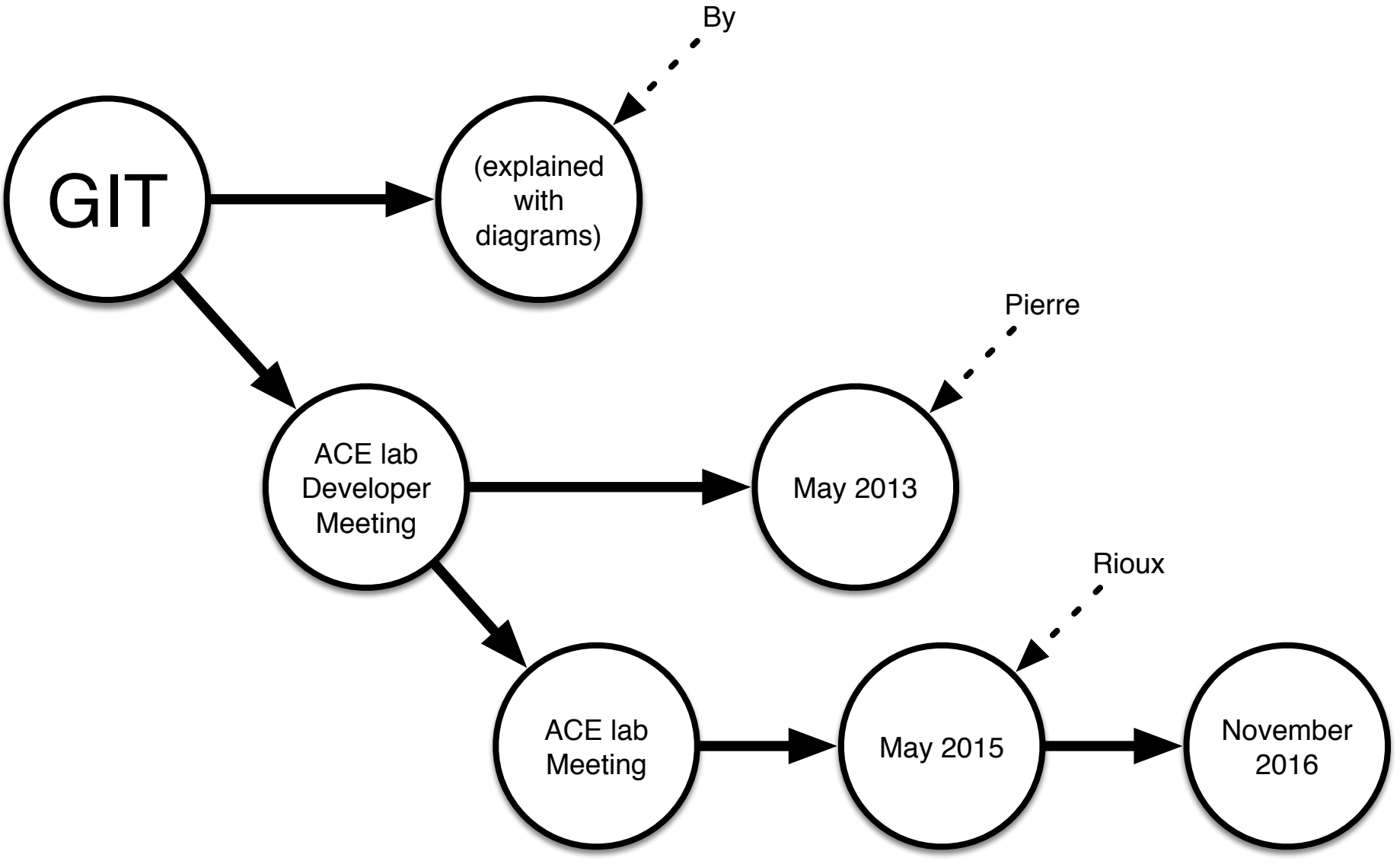

Revised again: October 2019

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Part 1: Basic Concepts

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- commits
- commit graph
- branches
- merging
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- repositories
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- multiple repositories
- repo convention
- commit races

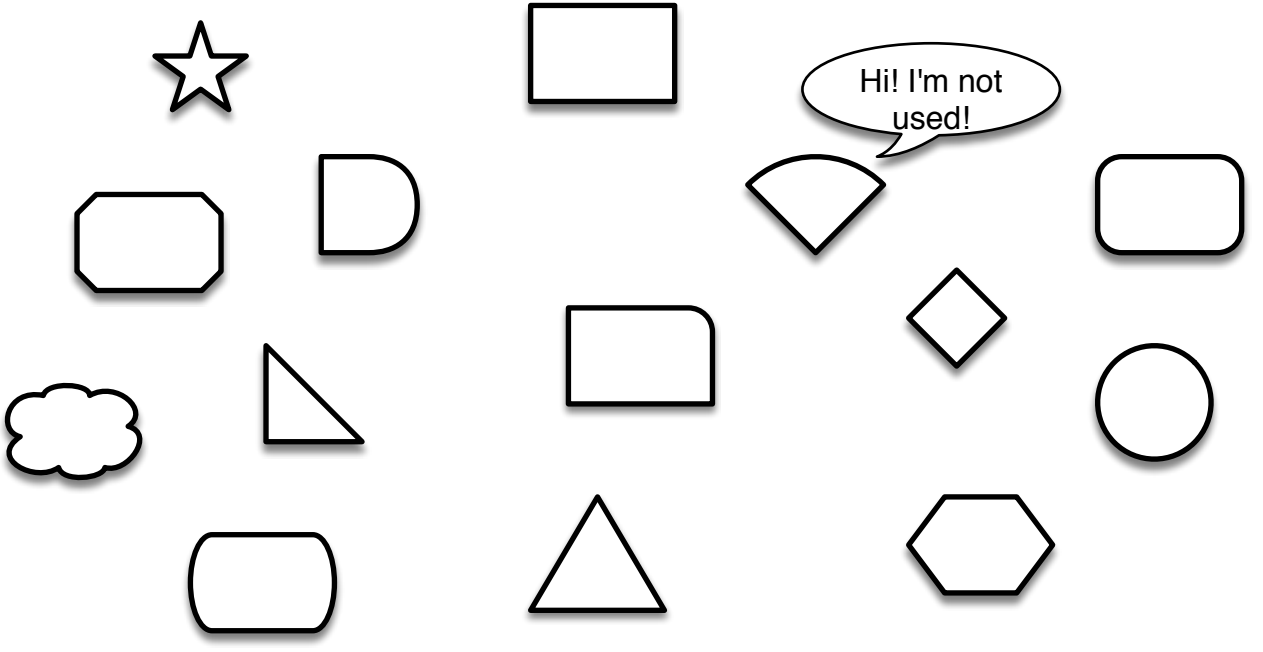
Part 2: Working With GIT

- git init work area
- git clone
- checking out
- staging area == index
- three trees
- operations graph
- git status
- git commit
- git pull and push
- conflicts
- manual merge
- recap whole cycle

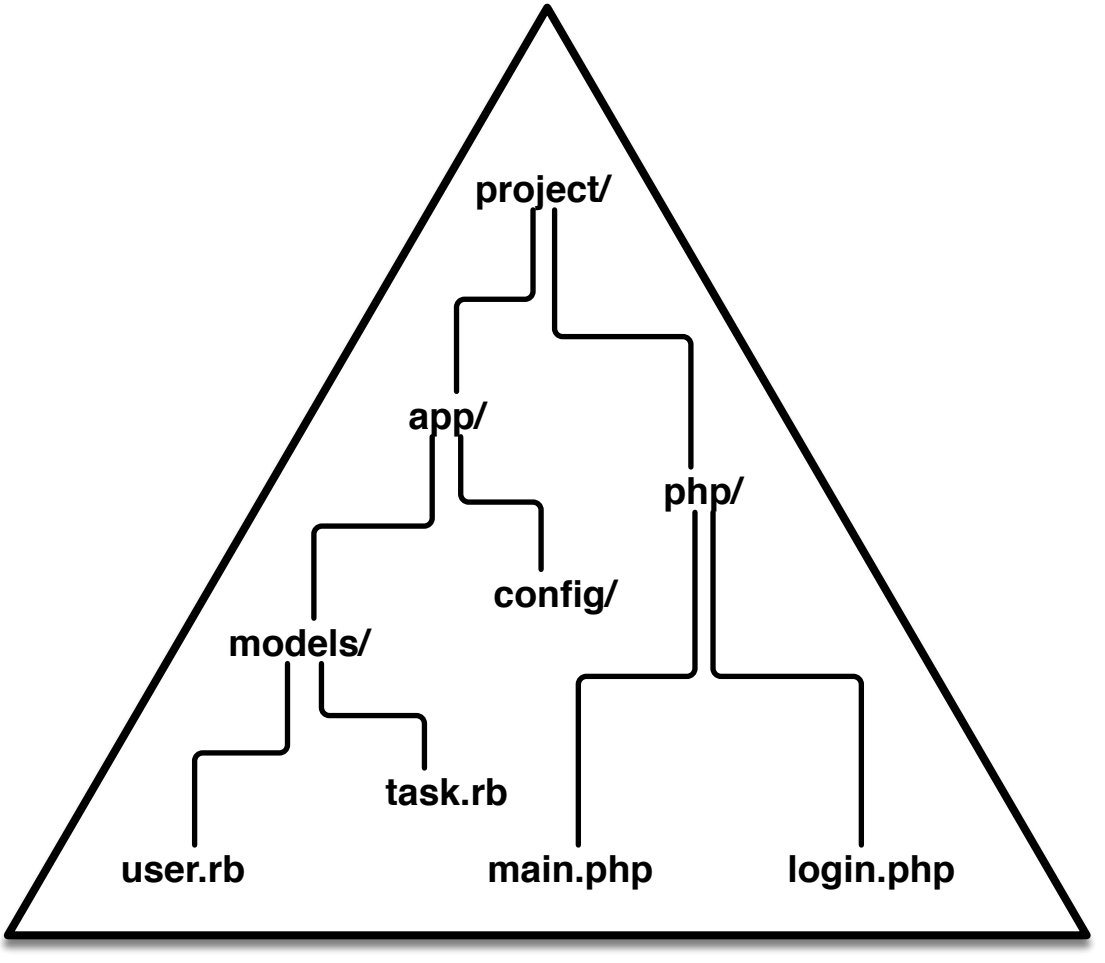
Rejoice, for this is the only slide with bullet points!

Part 1: Basic Concepts

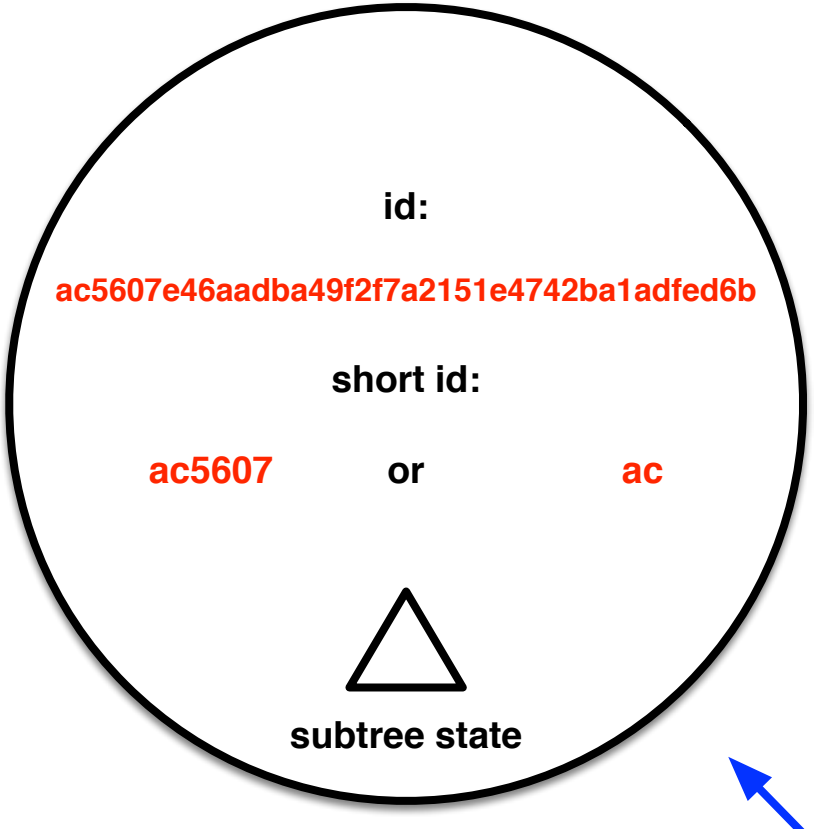
(Where we think on an abstract level and we use only three of the following shapes, unfortunately)



