GIT GUD

Agenda

1. Background
2. Internals
3. Tips & Tricks
4. Best Practices

1. => Lecture
2. => Lecture & Interactive
3. => Interactive
4. => Lecture

Background

what is `Git`?

Ask this question?

VCS

Version Control System

What does a VCS do?

[…] a system that records changes to a file or set of files over time

— Scott Chacon & Ben Straub [ProGit]

[ProGit] https://git-scm.com/book/en/v2

Version Control Systems

- CVS
- Perforce
- SVN
- Mercurial
- Git

Who has tried what?

Later: How they differ

Open Source

GNU GPL2

published under GNU General Public License version 2

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Next Slide: What makes Git different from, for example, SVN

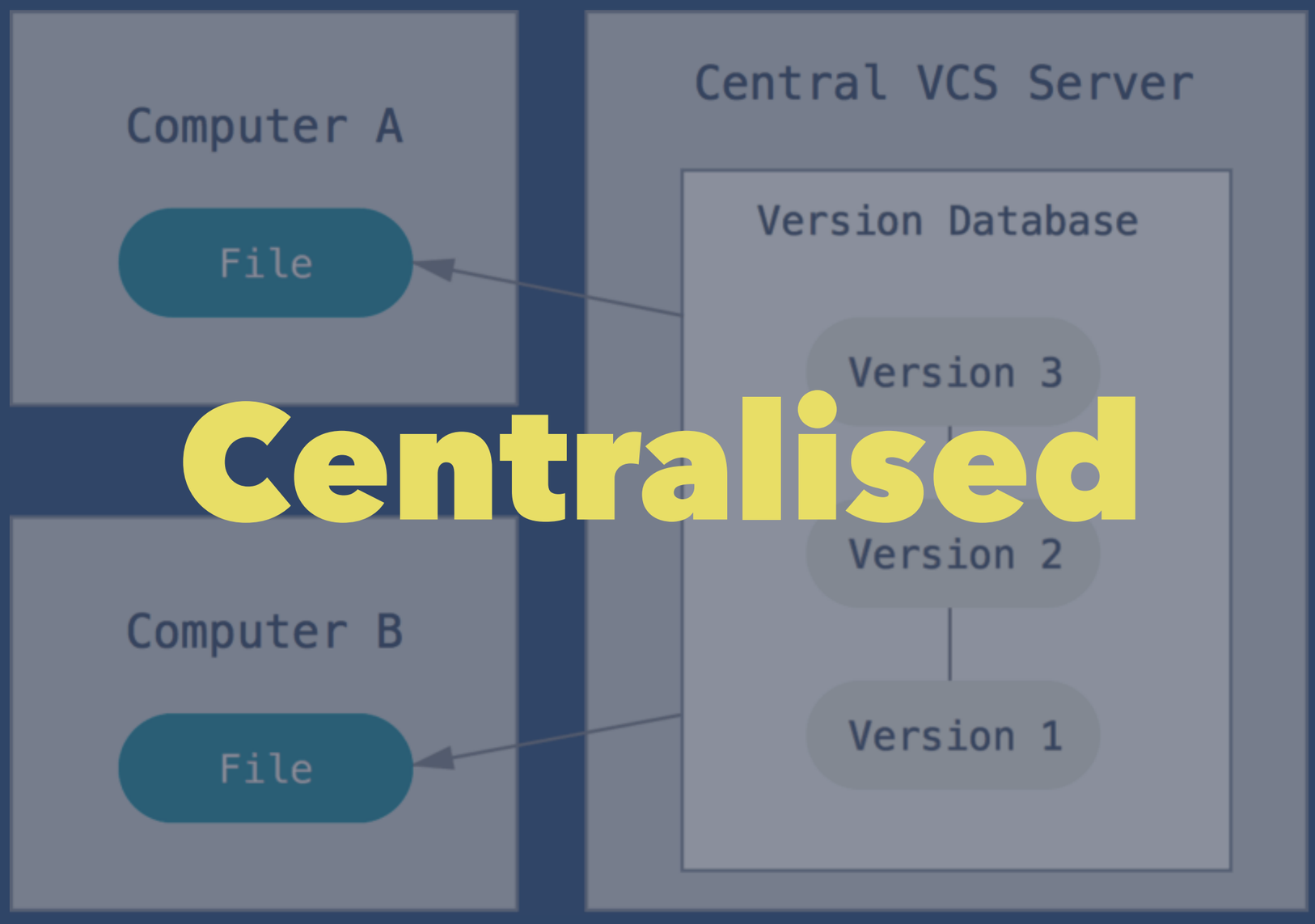
Distributed

What does that mean? For this we have understand:

Centralised

vs

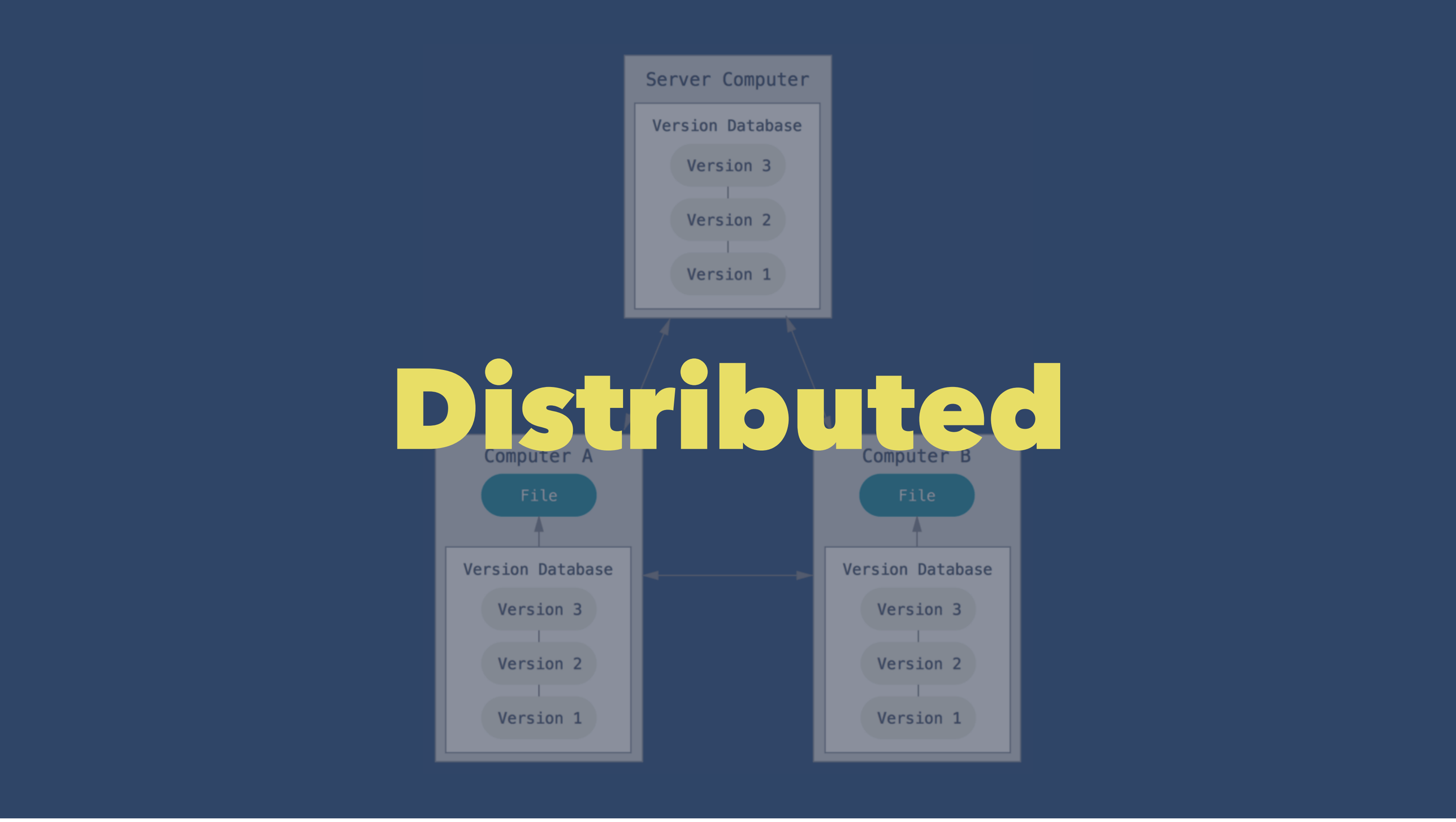
Distributed



Centralised

- Central repository = Single source of truth
- Server/Client communication

Examples: SVN, CVS, Perforce



Distributed

- Each repository a full backup (with exceptions)
- Communication between repositories
- Possibel to do centralised approach (usual approach)

Examples: Git, Mercurial

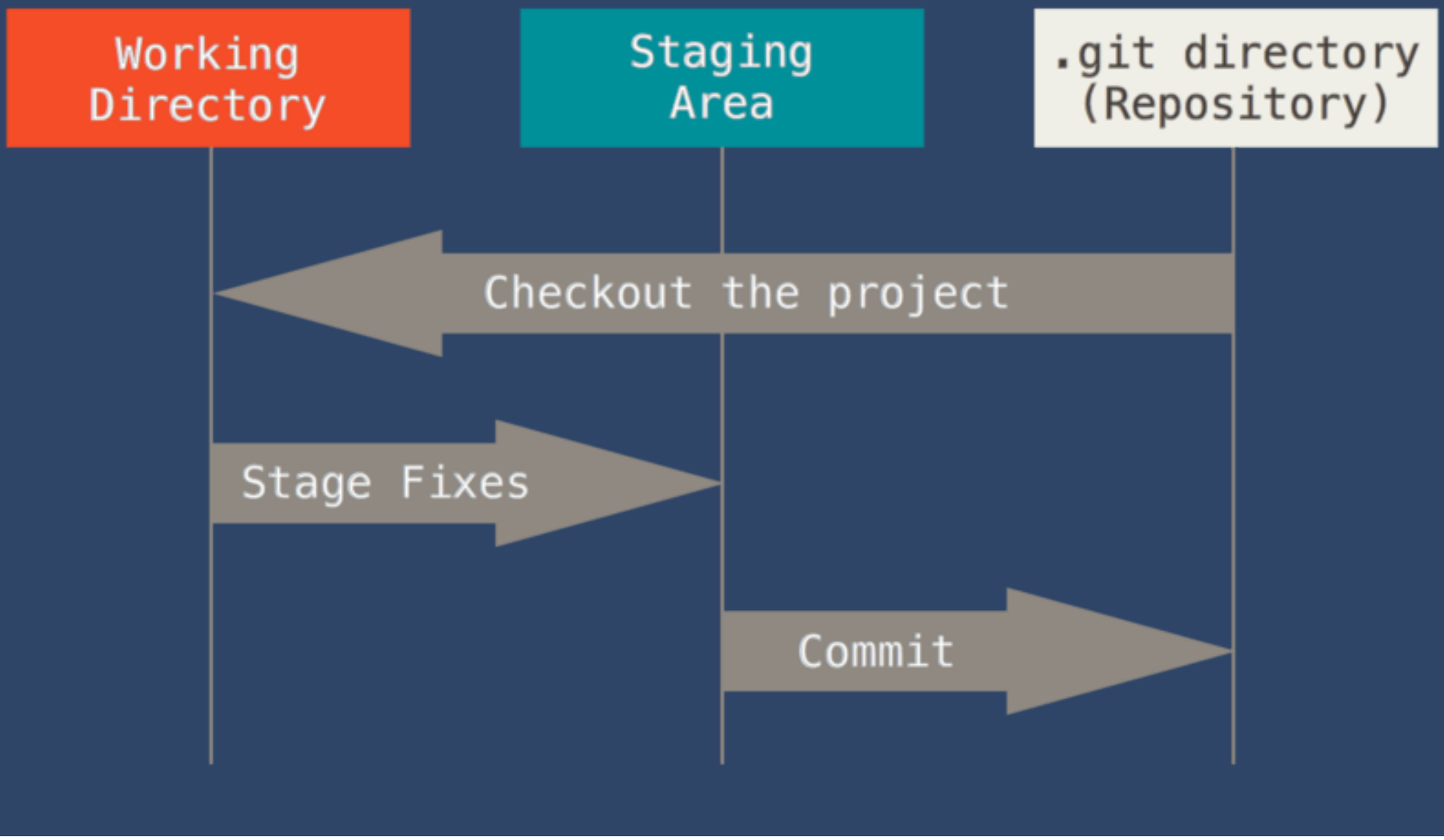
I could bore with commands, but you probably know those already.

