

Git gud

Talk on Git and GitHub

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Where you should end up after this talk

- You have an idea of the inner workings and the benefits of Git and version control systems
- You can use Git
- You can use GitHub

Git

What is Git?

- Git is a file system
- Git provides a VCS

What is a VCS?

- A VCS is a Version Control System
- A VCS lets you manage different versions of files
- It keeps track of the changes made on files and documents
- A VCS provides automated workflows to reduce your workload

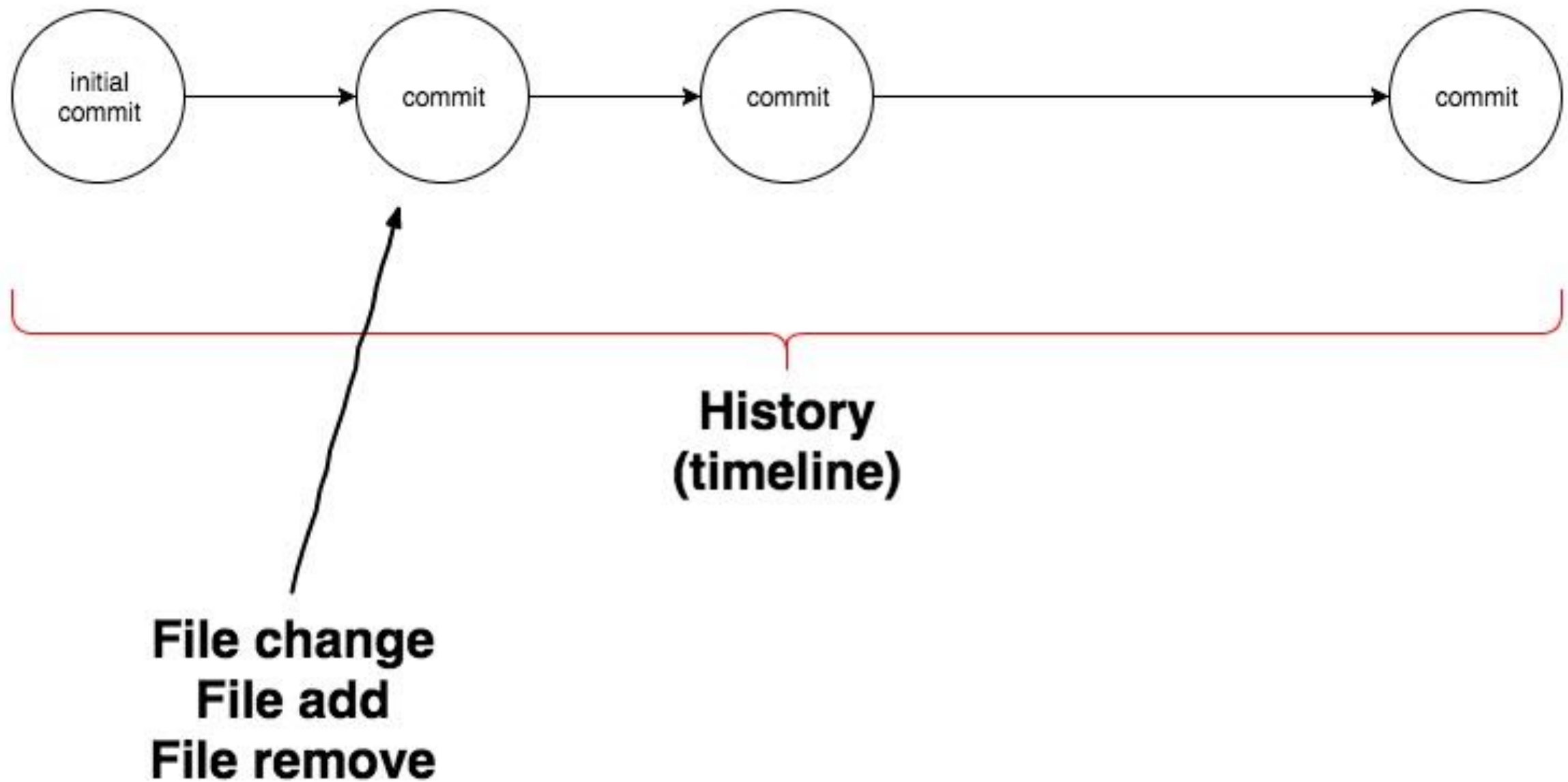
Reasons to use a Version Control System

- Instead of keeping track manually, a system lets you manage versions of your code
- This basically means that you can
 - Access a version history
 - Revert changes
 - Compare versions
 - Work with multiple people on the same file

