Using Git on OS-X

Munich Cocoaheads
2009-11-12
2009-12-10
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Coming up

Basic Concepts

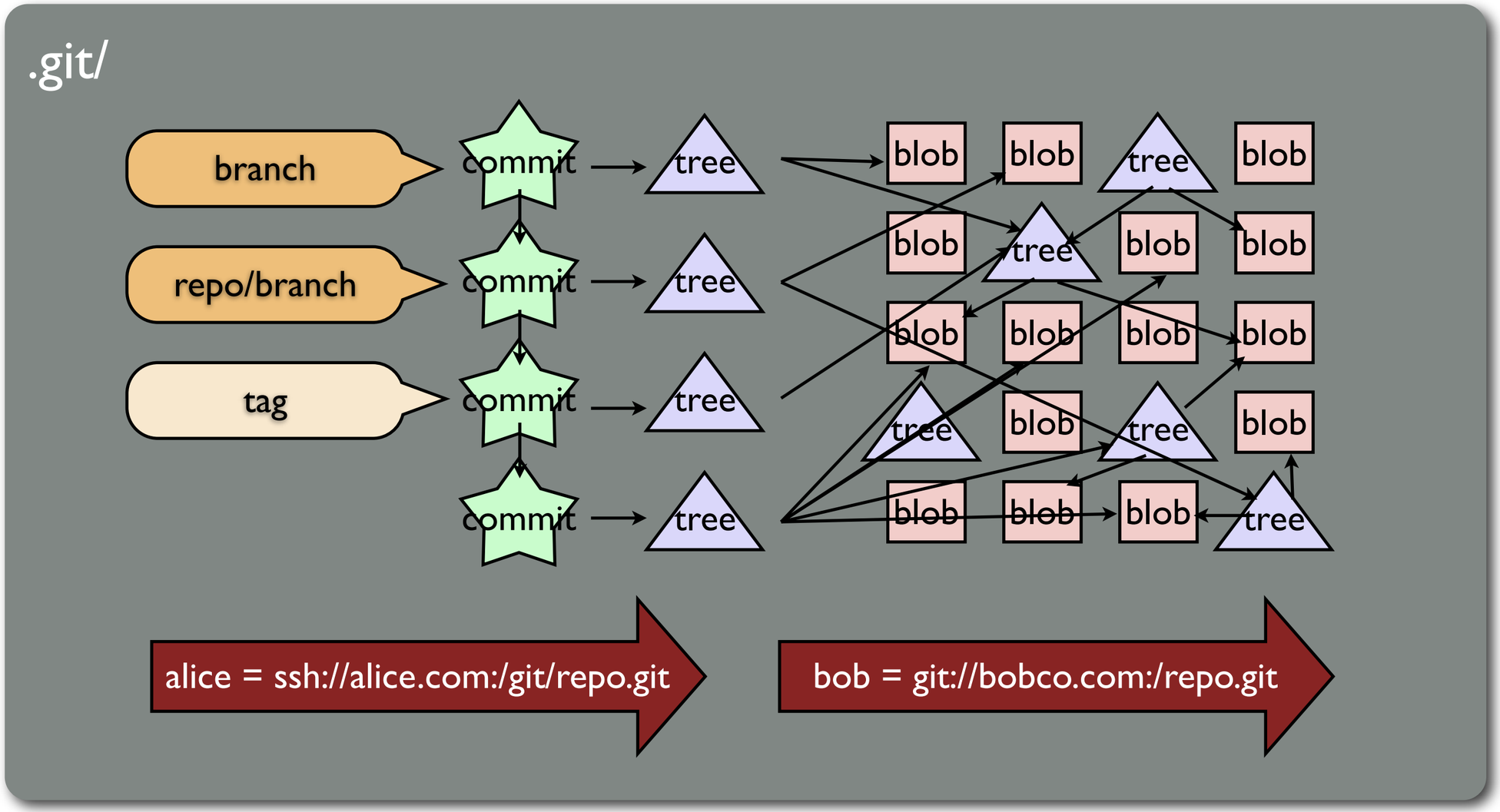
Daily Git

Git with XCode

Non-Obvious Git

What is git?

What is git?


.git/
branch
repo/branch
tag
commit
commit
commit
tree
tree
tree
blob
blob
tree
blob
blob
tree
blob
blob
blob
blob
blob
blob
blob
tree
blob
tree
blob
blob
blob
tree
alice = ssh://alice.com:/git/repo.git
bob = git://bobco.com:/repo.git

Blobs

blob	size

// Blah.m
// This class does
 	
@implementation Bla
 	
@synthesize a;	

Blobs

SHA-1

blob	size

```
// Blah.m
// This class does

@implementation Bla

@synthesize a;
```

Blobs

56906c1725109d441fe846300fd4e57063cc6d6b

blob	size

```
// Blah.m
// This class does

@implementation Bla

@synthesize a;
```

Blobs

56906c1...

blob	size

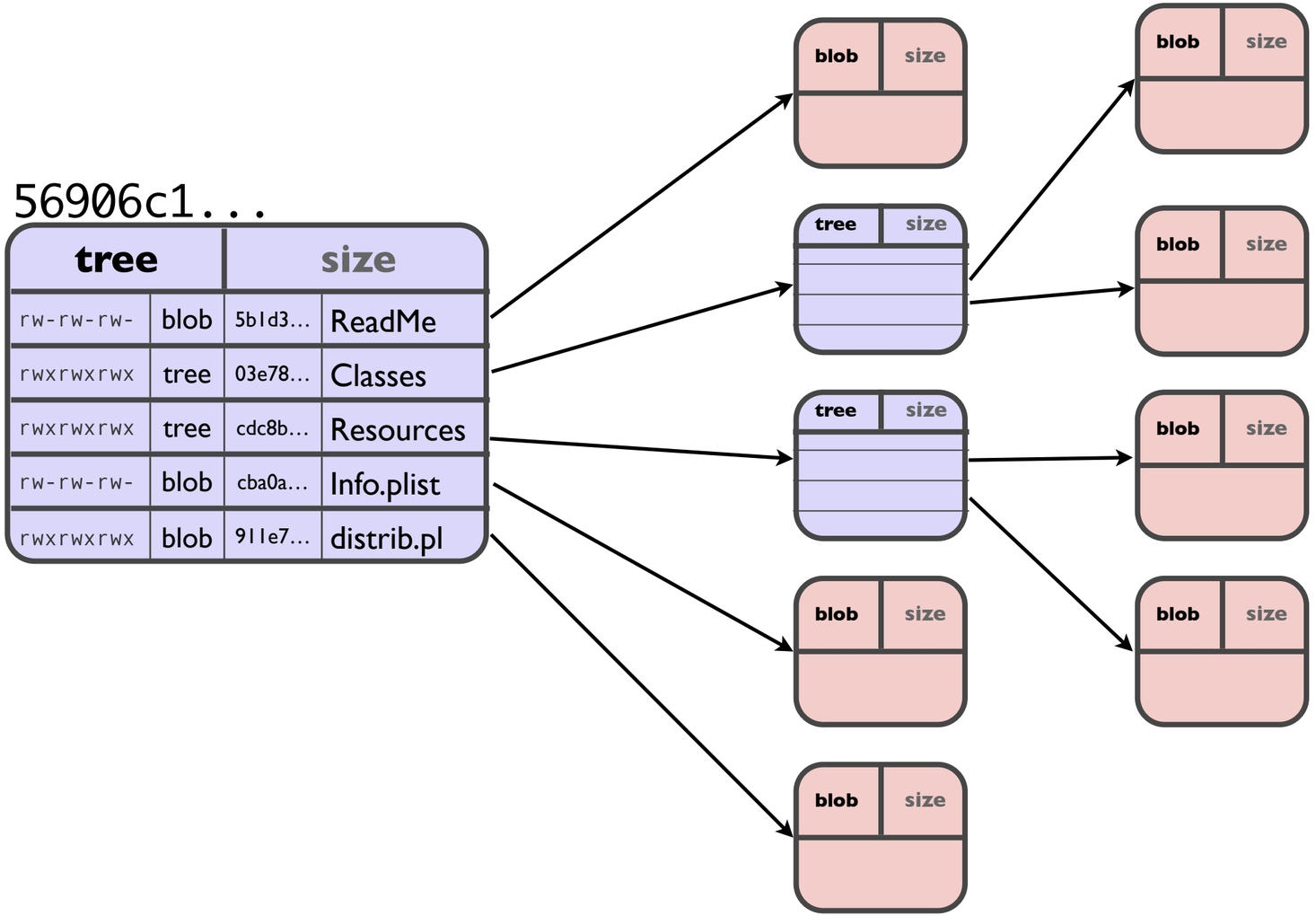
```
// Blah.m
// This class does

@implementation Bla

@synthesize a;
```

trees

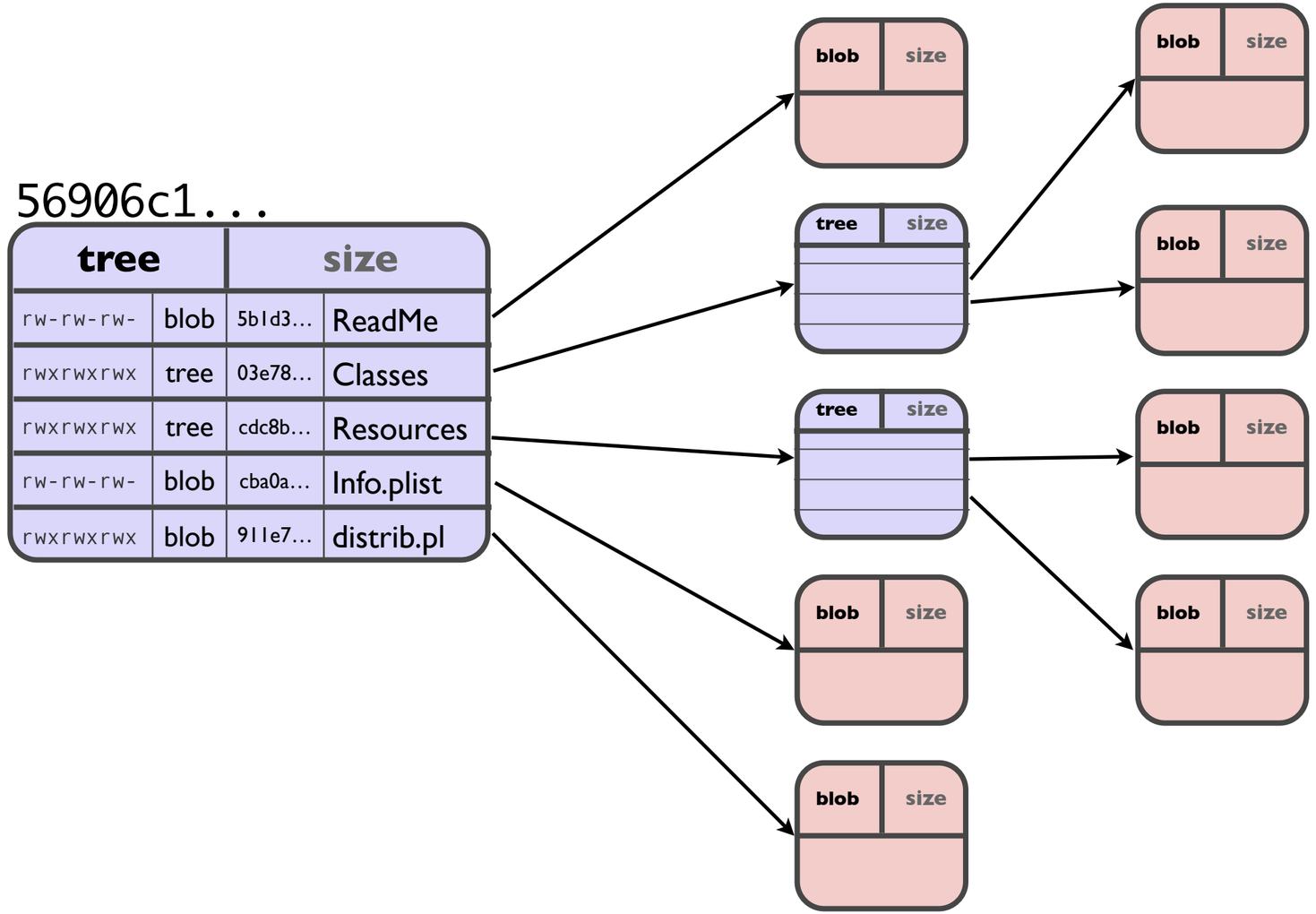
56906c1...