Triangle: a directory tree

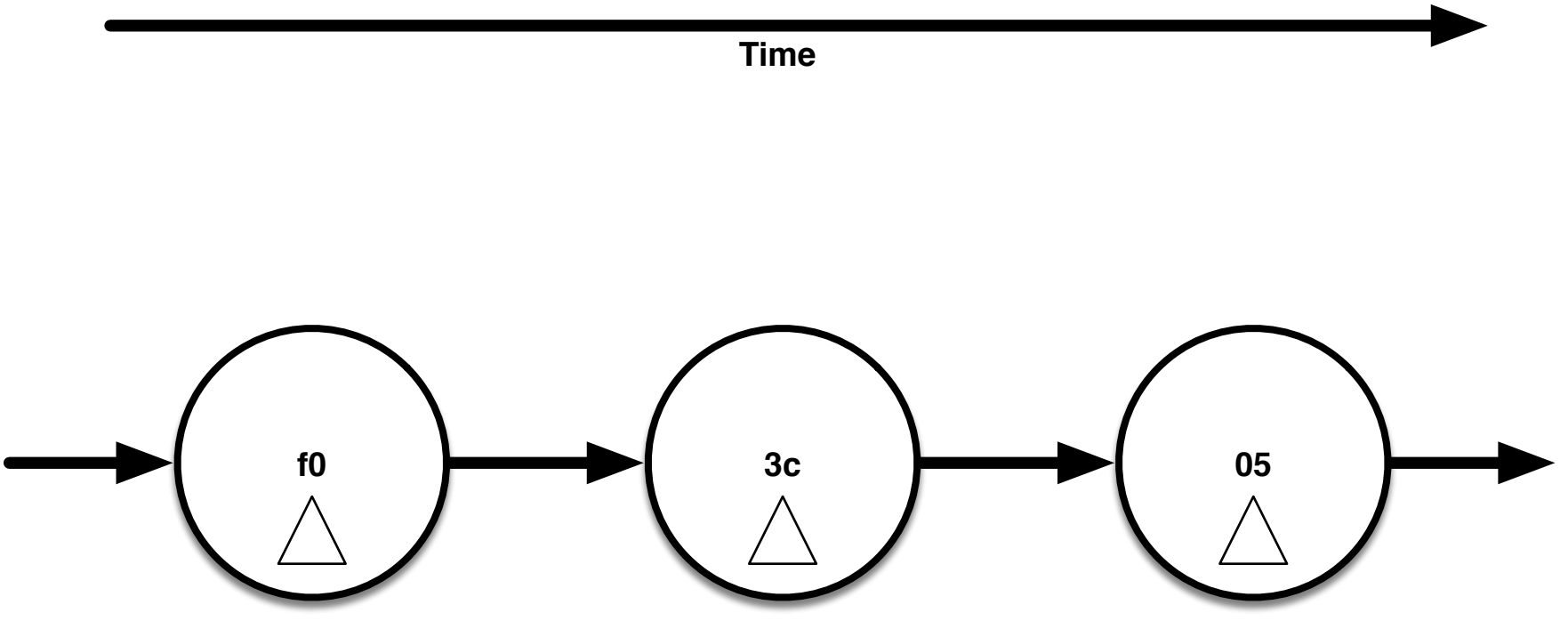


Circle: a commit



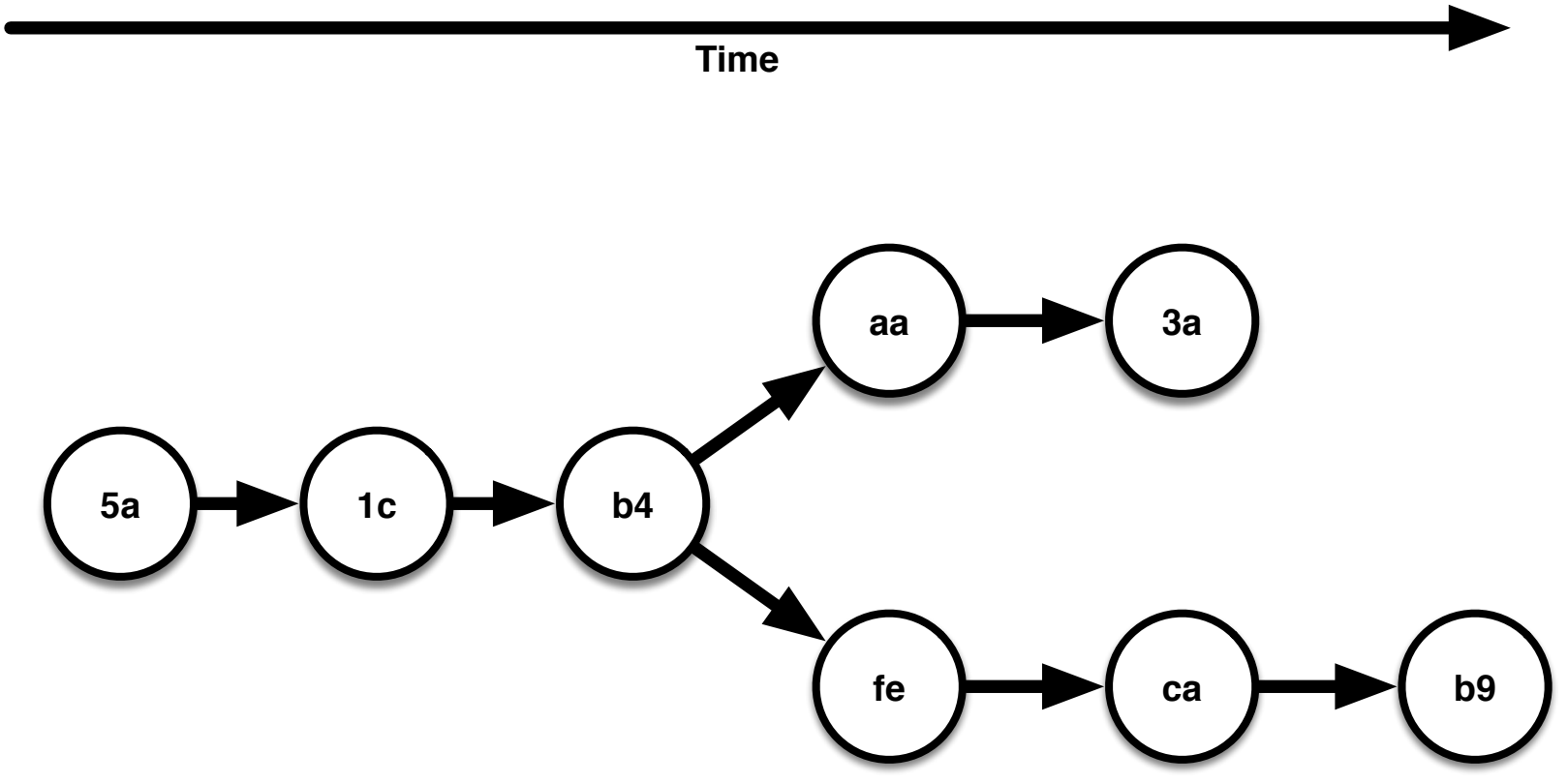
Note: basically immutable

Commit graph

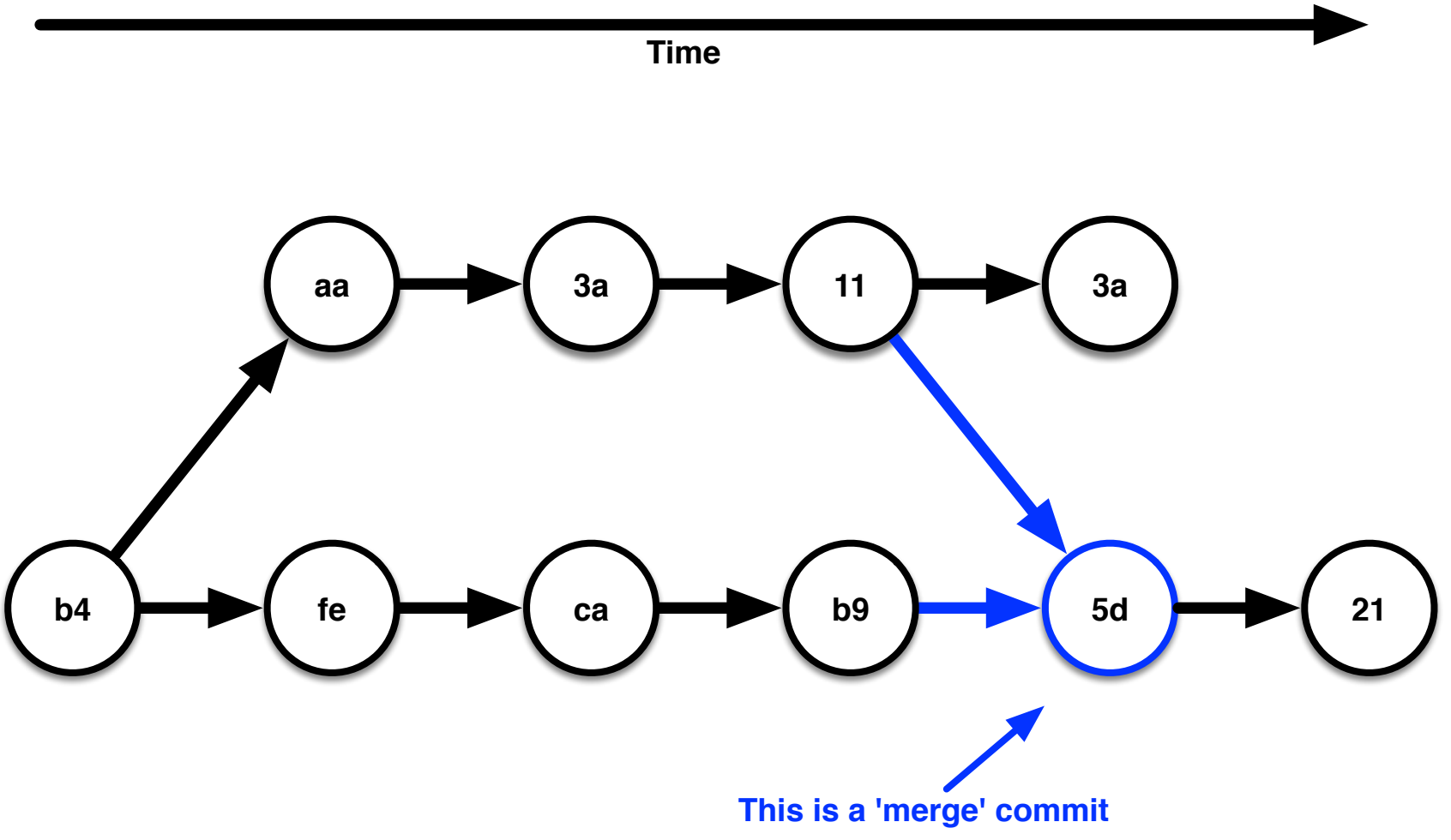


Note: in the real structure, arrows point the other way…

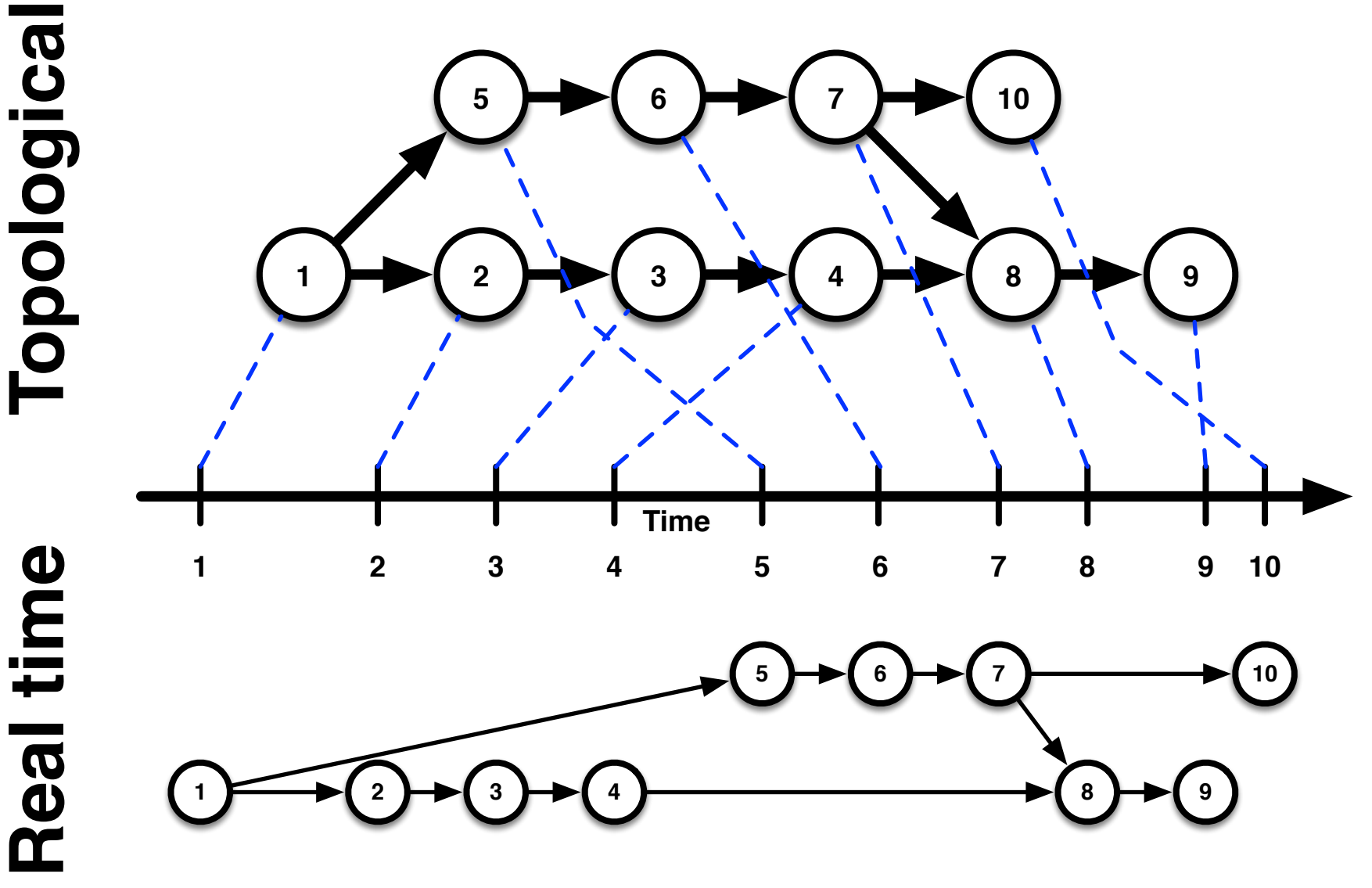
Commit graph branching



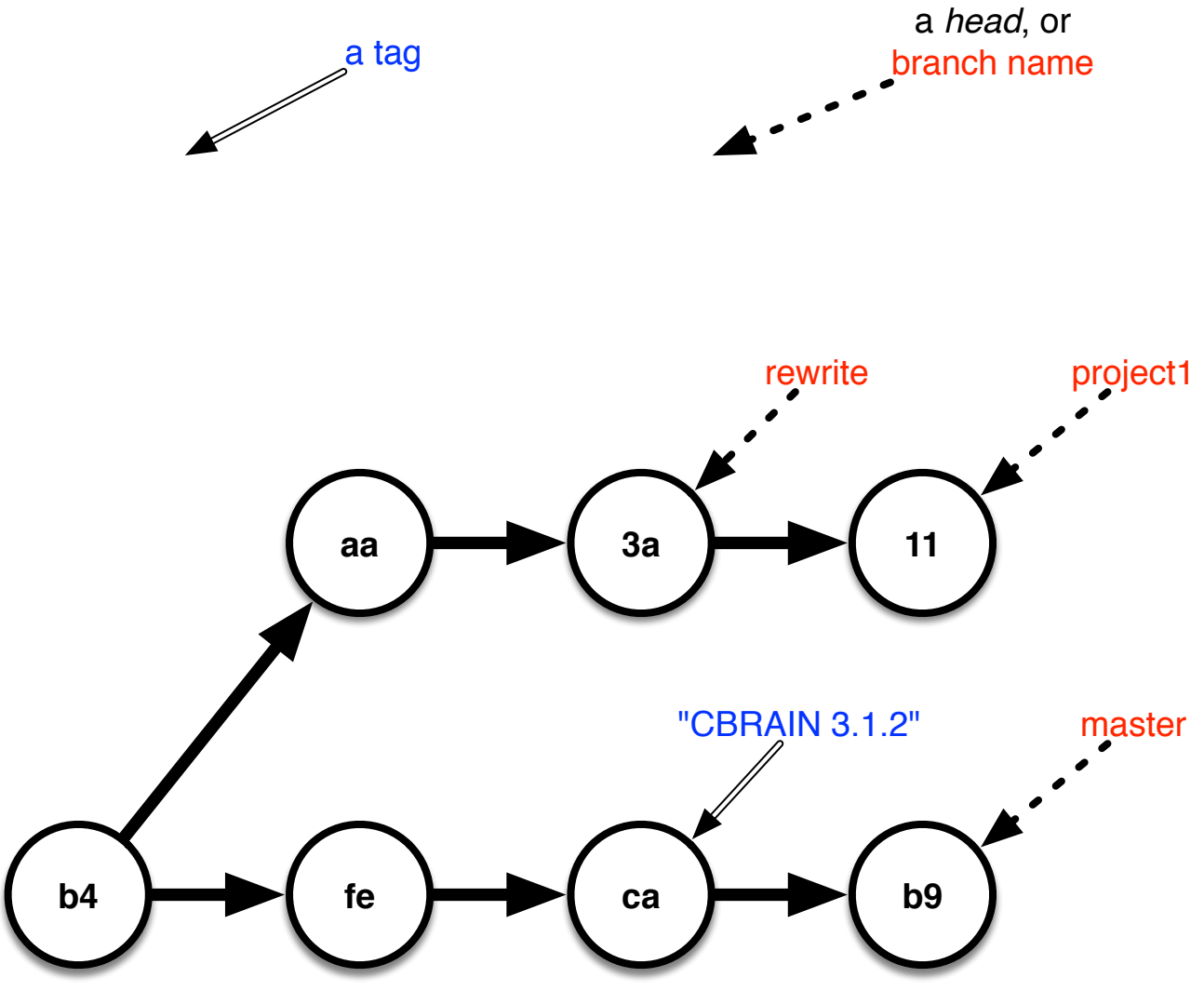
Commit graph merging



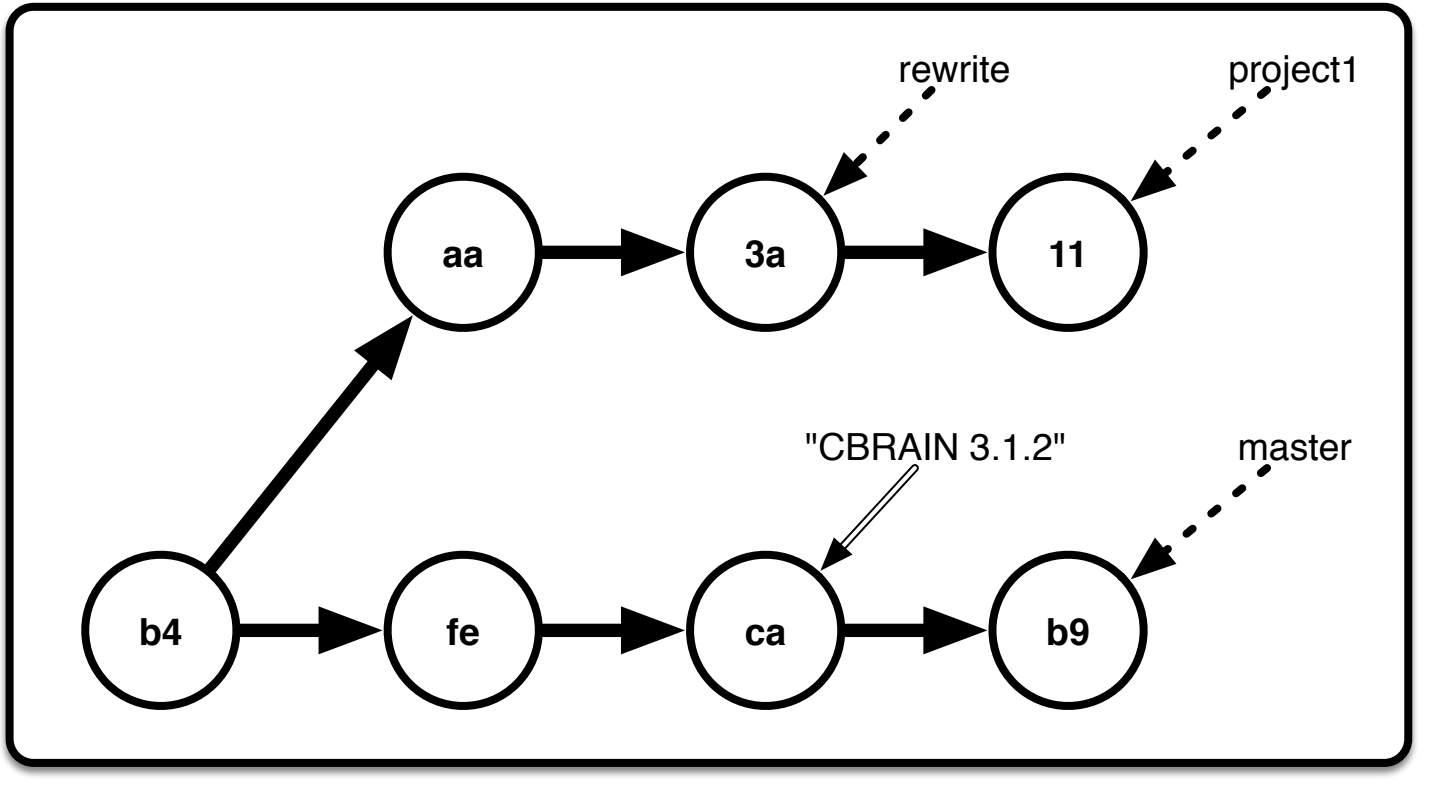
Commit graph ordering



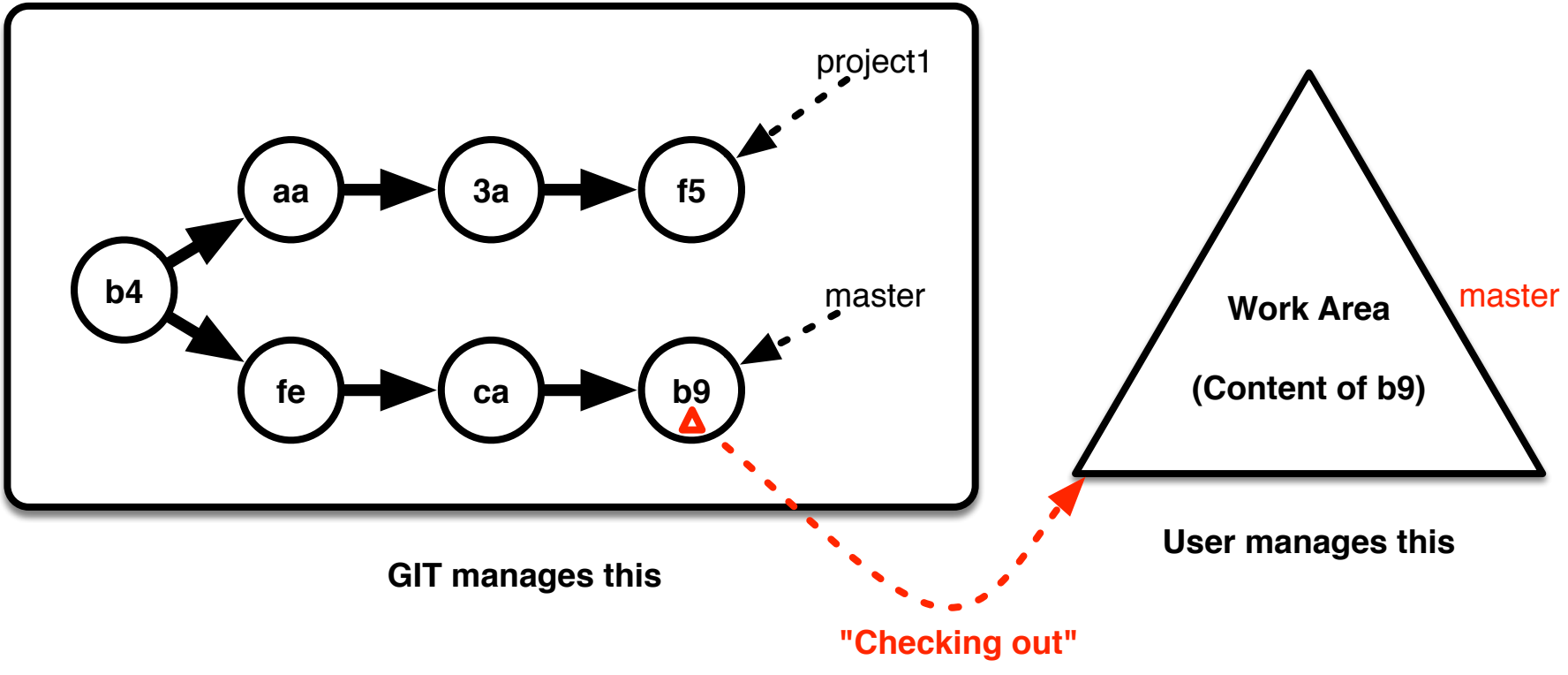
References


a tag
a *head*, or
branch name
rewrite
project1
aa
3a
11
"CBRAIN 3.1.2"
master
b4
fe
ca
b9