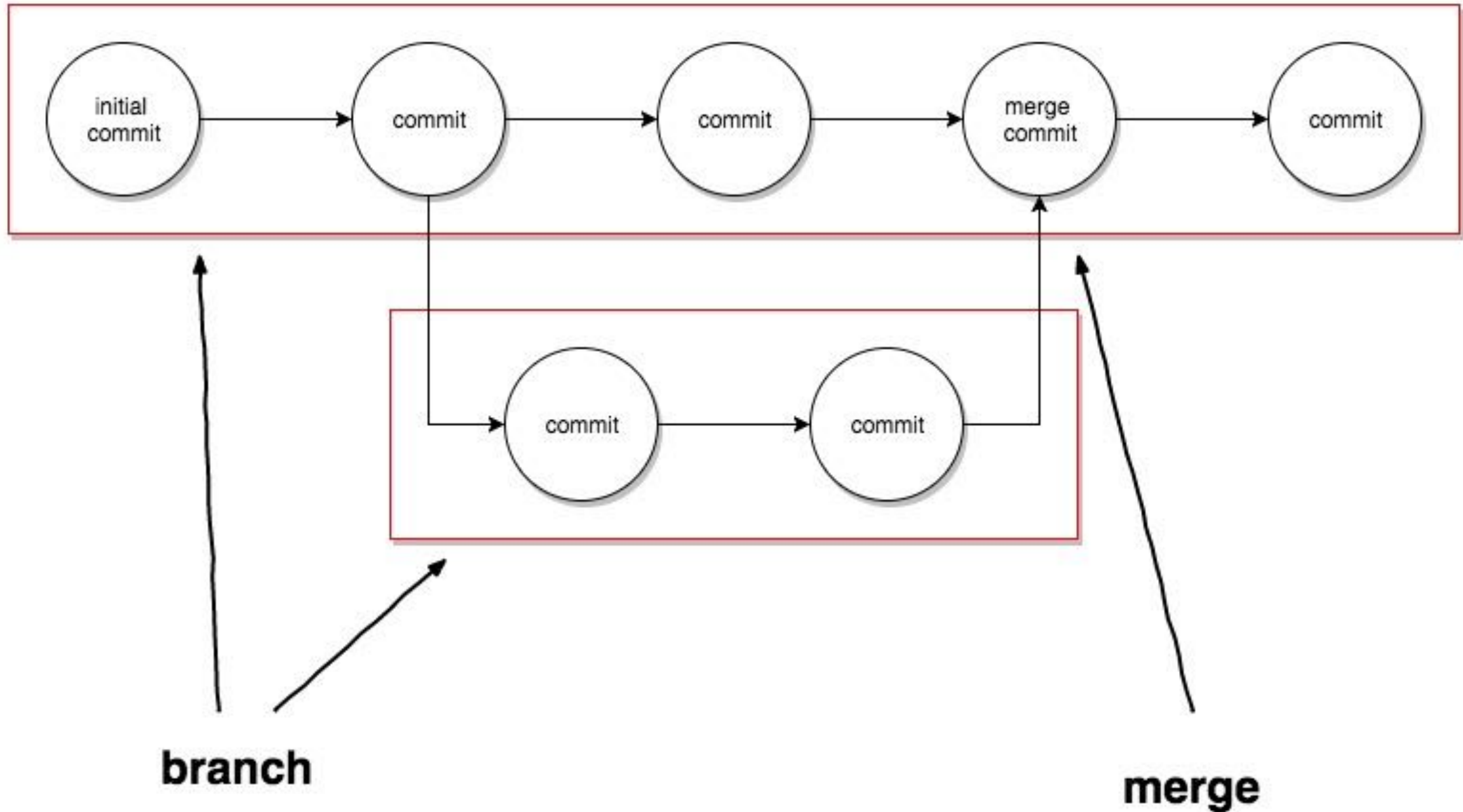
Git history

- Developed in 2005 by Linus Torvalds
- Replaced BitKeeper as a VCS in the Linux development
- Focus laid on:
 - BitKeeper-like Workflow
 - Speed
 - Security (no corruptions possible)
 - Ability to handle huge projects
 - Simplicity
- Git is still being developed (current version ^2.14.*)