tree		size	
rw-rw-rw-	blob	5b1d3...	ReadMe
rwxrwxrwx	tree	03e78...	Classes
rwxrwxrwx	tree	cdc8b...	Resources
rw-rw-rw-	blob	cba0a...	Info.plist
rwxrwxrwx	blob	911e7...	distrib.pl

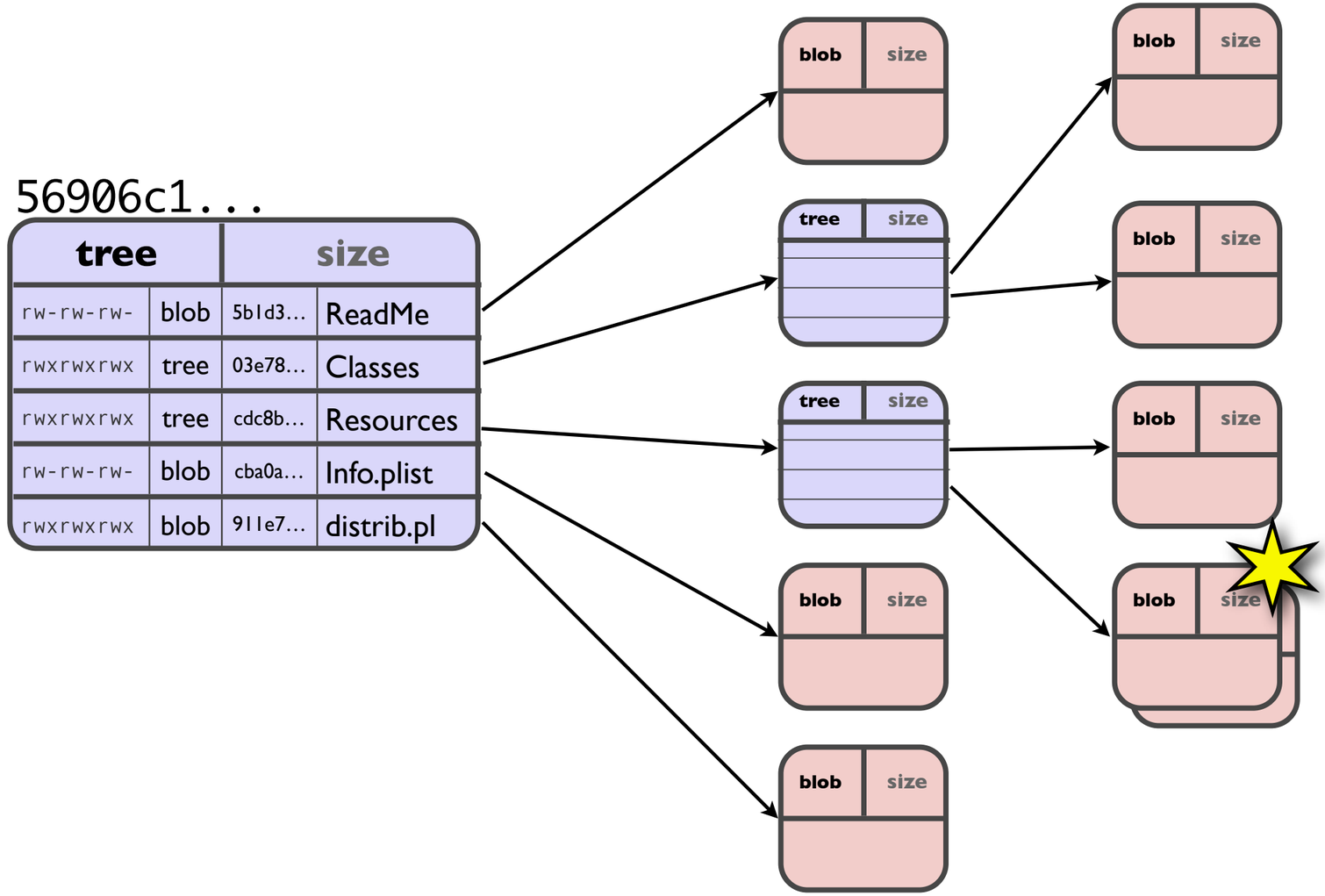
trees


56906c1...
tree
size
rw-rw-rw- blob 5b1d3... ReadMe
rwxrwxrwx tree 03e78... Classes
rwxrwxrwx tree cdc8b... Resources
rw-rw-rw- blob cba0a... Info.plist
rwxrwxrwx blob 911e7... distrib.pl
blob
size
tree
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

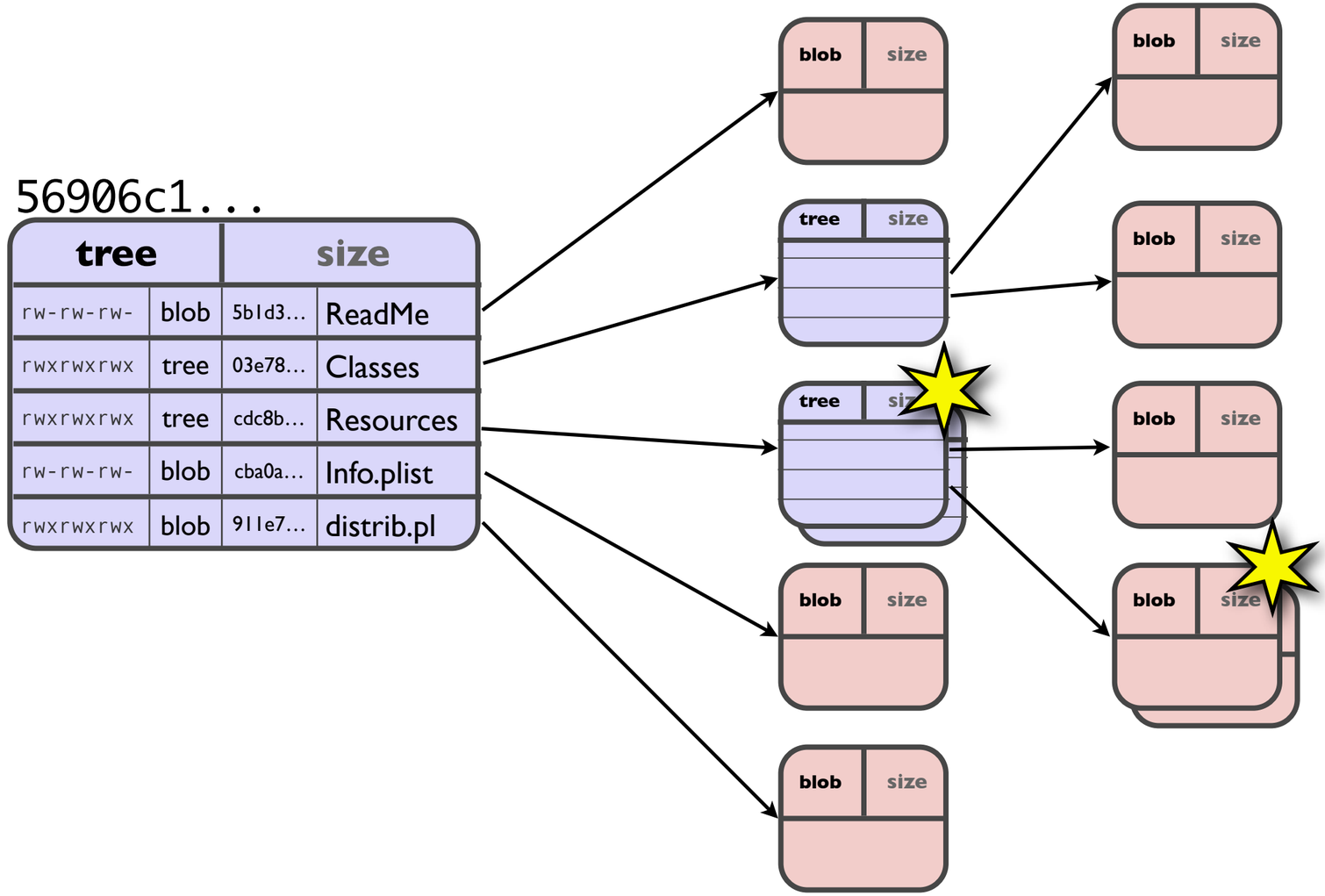
changes


56906c1...
tree
size
rw-rw-rw-
blob
5b1d3...
ReadMe
rwxrwxrwx
tree
03e78...
Classes
rwxrwxrwx
tree
cdc8b...
Resources
rw-rw-rw-
blob
cba0a...
Info.plist
rwxrwxrwx
blob
911e7...
distrib.pl
blob
size
tree
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

