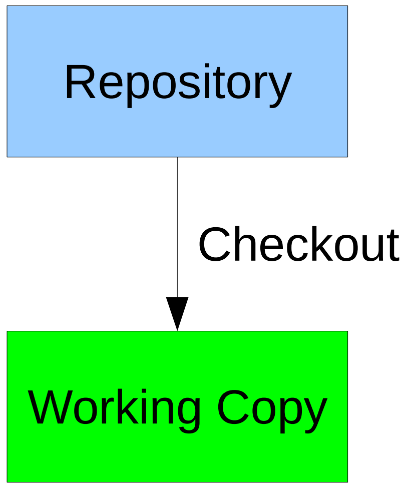
- A free, *distributed* revision control system
- Initially created by Linus Torvalds in 2005
- Runs on all major platforms
- *(British, slang):* A silly, incompetent, stupid, annoying or childish person.

I'm an egotistical bastard, and I name all my projects after myself. First Linux, now git.

## Distributed vs Centralized

### Centralized

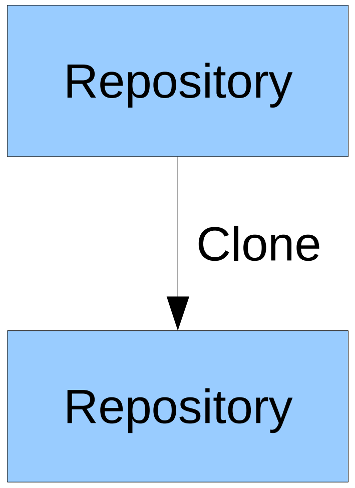
- You *checkout* a *working copy* (the tip of the source)



### Distributed

- You *clone* the repository

  (a full backup)

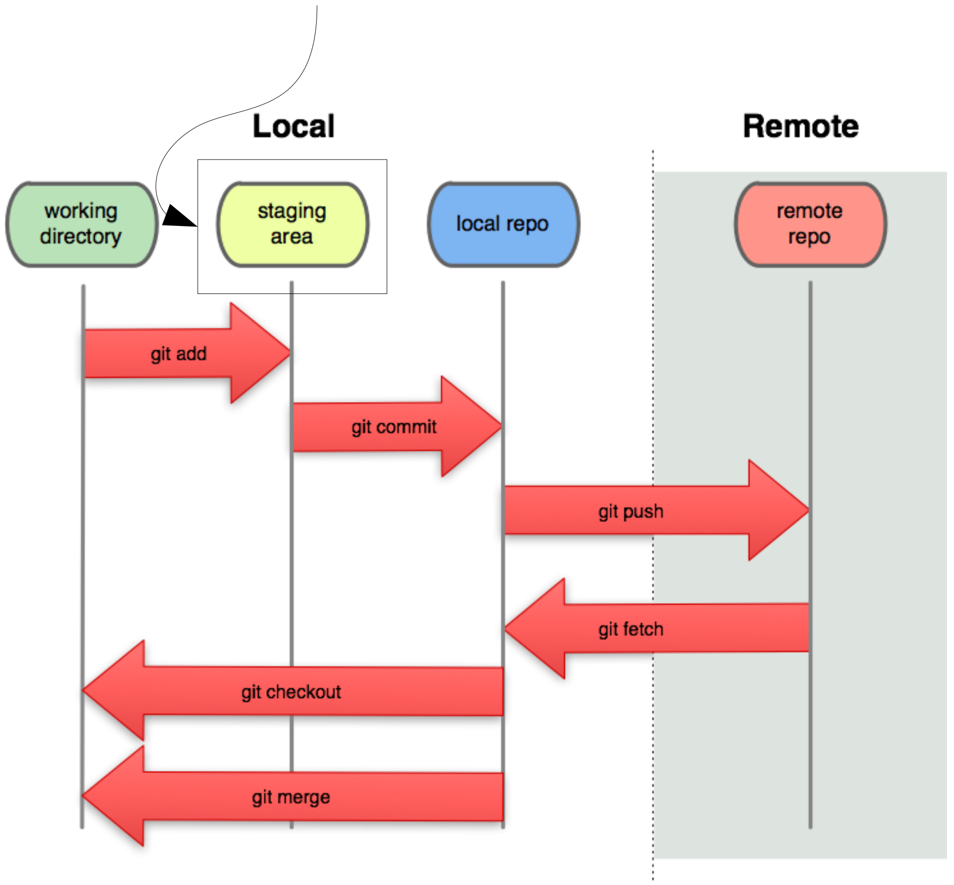


# Implication (I): Everything is local

Very little outside “push”, “pull” and “fetch” communicates with anything else than your hard disk

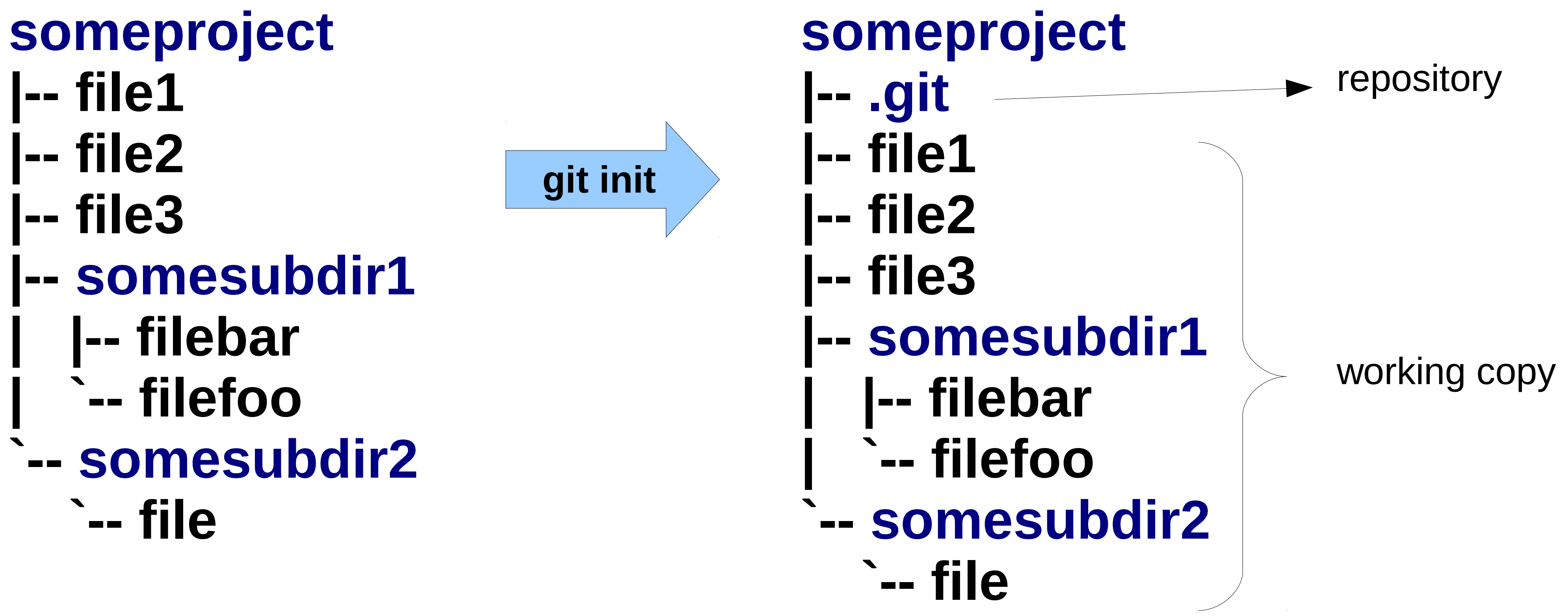
- Most operations are much faster
- Allows you to work offline

(Just ignore that for a moment.)



## Implication (II): Instant revision control

Putting your paper/thesis/talk/etc. under revision control is just a **git init** away!