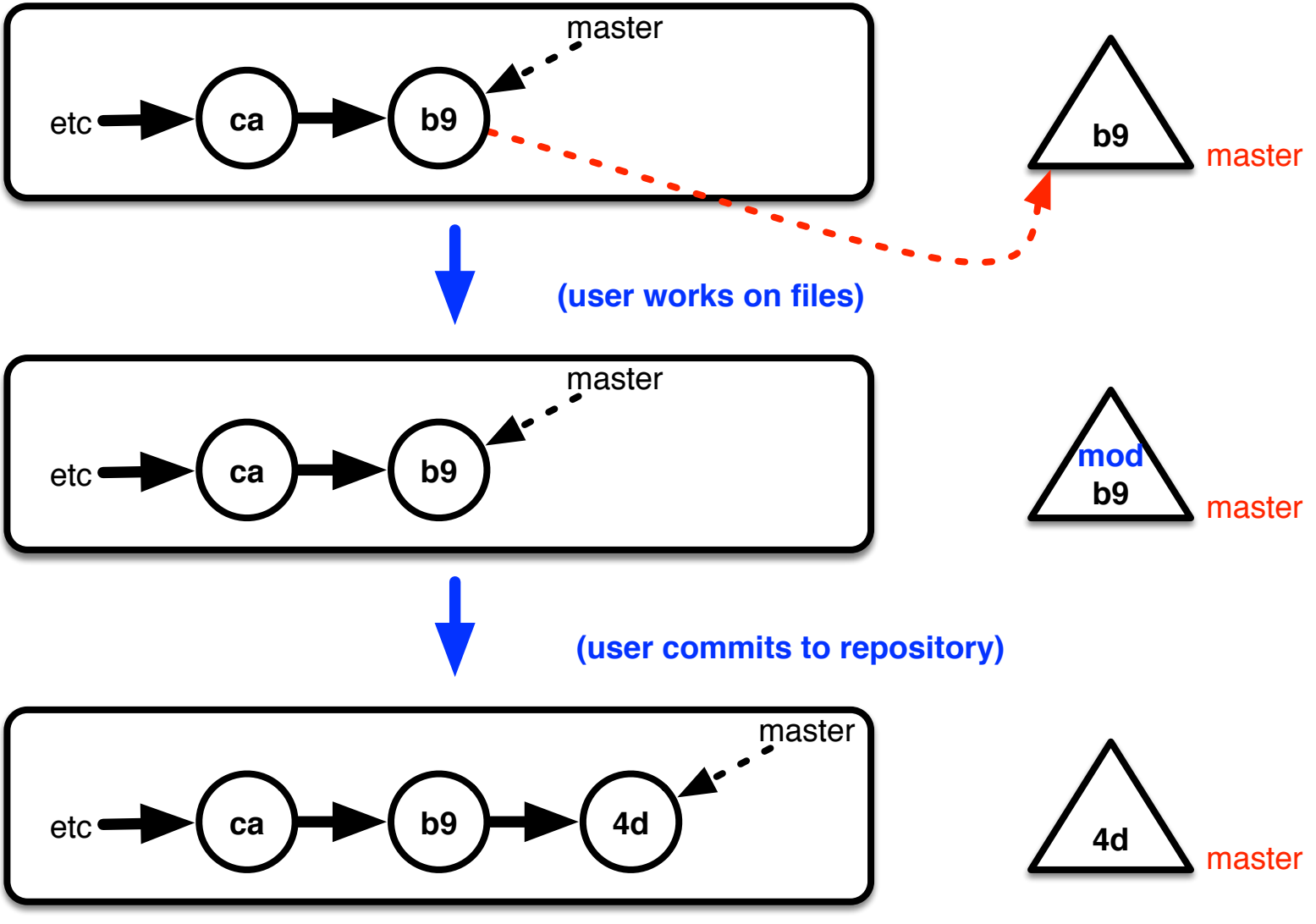
Rounded Rectangle: Bare repository



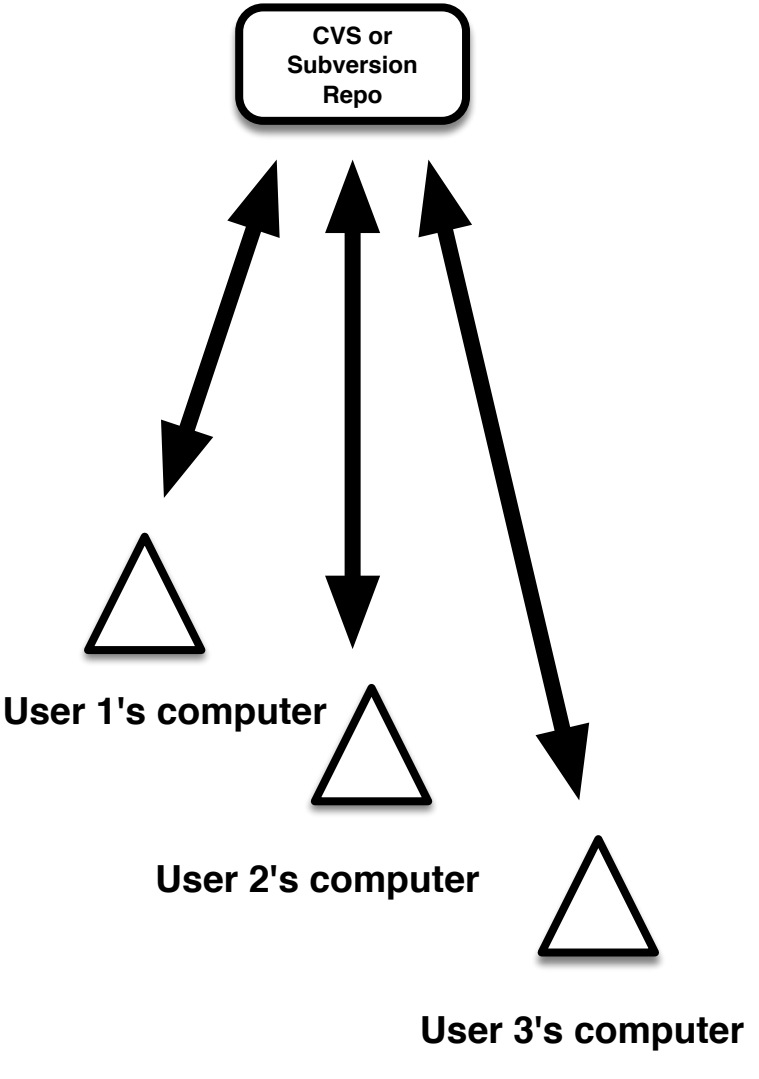
Repository + Work area

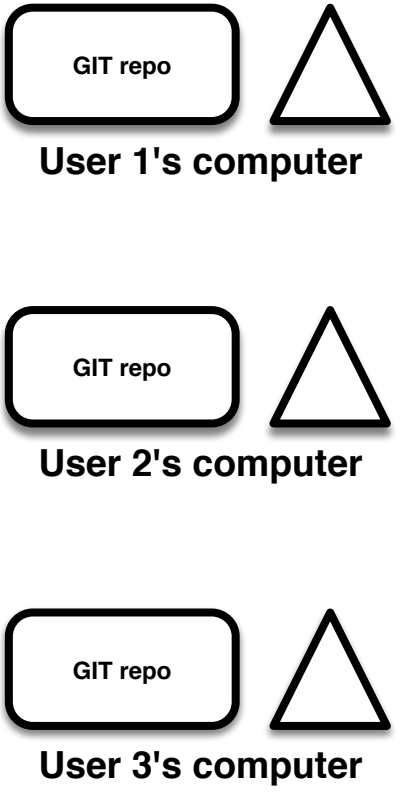


Commit progress (simplified view)

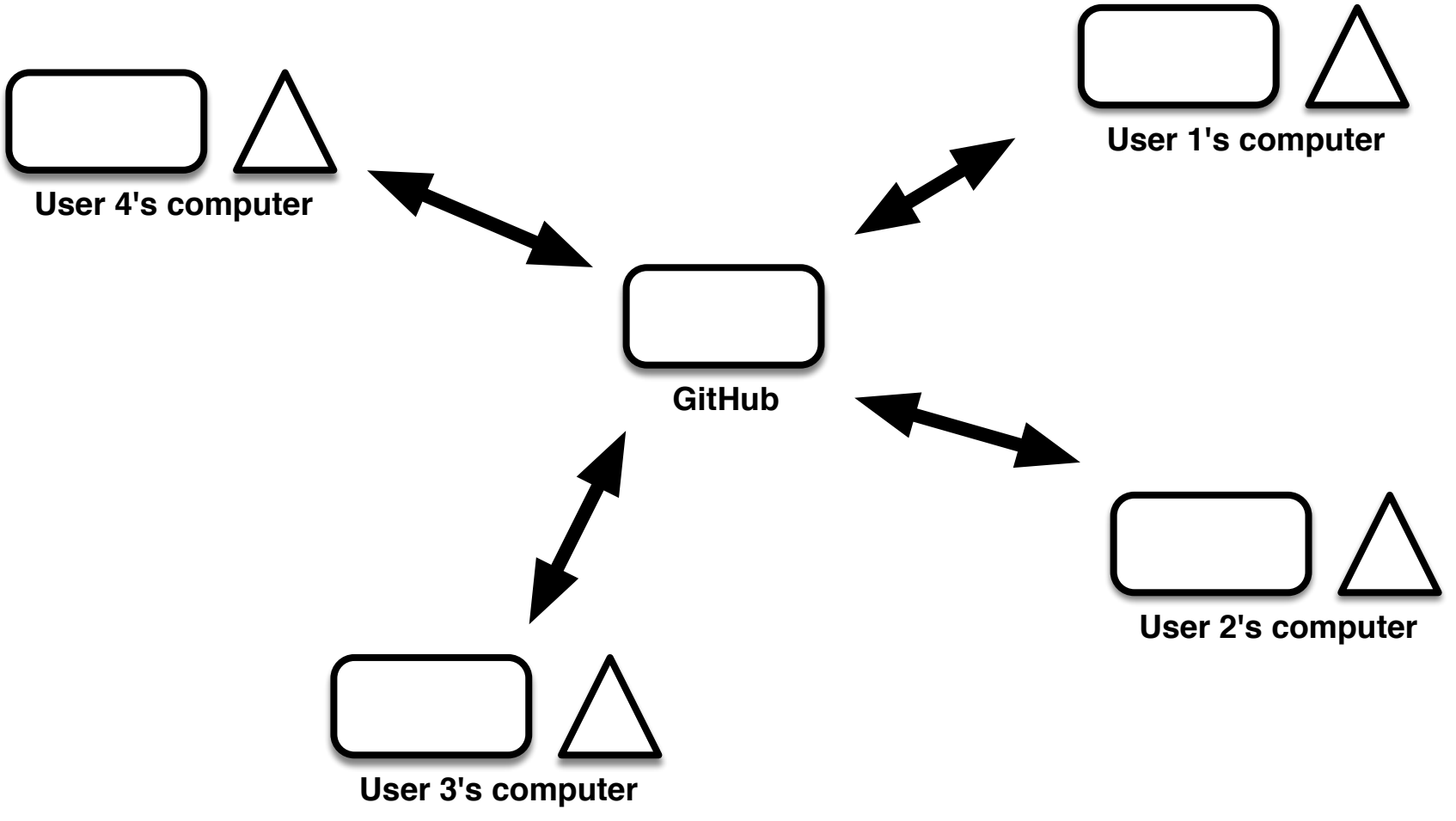


CVS/SVN vs GIT

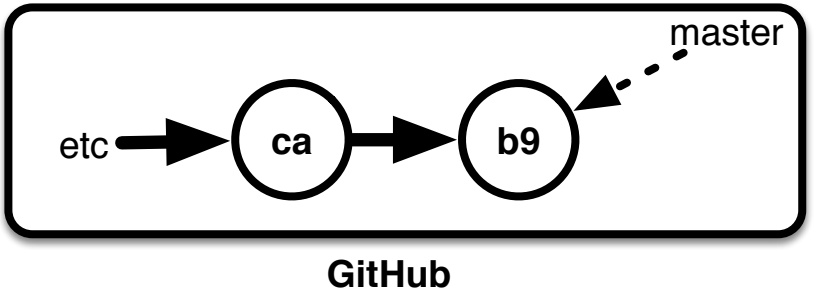




"Main Repo": purely a *convention*



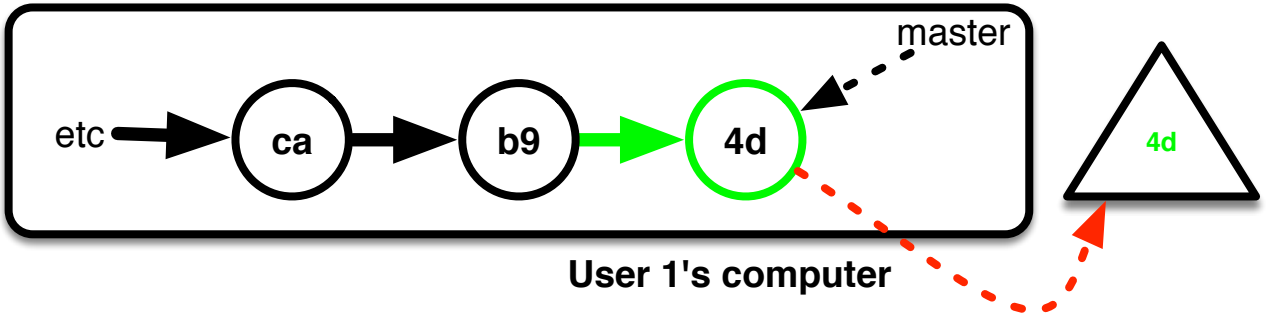
Multiple repositories



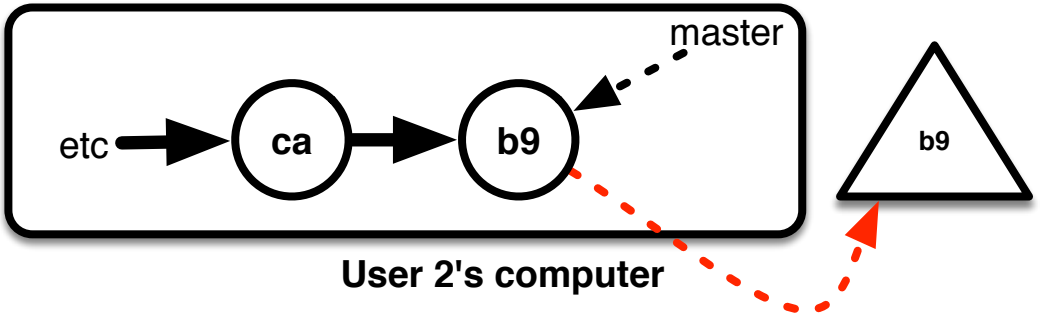
GitHub

(No triangle)

Note: there is NO checked-out directory structure at GitHub!