Let's talk about how Git works internally => Helps a lot for advanced stuff

- Terminology
- Object model

Expected Knowledge

- `add`
- `reset`
- `commit`
- `merge`

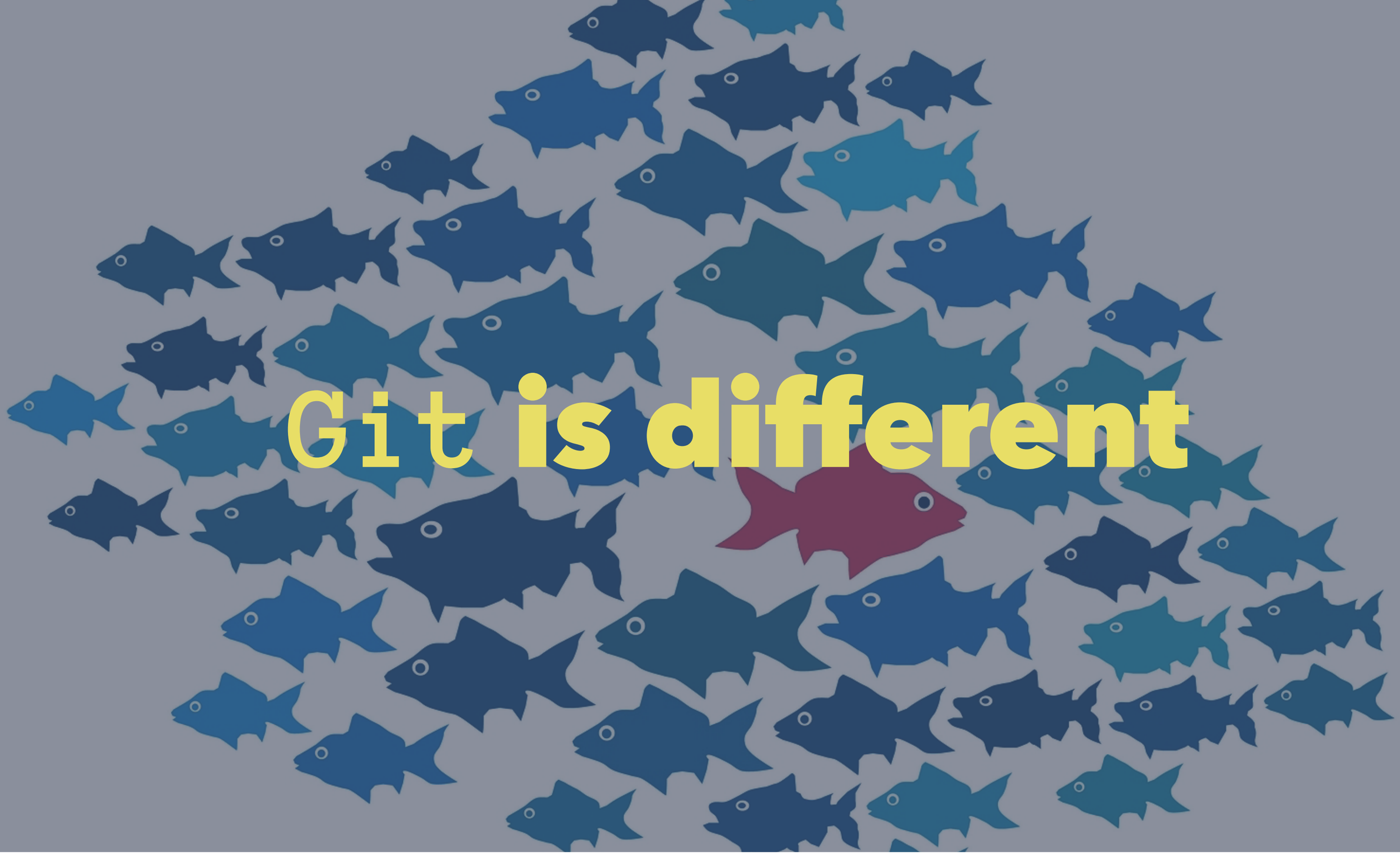


How to add changes?

(Probably familiar with this)

Follow up: How does Git track changes?

How does `Git` track changes?



Not only "Distributed"
=> The way Git thinks about it's files

The major difference [...] is the way Git thinks about its data.

— Scott Chacon & Ben Straub [ProGit]

[ProGit] https://git-scm.com/book/en/v2

Deltas: What changed?