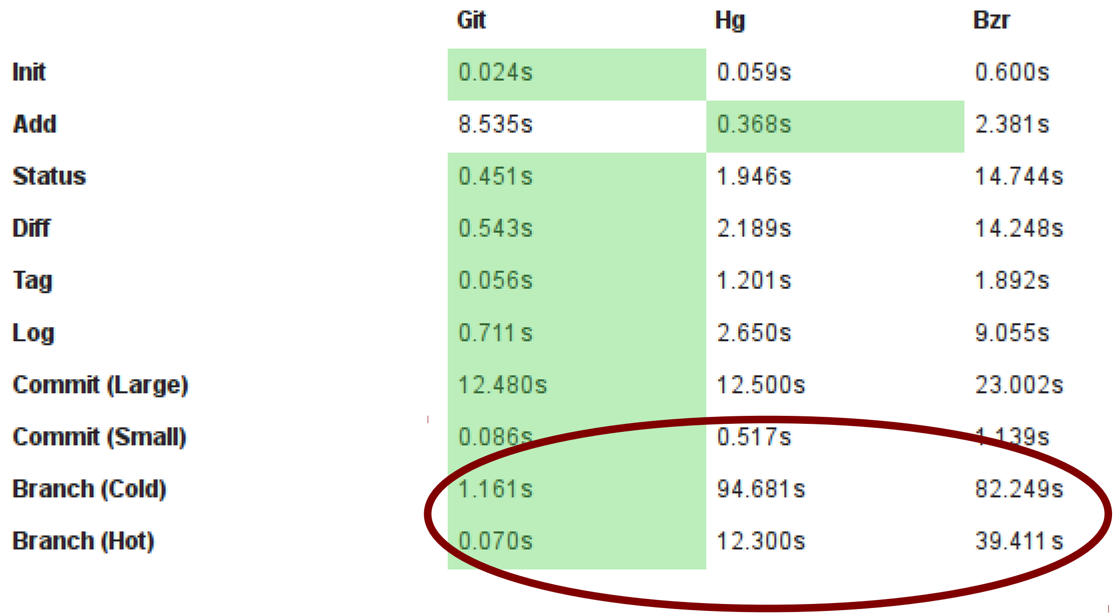
```
someproject
|-- file1
|-- file2
|-- file3
|-- somesubdir1
|   |-- filebar
|   `-- filefoo
`-- somesubdir2
    `-- file
```

```
someproject
|-- .git
|-- file1
|-- file2
|-- file3
|-- somesubdir1
|   |-- filebar
|   `-- filefoo
`-- somesubdir2
    `-- file
```

## Git's Features

- Fast
- Small
- The staging area
- Cheap local branching
- Any workflow

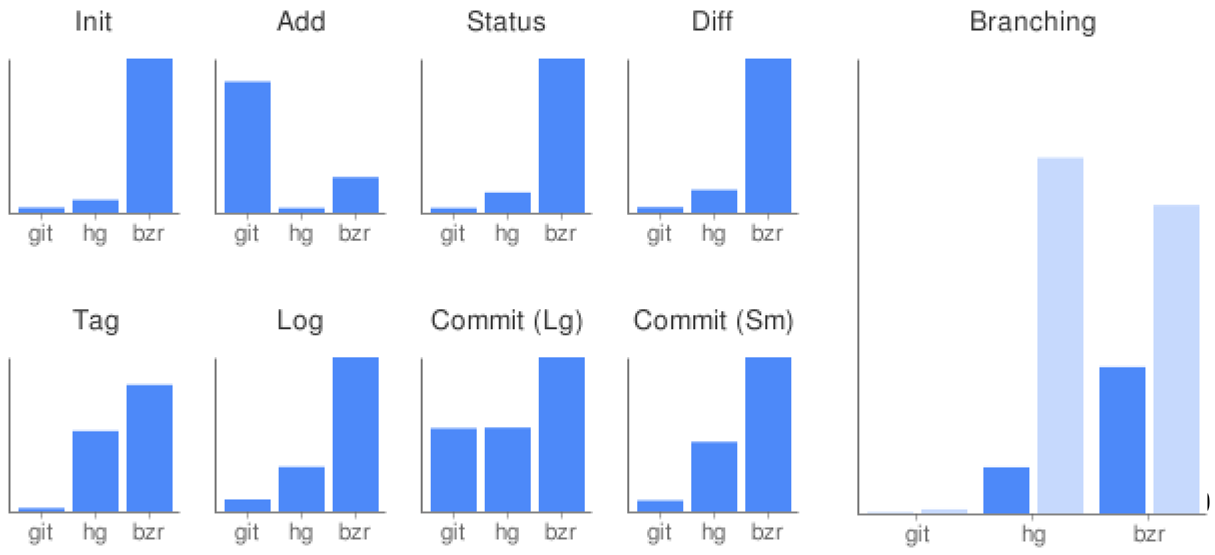
# Git is fast



| | Git | Hg | Bzr |
|---|---|---|---|
| Init | 0.024s | 0.059s | 0.600s |
| Add | 8.535s | 0.368s | 2.381s |
| Status | 0.451s | 1.946s | 14.744s |
| Diff | 0.543s | 2.189s | 14.248s |
| Tag | 0.056s | 1.201s | 1.892s |
| Log | 0.711s | 2.650s | 9.055s |
| Commit (Large) | 12.480s | 12.500s | 23.002s |
| Commit (Small) | 0.086s | 0.517s | 1.139s |
| Branch (Cold) | 1.161s | 94.681s | 82.249s |
| Branch (Hot) | 0.070s | 12.300s | 39.411s |

“Add” with over 2000 files!

First and second time
a repository was branched.

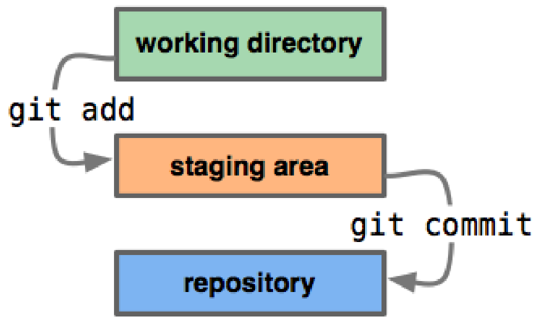


## Git is small

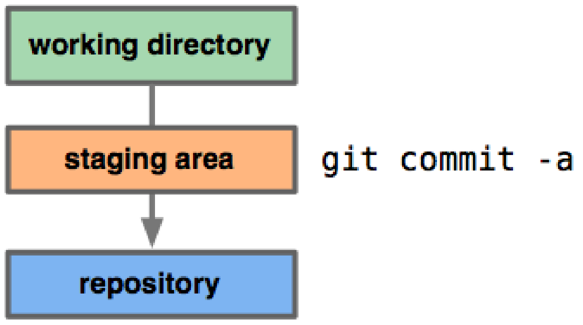
- Git stores it's data very efficiently
- The .git directory of the current Linux kernel (containing 4 years of the 2.6 line) is only half of the size than a checkout