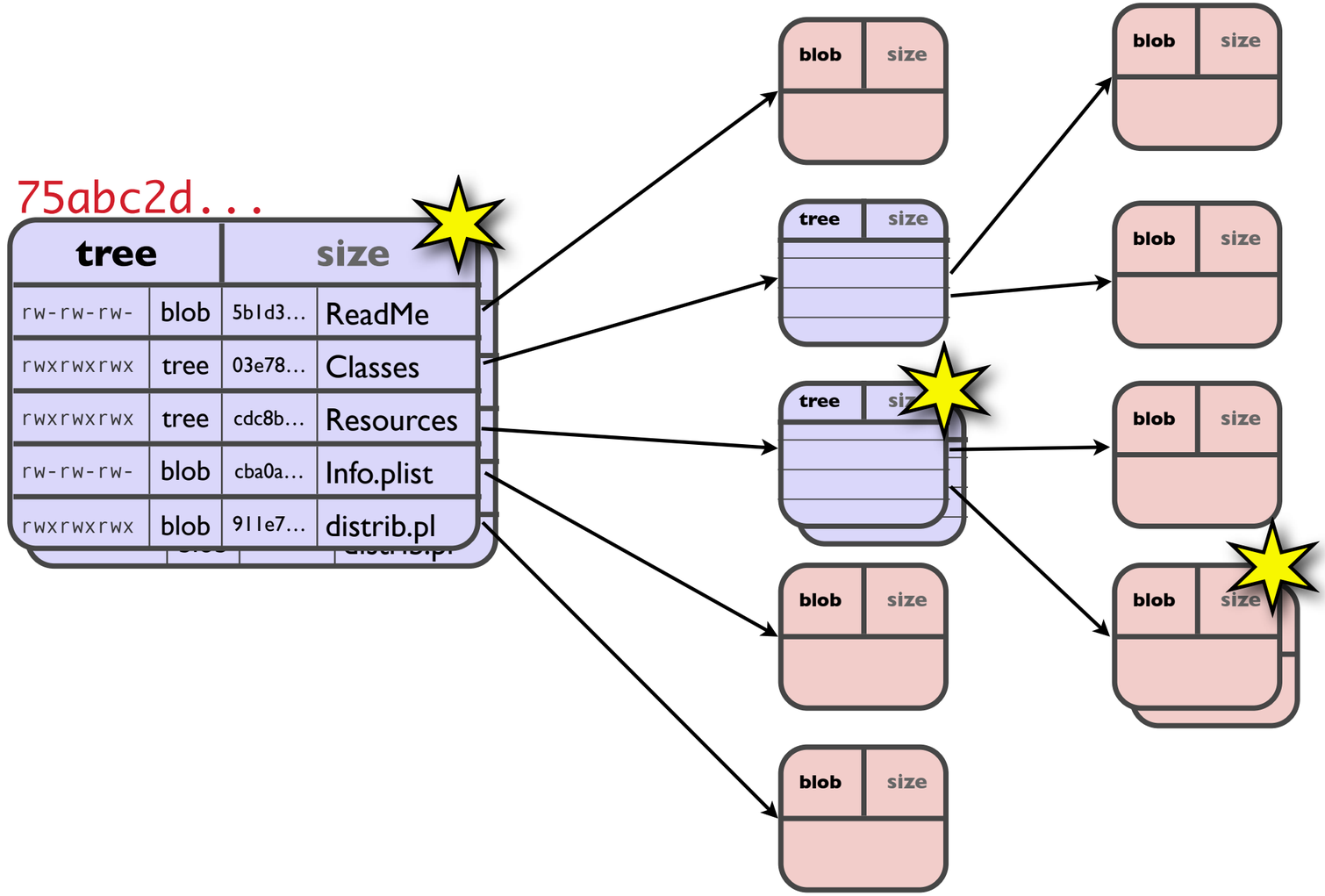
changes


56906c1...
tree
size
rw-rw-rw-
blob
5b1d3...
ReadMe
rwxrwxrwx
tree
03e78...
Classes
rwxrwxrwx
tree
cdc8b...
Resources
rw-rw-rw-
blob
cba0a...
Info.plist
rwxrwxrwx
blob
911e7...
distrib.pl
blob
size
tree
size
blob
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

changes


56906c1...
tree
size
rw-rw-rw- blob 5b1d3... ReadMe
rwxrwxrwx tree 03e78... Classes
rwxrwxrwx tree cdc8b... Resources
rw-rw-rw- blob cba0a... Info.plist
rwxrwxrwx blob 911e7... distrib.pl
blob
size
tree
size
blob
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

changes

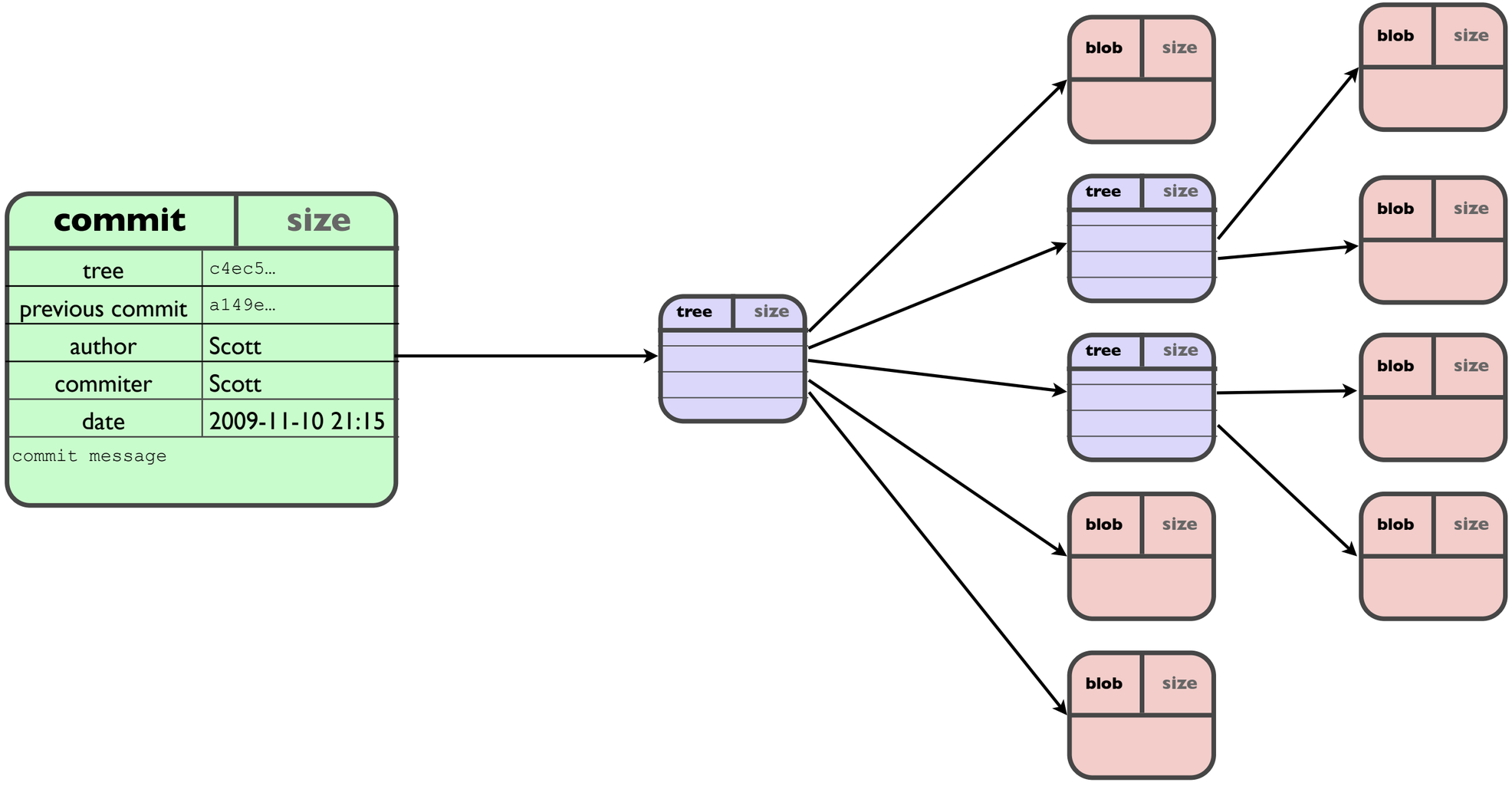

75abc2d...
tree
size
rw-rw-rw-
blob
5b1d3...
ReadMe
rwxrwxrwx
tree
03e78...
Classes
rwxrwxrwx
tree
cdc8b...
Resources
rw-rw-rw-
blob
cba0a...
Info.plist
rwxrwxrwx
blob
911e7...
distrib.pl
blob
size
tree
size
blob
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

commits

56906c1...

commit	size
tree	c4ec5...
previous commit	a149e...
author	Scott
commiter	Scott
date	2009-11-10 21:15
commit message	

commits

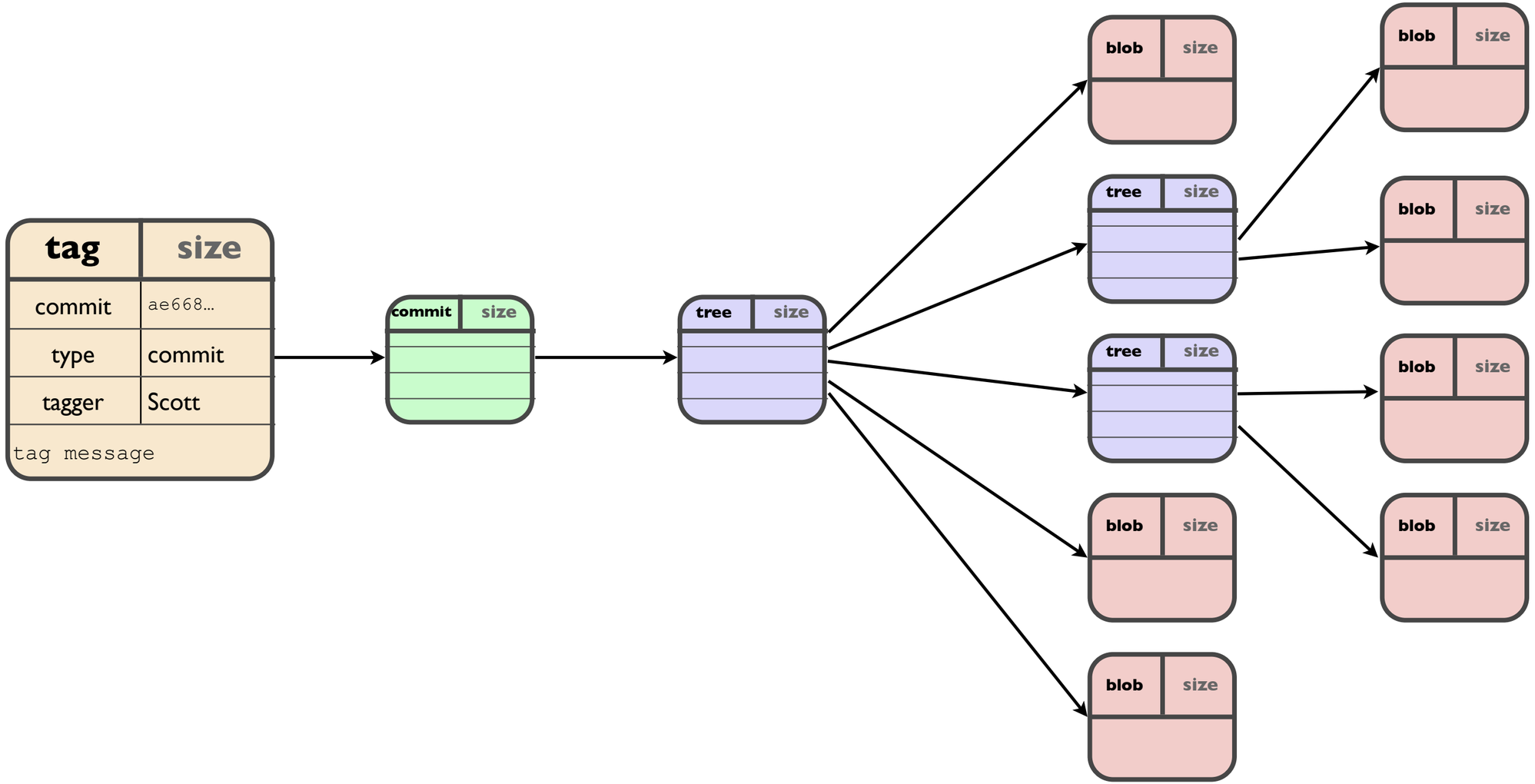

commit
size
tree
c4ec5...
previous commit
a149e...
author
Scott
commiter
Scott
date
2009-11-10 21:15
commit message
tree
size
blob
size
tree
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

tags

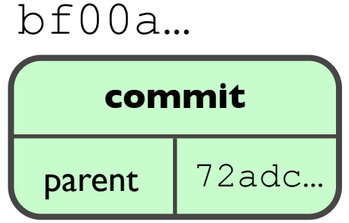
56906c1...