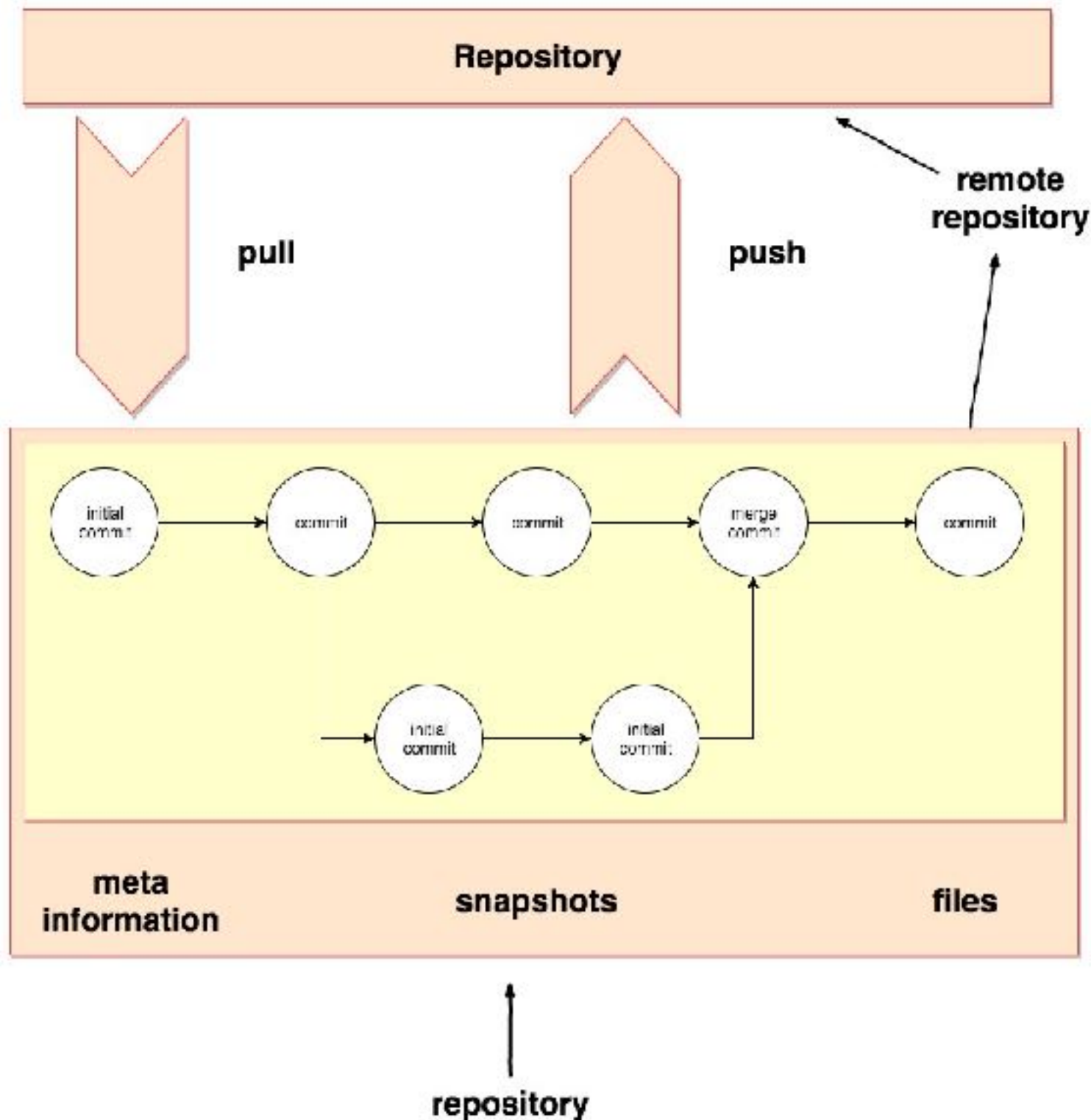
Terminology



Terminology



Terminology



How does Git work?

- Git is a content-addressable file system
- After you initiated a repository, you will see:

```
~/Workspace/Studium/SoftwareEngineering ➤ cd gitExample
~/Workspace/Studium/SoftwareEngineering/gitExample ➤ git init
Initialized empty Git repository in /Users/ry77/Workspace/Studium/SoftwareEngineering/gitExample/.git/
~/Workspace/Studium/SoftwareEngineering/gitExample ➤ master ➤ cd .git
~/Workspace/Studium/SoftwareEngineering/gitExample/.git ➤ master ➤ ls -la
total 24
drwxr-xr-x  9 ry77  staff  306 24 0kt 22:26 .
drwxr-xr-x  3 ry77  staff  102 24 0kt 22:26 ..
-rw-r--r--  1 ry77  staff   23 24 0kt 22:26 HEAD
-rw-r--r--  1 ry77  staff  137 24 0kt 22:26 config
-rw-r--r--  1 ry77  staff   73 24 0kt 22:26 description
drwxr-xr-x 12 ry77  staff  408 24 0kt 22:26 hooks
drwxr-xr-x  3 ry77  staff  102 24 0kt 22:26 info
drwxr-xr-x  4 ry77  staff  136 24 0kt 22:26 objects
drwxr-xr-x  4 ry77  staff  136 24 0kt 22:26 refs
```

.git folder contents

```
~/Workspace/Studium/SoftwareEngineering/gitExample/.git master ls -la
```

```
total 32
```

drwxr-xr-x	10	ry77	staff	340	24	0kt	22:46	.	
drwxr-xr-x	4	ry77	staff	136	24	0kt	22:46	..	
-rw-r--r--	1	ry77	staff	23	24	0kt	22:26	HEAD	Current branch
-rw-r--r--	1	ry77	staff	137	24	0kt	22:26	config	
-rw-r--r--	1	ry77	staff	73	24	0kt	22:26	description	
drwxr-xr-x	12	ry77	staff	408	24	0kt	22:26	hooks	
-rw-r--r--	1	ry77	staff	104	24	0kt	22:46	index	Staging information