# The staging area

- Intermediate area to store changes before committing them



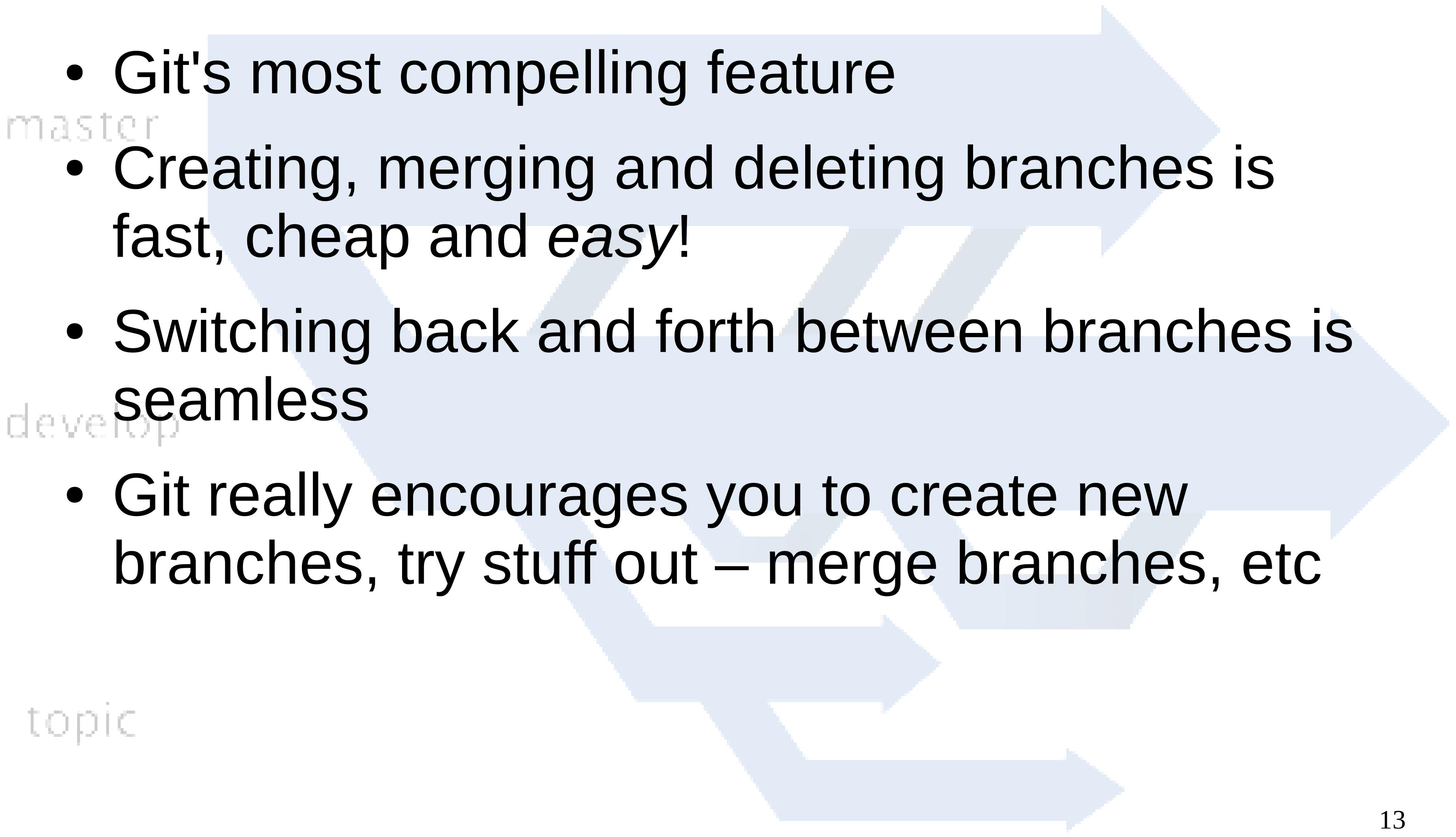
- Why is this cool?
  - Make two logically unrelated changes
  - Stage the first file and commit it
  - Stage the second file and commit it
  - Works even on a patch basis within one file!
- But you don't have to use it:



## Question

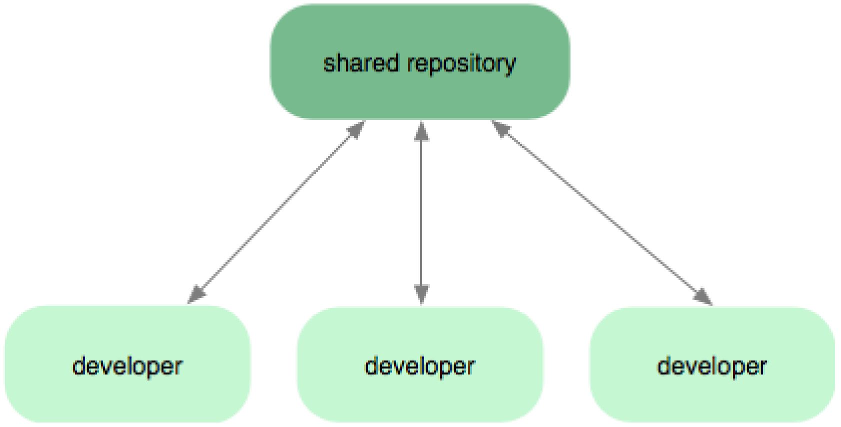
Does everyone know what a branch is?

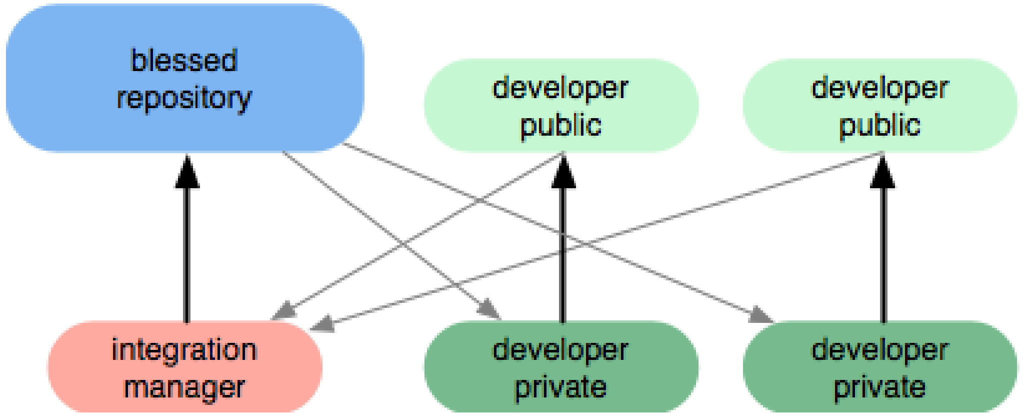
# Cheap local branching

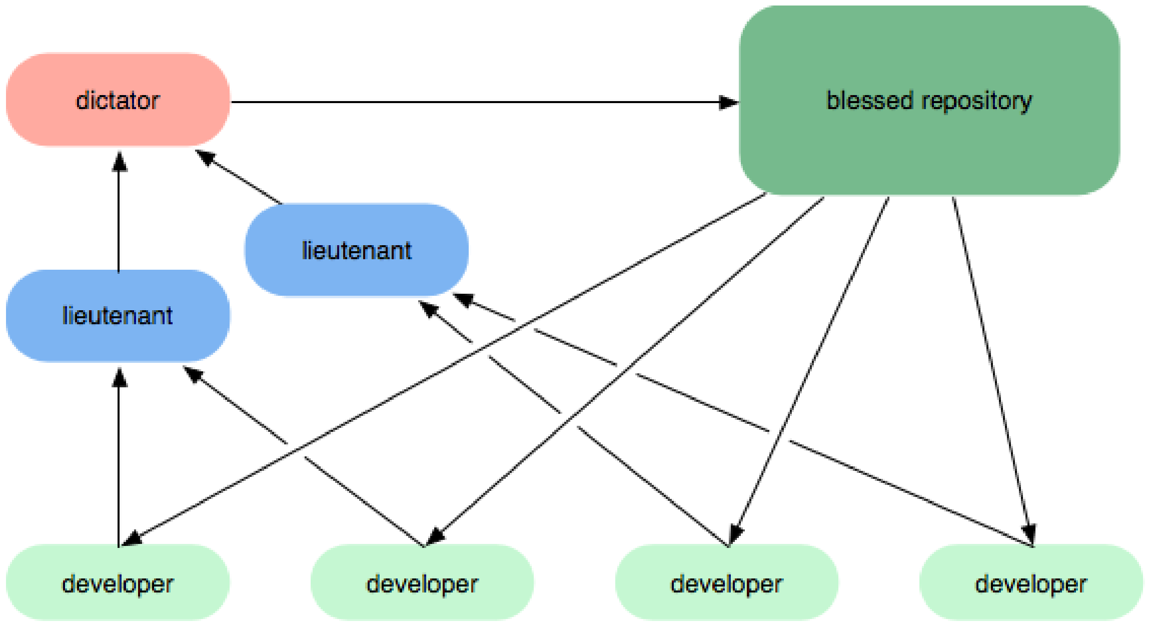


- Git's most compelling feature
- Creating, merging and deleting branches is fast, cheap and *easy*!
- Switching back and forth between branches is seamless
- Git really encourages you to create new branches, try stuff out – merge branches, etc

# Any workflow







## Who is using Git?

- Linux kernel
- X.org Server
- Qt
- GNOME
- Samba
- Perl
- VLC
- Wine
- Ruby on Rails
- rsync
- Android mobile platform
- ...