tag	size
commit	ae668...
type	commit
tagger	Scott
tag message	

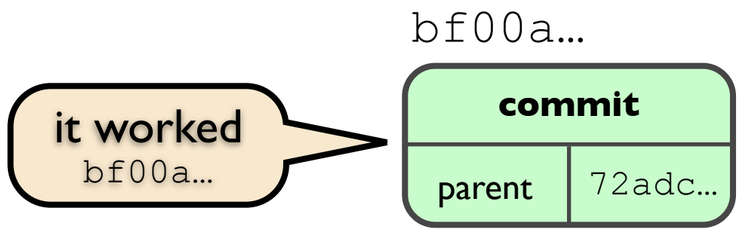
Tags


tag
size
commit
ae668...
type
commit
tagger
Scott
tag message
commit
size
tree
size
blob
size
tree
size
blob
size
blob
size
tree
size
blob
size
blob
size
blob
size
blob
size

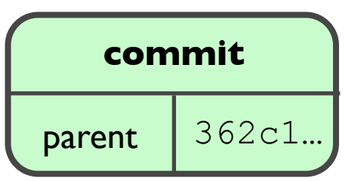
Light-weight tags



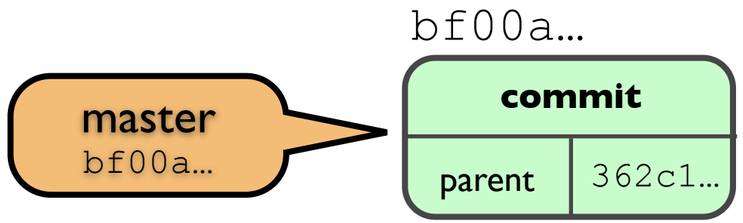
Light-weight tags



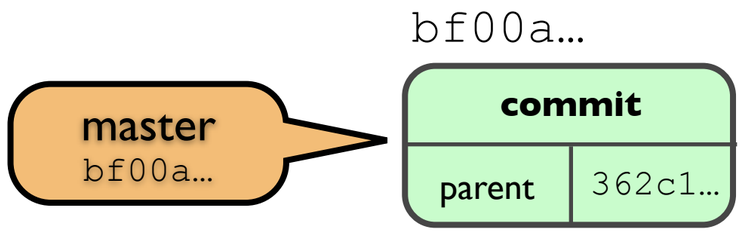
Branches



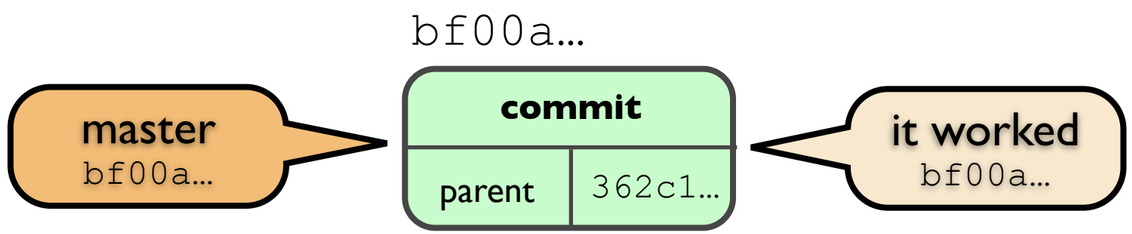
Branches



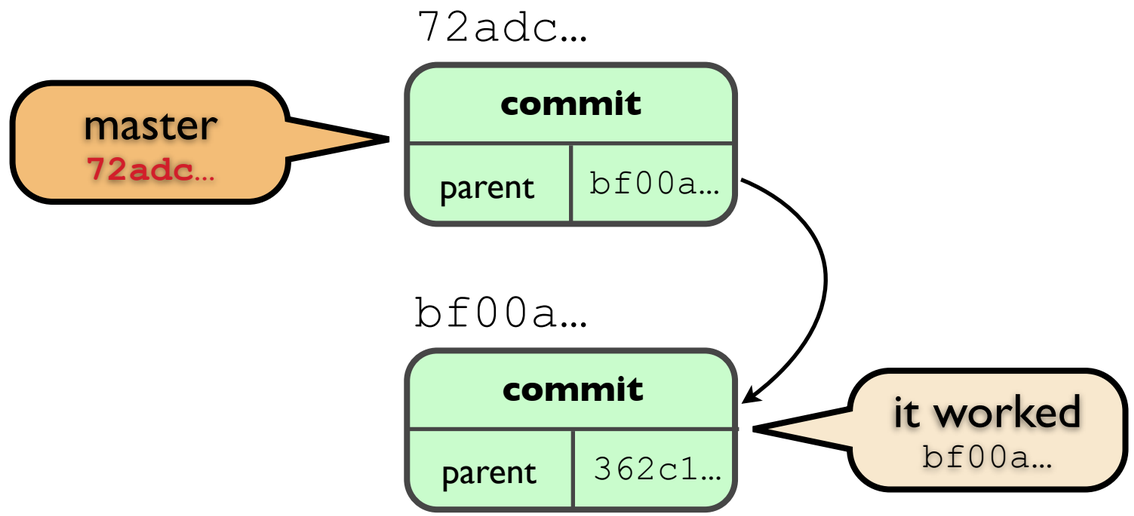
Branches ‘v’ Tags



Branches ‘v’ Tags

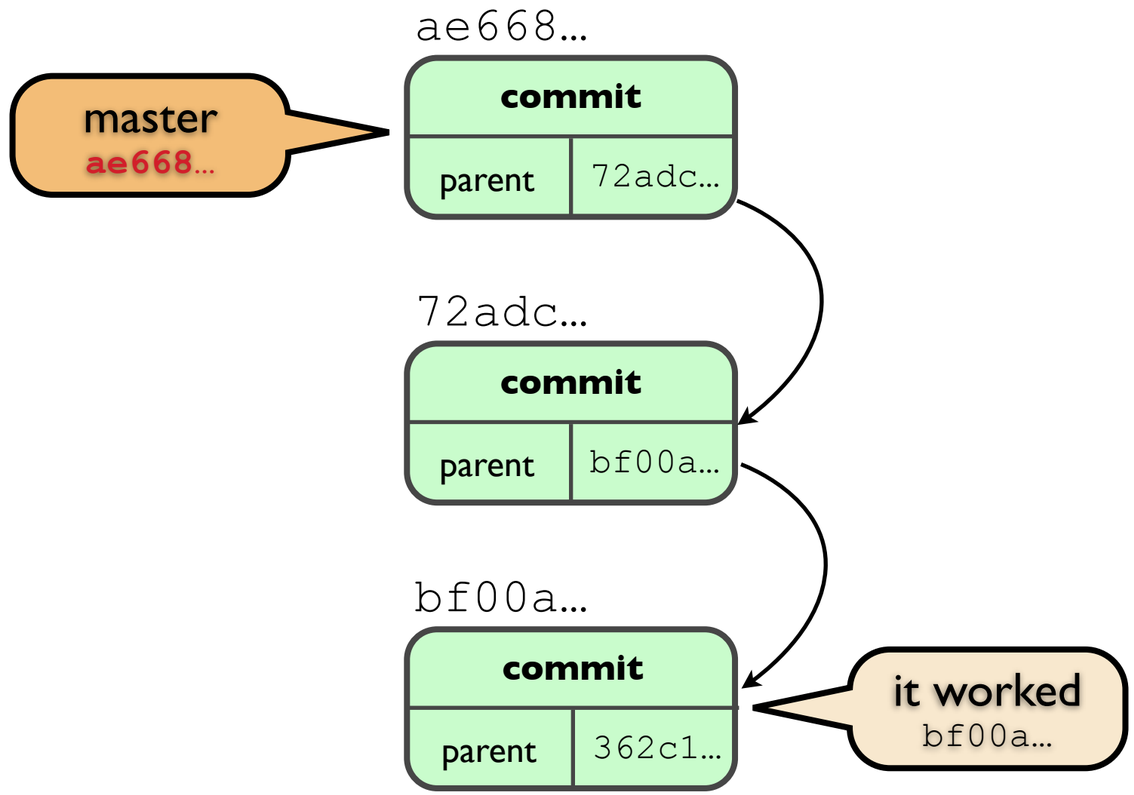


Branches ‘v’ Tags