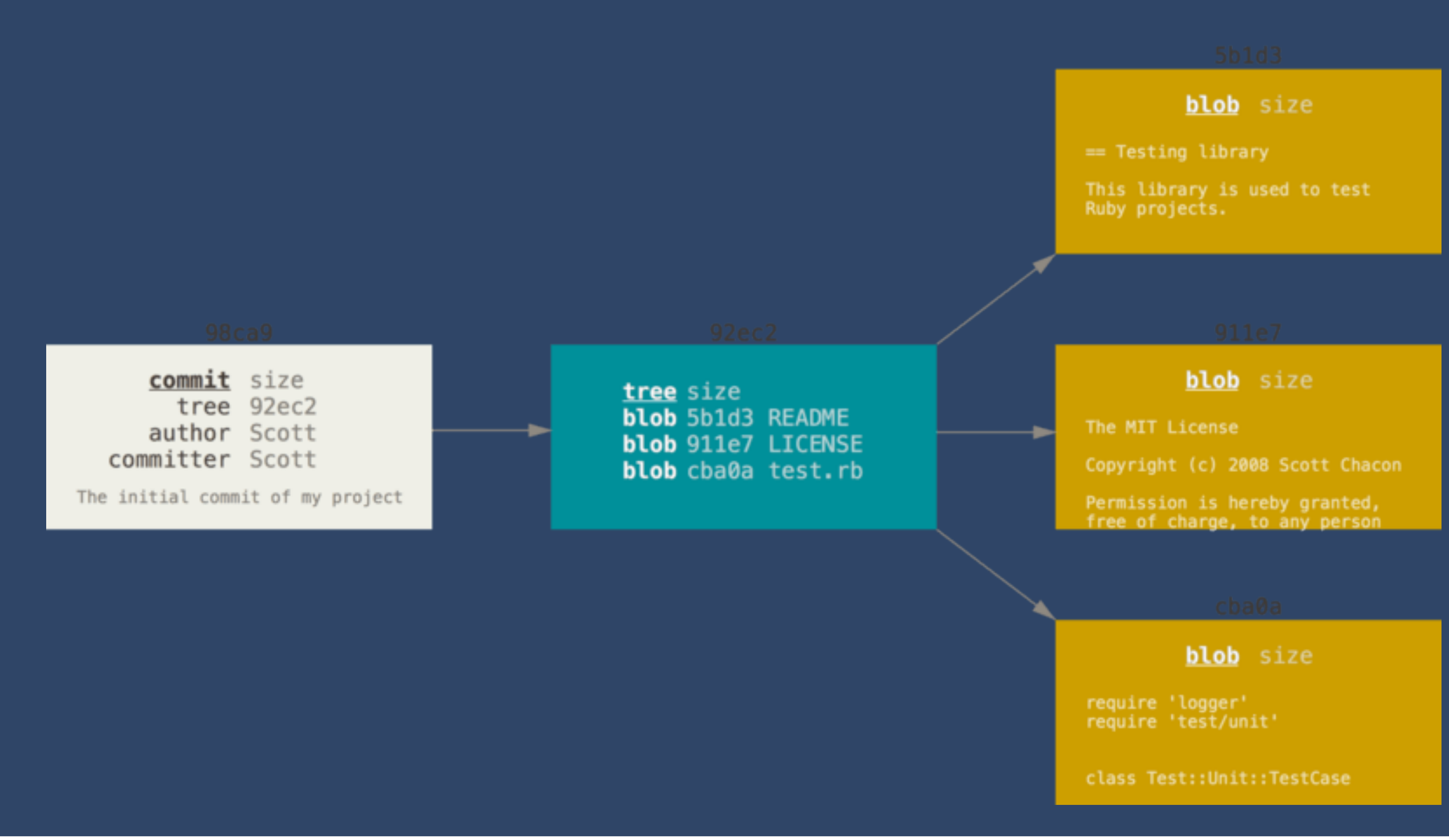
Snapshots: Current state

Q: Any advantages you can think of?

How does Git build this to a commit?

What is a

Commit



Commit -> Tree -> Tree | BLOB

Commit: Tree + Parents + Metadata

Git is closer to a filesystem then to a classic VCS

Next slide: How does Git identify objects?

SHA1

Hash built over all properties of the object (Commit => Author, Committer etc.)
You might have heard to never change commits after pushing: Hash changes when properties change

Try it out!

Clone workshop repository

```
git clone
git@github.com:Zeeker/git-workshop.git
```

```
$ cd git-workshop

$ echo 'Some random text' > my_file

$ git hash-object -w my_file
1a76b8a41993e2c667f5b191fb57abdab2102a8b

$ git cat-file -t 1a76b8a41993e2c667f5b191fb57abdab2102a8b
blob
```

```
$ git cat-file -p 1a76b8a41993e2c667f5b191fb57abdab2102a8b
Some random text
```

You can actually find the blob in .git/objects/1a/76b8a41993e2c667f5b191fb57abdab2102a8b

Git only uses the content; create an identical file and the hash will be the same

```
➜ git log --all --decorate --graph --oneline
* f097585 (HEAD → waldo-came-and-left, origin/waldo-came-and-left) Add some more distracting stuff
* 0356fc5 Add some distracting stuff
* 8a28c0f Waldo left the building
* eeaf062 Add company for wald
* c85f3cf
* d175476
| *   f20c965 (origin/master, master) Merge branch 'd
| |\
| |/
|/|
* | 12e86b3 (origin/dev, dev) Add bar
* | 4043e69 Add some content to foo
|/
* c9866a9 Add foo
```

How history is made

`git` history at least

Each commit has a reference on it's parent => Single linked list

Not really single though ...

Q: You want to remove the last commit, how?

$$\wedge$$

and

$$\sim\langle N\rangle$$

Better have an example

```
$ git checkout ancestry
...

$ git log --oneline -1 HEAD
822eca1 Add the number 5 to numbers

$ git log --oneline -1 HEAD^
d4bd446 Add the number 4 to numbers

$ git log --oneline -1 HEAD^^
1b94d52 Add the number 3 to numbers

$ git log --oneline -1 HEAD~2
1b94d52 Add the number 3 to numbers
```

Q: Ask this!

Let's take a look

```
$ ls -l .git/refs/heads
total 32
-rw-r--r--  1 swolf  staff  41 Jan 16 09:06 ancestry
-rw-r--r--  1 swolf  staff  41 Jan 16 07:00 dev
-rw-r--r--  1 swolf  staff  41 Jan 16 07:00 master
-rw-r--r--  1 swolf  staff  41 Jan 16 07:02 waldo-came-and-left
```

All references in `.git/refs`:

- branches in `heads`
- remote branches in `remotes/<remote-name>`
- tags in `tags`

Huh, `master` is a file ...