drwxr-xr-x	3	ry77	staff	102	24	0kt	22:26	info	
drwxr-xr-x	5	ry77	staff	170	24	0kt	22:46	objects	Content (object database)
drwxr-xr-x	4	ry77	staff	136	24	0kt	22:26	refs	Pointers into commit objects

Git objects

- There are three types of objects:
 - blob
 - tree
 - commit object

Blob

- Everything in git is identified by it's SHA-1 checksum
- Git hashes the contents of a file plus a header using SHA-1
- Git stores the object, first two chars of the hash as a directory name, last 38 chars as the file name
- The content is retrievable by addressing it via it's SHA-1 checksum
- Problem: No file names are stored! -> only addressable via SHA-1!

Blob

```
~/gitExample ➤ git init
Initialized empty Git repository in /Users/ry77/gitExample/.git/
~/gitExample ➤ master vim hello.txt
~/gitExample ➤ master ls -la .git/objects
total 0
drwxr-xr-x  4 ry77  staff  136 24 0kt 22:56 .
drwxr-xr-x  9 ry77  staff  306 24 0kt 22:56 ..
drwxr-xr-x  2 ry77  staff   68 24 0kt 22:56 info
drwxr-xr-x  2 ry77  staff   68 24 0kt 22:56 pack
~/gitExample ➤ master git add hello.txt
~/gitExample ➤ master + cat .git/objects/49/5cc9fa8f9c127aaee426bcb7e09f46d82199d7
xK000R04f0H000W(0H-JU0H0{%
```

Tree

- Tree objects are basically UNIX directory entries
- They contain of a SHA-1 pointer to a blob/tree as well as it's
 - mode (file, executable, symlink)
 - type
 - name
- New snapshot = new tree object
- Problems: Still only a SHA-1 identifier, zero metadata on the tree (name, date etc.)