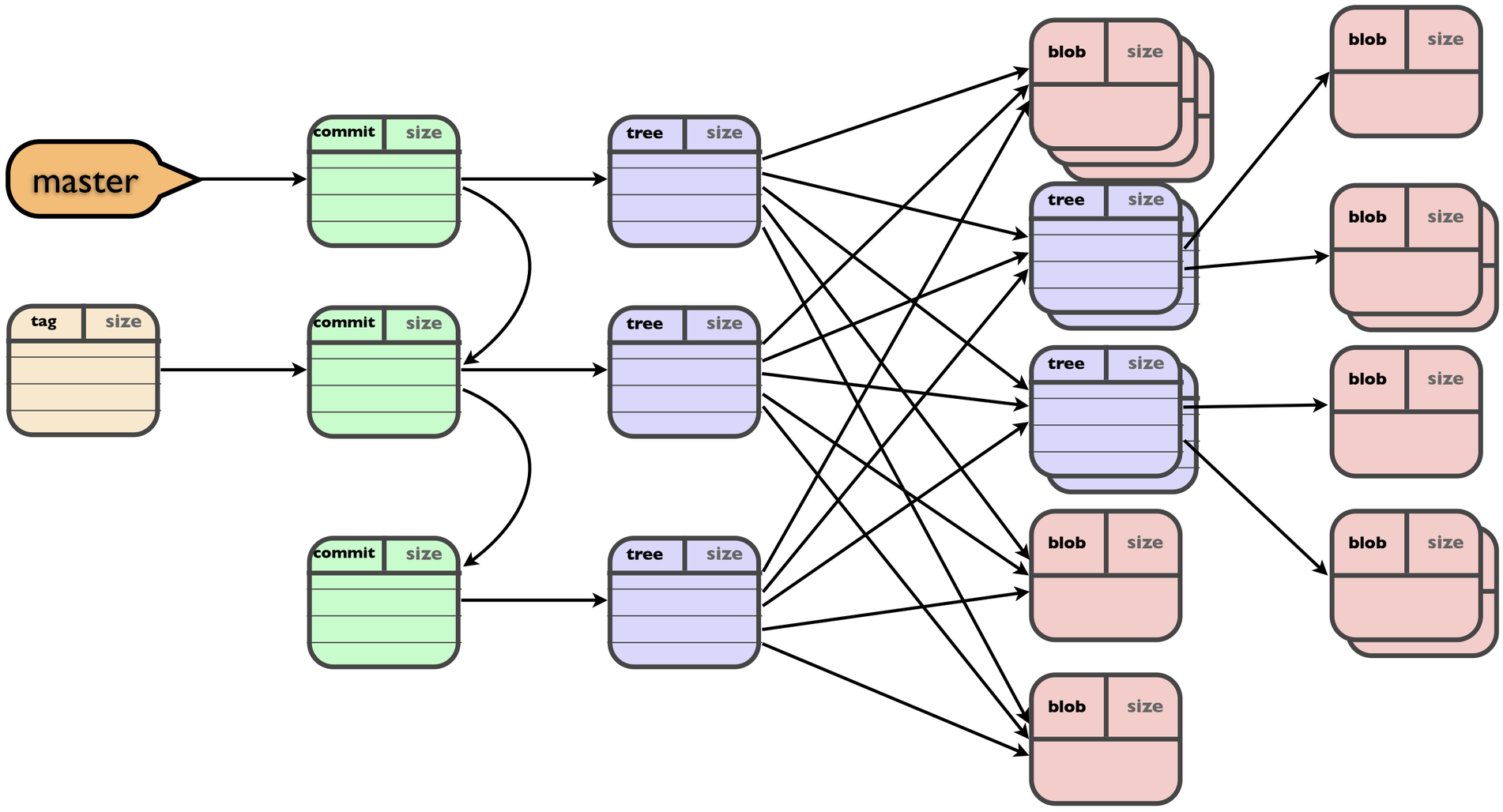
Branches ‘v’ Tags

HEAD and your current branch are automatically updated when you commit a change.



tags are immutable and reliably point to a known state of the entire repository

The whole lot



Sharing

my
repository

Sharing

my repository

Alice' repository

Sharing

my repository

Alice' repository

Bob's repository

Sharing

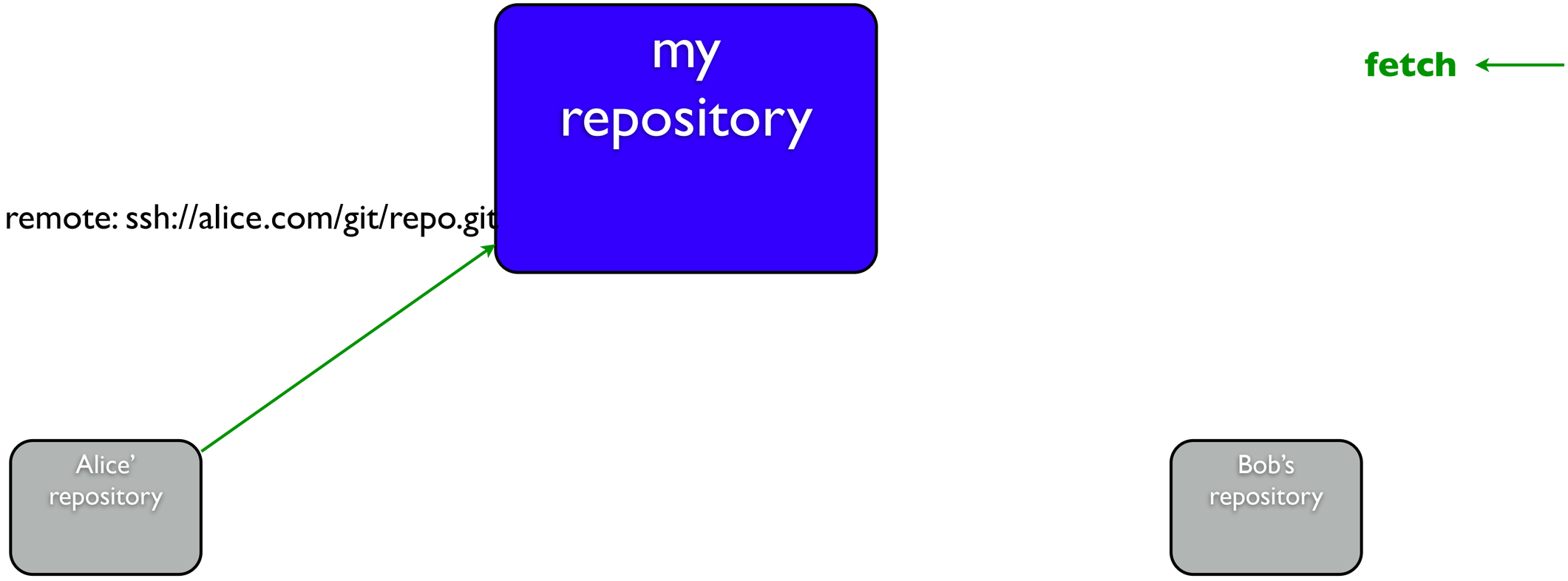
my repository

remote: ssh://alice.com/git/repo.git

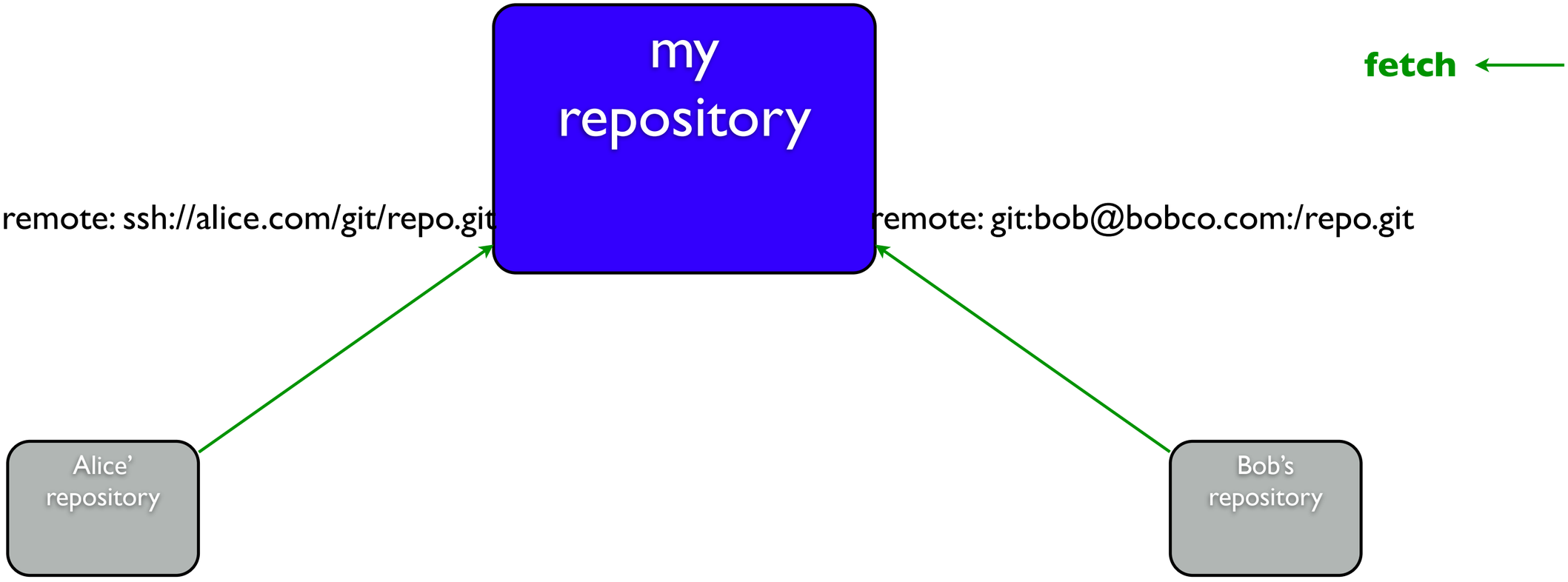
Alice' repository

Bob's repository

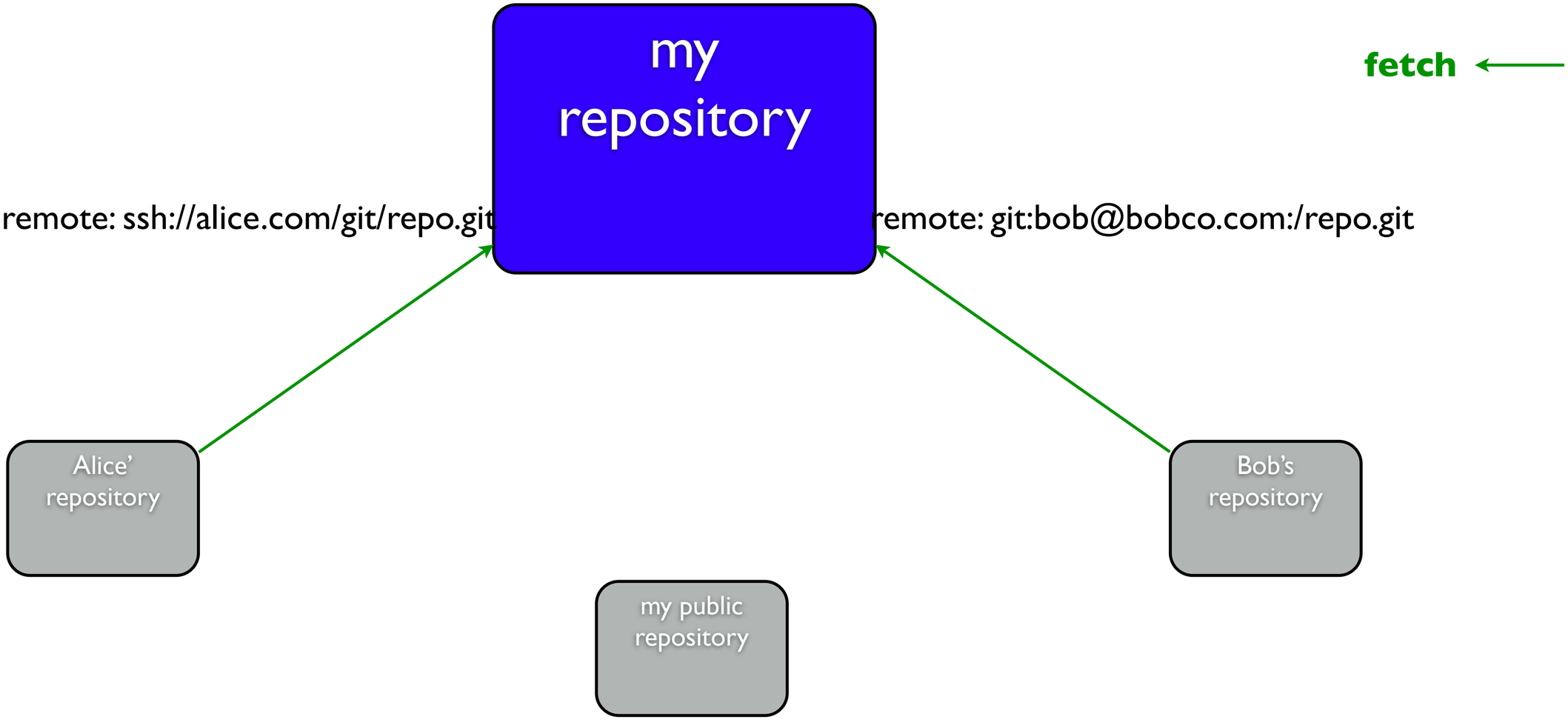
Sharing


my repository
fetch
remote: ssh://alice.com/git/repo.git
Alice' repository
Bob's repository