Q: What do you think is in master?

I wonder what's in there ...

```
$ cat .git/refs/heads/master
f20c96538c6dca6fb37e631388814fe941afc2ae
```

It's just a hash!

Let us inspect the object!

We can use `git cat-file --batch`

```
$ cat .git/refs/heads/master | git cat-file --batch
f20c96538c6dca6fb37e631388814fe941afc2ae commit 540
tree 9ab6d12a4587fb4a02de1b5e745277c6c832cf5a
parent c9866a994539e01938ceec6c75ada013ce456e9b
parent 12e86b3370f931c423022a8c8d7d7fa7413e0bc4
author Sascha Wolf <sascha.wolf@grandcentrix.net> 1516082444 +0100
committer Sascha Wolf <sascha.wolf@grandcentrix.net> 1516082444 +0100
gpgsig -----BEGIN PGP SIGNATURE-----

 iHUEABEIAB0WIQTQyMji07ff76Vkk26j80vFo8w6AAUCWl2VDAAKCRCj80vFo8w6
 AOqtAPoCPrGCN1QZKKGmlqZu43n824v2wviWbUujd9CBwuUURQD/dn2EJ2zHi+zQ
 qBKm1cfsi5vwTiYj31O4UbOZ1rJbW1M=
 =vi7g
 -----END PGP SIGNATURE-----

Merge branch 'dev'
```

What about HEAD?

Q: What do you think is HEAD?

Q: Have you ever seen "detached HEAD"?

```
$ cat .git/HEAD
ref: refs/heads/master

$ git checkout --detach master
...
$ cat .git/HEAD
f20c96538c6dca6fb37e631388814fe941afc2ae
```

1. Reference onto a branch
2. Reference onto a commit (detached HEAD)

Q: How does a merge differ from a usual commit?

What does the log tell us?

```
$ git log --decorate --graph --oneline
*   f20c965 (origin/master, master) Merge branch 'dev'
|\
| * 12e86b3 (origin/dev, dev) Add bar
| * 4043e69 Add some content to foo
|/
* c9866a9 Add foo
```

Remember the commit object?

```
$ cat .git/refs/heads/master | git cat-file --batch
f20c96538c6dca6fb37e631388814fe941afc2ae commit 540
tree 9ab6d12a4587fb4a02de1b5e745277c6c832cf5a
parent c9866a994539e01938ceec6c75ada013ce456e9b
parent 12e86b3370f931c423022a8c8d7d7fa7413e0bc4
author Sascha Wolf <sascha.wolf@grandcentrix.net> 1516082444 +0100
committer Sascha Wolf <sascha.wolf@grandcentrix.net> 1516082444 +0100
gpgsig -----BEGIN PGP SIGNATURE-----

 iHUEABEIAB0WIQTQyMji07ff76Vkk26j80vFo8w6AAUCWl2VDAAKCRCj80vFo8w6
 AOqtAPoCPrGCN1QZKKGmlqZu43n824v2wviWbUujd9CBwuUURQD/dn2EJ2zHi+zQ
 qBKm1cfsi5vwTiYj31O4UbOZ1rJbW1M=
 =vi7g
 -----END PGP SIGNATURE-----

Merge branch 'dev'
```

Q: Do you notice something?

=> Two parents

Tips & Tricks

We're going to look at

- `bisect`
- `--patch` mode
- `stash`
- `reflog`
- `rebase`
- `filter-branch`

One thing before we start ...

Use aliases for intersting command+option combinations

Aliase

`git config --global alias.<your-alias> <command>`

In Action

```
$ git config --global alias.l 'log --decorate --graph --oneline'

$ git l -3
*   f20c965 (HEAD -> master, origin/master) Merge branch 'dev'
|\
| * 12e86b3 (origin/dev, dev) Add bar
| * 4043e69 Add some content to foo
|/
```

`--global` to put it into your `~/.gitconfig`

git bisect

a smart bug hunters weapon

git bisect

Search for the first commit which introduces an issue

```
$ git bisect start
$ git bisect bad <known bad commit>
$ git bisect good <known good commit>
```

Shortcut

```
$ git bisect <known bad commit> <known good commit>
```

Automate it!

`git bisect run <command>`

Exit codes are used

1: bad commit

0: good commit

Let's try it out!

```
git bisect start waldo-came-and-left d175
```

Show the asciinema as demonstration at the end

Stop bisecting

`git bisect reset`


--patch
add | checkout | reset

Let's try it out!

```
$ git checkout patch-practice
...

$ git apply patch-practice.diff
...

$ git add --patch # Try to add only the above line!
```

Tip 1: ? for help

Tip 2: s for split

Level up your --patch

edit mode

It's possible to edit things before adding it to the index!
=> Show it on the example patch

Q: Who knows this already?

`git stash`

- push create a stash from current changes
- pop apply and delete a stash
- drop delete a stash

Use `stash@{<n>}` to reference older stashes

`git reflog`

a history for your `HEAD`

Try it out!