Commit object

- A commit object points to a tree object and holds meta
- A commit object contains of user-added information:
 - Tree pointer
 - Message
 - Preceded commit (can be none)and automatically added information
 - username, user e-mail
 - timestamp
- -> Now we have a history!

Viewing Git objects

CLI example

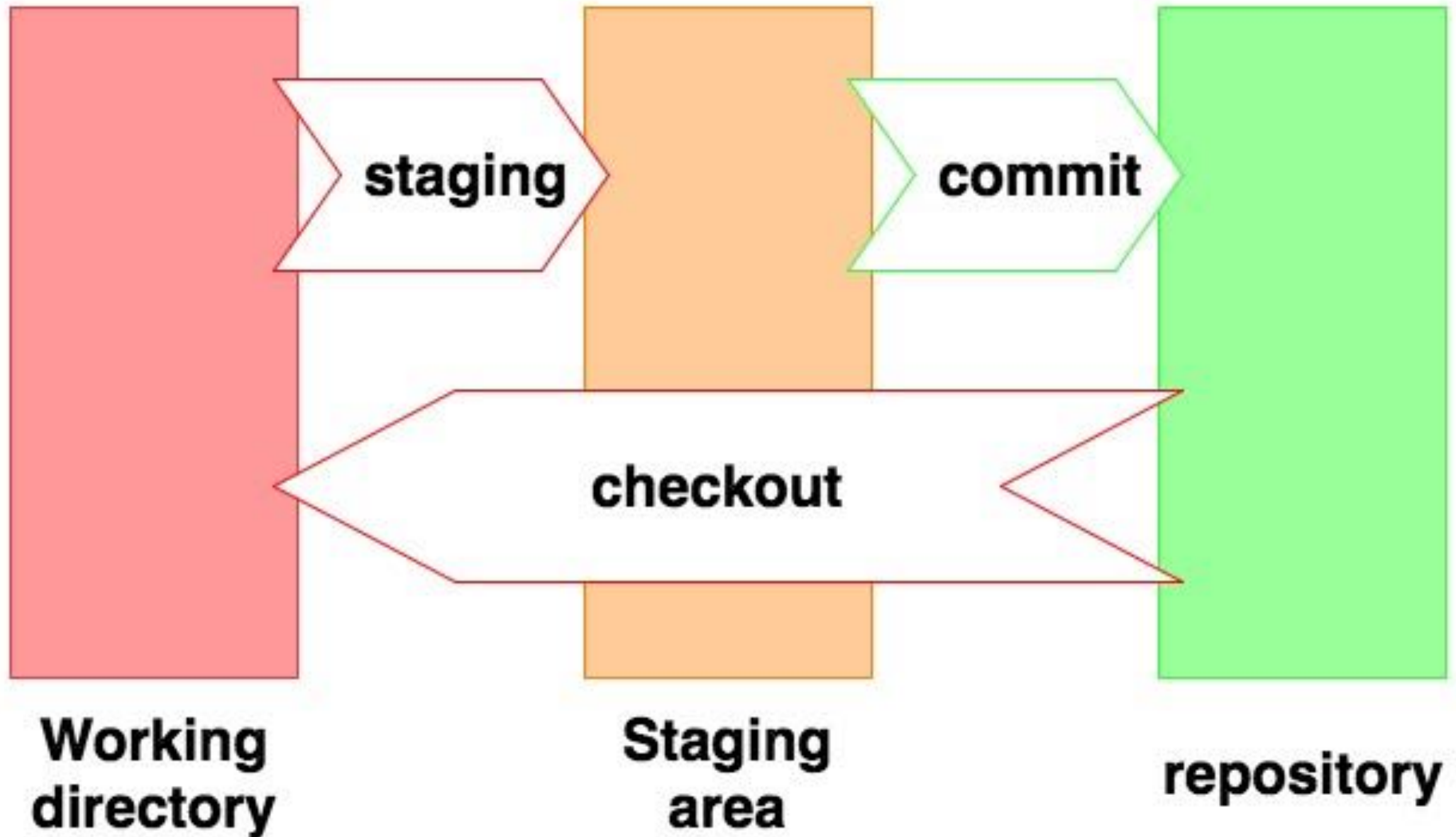
Hidden workflows

- You only use user-friendly *porcelain* commands
- There are commands for using Git's inner workings