Questions so far?

# Part II: Tutorial

## Standalone developer

- **git init** to create a new repository
- **git add** to add files to the index file.
- **git commit** to advance the current branch.
- **git diff** and **git status** to see what you are in the middle of doing.
- **git checkou**t and **git branch** to switch branches.
- **git merge** to merge between local branches.
- **git log** to see what happened.
- **git show-branch** to see where you are.
- **git reset** and **git checkout** (with pathname parameters) to undo changes.
- **git tag** to mark known point.

# Creating a new repository

```
$ git init
```

Creates an empty git repository

```
$ git add .
```

A snapshot of the current directory is now stored in a temporary staging area called the index.

```
$ git commit
```

Stores the first version of the project in the repository

## Making changes

**$ (edit file1, file2, file3)**

**$ git diff**

See what changed between your working copy and the index

**$ git add file1 file2 file3**

Add the updated contents to the index

**$ git status**

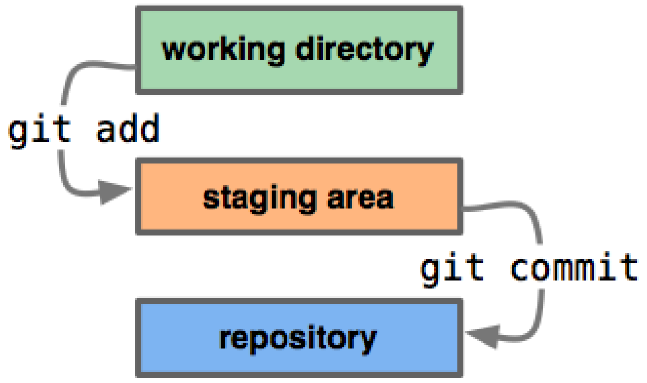
Get a brief overview of the situtation

**$ git commit**

Commit the changes to the repository

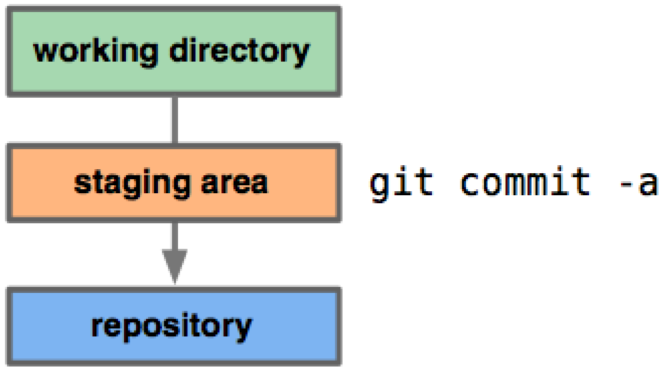
## Making changes (II)

```
$ (edit file1, file2, file3)
$ git add file1 file2 file3
$ git commit
```



Is equivalent to:

```
$ (edit file1, file2, file3)
$ git commit -a
```



# Making changes (III)

You can even:

A nifty, new feature

```
$ (edit file1, file2, file3)
```

A bugfix

```
$ git add file1
$ git commit -m “nifty new feature”
$ git add file2 file3
$ git commit -m “bugfix”
```

And even:

```
$ git add --interactive
```

# Managing branches

**$ git branch experimental**

Creates a new branch called “experimental”

**$ git branch**

```
  experimental
* master
```

Shows where we are

**$ git checkout experimental**

Switches to branch “experimental”

**$ git branch**

```
* experimental
  master
```

# Managing branches (II)

**See the difference between two branches:**

```
$ (edit files in experimental)
$ git commit -a
$ git diff master
```

**Merging two branches:**

```
$ git checkout master
$ git merge experimental
```

Without conflicts you're done here, else:

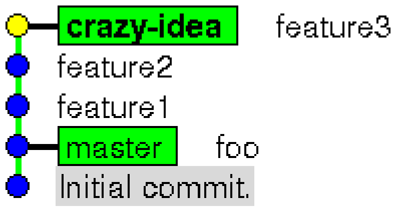
```
$ (resolve conflicts) # more on that in a sec...
$ git commit -a
```

**Removing a branch:**

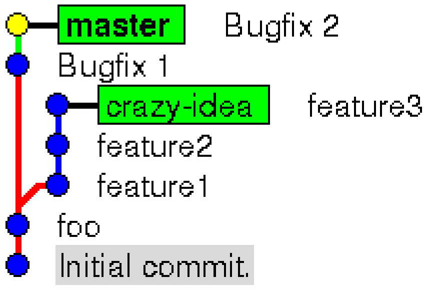
```
$ git branch -d experimental
```

# Managing branches (III)

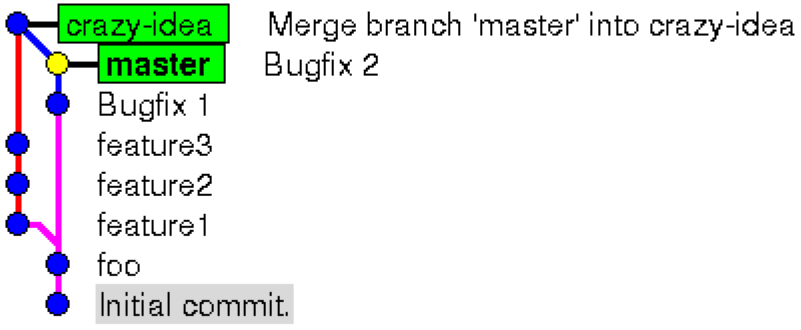
```
$ git branch crazy-idea
$ git checkout crazy-idea
$ (edit files in crazy-idea)
$ git commit -a
```



```
$ git checkout master
$ (fix a bug in master)
$ git checkout crazy-idea
$ git merge master
```



```
$ git checkout master
$ git merge crazy-idea
$ git branch -D crazy-idea
```



# Resolving Conflicts

**This is how a conflict looks like:**

```
Here are lines that are either unchanged from the common
ancestor, or cleanly resolved because only one side changed.
<<<<<<< yours:sample.txt
Conflict resolution is hard;
let's go shopping.
=======
Git makes conflict resolution easy.
>>>>>>> theirs:sample.txt
And here is another line that is cleanly resolved or unmodified
```

**Resolve the conflict and do:**

```
$ git add sample.txt
$ git commit sample.txt
```

# Reverting changes

**$ git checkout <file>**

Reverts one file back to its original state

What if I have a file called like a branch?

**$ git checkout -- <file>**

**$ git checkout -f**

Throws out *all* changes since the last commit.

Also, be aware that **‘git revert’ is not equivalent to ‘svn revert’**!
git-revert is used to reverse commits.