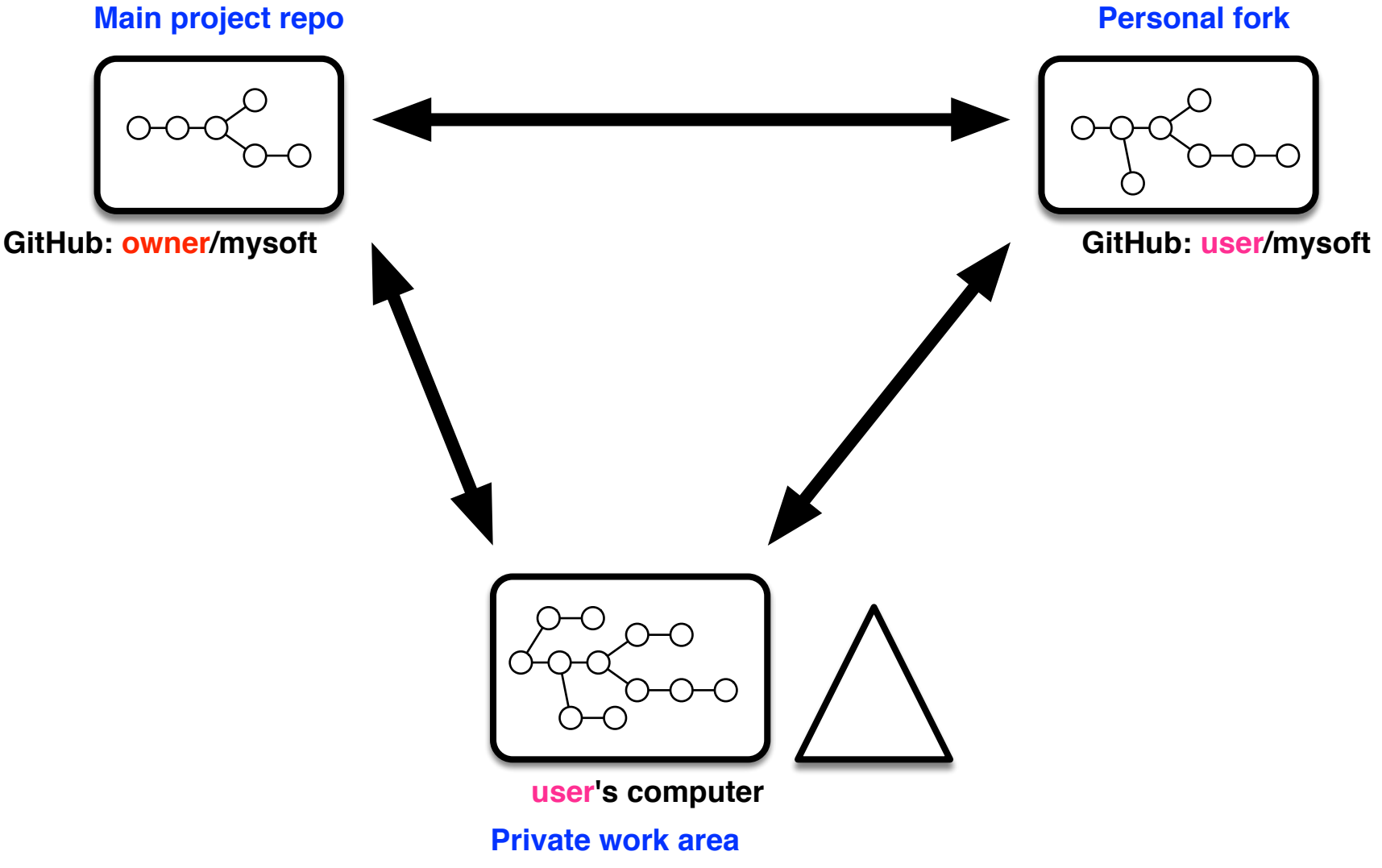


User 1's computer

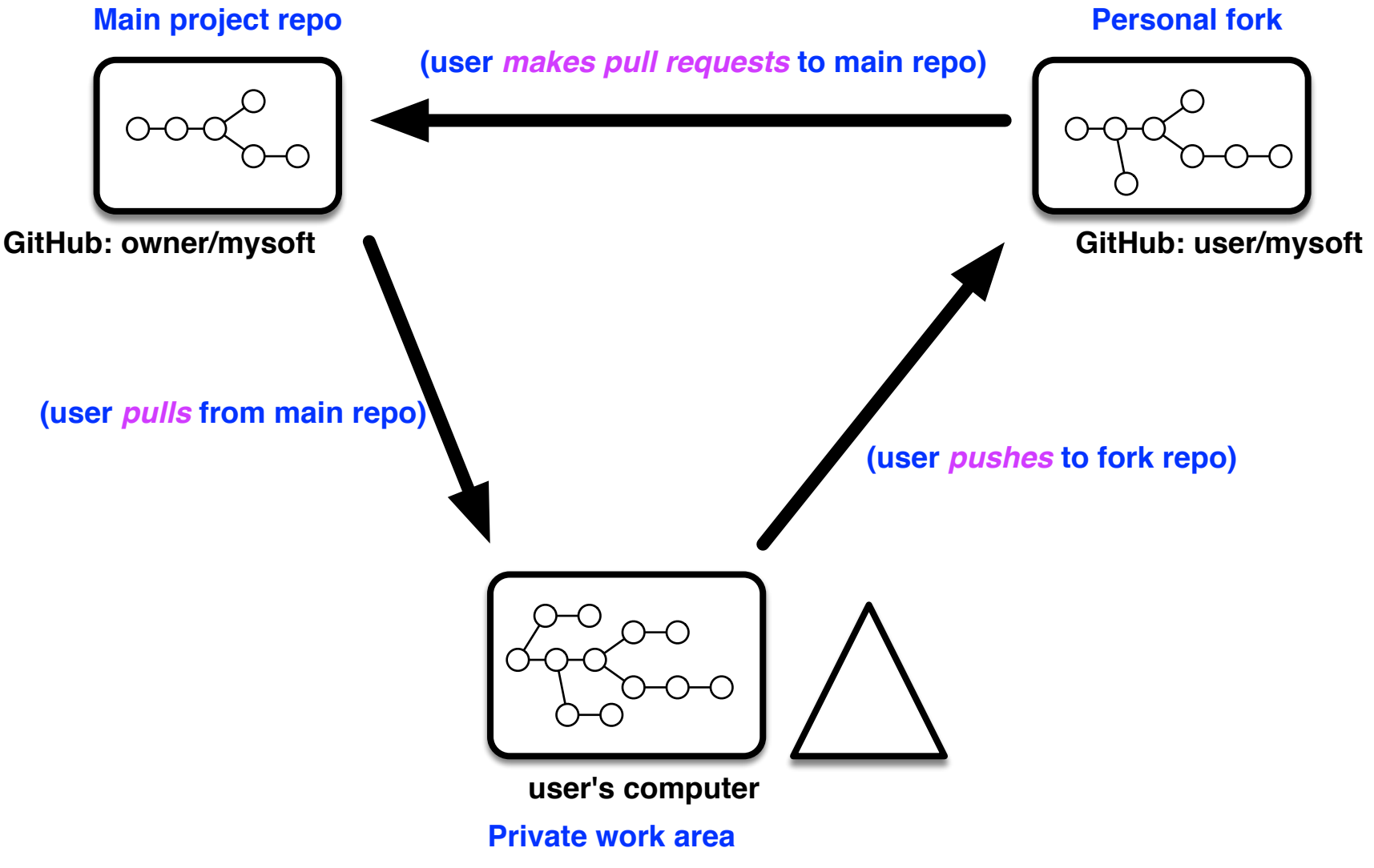


User 2's computer

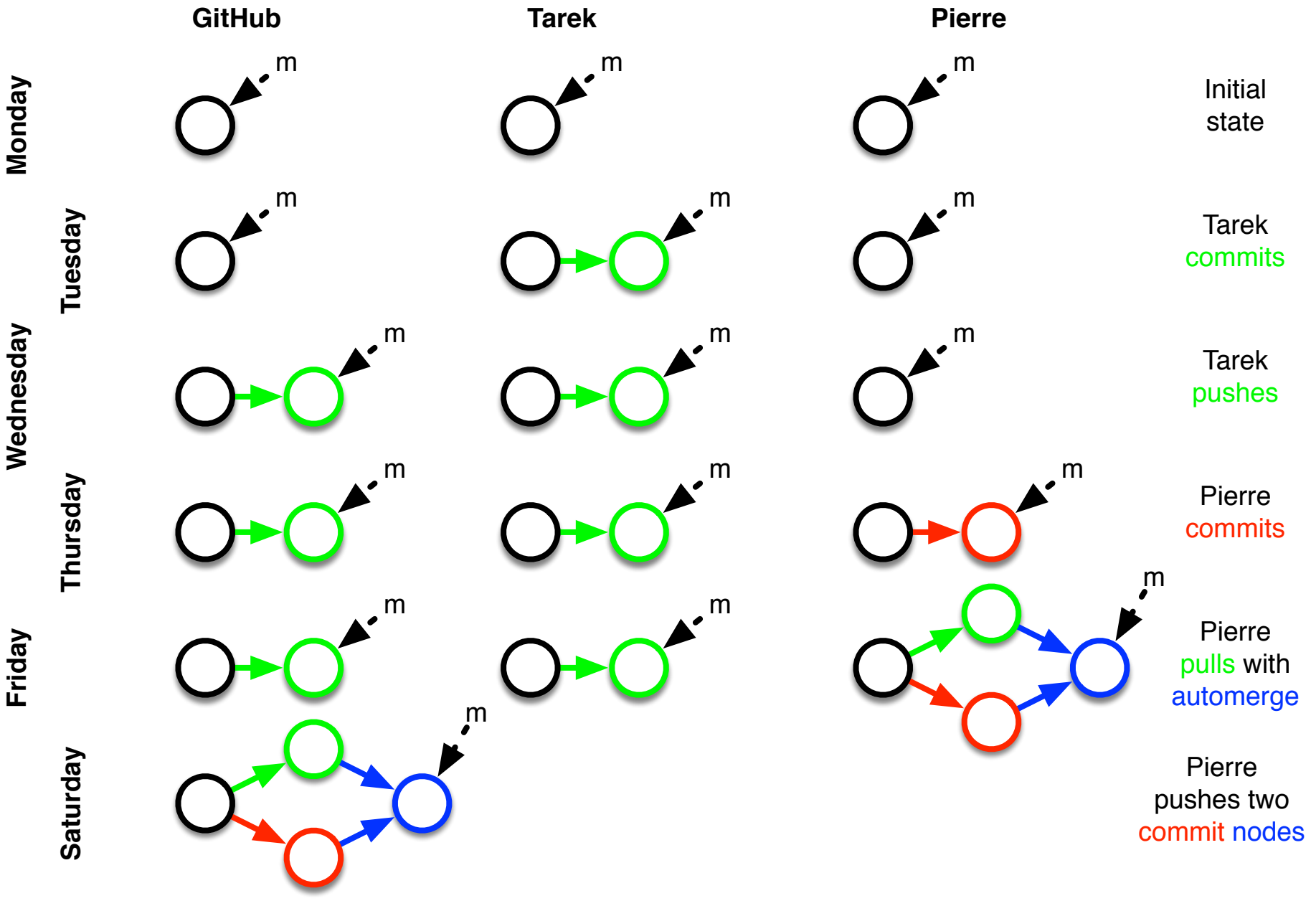
GitHub Forks



Typical Fork Workflow

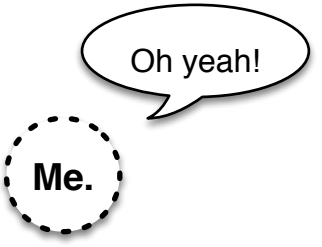


Commit races lead to merging

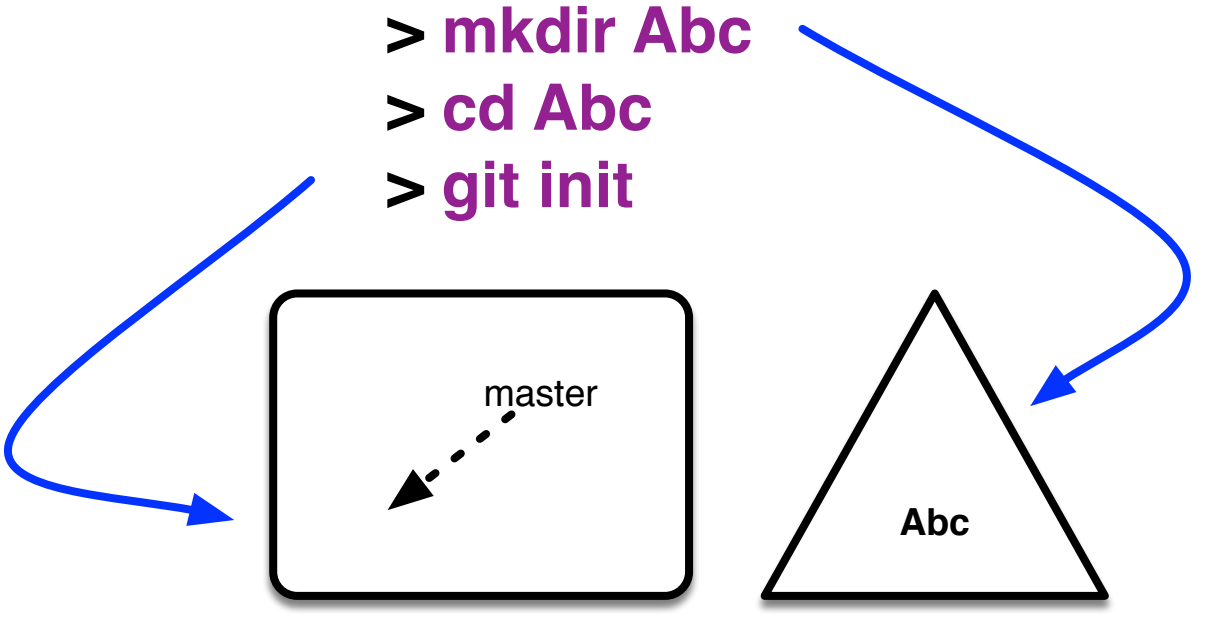


Part 2: Working With GIT

(Where we run UNIX commands and do not even introduce a single new shape, except for a dotted one)



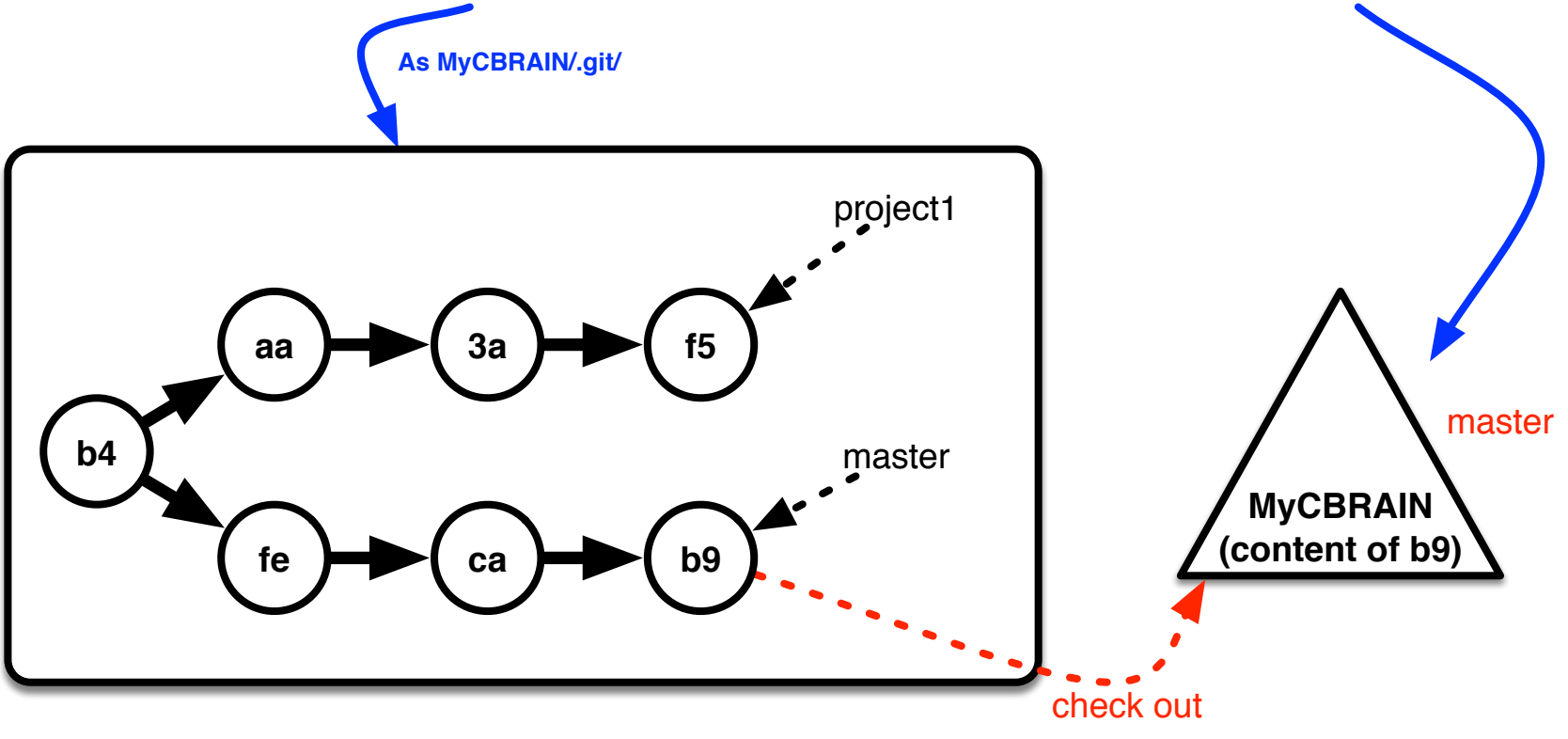
Creating your own blank GIT repository



You can also run git init in a directory that already has files; they will not be touched.