Hidden workflows

CLI example

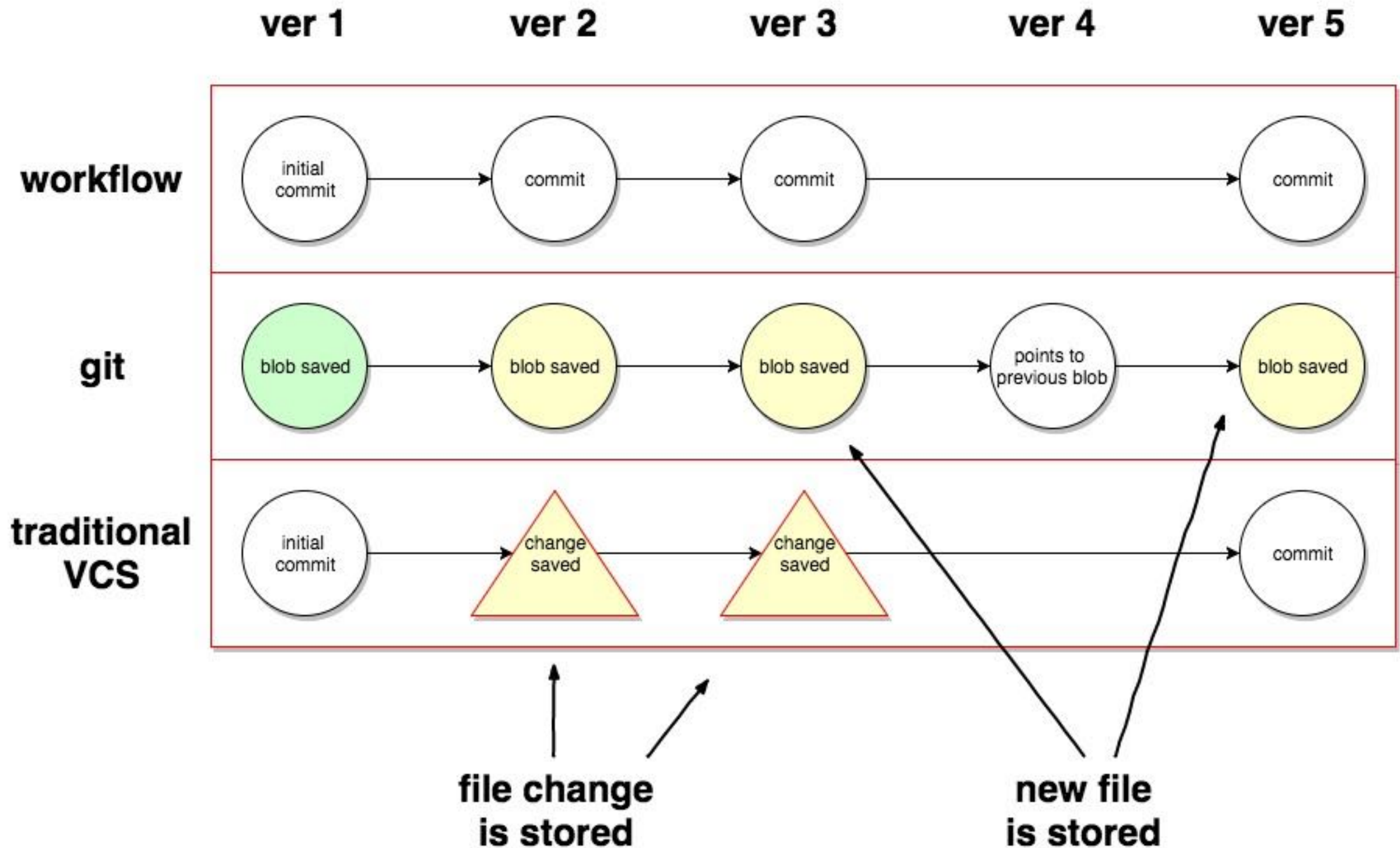
Git areas



Git as a VCS

- Git is basically a file system - but what does that mean?
- Traditional VCSs store file-based changes
- Git stores snapshots

Git as a VCS



How to use a CLI

- Enter your working directory

```
cd /home/user/project
```

- Enter your commands (use programs)

```
vim index.html
```

- Use parameters to change what the commands do

```
ls -latr
```

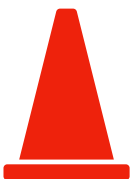

How to use a CLI

- Get help by accessing the man pages or the help

```
man git
```

```
git help
```

- Watch out while using CLIs
 - They do what you want them to do
 - They won't always warn you or forbid commands, watch out while forcing commands



```
rm -rf /
```

Basic usage

- Create a new repository:

```
git init
```

- Clone a repository

```
git clone
```

Basic usage

- Look at the current status

```
git status
```

- Work on the files, change them

```
vim <file to work on>
```

- Update the index

```
git add <file to add>
```

Basic usage

- Create a commit object

```
git commit
```

```
git commit -m „<commit message>“
```

- Send your changes to the remote repository

```
git push
```

Branching

- A branch is a pointer to a commit
(implemented as a file that contains a commit hash)
- The file *HEAD* will point to the current branch
- The *master* is just another branch, created by `git init`
- To set the *HEAD* to a new branch

```
git branch <branch>  
git checkout <branch>
```

```
git checkout -b <branch>
```

Branching

- Once you committed, the *HEAD* and the current branch move along
- If you checkout a different branch now and commit, you will get a *divergent history*

Merging

- What to do after multiple branches exist?