# Exploring project history

**$ git log**

```
commit ec06de4c3849c7b3d91b60ff09e10f1108c23cea
Author: user-a <venthur@debian.org>
Date:   Thu May 14 11:58:00 2009 +0200

    added file z

commit 301ee9f80df142e67b4de77225e3ed1af4b2036b
Merge: fef7261 54b87da
Author: user-b <venthur@debian.org>
Date:   Mon May 11 17:32:49 2009 +0200

    Merge branch 'devel'
```

**$ git log -p**

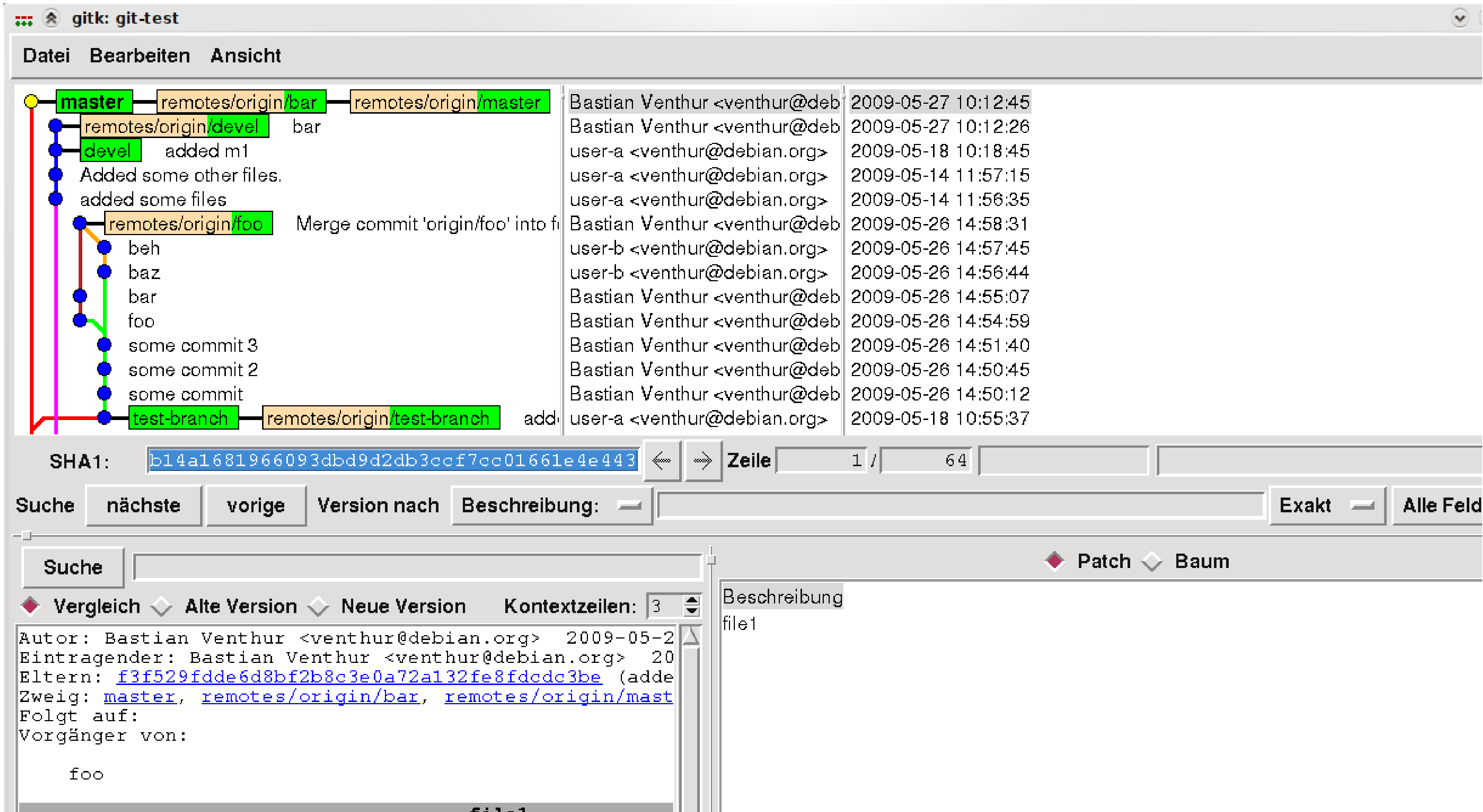
Like above but with with patches.

# Exploring project history (II)

```
$ git show-branch
* [master] Add ´git show-branch´.
 ! [fixes] Introduce "reset type" flag to "git reset"
  ! [mhf] Allow "+remote:local" refspec to cause --force when fetching.
---
  + [mhf] Allow "+remote:local" refspec to cause --force when fetching.
  + [mhf~1] Use git-octopus when pulling more than one heads.
 +  [fixes] Introduce "reset type" flag to "git reset"
  + [mhf~2] "git fetch --force".
  + [mhf~3] Use .git/remote/origin, not .git/branches/origin.
  + [mhf~4] Make "git pull" and "git fetch" default to origin
  + [mhf~5] Infamous ´octopus merge´
  + [mhf~6] Retire git-parse-remote.
  + [mhf~7] Multi-head fetch.
  + [mhf~8] Start adding the $GIT_DIR/remotes/ support.
*++ [master] Add ´git show-branch´.
```

# Exploring project history (III)

**$ gitk** or **$ gitk --all**



```
master  remotes/origin/bar  remotes/origin/master      Bastian Venthur <venthur@deb  2009-05-27 10:12:45
remotes/origin/devel  bar                              Bastian Venthur <venthur@deb  2009-05-27 10:12:26
devel  added m1                                        user-a <venthur@debian.org>   2009-05-18 10:18:45
Added some other files.                                user-a <venthur@debian.org>   2009-05-14 11:57:15
added some files                                       user-a <venthur@debian.org>   2009-05-14 11:56:35
remotes/origin/foo  Merge commit 'origin/foo' into f   Bastian Venthur <venthur@deb  2009-05-26 14:58:31
beh                                                    user-b <venthur@debian.org>   2009-05-26 14:57:45
baz                                                    user-b <venthur@debian.org>   2009-05-26 14:56:44
bar                                                    Bastian Venthur <venthur@deb  2009-05-26 14:55:07
foo                                                    Bastian Venthur <venthur@deb  2009-05-26 14:54:59
some commit 3                                          Bastian Venthur <venthur@deb  2009-05-26 14:51:40
some commit 2                                          Bastian Venthur <venthur@deb  2009-05-26 14:50:45
some commit                                            Bastian Venthur <venthur@deb  2009-05-26 14:50:12
test-branch  remotes/origin/test-branch  add           user-a <venthur@debian.org>   2009-05-18 10:55:37
```

```
SHA1: b14a1681966093dbd9d2db3ccf7cc01661e4e443   Zeile 1 / 64
Kontextzeilen: 3
```

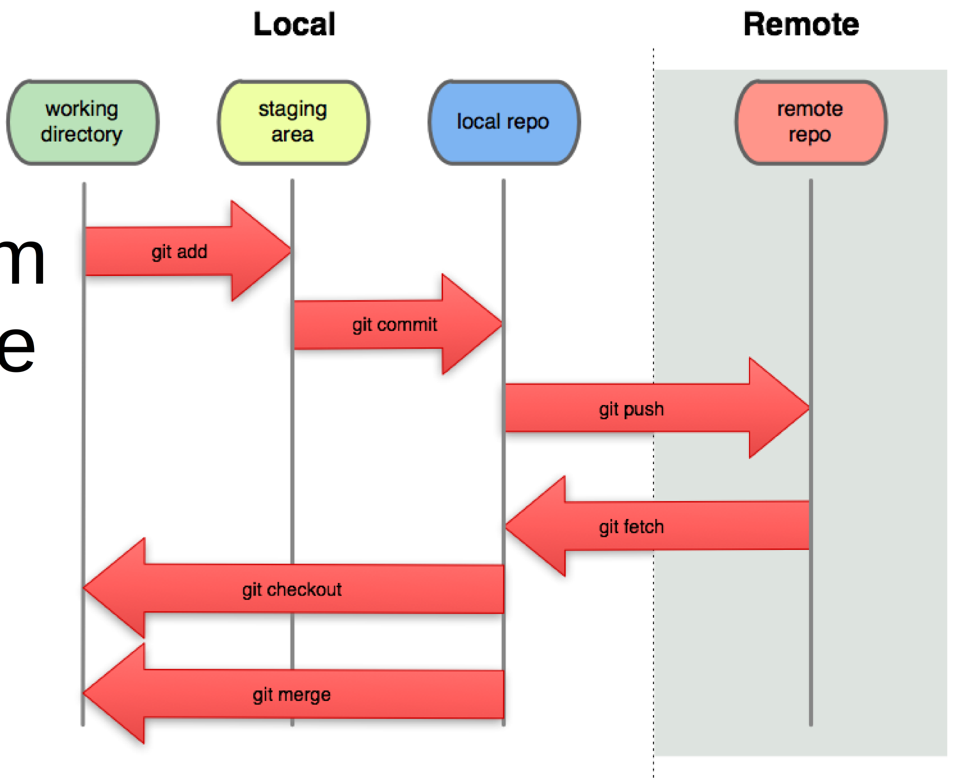
```
Autor: Bastian Venthur <venthur@debian.org>  2009-05-2
Eintragender: Bastian Venthur <venthur@debian.org>  20
Eltern: f3f529fdde6d8bf2b8c3e0a72a132fe8fdcdc3be  (adde
Zweig: master, remotes/origin/bar, remotes/origin/mast
Folgt auf:
Vorgänger von:

    foo
```

```
Beschreibung
file1
```