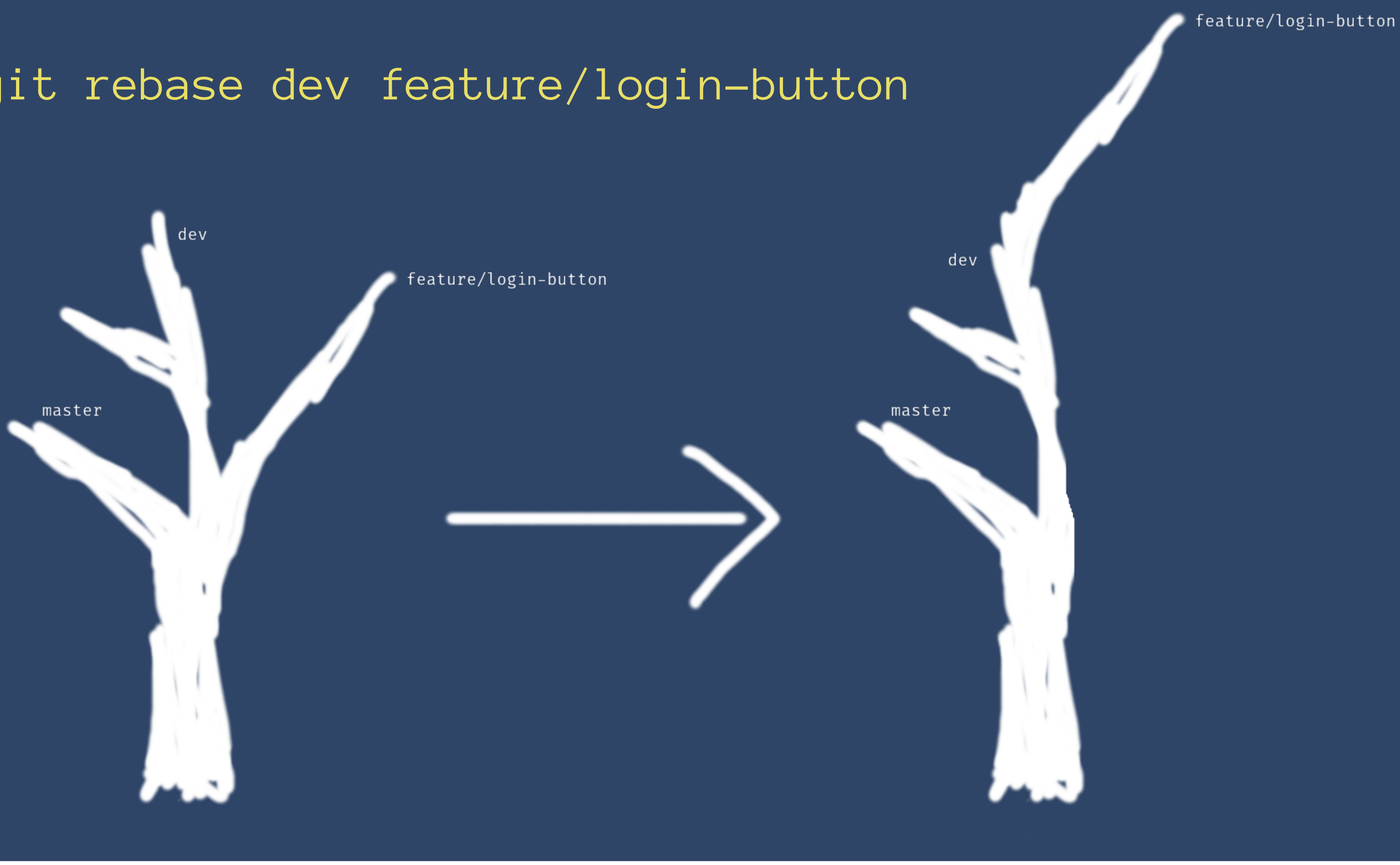
```
git reflog
```

Branches have `reflog`s too!

```
git reflog <some branch>
```

Q: What rebase do?

git rebase dev feature/login-button



Let's try it out

```
$ git checkout rebase-practice
...

$ git rebase dev
???
```

Huh, seems like we got a conflict ...

foo was removed but we want to keep it!

Q: What can we do?


git rebase --interactive
© Sergey Dolya — www.sergeydolya.com
downloaded from pickywallpapers.com

Let's fix this

We don't want to remove foo!

```
$ git rebase --abort
...

$ git rebase --interactive dev
???
```

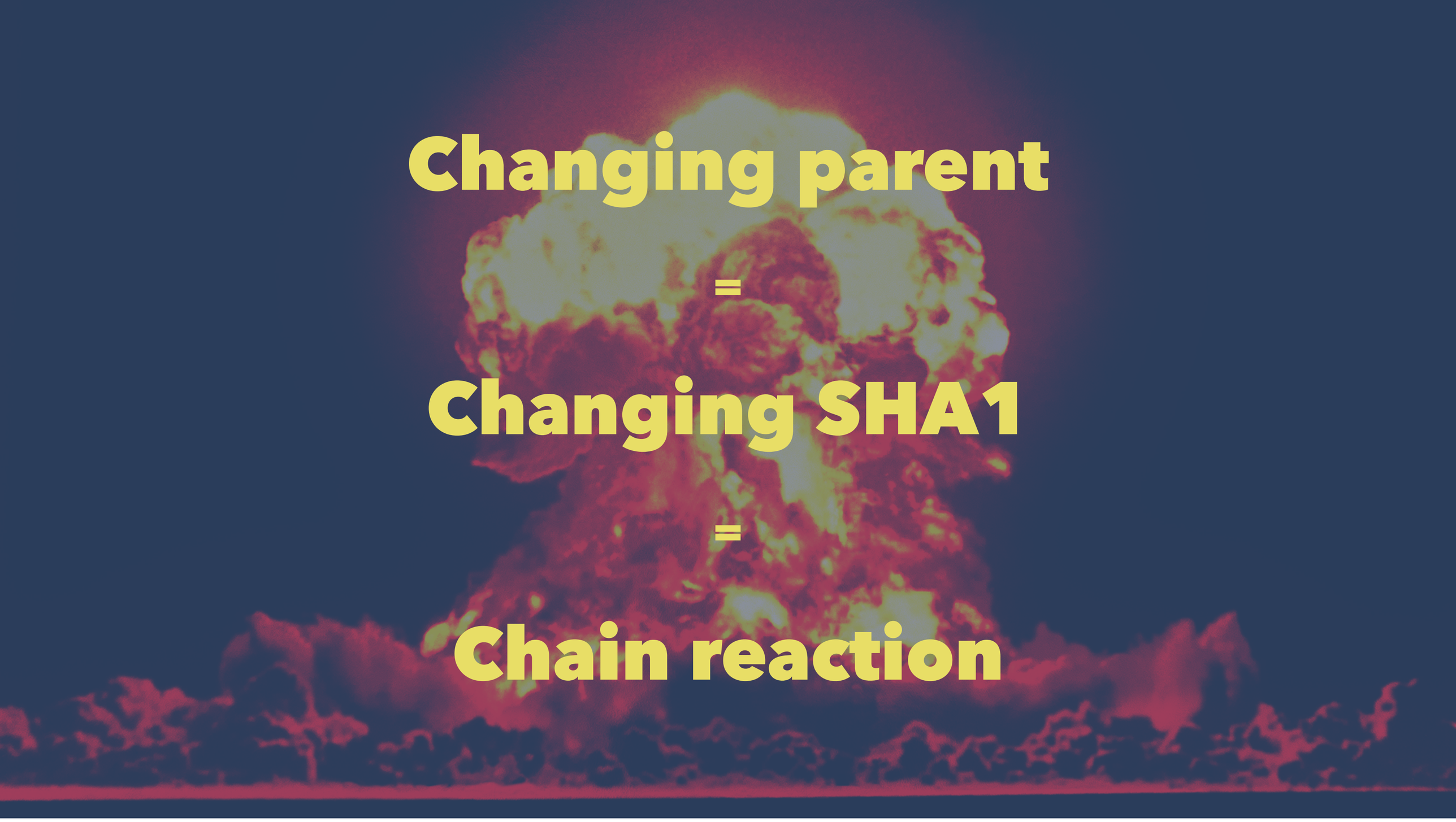
Avoid rebasing pushed commits!