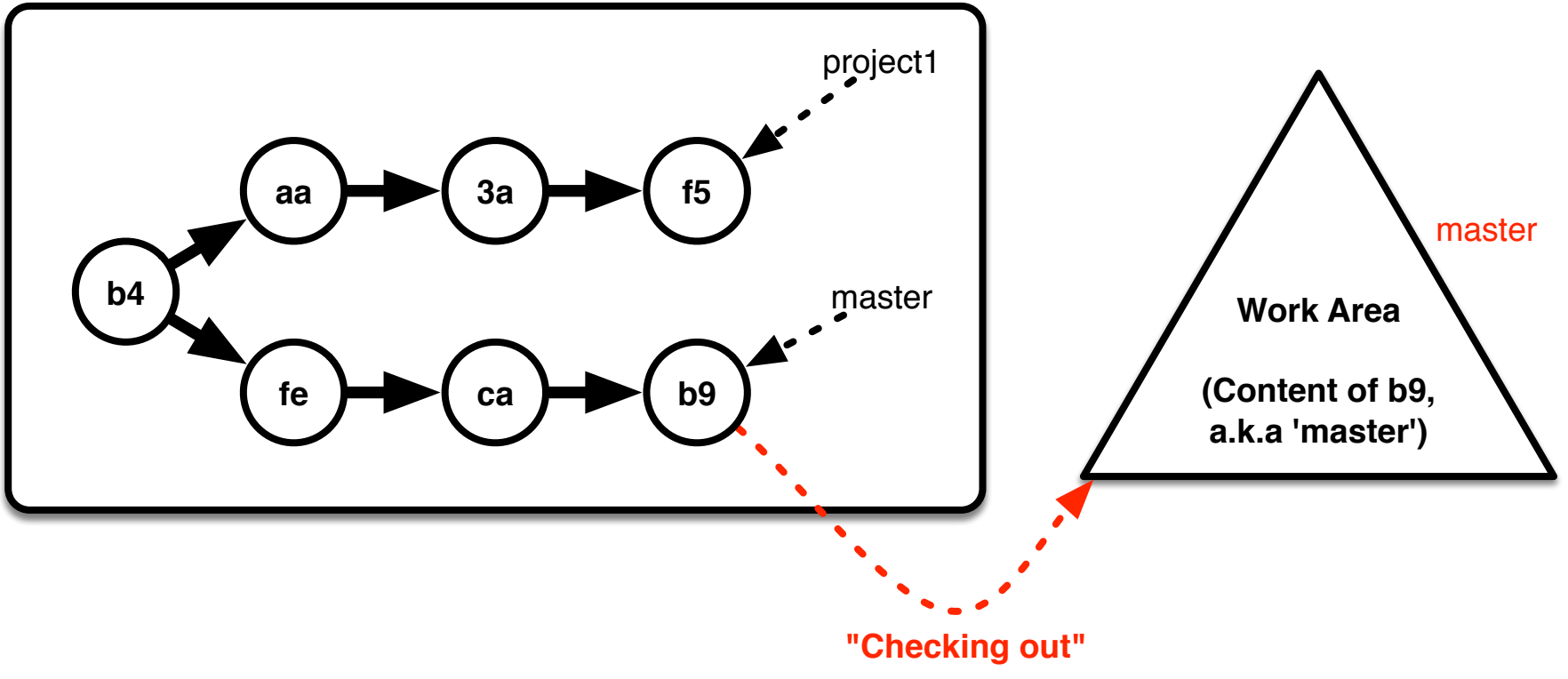
Locally cloning another repository

> git clone https://github.com/aces/cbrain.git MyCBRAIN



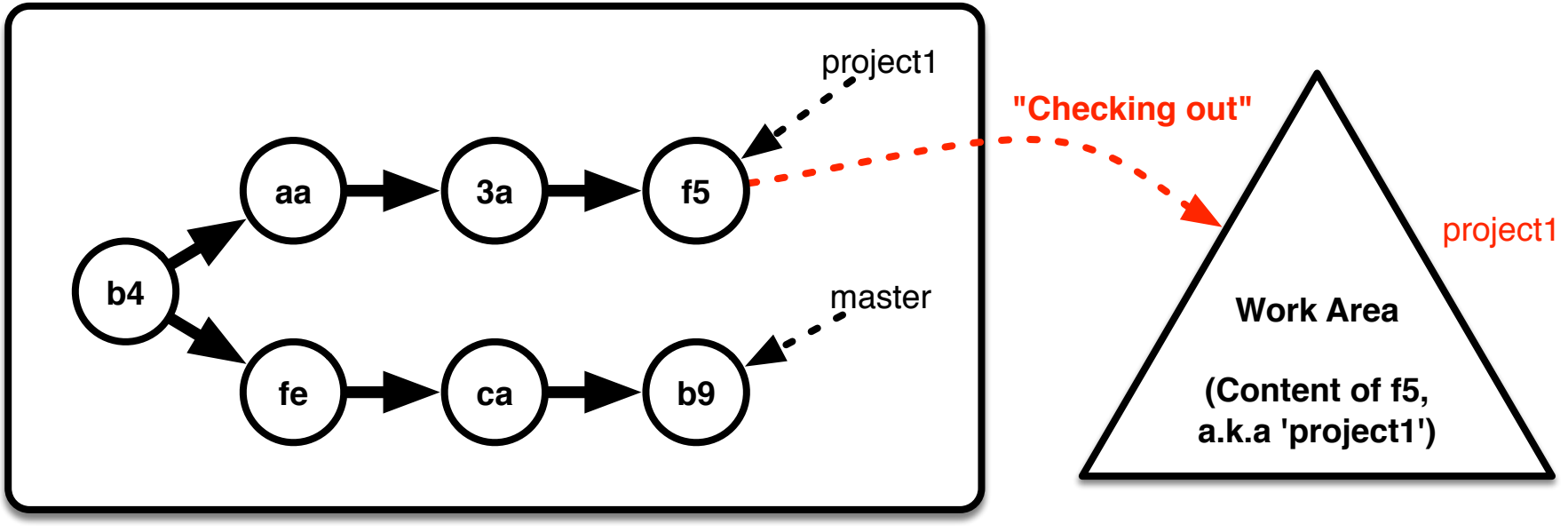
This also sets up the configuration for pulling and pushing to the remote repository on GitHub.

Checking out (1/2)



> git checkout master

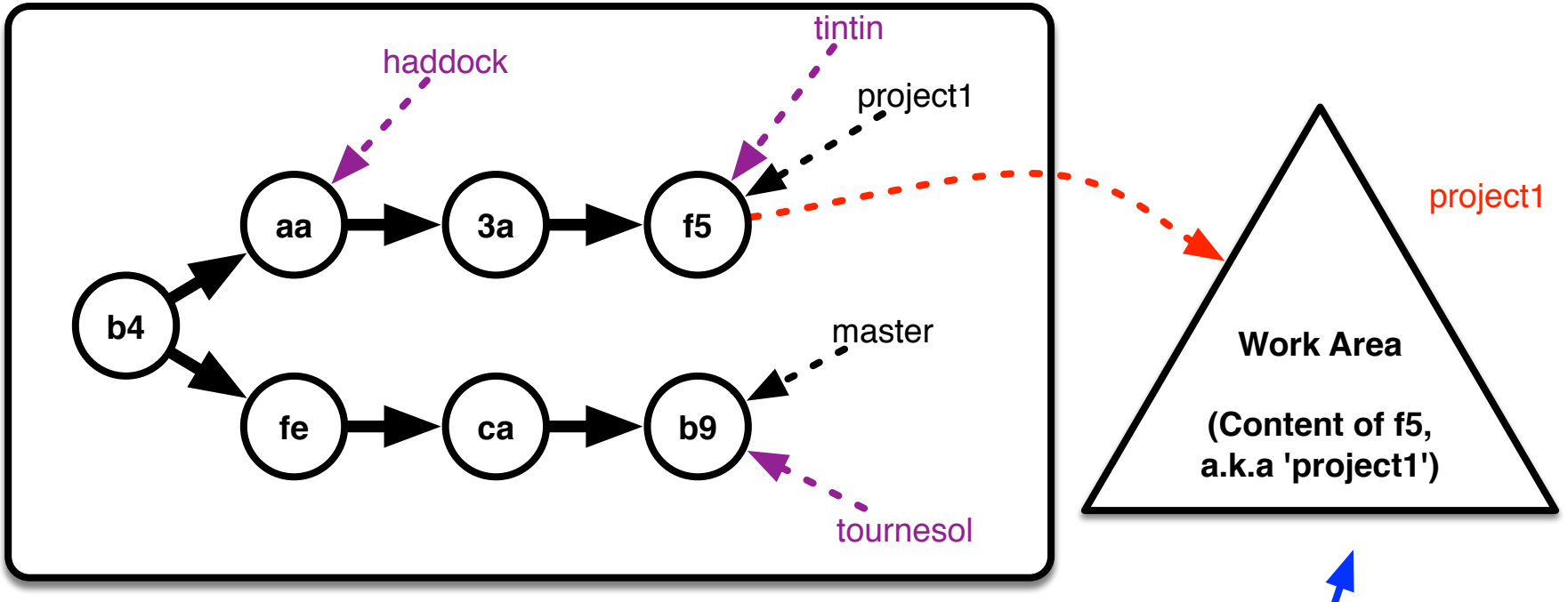
Checking out (2/2)



> git checkout project1

Note: there is **no** such concept as '**checking in**' !

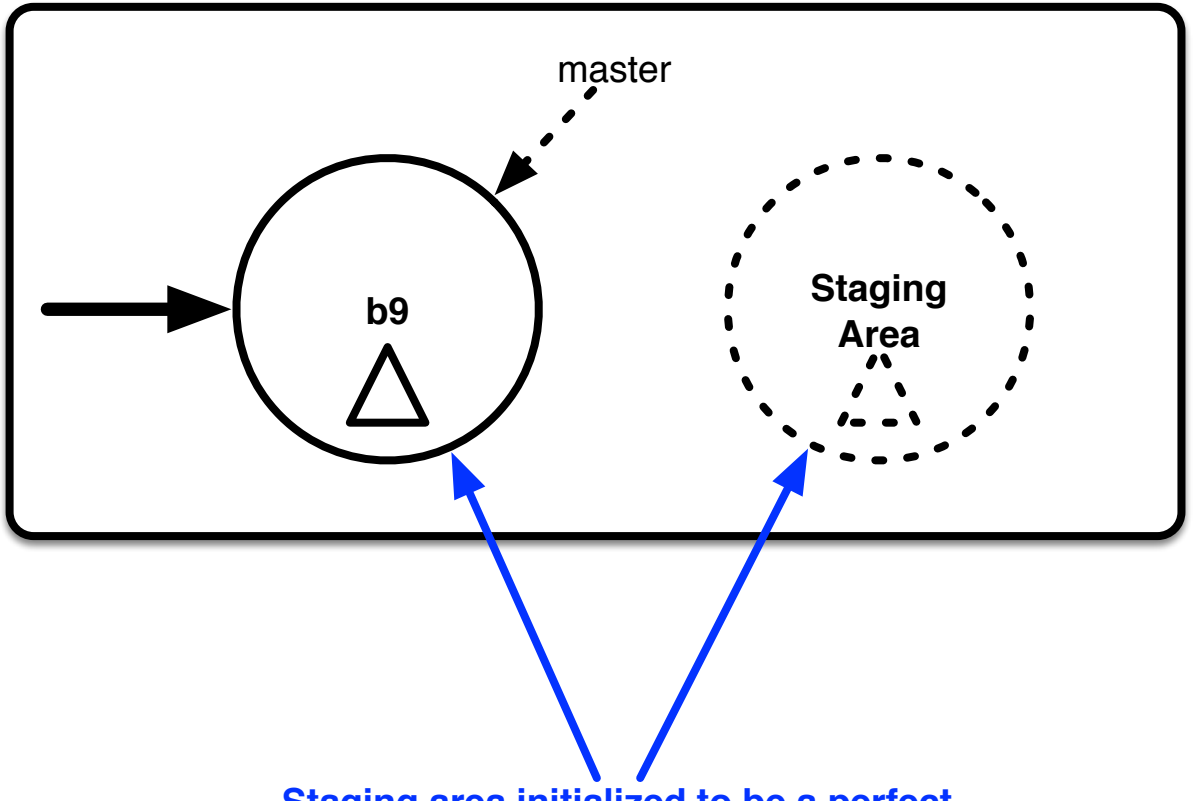
Branching out

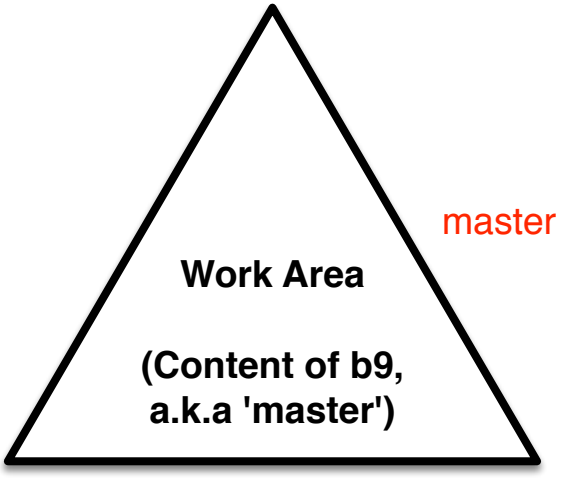


> git branch tintin
> git branch haddock aa
> git branch tournesol master

Note: nothing is modified in the current environment,
not even the currently checked out branch.

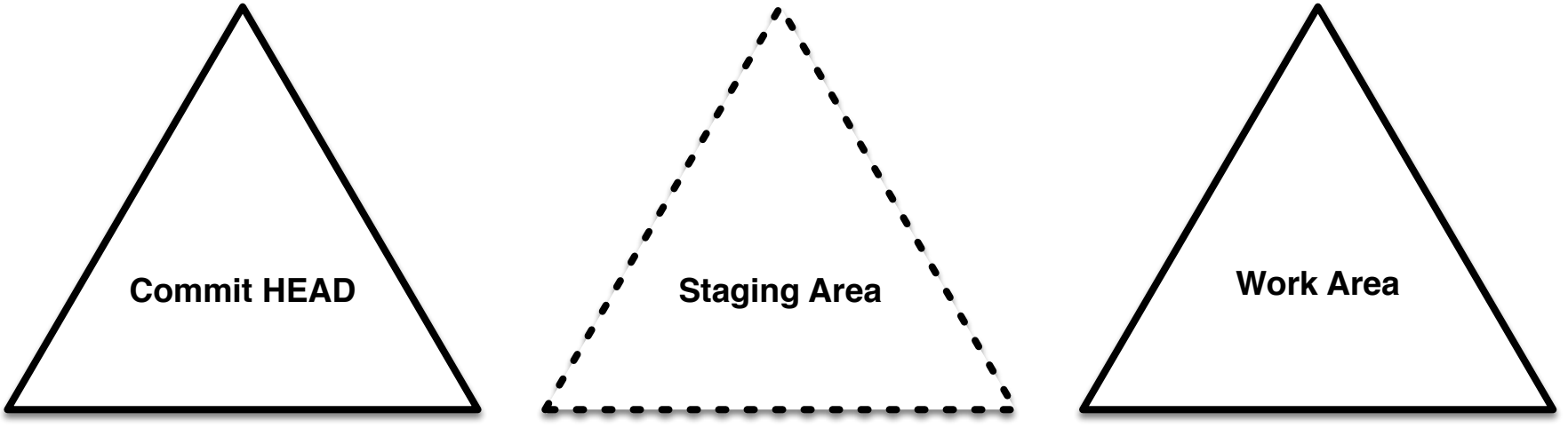
Dotted Circle: Staging area ('index')





Staging area initialized to be a perfect
shadow of HEAD of branch 'master' (b9).

Three trees

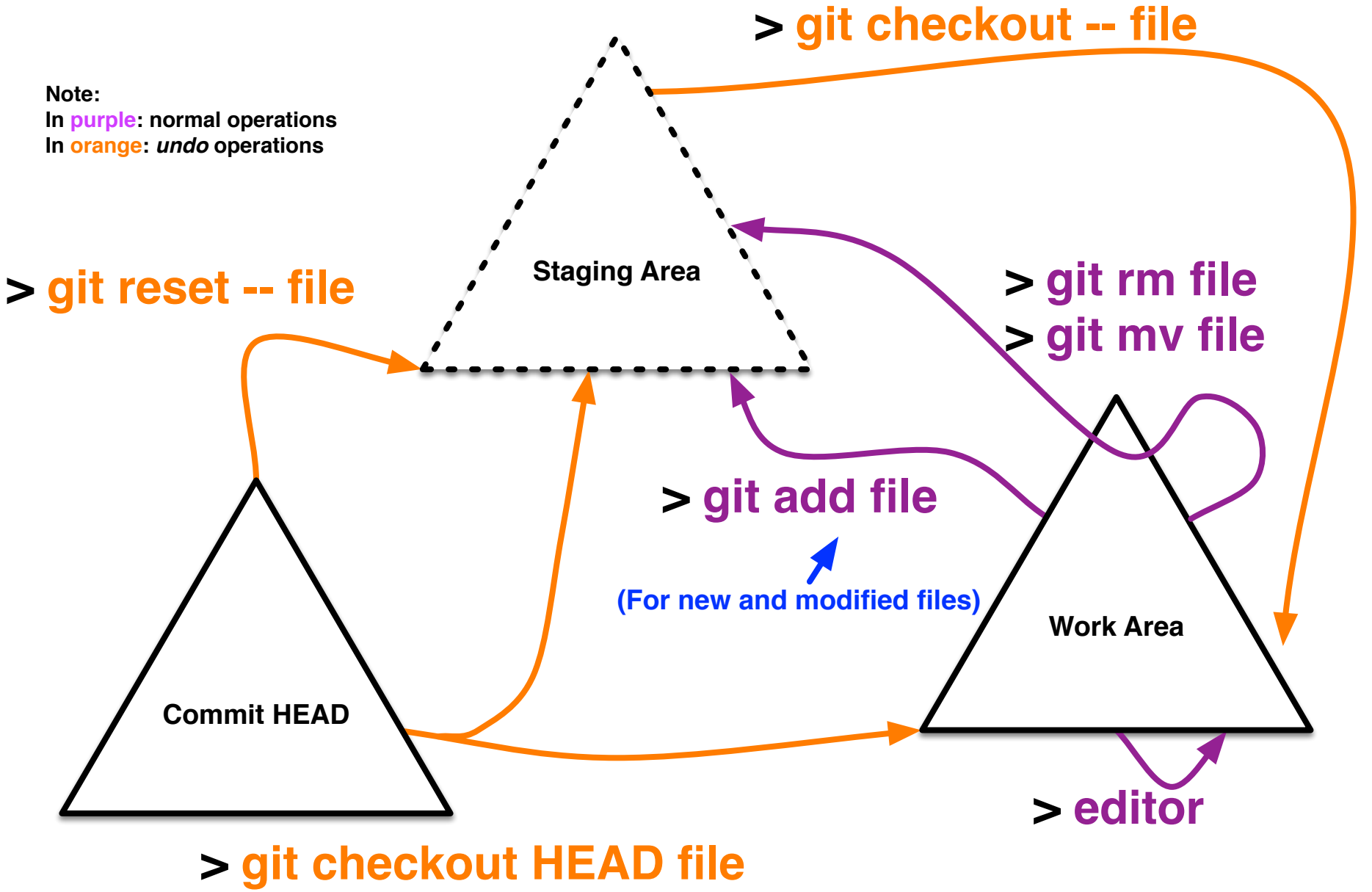


Immutable

MUST be changed using GIT commands

Can be changed using UNIX commands: editor, cp, rm, mv, etc (with caveats)