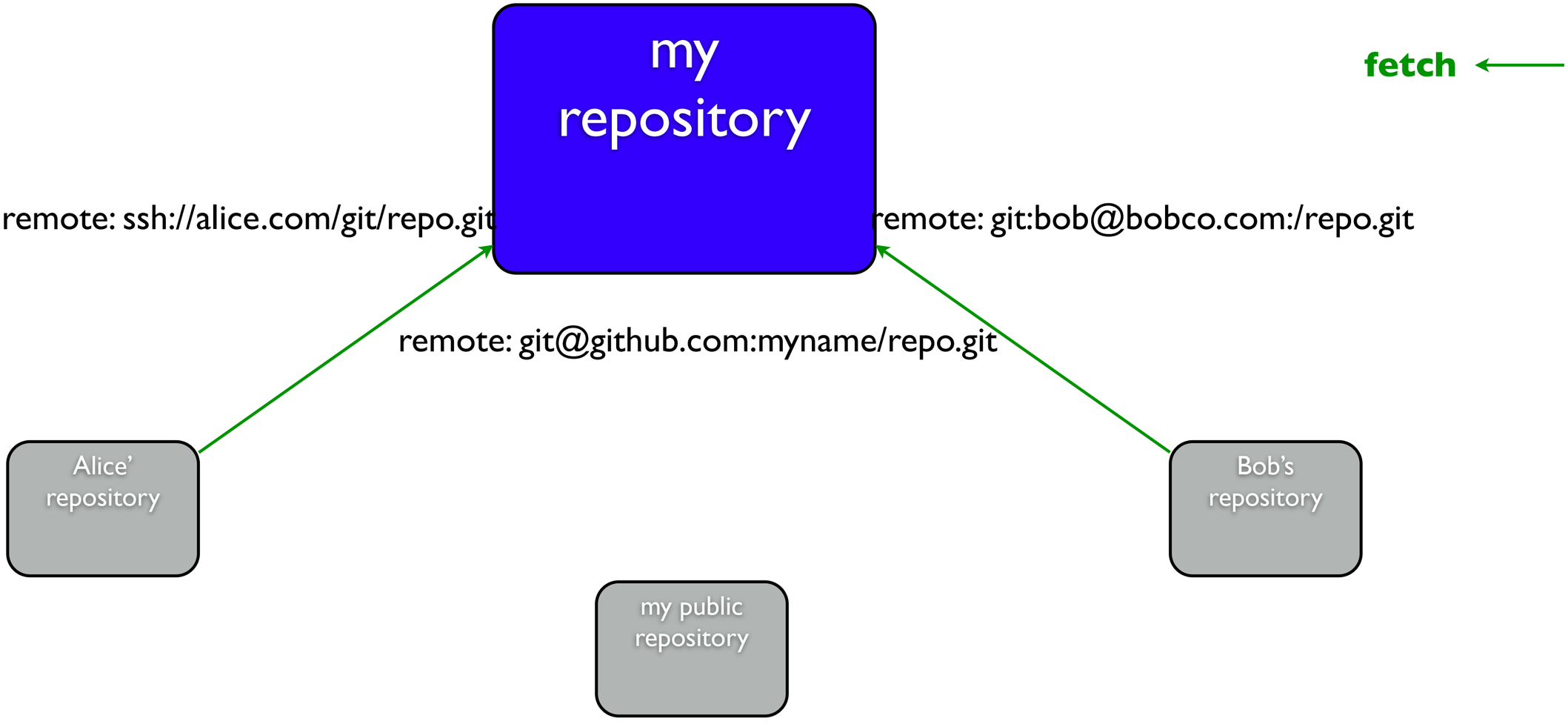
Sharing


my repository
fetch
remote: ssh://alice.com/git/repo.git
remote: git:bob@bobco.com:/repo.git
Alice' repository
Bob's repository

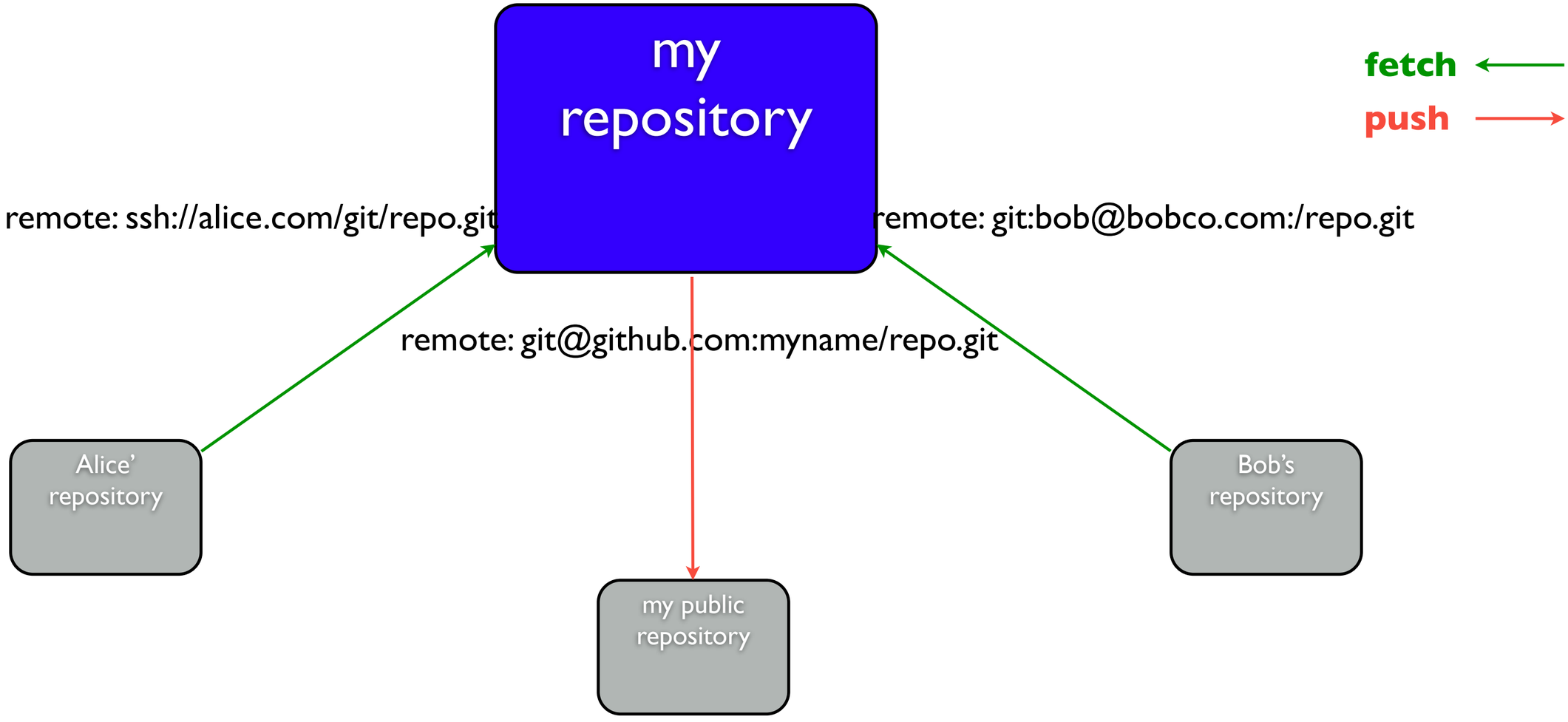
Sharing


my repository
fetch
remote: ssh://alice.com/git/repo.git
remote: git:bob@bobco.com:/repo.git
Alice' repository
Bob's repository
my public repository

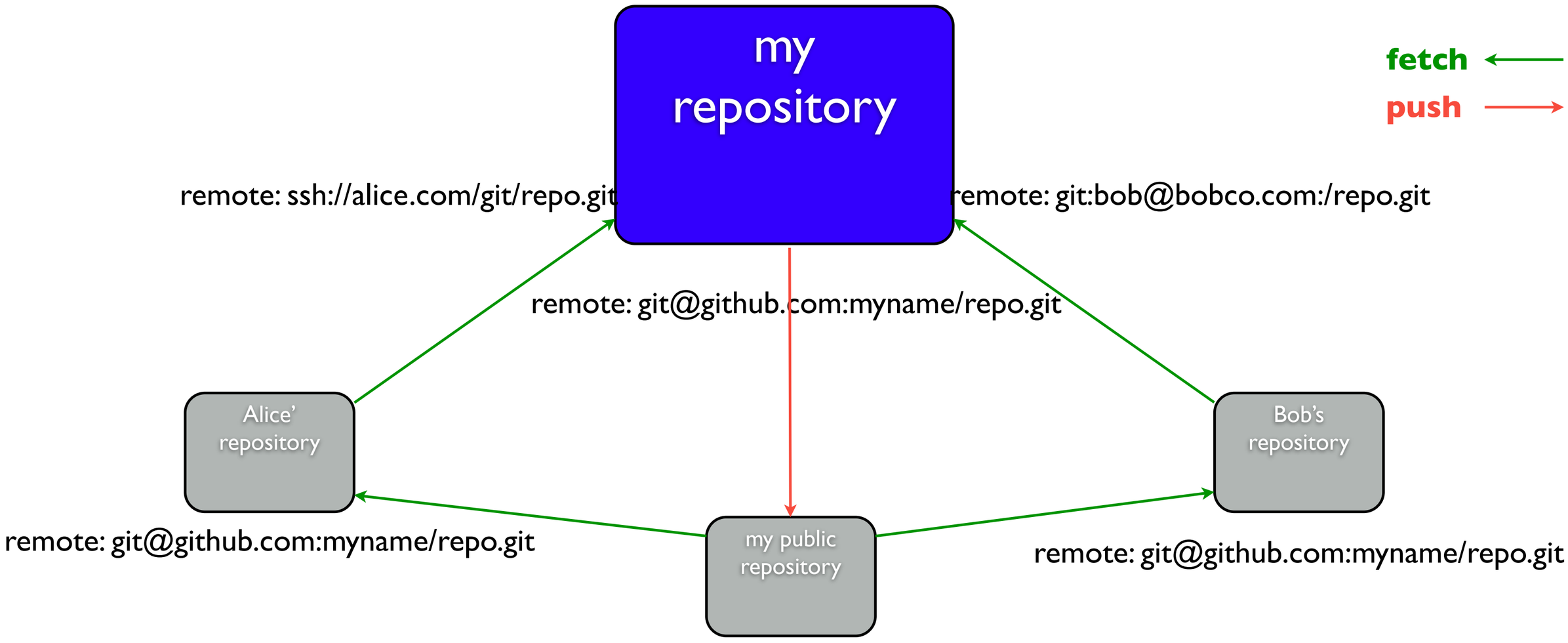
Sharing


my repository
fetch
remote: ssh://alice.com/git/repo.git
remote: git:bob@bobco.com:/repo.git
remote: git@github.com:myname/repo.git
Alice' repository
Bob's repository
my public repository