- Merge another branch into the *HEAD* using

```
git merge <branch>
```

- If the history is not divergent, the branch will move along (the pointer will point to the new commit)

Merging

- What if the history is divergent?
- Git can merge your branches together, if the same part of the same file has *not* been changed in both branches
- Git will create a *merge commit*: a commit that has two ancestors

Merging

- What if the same part of the same file has been changed?



-> You will have to handle *merge conflicts*.

- Git will inform you that merge conflicts occurred during merging
- Git will modify the file so that you can fix the merge conflict

Merging

```
~/gitExample ➤ ↗ master ➤ git merge FixingHelloTxt
Auto-merging hello.txt
CONFLICT (content): Merge conflict in hello.txt
Automatic merge failed; fix conflicts and then commit the result.
✖ ➤ ~/gitExample ➤ ↗ master ●+ >M< ➤ vim hello.txt
~/gitExample ➤ ↗ master ●+ >M< ➤ cat hello.txt
Hello there!
<<<<<<< HEAD
How are you?
=====
Today is a good day.
>>>>>>> FixingHelloTxt
~/gitExample ➤ ↗ master ●+ >M< ➤ vim hello.txt
~/gitExample ➤ ↗ master ●+ >M< ➤ git add hello.txt
~/gitExample ➤ ↗ master + >M< ➤ git commit
[master 0c69d68] Merge branch 'FixingHelloTxt'
~/gitExample ➤ ↗ master ➤ cat hello.txt
Today is a good day.
~/gitExample ➤ ↗ master ➤
```

Merging

- Fix the merge conflict

```
vim <file>
```

- After you have fixed the merge conflict, you can update the tree by using

```
git add <file>
```

- After that, you can try to finish the merge, if you fixed all merge conflicts

```
git commit
```

Advanced usage

- Some interesting commands you might need while using Git as your VCS:
- If you want to stash away your changes:

```
git stash
```