GIT operations on individual files



GIT status

```
unix> edit project_file_1
unix> edit project_file_2
unix> git add project_file_2
unix> git rm project_file_BAD
unix> edit NEW_FILE.txt
unix> git add NEW_FILE.txt
unix> git mv elizabeth.txt charles.txt
unix> touch irrelevent.txt
unix> git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#  deleted:    project_file_BAD
#  new file:   NEW_FILE.txt
#  modified:   project_file_2
#  renamed:    elizabeth.txt -> charles.txt
#
# 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:   project_file_1
#
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#  irrelevent.txt
```

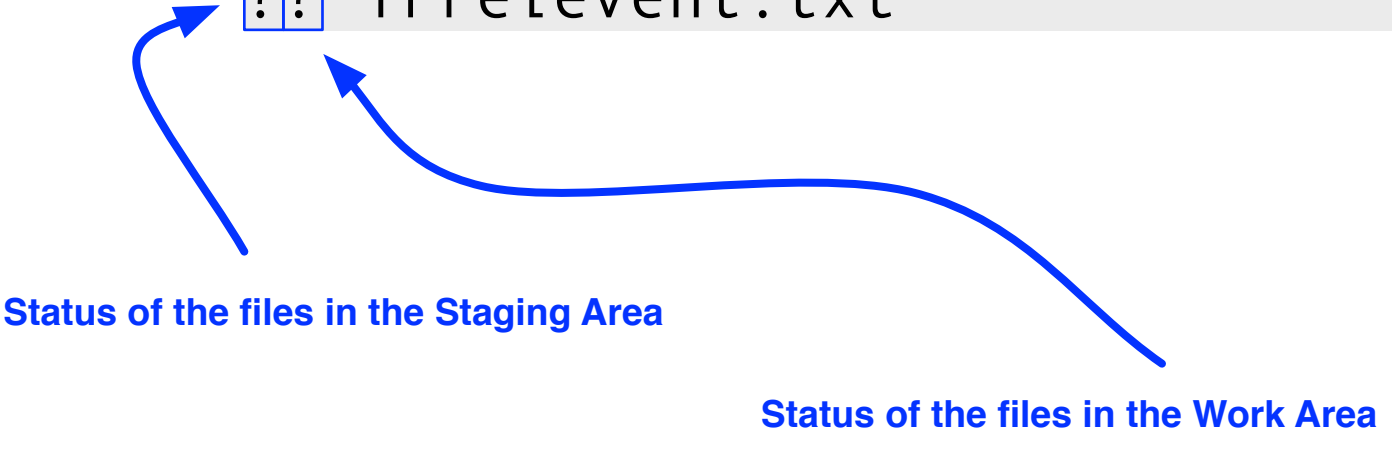
What would go into the next commit.

What is changed in the work area, but WON'T go in the next commit.

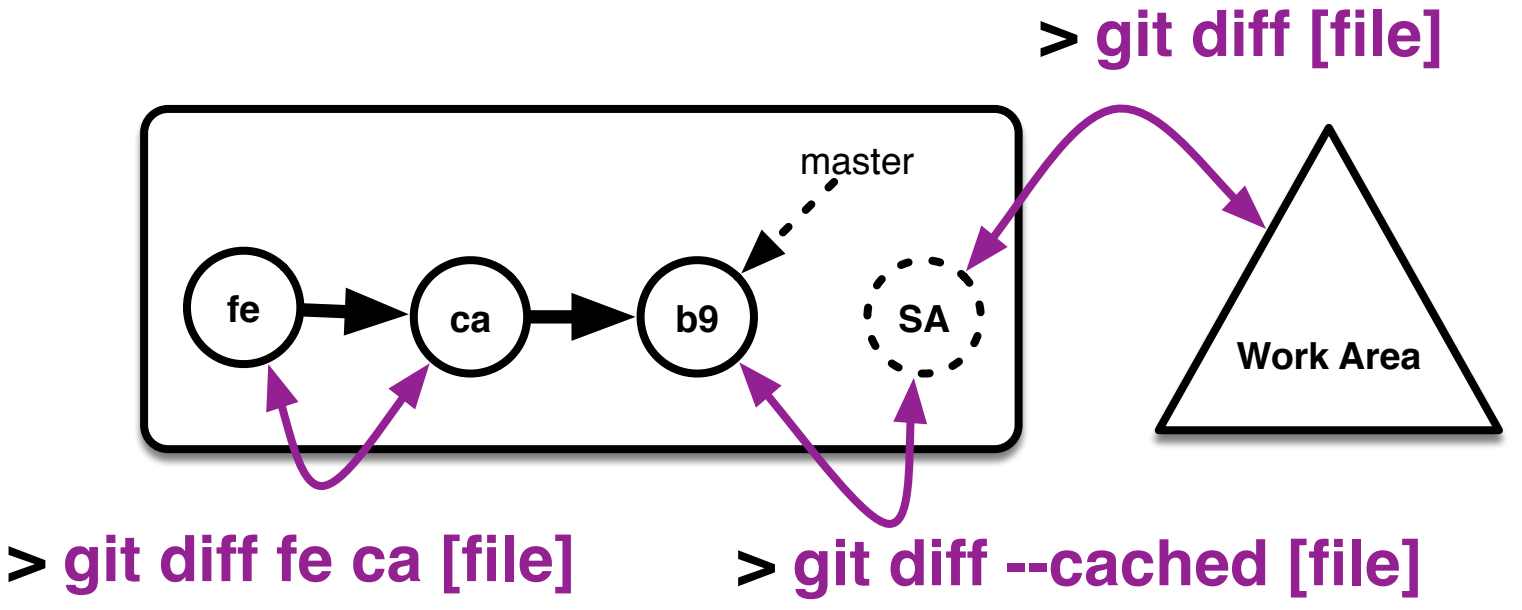
New files in work area, not registered to be in GIT repository at all.

GIT status -s

```
unix> git status -s
D  project_file_BAD
A  NEW_FILE.txt
 M project_file_1
M  project_file_2
R  elizabeth.txt -> charles.txt
?? irrelevent.txt
```

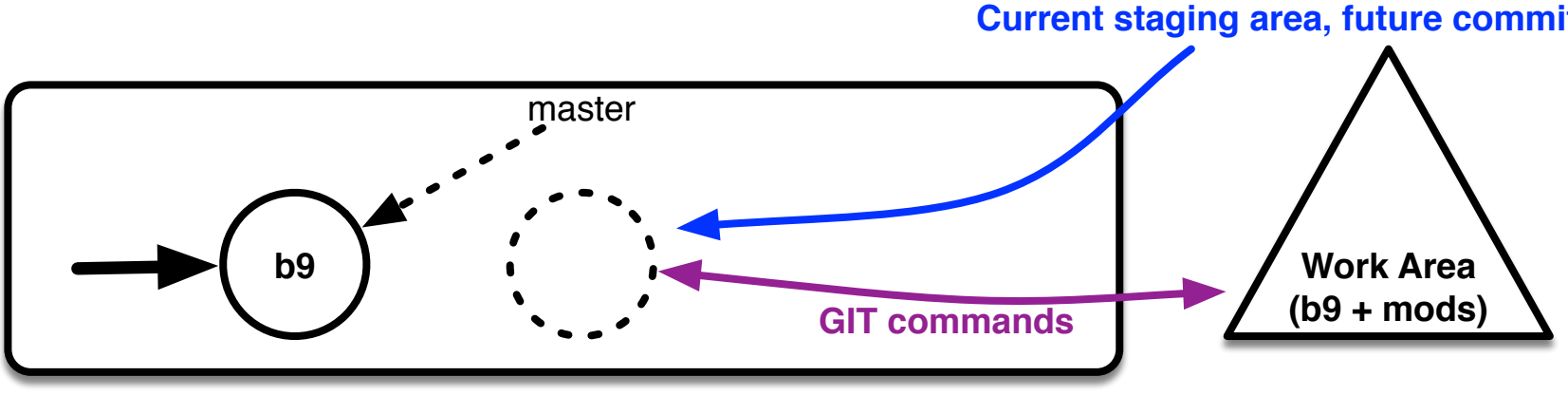


GIT diff



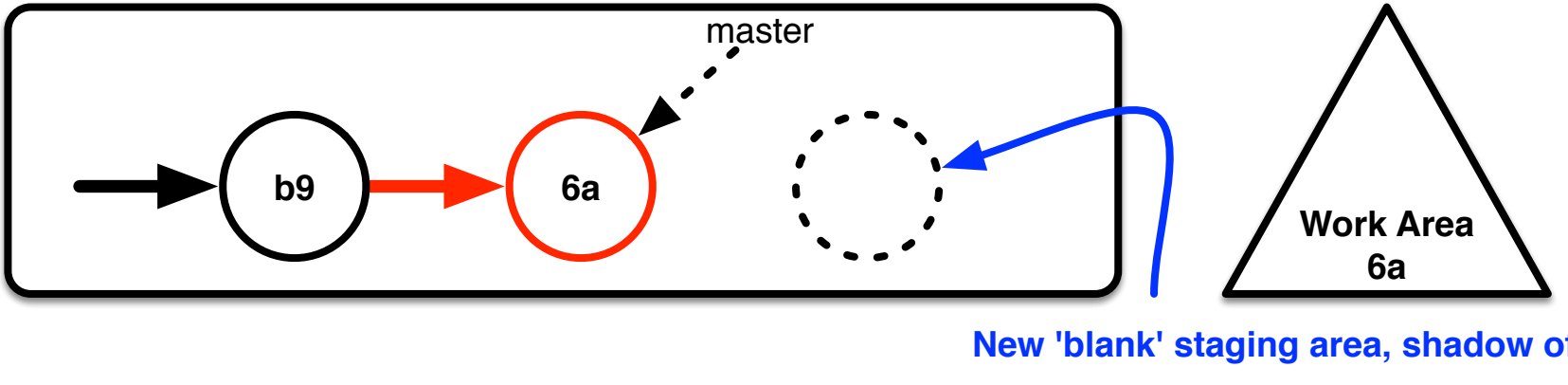

```
unix> git diff
diff --git a/BrainPortal/Rakefile b/BrainPortal/Rakefile
index 02a5494..dfd0c36 100644
--- a/BrainPortal/Rakefile
+++ b/BrainPortal/Rakefile
@@ -23,14 +25,11 @@
 # Add your own tasks in files placed in lib/tasks ending in .rake,
 # for example lib/tasks/capistrano.rake, and they will automatically be available to Rake.

-require File.expand_path('../config/application', __FILE__)
-require 'rake'
-

-CbrainRailsPortal::Application.load_tasks
+CbrainRailsPortal::Application.load_tasks.2
```

GIT commit



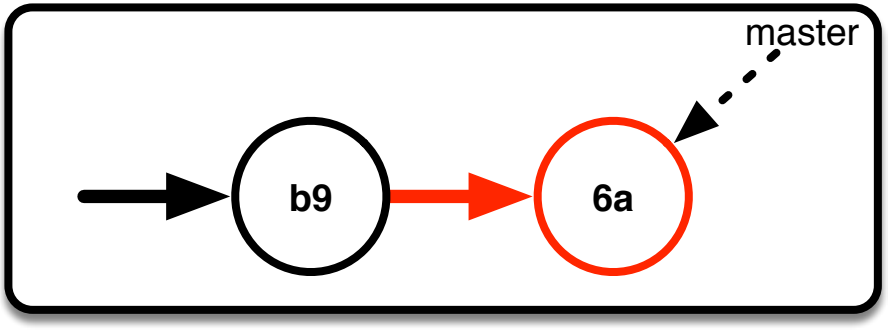

```
unix> git commit -m 'JUNK COMMIT'
[master 6a13d12] JUNK COMMIT
 4 files changed, 2 insertions(+), 165 deletions(-)
 delete mode 100644 BrainPortal/Gemfile.lock
 create mode 100644 BrainPortal/NEW_FILE.txt
 rename BrainPortal/{config.ru => config.ru.renamed} (100%)
```

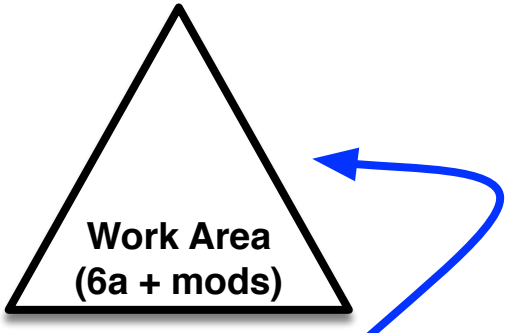
Note: No editor invoked



GIT push (simple case)

User's Computer

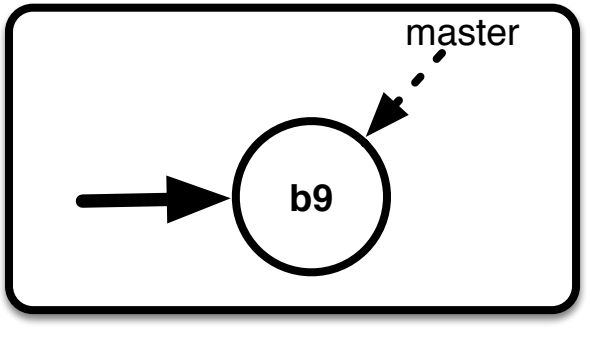




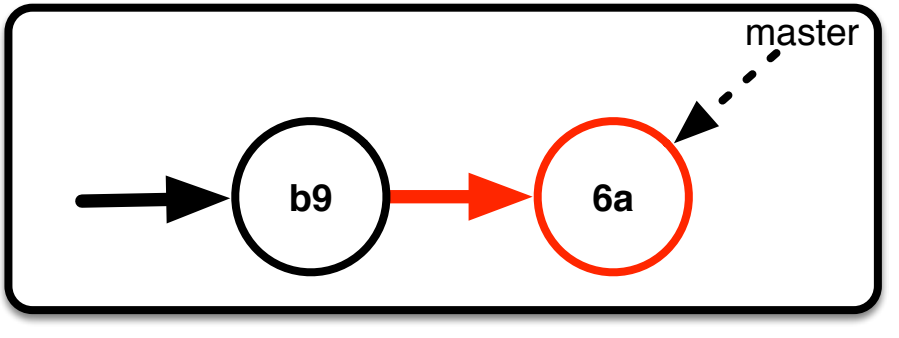

```
unix> git push
Counting objects: 5, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 287 bytes, done.
Total 3 (delta 2), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
   b9d9623..6a13d12  master -> master
```

Note: nothing is modified on this side

GitHub



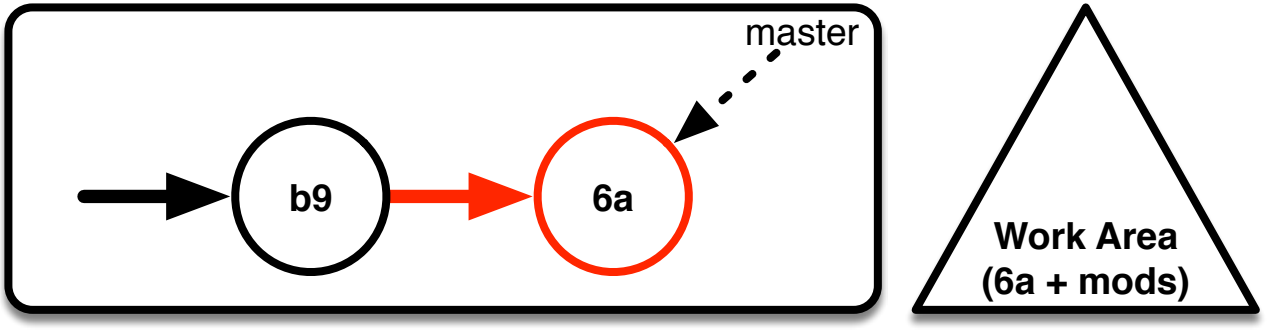
Before push



After push

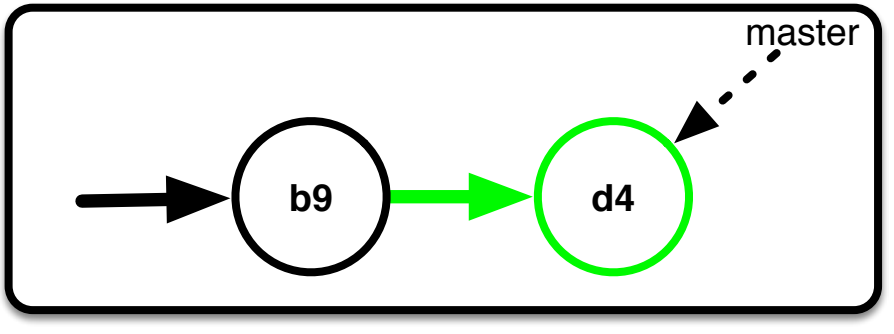
GIT push (merge needed)

User's Computer




```
unix> git push
 ! [rejected]        master -> master (non-fast-forward)
error: failed to push some refs
To prevent you from losing history, non-fast-forward updates were rejected
Merge the remote changes (e.g. 'git pull') before pushing again.  See the
'Note about fast-forwards' section of 'git push --help' for details.
```