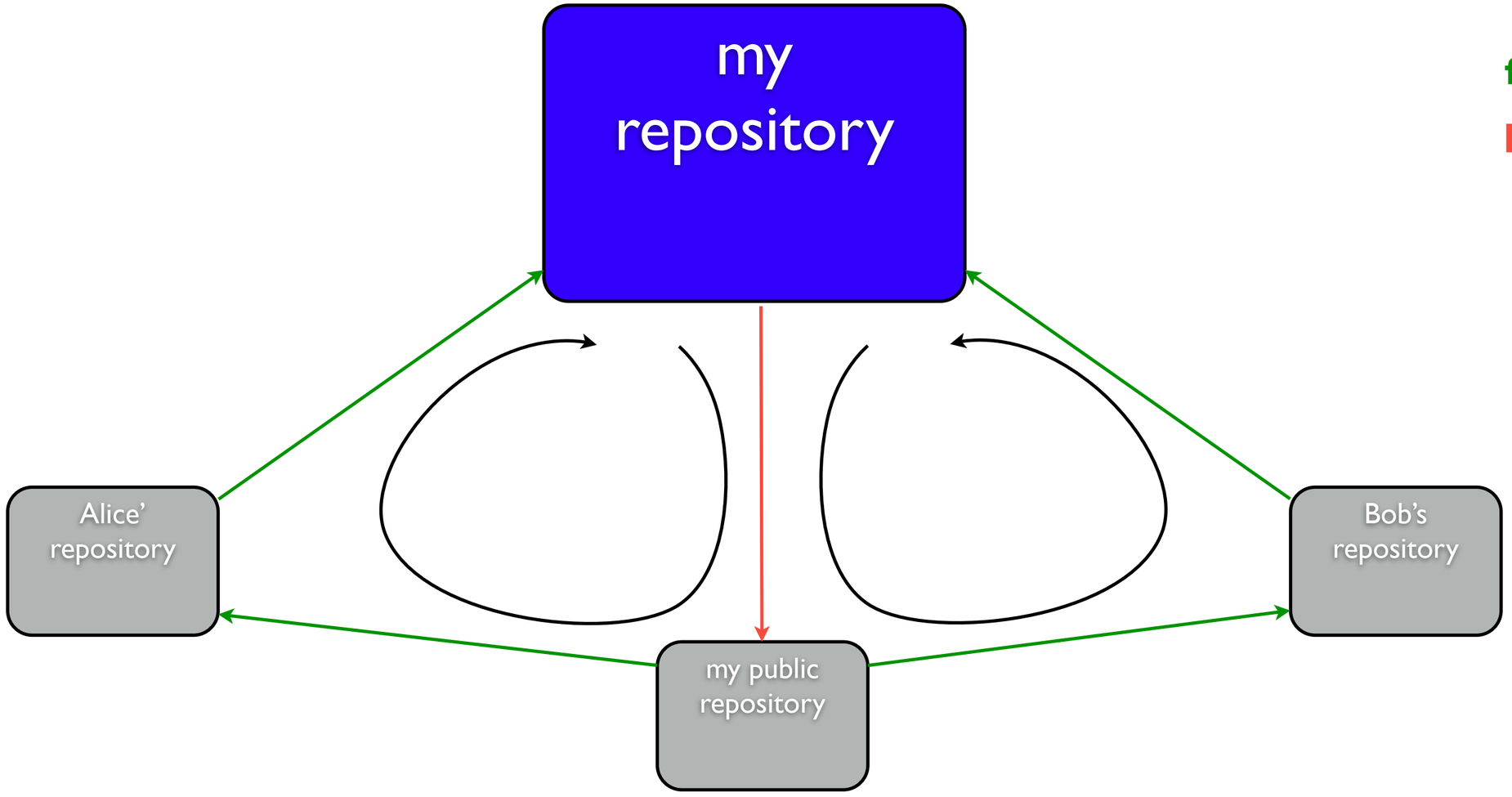
Sharing


my repository
fetch
push
remote: ssh://alice.com/git/repo.git
remote: git:bob@bobco.com:/repo.git
remote: git@github.com:myname/repo.git
Alice' repository
my public repository
Bob's repository

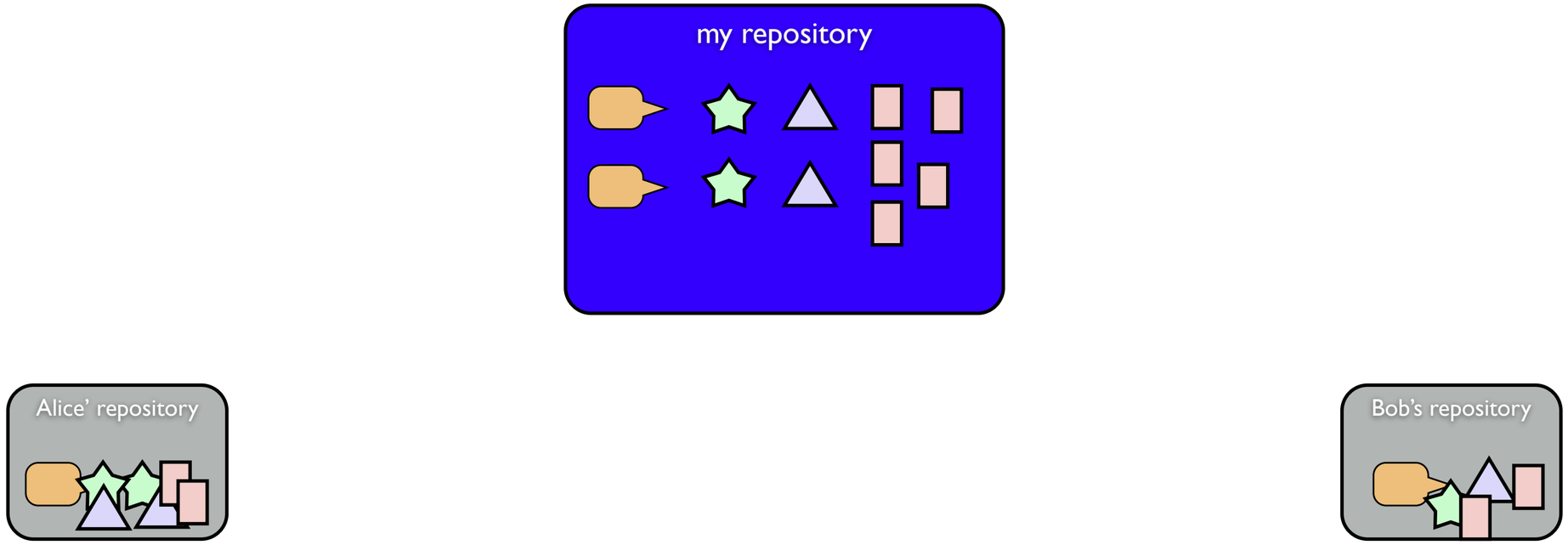
Sharing


my repository
fetch
push
remote: ssh://alice.com/git/repo.git
remote: git:bob@bobco.com:/repo.git
remote: git@github.com:myname/repo.git
Alice' repository
Bob's repository
remote: git@github.com:myname/repo.git
my public repository
remote: git@github.com:myname/repo.git