# Participating Developer

- **git clone** from the upstream to prime your local repository.
- **git pull** and **git fetch** from "origin" to keep up-to-date with the upstream.
- **git push** to shared repository, if you adopt CVS style shared repository workflow



## Just to make it a *bit* more complicated...

Two kinds of branches:

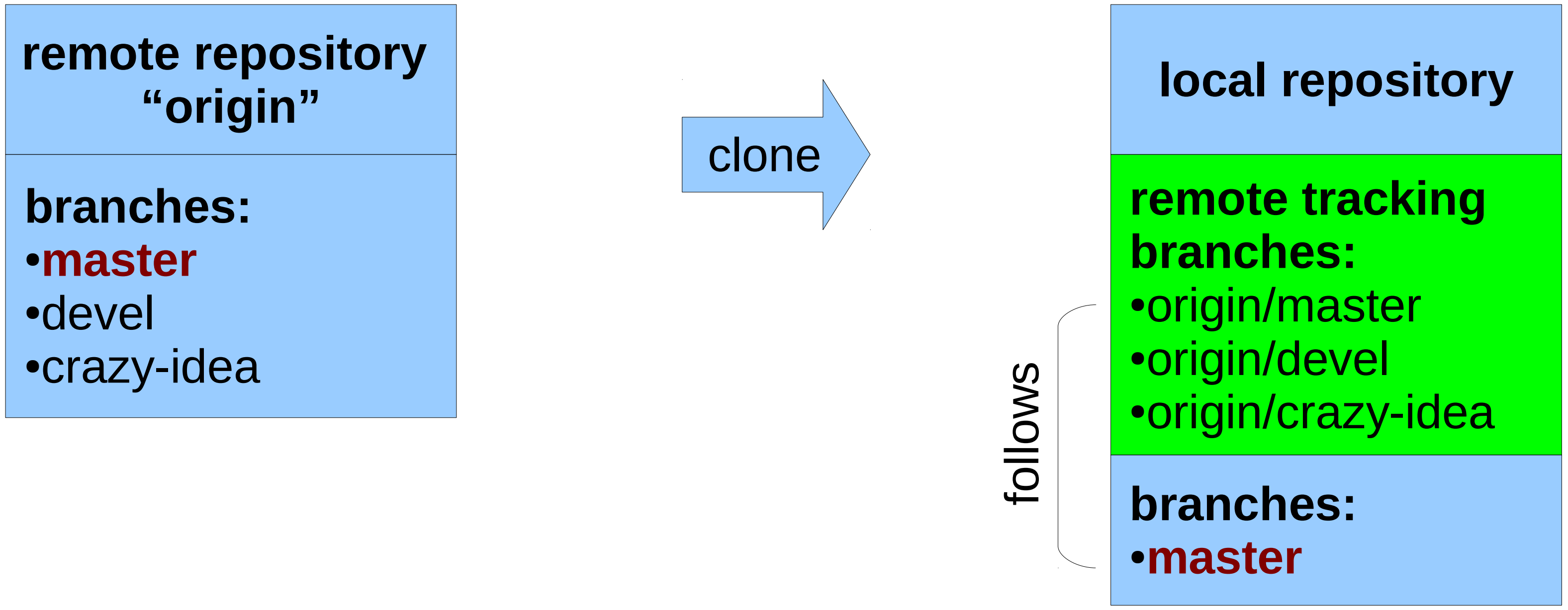
- **Local branches** (e.g.: foo)
- **Remote tracking branches** (e.g.: origin/foo)
  - Read-only
  - Follow what's happening remotely

## git clone

**$ git clone git://some.re.po**

- Clones repo into a newly created directory
- Creates remote tracking branches for each branch in repo
- Creates and checks out a local branch equal to repo's currently active branch

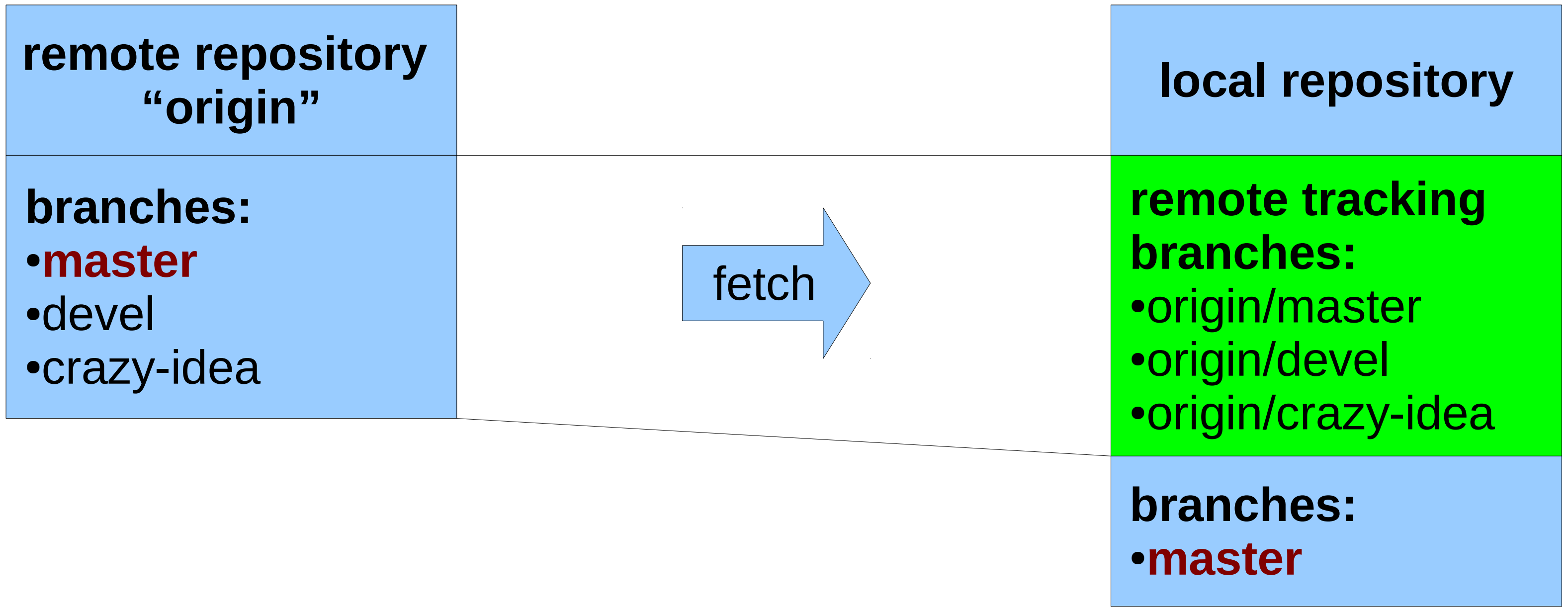
# git clone (II)


remote repository "origin"
branches:
•master
•devel
•crazy-idea
clone
local repository
remote tracking branches:
•origin/master
•origin/devel
•origin/crazy-idea
follows
branches:
•master

# git fetch

**$ git fetch**

- Updates *all* remote tracking branches
- Does not touch your local branches!