GitHub

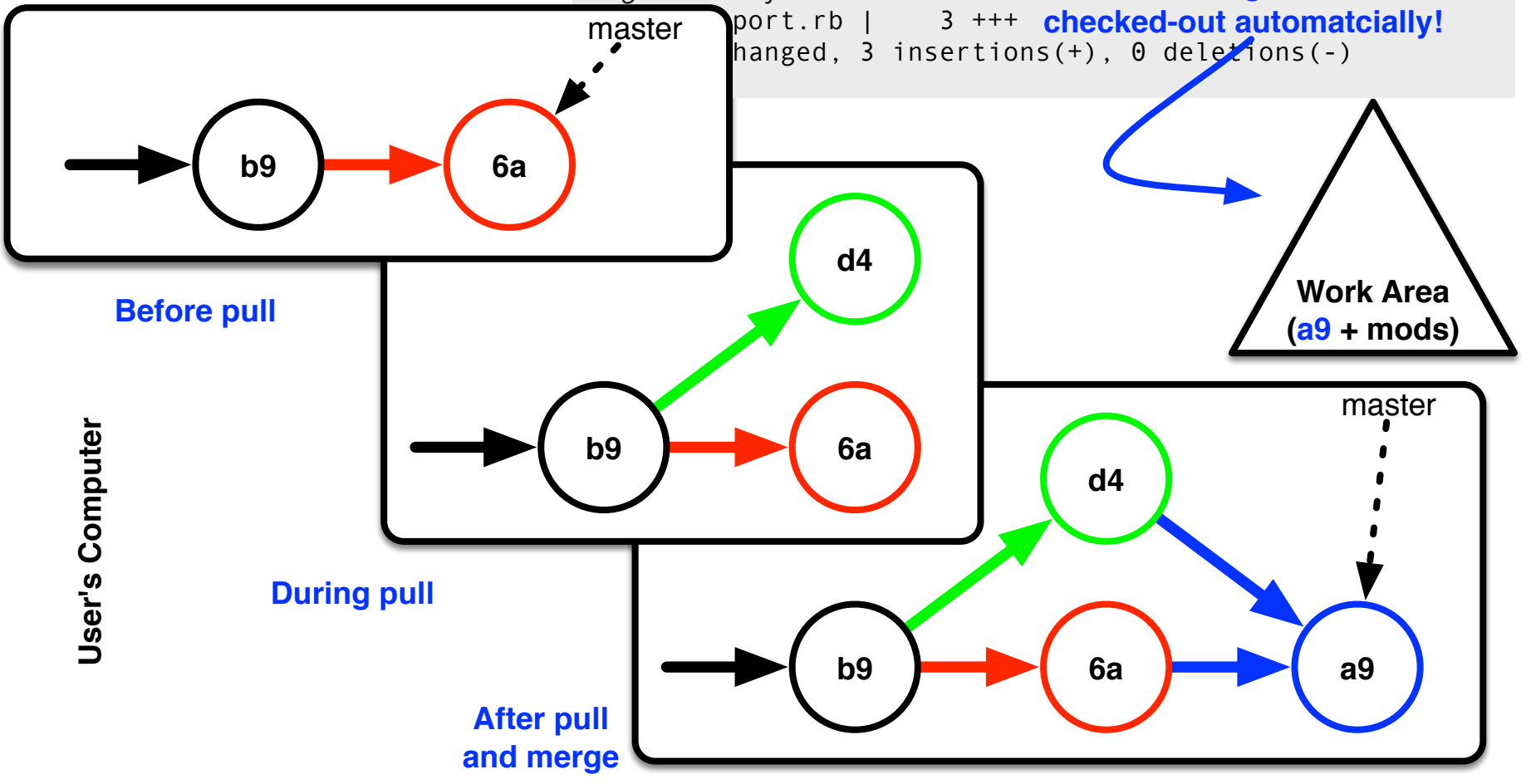


Before push;
this prevents it

GIT pull (with merge)

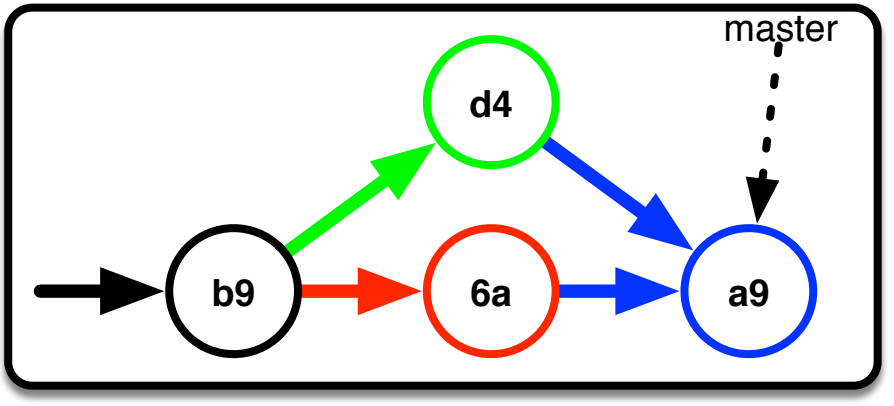
```
unix> git pull
remote: Counting objects: 5, done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 3 (delta 2), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
   b9d9623..a93a987  master     -> origin/master
Merge made by recursive.
port.rb |    3 +++
hanged, 3 insertions(+), 0 deletions(-)
```

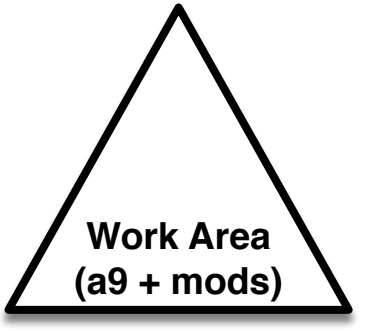
Note: the merged commit is also checked-out automatcially!



GIT push of merged commits

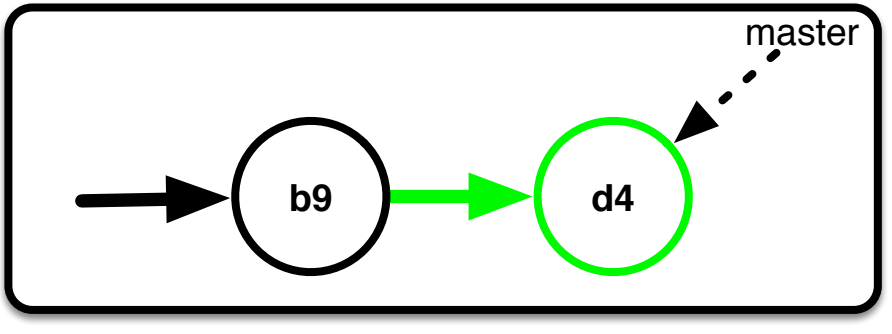
User's Computer

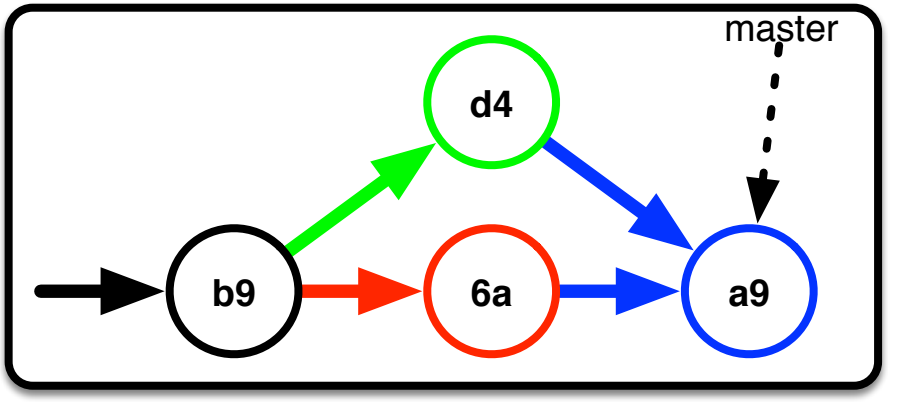





```
unix> git push
Counting objects: 8, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (5/5), done.
Writing objects: 100% (5/5), 539 bytes, done.
Total 5 (delta 3), reused 0 (delta 0)
Unpacking objects: 100% (5/5), done.
   b9d9623..a93a987  master -> master
```

GitHub

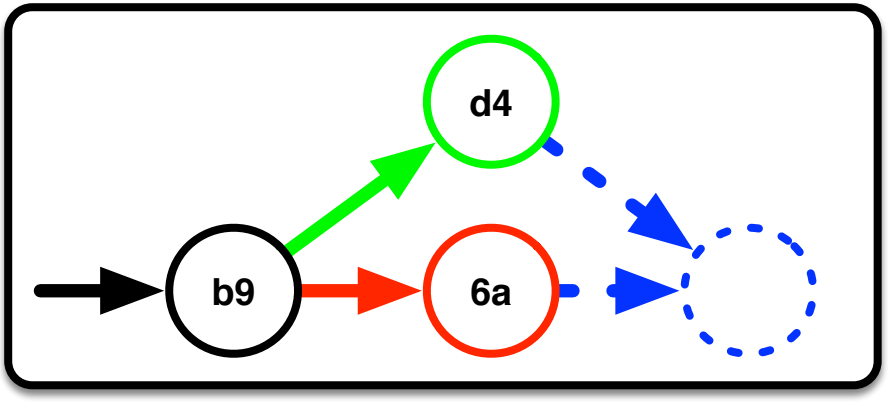


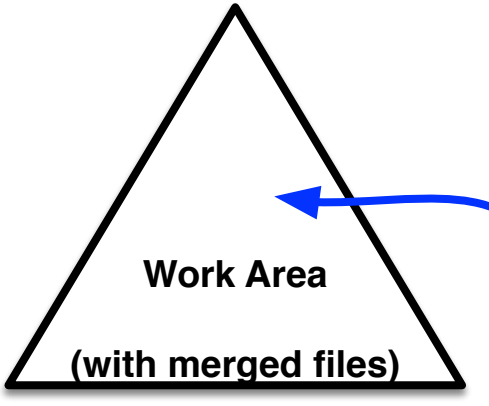


Before push

After push

Merge conflicts






```
unix> git pull
remote: Counting objects: 8, done.
remote: Compressing objects: 100% (5/5), done.
remote: Total 5 (delta 3), reused 0 (delta 0)
Unpacking objects: 100% (5/5), done.
   b9d9623..d4087aa  master     -> origin/master
Auto-merging my_file.txt
CONFLICT (content): Merge conflict in my_file.txt
Automatic merge failed; fix conflicts and then commit the
result.
```

my_file.txt contains conflict tokens

Note: work area and git repo are now in a special 'merge mode'.

Conflict resolution

Excerpt from my_file.txt

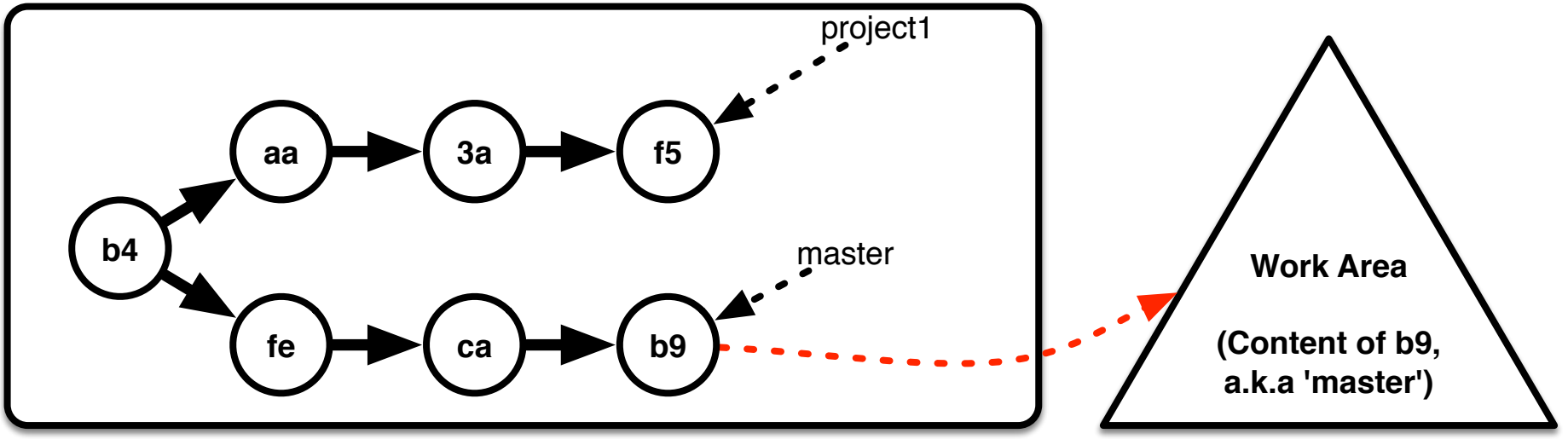
```
# CBRAIN Project
<<<<<<< HEAD
Changed in d4, line 1
Changed in d4, line 2
Changed in d4, line 3
Changed in d4, line 4
Changed in d4, line 5
Changed in d4, line 6
=======
#
Changed in 6a, line 1
Changed in 6a, line 2
Changed in 6a, line 3
#
>>>>>>> d4087aa6f2350a94eb86ae210a1116c4e7a55b49
# This program is free software: you can redistribute it and/or modify
```

Edit the file;
Fix these lines;
Run "git add";
Commit.

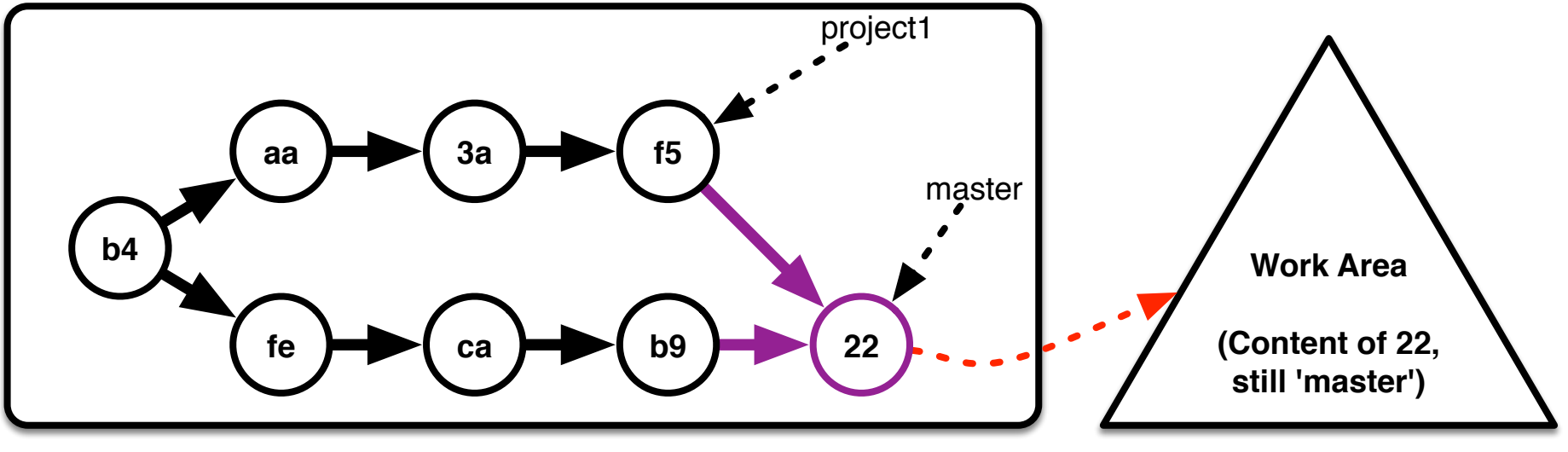
These three lines were added by GIT

You must resolve all conflicts in all files and then commit before you can proceed to use GIT as usual.