If you want to apply them:

```
git stash apply  
git stash pop
```

Advanced usage

- If you forgot to stage a file or you messed up the commit message:

```
git commit --amend
```

- If you want a specific commit to be part of your tree as well:

```
git cherry-pick <commit>
```

- If you want to revert a commit:

```
git revert <commit>
```

Advanced usage

- If you want to change past commits to squash them, rename them or else:

```
git rebase -i -> interactive rebasing
```

- If you want to search for the commit that introduced a bug:

```
git bisect start
```

- If you want to create a tag:

```
git tag -a <version> -m „<message>“
```

Advanced usage

- Take a look at the log

```
git log [--graph]
```

Benefits of the way Git is implemented

- Git is completely local and decentralized (vs Subversion)
- Everybody can develop and commit offline and then spread his work online
- Git is high speed: Git being offline and the key-value database make it extremely fast
- Git has integrity: Everything is referred to by a checksum
- It is hard to lose data: Removed files are still part of older snapshots
- Branching is *very* easy and very mighty

Get the most use out of a Version Control System

- + Make use of the workflow (commit often, push often etc.)
- + Use ASCII files (not only code, documentation or blogs as well)
- + Use scripts to get automatically created change reports and statistics
- + Use your VCS to find mistakes

Best practices

- When to commit?
 - > Commit every time you want to create a snapshot of your code:
 - Commit if you finished some aspect of the ticket you are working on
 - Separate different activities during development with different commits (group changes by their effect)
 - Commit in fear of losing progress

Best practices

- If you create multiple commits during the completion of one task, mark them as

WIP (Work In Progress)

- Try to keep all WIP-commits out of the master by squashing them into previous commits
- Avoid pushing WIP-commits while working on a branch with another person (getting rid of them will get a lot harder!)

Best practices

- How to name commits?
 - > Short, understandable, precise
 - > Title: 50 characters, Comment: 50-70 character per line
 - > Add a short task description (BUGFIX, TASK, etc.)
 - > Add ticket IDs or issue IDs to trigger workflows

`WIP: PPR-5 implement search`

- Think of your own clever conventions!

Best practices

- What to create branches for?
 - Create a branch every time you want to fix a bug, implement something or change a file
 - Use tickets as an orientation: Create a branch for every ticket/issue you work on
 - Throw away old branches (it just gets confusing over time)

Best practices

- How do I name branches?
 - > UpperCamelCase
 - > Speaking names
 - > Use ticket IDs or issue IDs
 - > Avoid more than 4 words

What to avoid

- Git is just a tool - avoid spending too much time on configuring repositories, correcting the history etc.
- Do not rely on git - it won't fix your user-generated problems!
- Do not use Git for backups!
- Pay attention to what you are doing - Git will do whatever you tell it to do!

What to avoid at all costs



Git submodules

GUI tools, plugins

- Most IDEs provide a Git plugin
- The plugin will provide buttons and shortcuts for the important git features, as well as a nice GUI
- There are a lot of Git standalone GUI tools
 - Tower
 - SourceTree
 - GitKraken
 - GitHub Desktop

Git integrations

- Most Issue Trackers invite you to connect them to a Git repository
- They let you
 - Close tickets by using specific commit messages
 - Create custom workflows

Git integrations

- A lot of CI-tools let you connect them to repositories
- By using specific commit messages you can
 - trigger builds
 - trigger automated tests
 - trigger deployments

Tools for handling Merge Conflicts

- There are many tools that let you manage merge conflicts
 - DiffMerge
 - Kaleidoscope

GitHub

What is GitHub?

- GitHub is a repository hosting service
 - GitHub is hosting Git repositories
 - GitHub lays it's focus heavily on collaborative developing
- > Comparable to GitLab

GitHub features

- Repository hosting (used for remote repositories)
- Wikis
- Issue tracking
- GitHub Pages
- Statistics, graphs on repositories and users
- GitHub Gists

GitHub features

- Pull requests
- CI
- Private repositories (premium feature)

**Are there any
questions?**