## git fetch (II)

- If you want to merge (update!) your local master branch with origin's changes

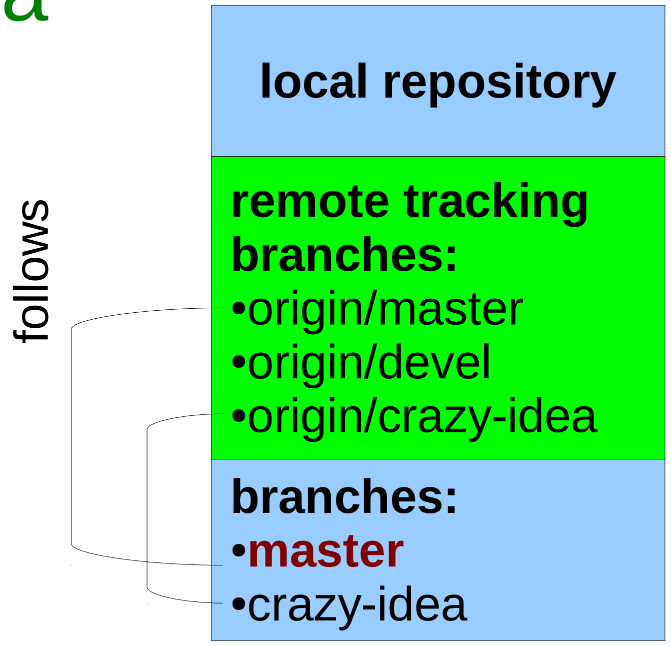
```
$ git checkout master
$ git merge origin/master
```

# Creating a local branch from a remote tracking branch

Remember: remote tracking branches are read only!

```
$ git checkout --track origin/crazy-idea
```

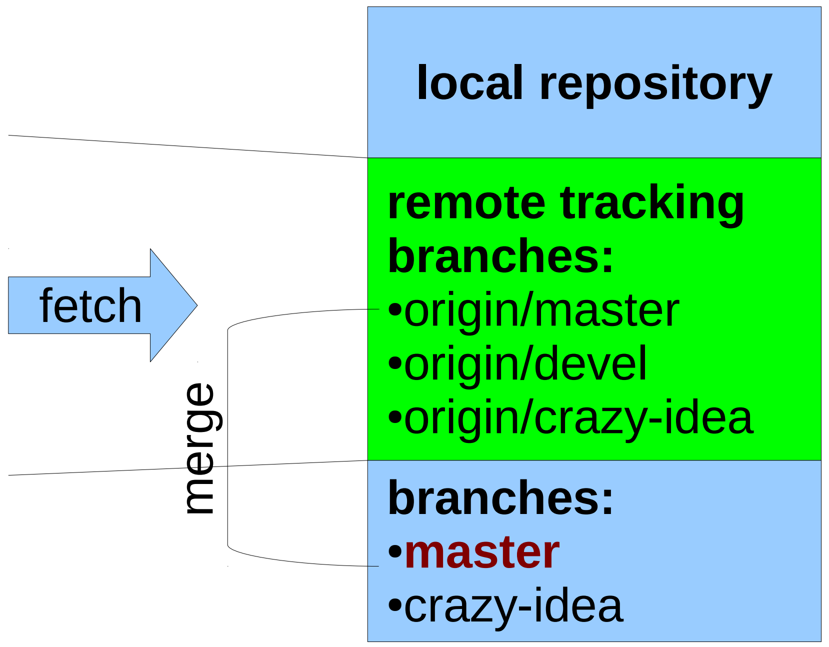
Creates a local branch crazy-idea which follows origin/crazy-idea



# git pull

**$ git pull**

- Updates all remote tracking branches
- Merges your current active branch the connected remote tracking branch



## pull vs fetch

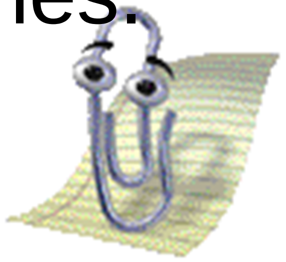
**$ git fetch**

- Updates *all* remote tracking branches

**$ git pull**

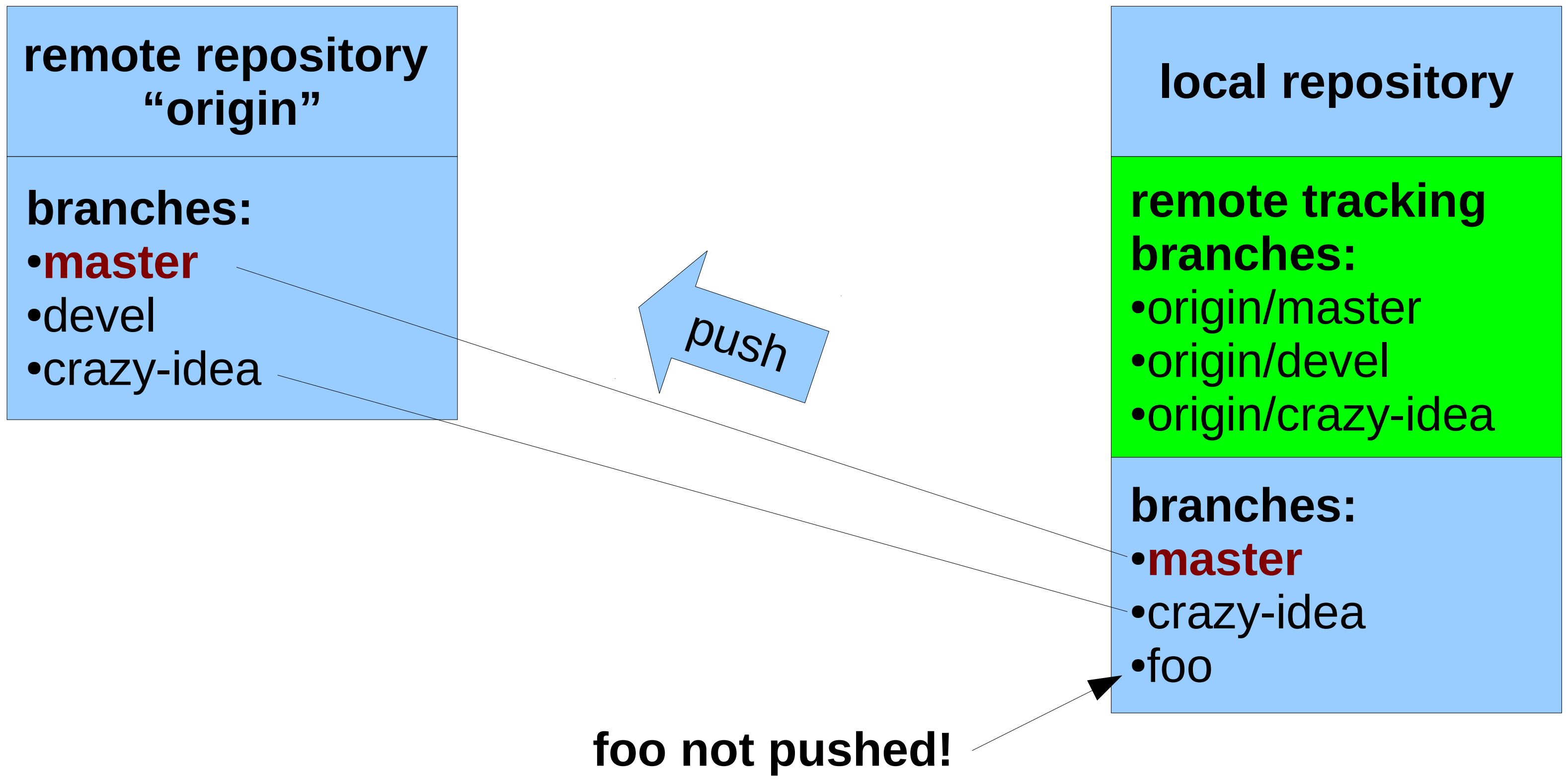
- **git fetch** for *all* remote tracking branches
- + **git merge** for the *current* branch

It's generally safe to call **git fetch** during your work, since it does not touch your local branches.



# git push

Update origin's branches with all branches that are common between your local repository.