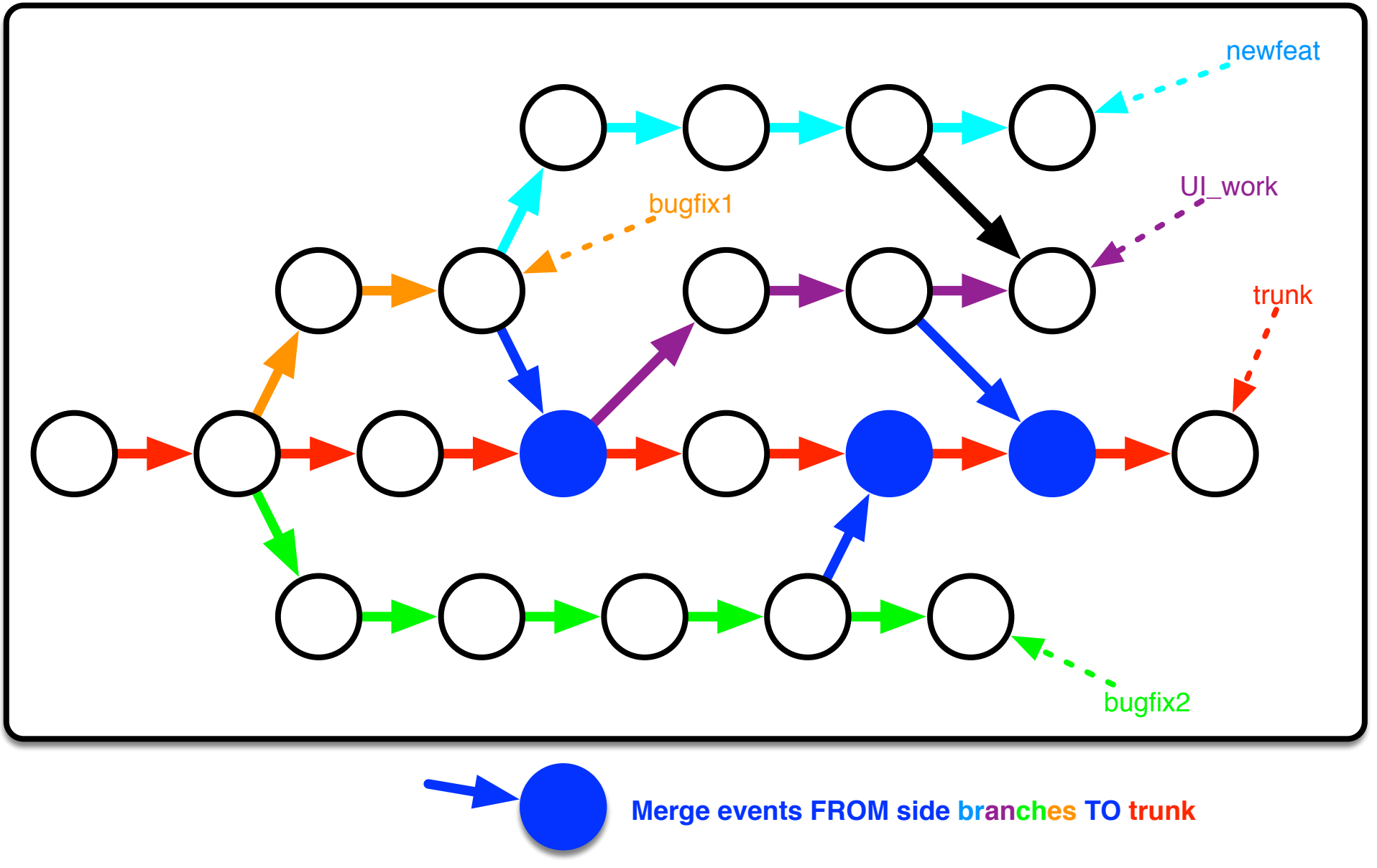
Merging branches



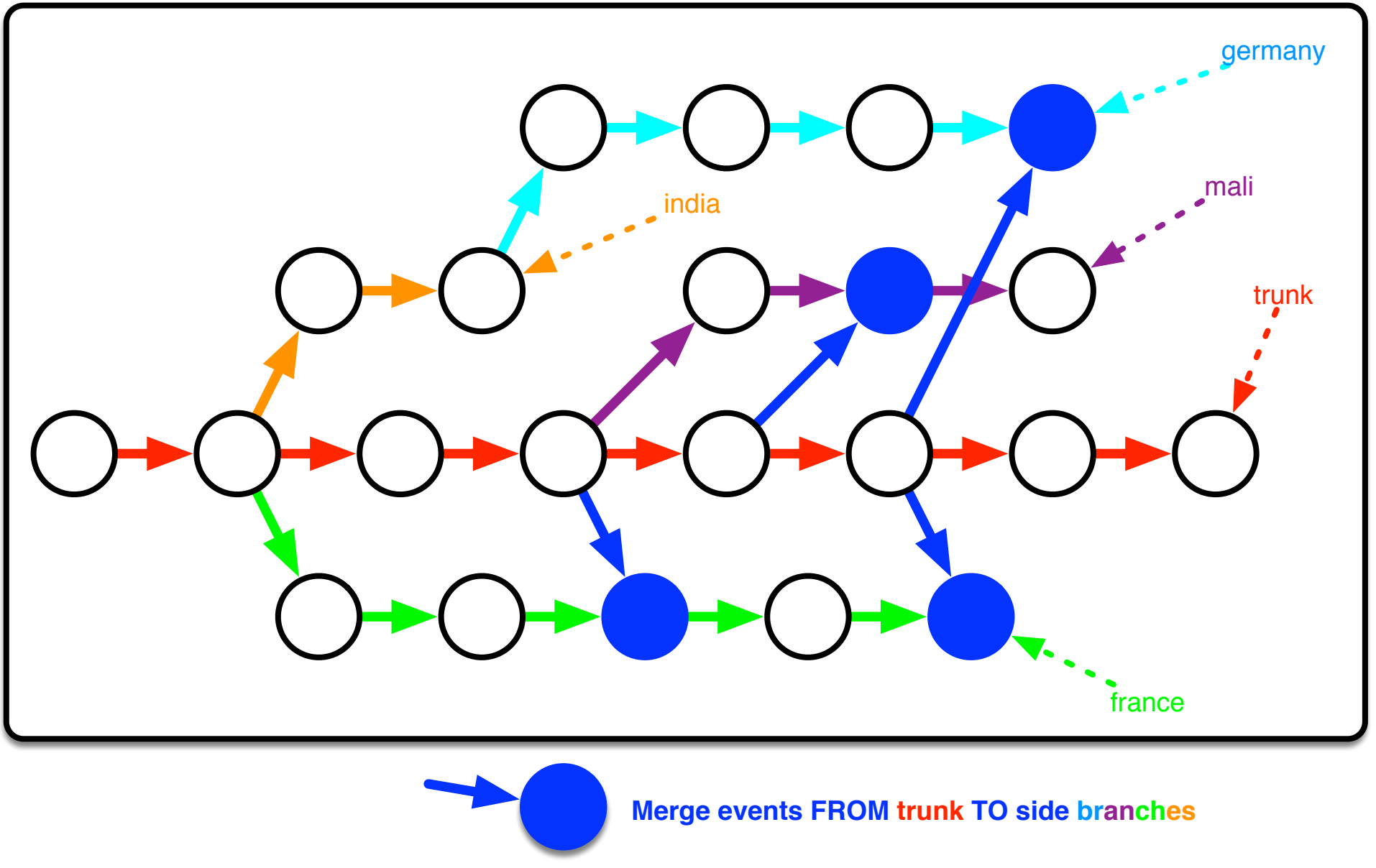
> git merge project1



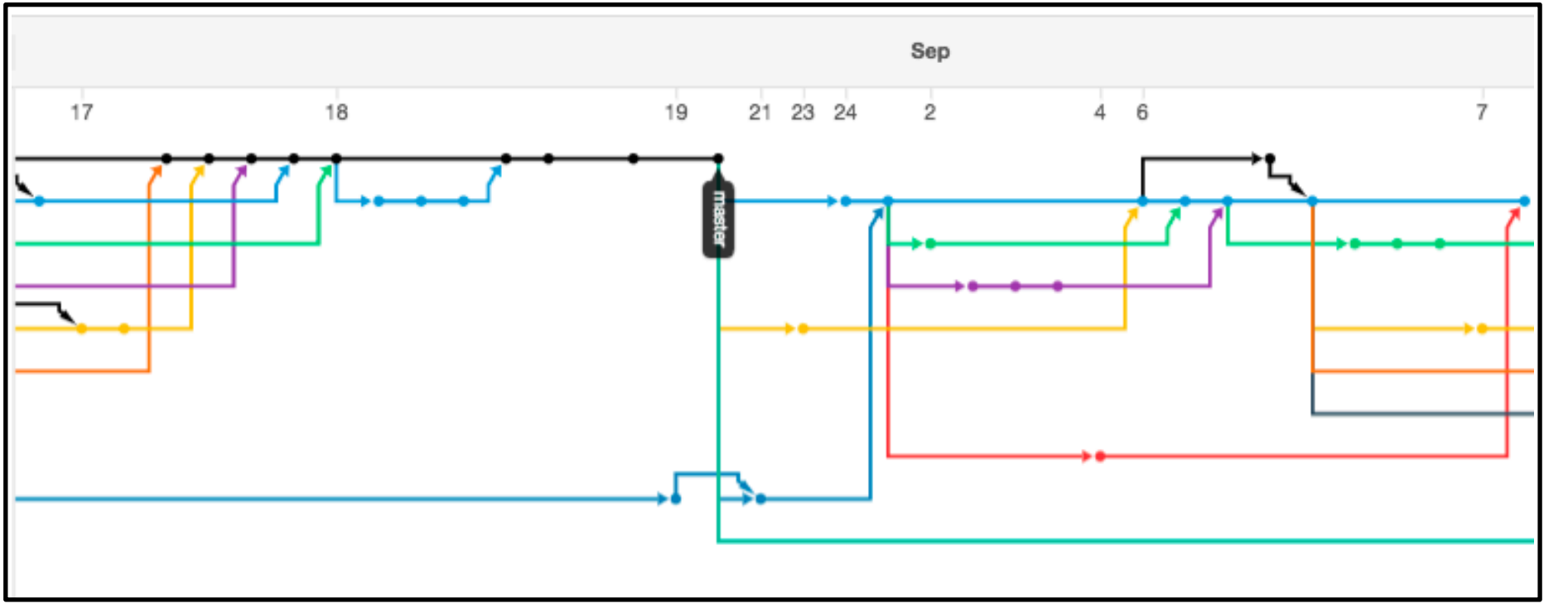
Branching towards a trunk



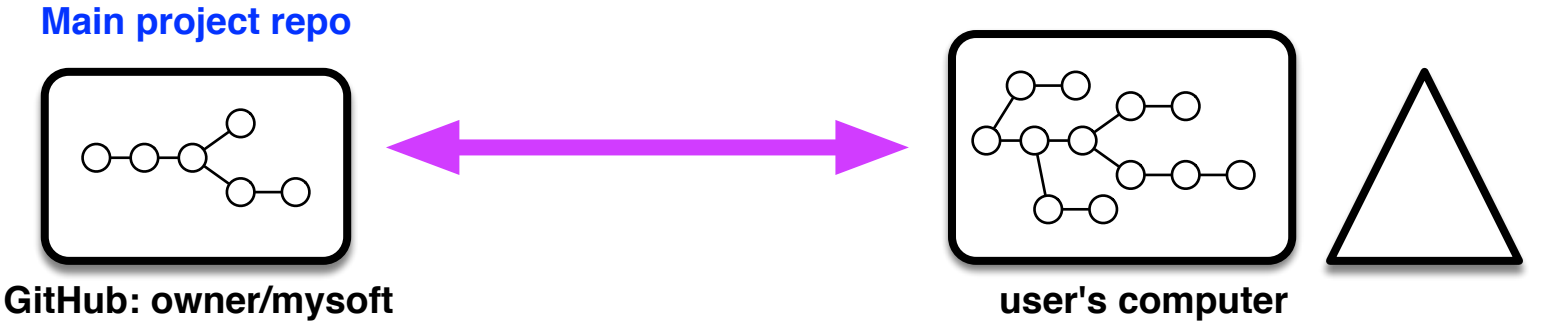
Branching towards subprojects



An example: CBRAIN weaving



Typical Work Cycle: No Forks



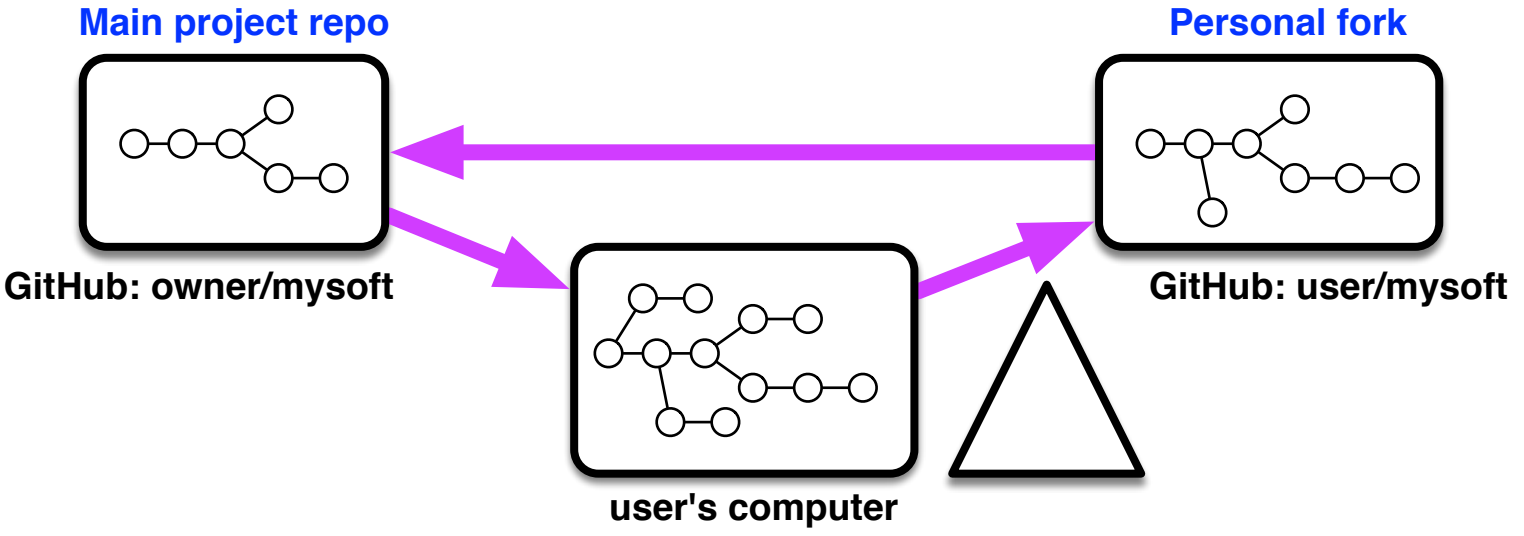

```
> git checkout # optional
> edit; git add/rm/mv/reset etc
> git commit

> git pull
> (resolve conflicts; commit)
> git push
```

Repeat: Make progress in your local repository.

Just once: Integrate other people's work.

Repeat.

Typical Work Cycle: With Forks




```
> git checkout somebranch
> git pull github somebranch
> git checkout -b newstuff

> edit; git add/rm/mv/reset etc
> git commit

> git push myfork newstuff
> (use GitHub's interface to make
  pull request)
```

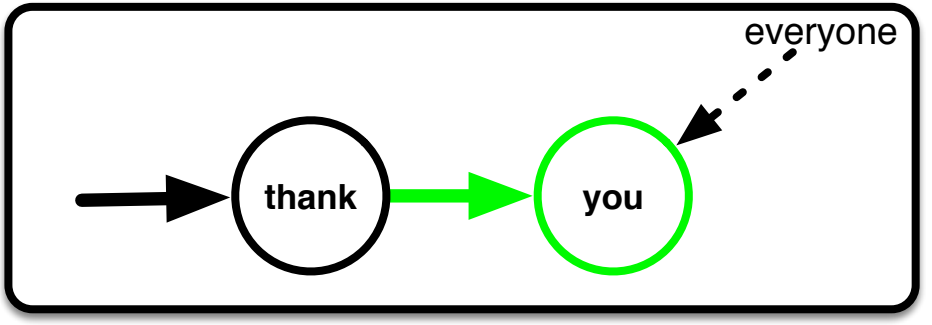
Just once: select a base starting point from other people's work.

Repeat: Make progress in your local repository.

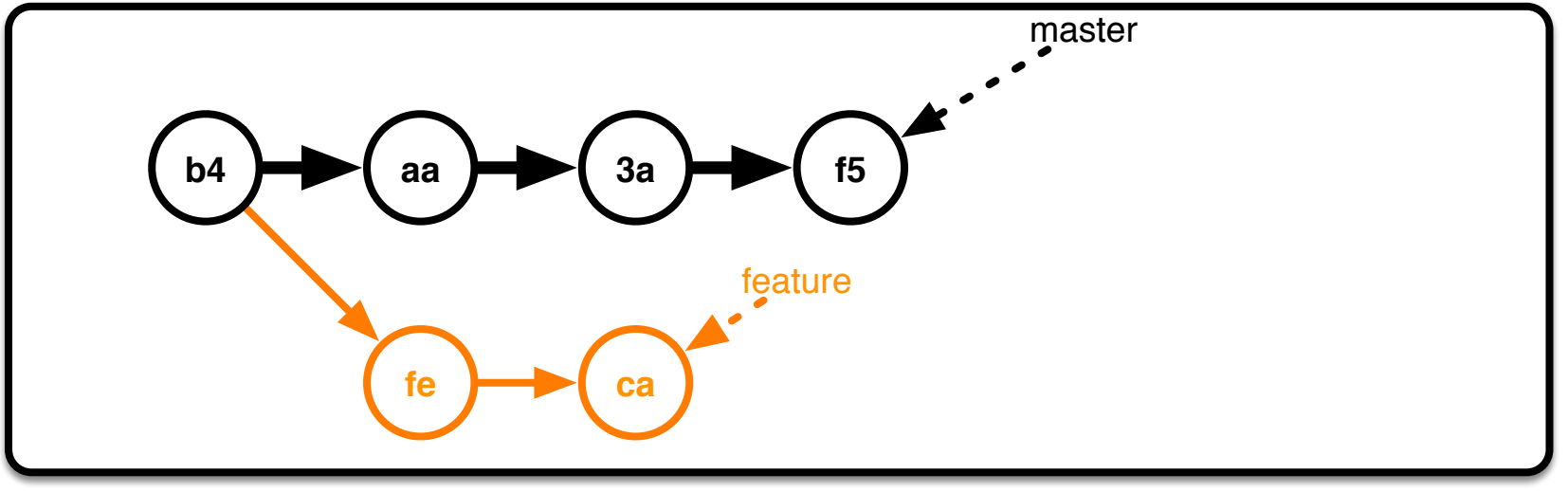
Just once: send modifications to fork

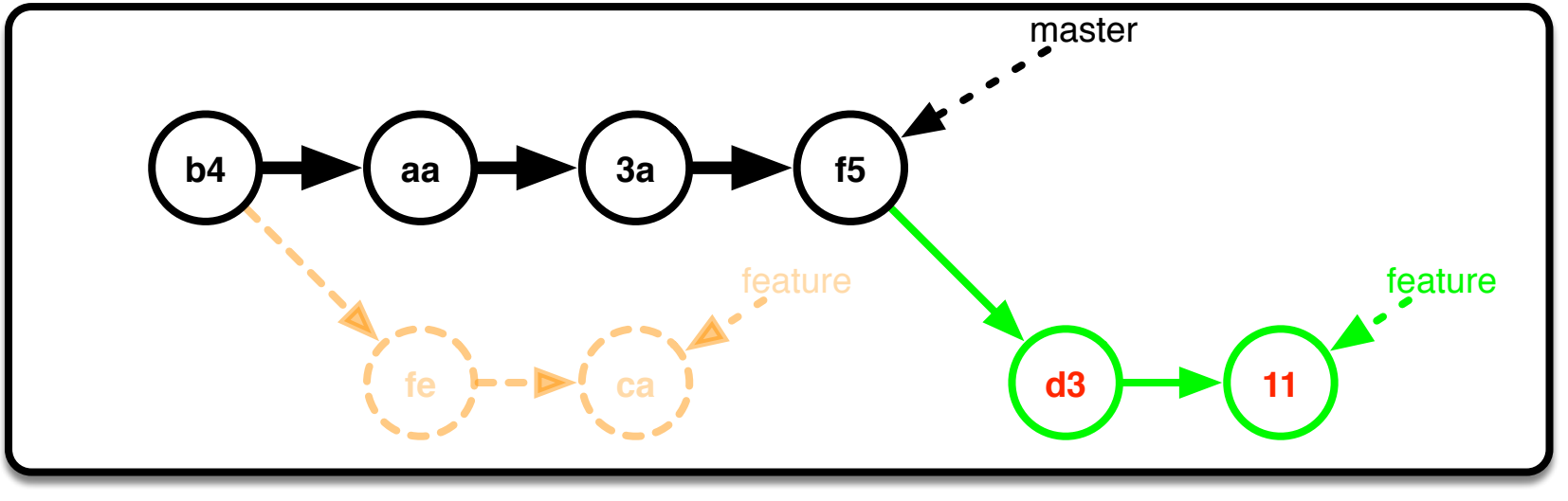
Repeat.

The End



Addendum: Rebasing




```
> git checkout feature
> git rebase f5
```