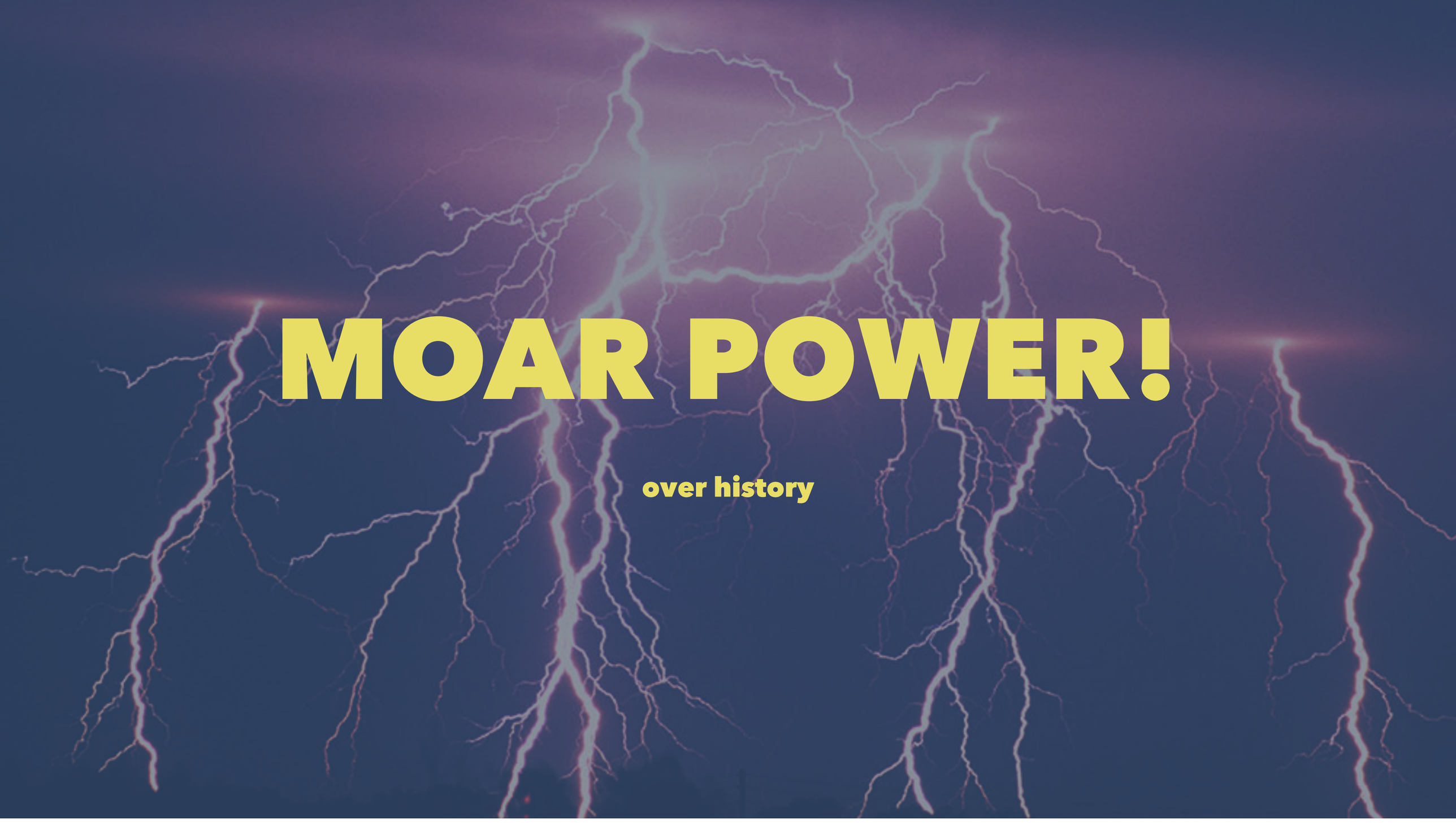
Q: Do you know why?