## git push (II)

To push a local branch:

**$ git push origin foo**

- After this explicit push:
  - You have an origin/foo remote tracking branch “connected” with foo
  - every following **git push** is sufficient

# Typical workflow:

Only once:

```
$ git clone git://some.re.po
```

```
$ (hacky, branch, hacky, merge, etc.)
$ git fetch
```

Fetch upstream's changes

```
$ git merge origin/master
```

Merge the changes from origin/master into current branch

```
$ git push
```

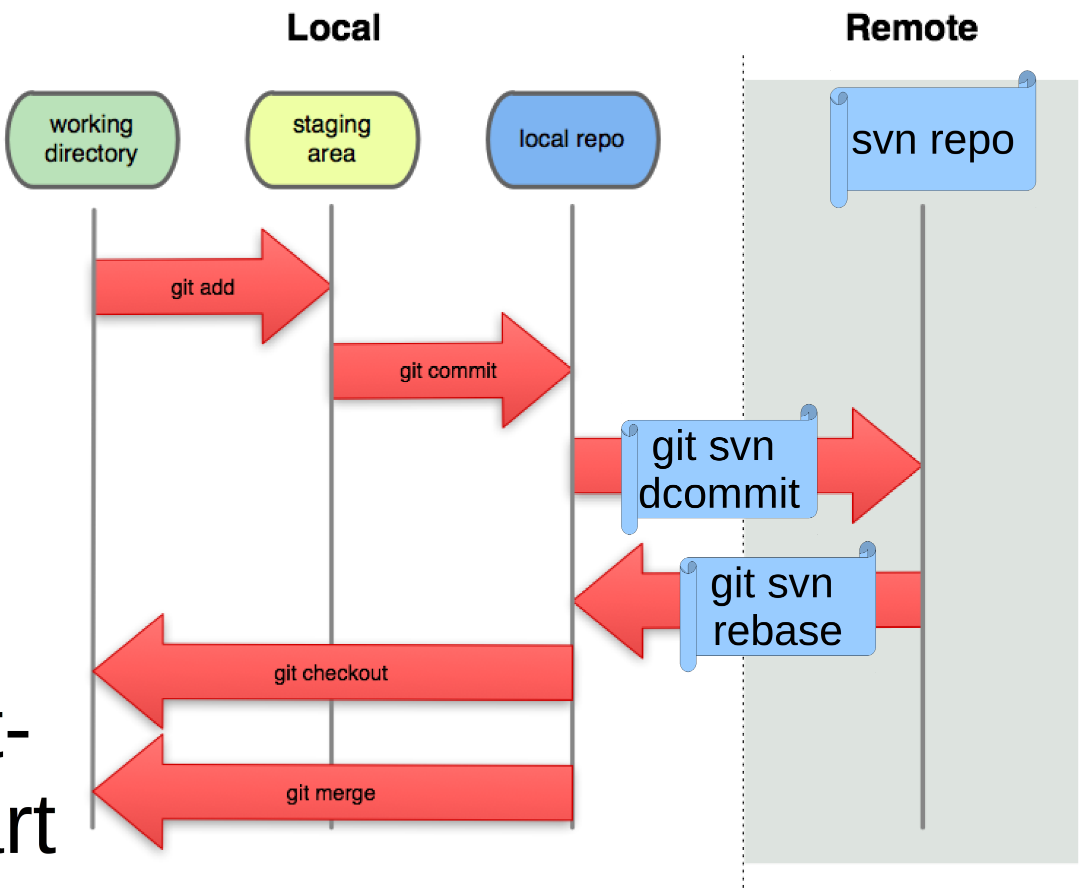
Push your changes back to origin

## “But at work we have to use SVN!”

# git-svn in a nutshell

## Git SVN

- Plug-in for git
- Allows bidirectional operation between a single SVN branch and git
- Use git locally and git-svn for the remote part



# git-svn in a nutshell (II)

**$ git svn clone http://svn.reposito.ry**

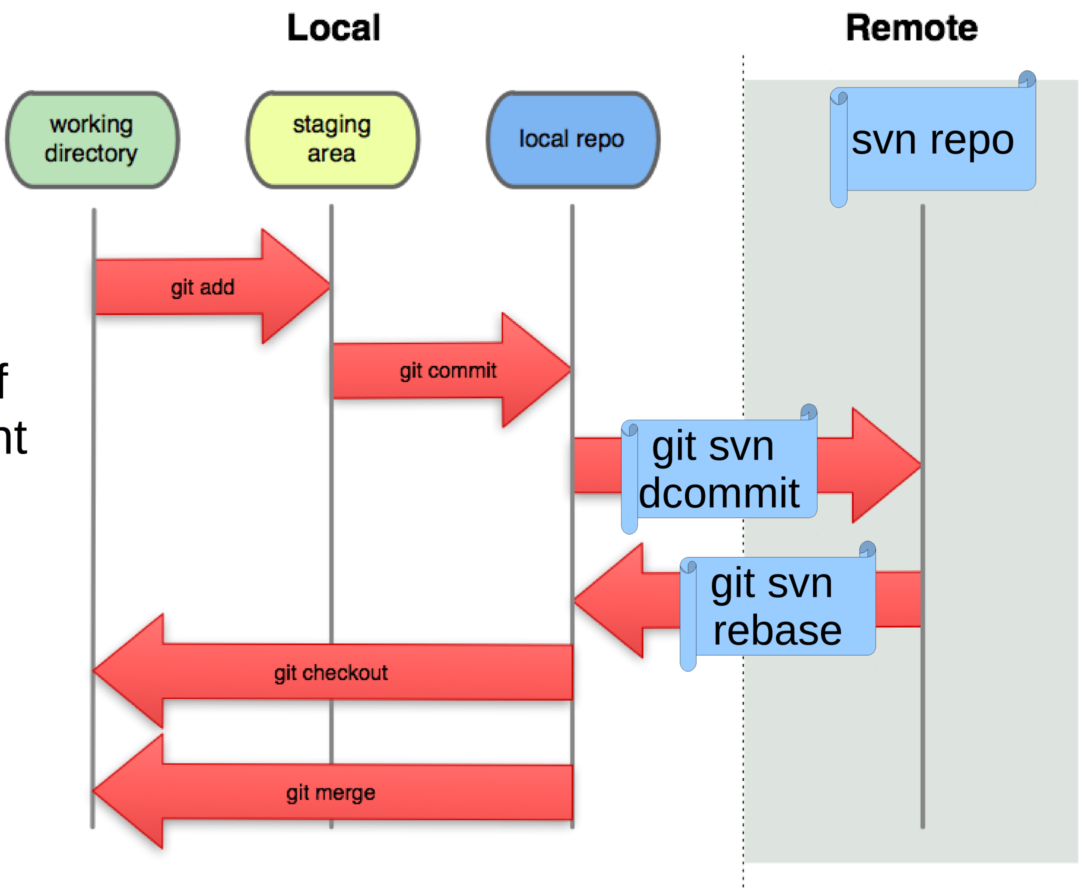
Creates emtpy git repository and fetches **every** revision from the svn repo into it.

**$ git svn rebase** ("svn update")

Fetches revisions from the SVN parent of the current HEAD and rebases the current (uncommitted to SVN) work against it.

**$ git svn dcommit** ("svn commit")

Will create a revision in SVN for each commit in git.



# git-svn in a nutshell (III)

- git-svn does not work well with remote (SVN) branches!
- Best to track only the main line (trunk) and use local git branches for your development

```
$ git svn rebase
$ git branch new-feature
$ git checkout new-feature
$ (hacky, hacky)
$ git checkout master
$ git merge new-feature
$ git svn dcommit
```

Remote SVN operations

Local git operations

## Summary

- Difference: Centralized and Distributed VCS
- Howto create/clone a repository
- Difference: local- and remote tracking branches
- Basic git usage
- Git with SVN

## Next Actions:

- Take a project of your choice (thesis, paper, …) and put it under git revision control
- Use git-svn to use git locally with SVN repositories
- Convince your group to move from SVN to git

*Fin.*

## Useful Resources

- git tutorial:
  **$ man gittutorial**
- Everyday git with 20 commands or so:
  http://www.kernel.org/pub/software/scm/git/docs/everyday.html
- git ready:
  http://www.gitready.com/
- Why git is better than X:
  http://whygitisbetterthanx.com
- Git Cheat Sheet:
  http://cheat.errtheblog.com/s/git
- Git Cheat Sheet:
  http://git.or.cz/gitwiki/GitCheatSheet
- Git community book:
  http://book.git-scm.com/index.html