`rebase` rewrites history

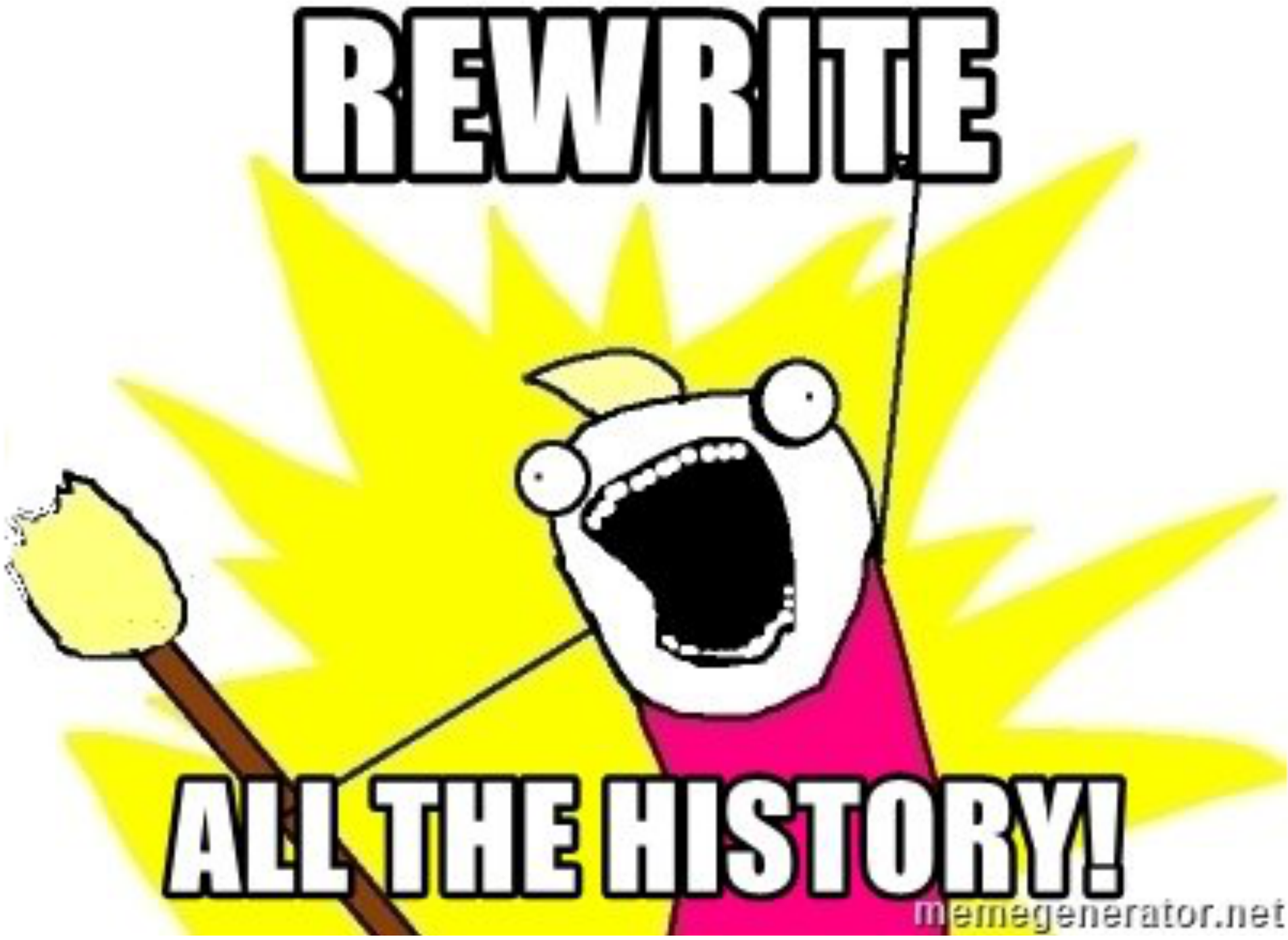
with great power comes great responsibility

Q: Why is that bad?


Changing parent
=
Changing SHA1
=
Chain reaction


MOAR POWER!
over history

git filter-branch



Lot's of ways to rewrite history

`git filter-branch`

Allows to rewrite

```
--env-filter <command>
--index-filter <command>
--msg-filter <command>
--parent-filter <command>
--subdirectory-filter <directory>
--tag-name-filter <command>
--tree-filter <command>
```

Need to remove a sensitive file from all commits?

`tree-filter` to the rescue

Honourable mentions

- `cherry-pick`: "copy" one+ commits onto the current branch
- `clean`: remove untracked files and folders
- `commit --amend`: include added changes in last commit
- `grep`: search pattern in tracked files
- `worktree`: checkout a reference into another worktree

[2] http://sethrobertson.github.io/GitBestPractices

IN CASE OF FIRE

Git Commit

Git Push

Git Out

Commit often
Perfect later
Publish once

You can use interactive rebase for "Perfect later"

Use shortlived branches

or at least merge upstream work regularly

Do not rewrite published history!

N: Otherwise your colleagues might do this


ORBO

Commit Messages

Commit Messages

`<Topic|File>: <Short description> (50 characters sort limit)`

`<More detailed description> (bullet points are fine)`
`- problem (what is the issue with the current implementation)`
`- choosen approach with reasoning`
`- maybe rejected approaches`

Use imperativ

`Add foo` instead of `Added foo`

N: Don't do this

	COMMENT	DATE
	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
	ENABLED CONFIG FILE PARSING	9 HOURS AGO
	MISC BUGFIXES	5 HOURS AGO
	CODE ADDITIONS/EDITS	4 HOURS AGO
	MORE CODE	4 HOURS AGO
	HERE HAVE CODE	4 HOURS AGO
	AAAAAAAA	3 HOURS AGO
	ADKFJSLKDFJSDKLFJ	3 HOURS AGO
	MY HANDS ARE TYPING WORDS	2 HOURS AGO
	HAAAAAAAAAANDS	2 HOURS AGO

AS A PROJECT DRAGS ON, MY GIT COMMIT MESSAGES GET LESS AND LESS INFORMATIVE.


Thank you