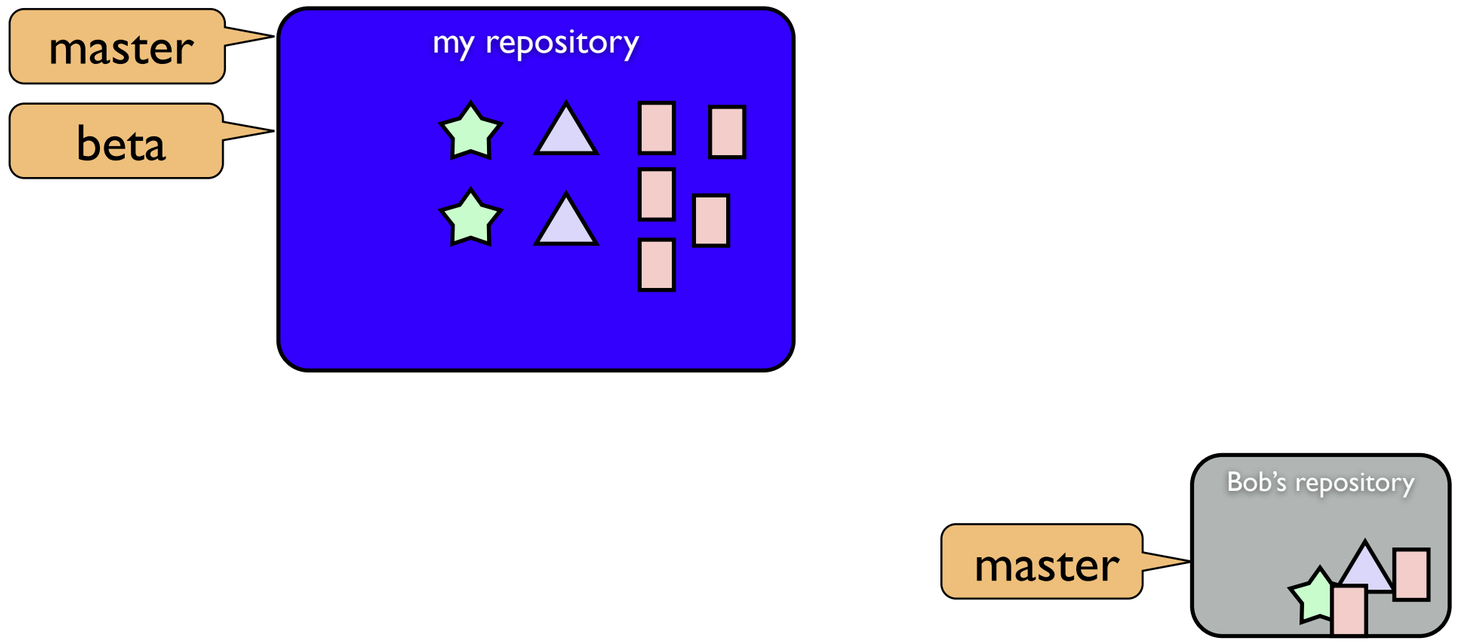
Sharing

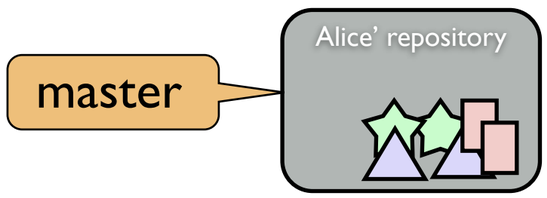

my
repository
Alice'
repository
Bob's
repository
my public
repository
fetch
push

Namespaces



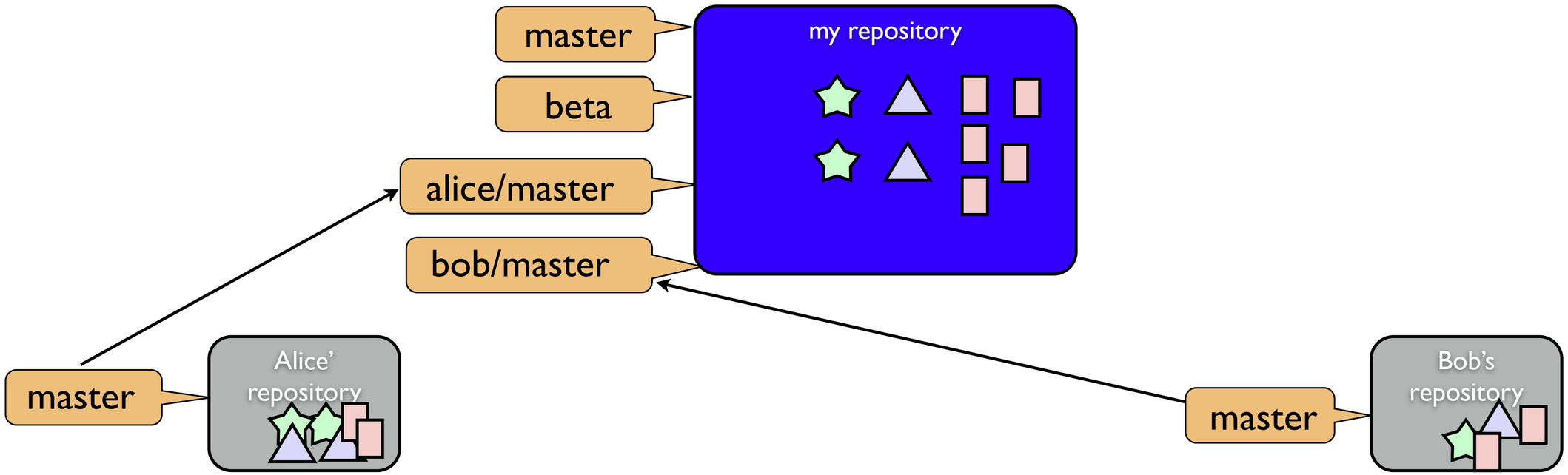
Namespaces


master
beta
my repository


master
Alice' repository

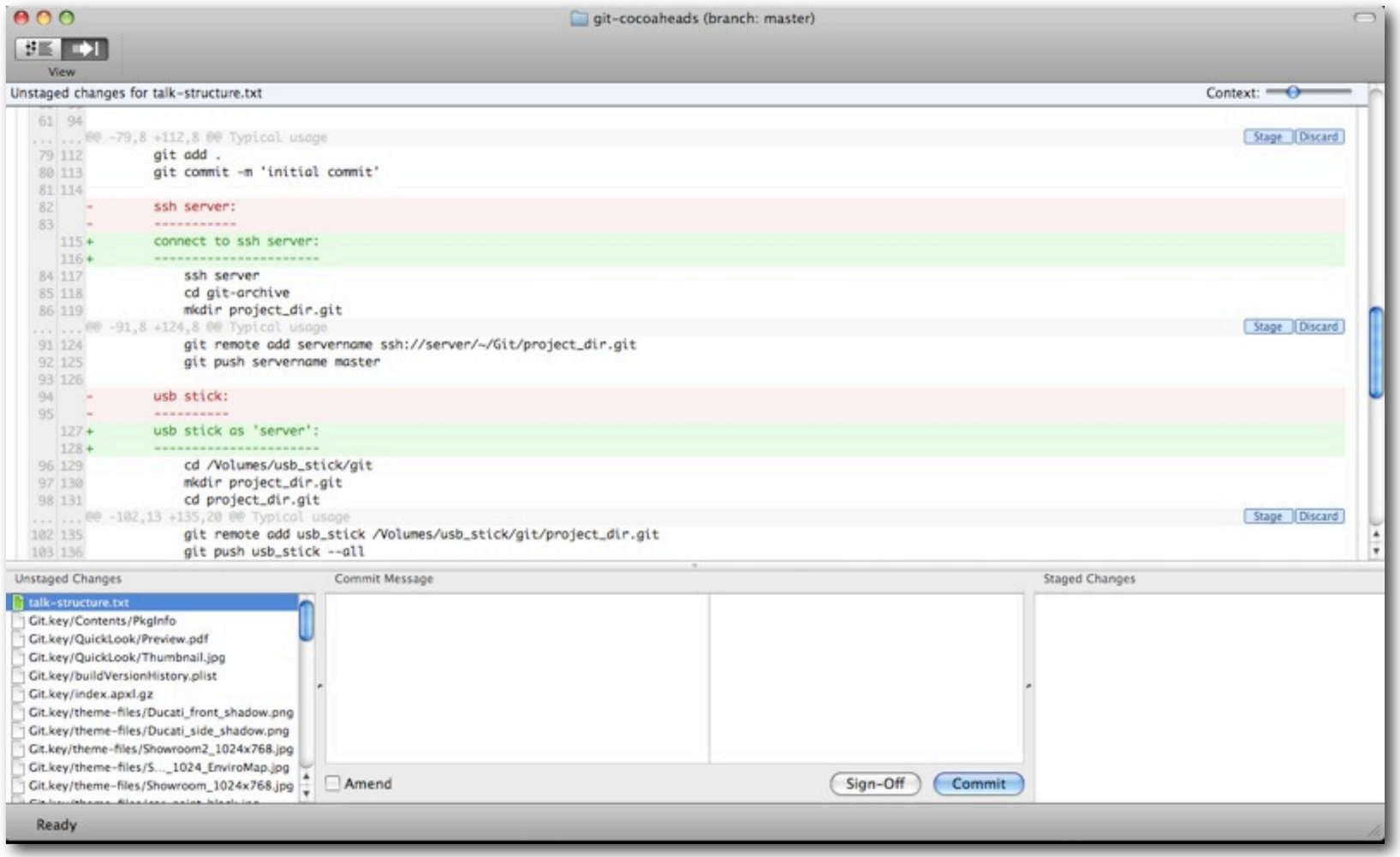
master
Bob's repository

Namespaces

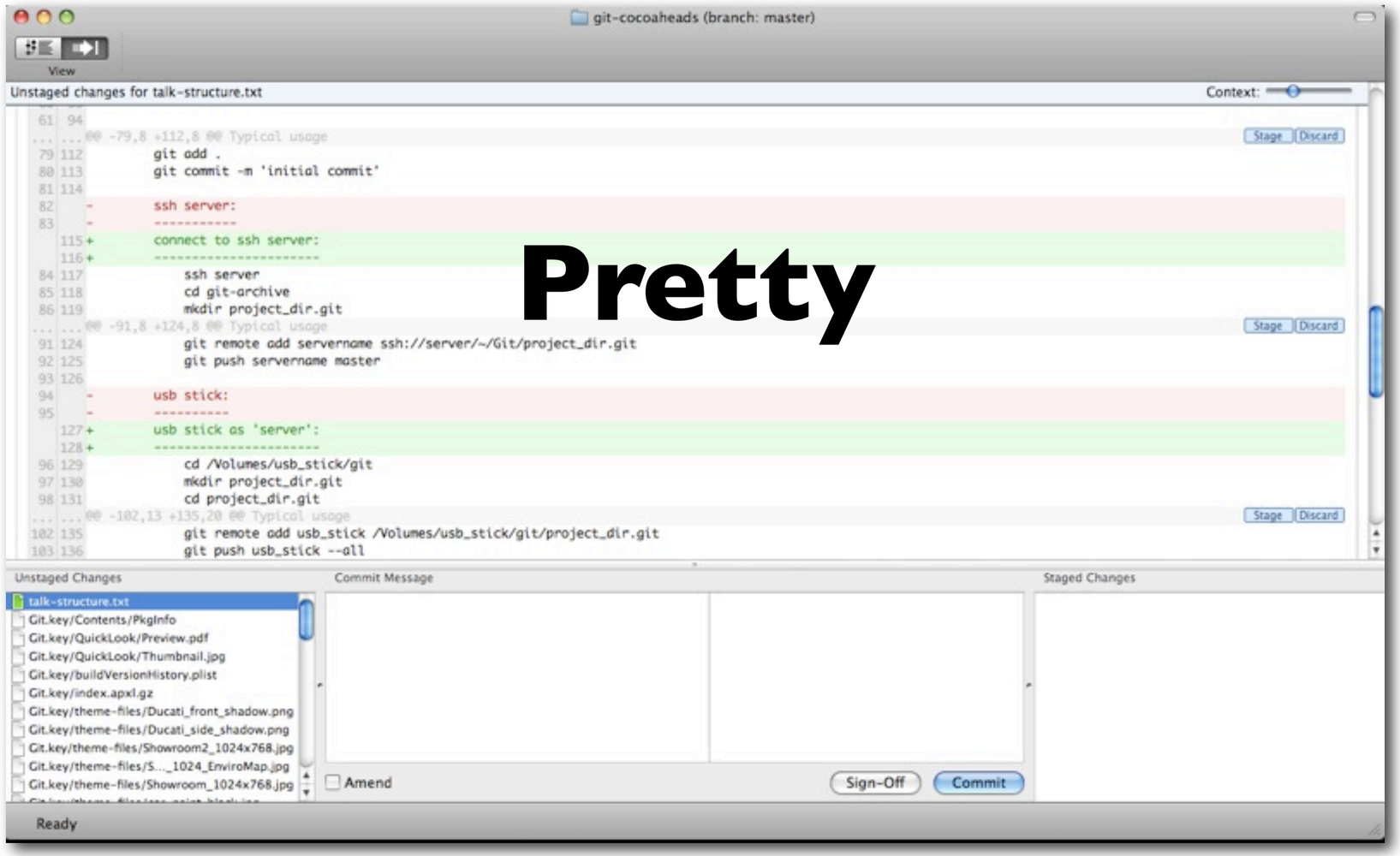

master
beta
alice/master
bob/master
my repository
master
Alice'
repository
master
Bob's
repository

Git On OS-X

gitx

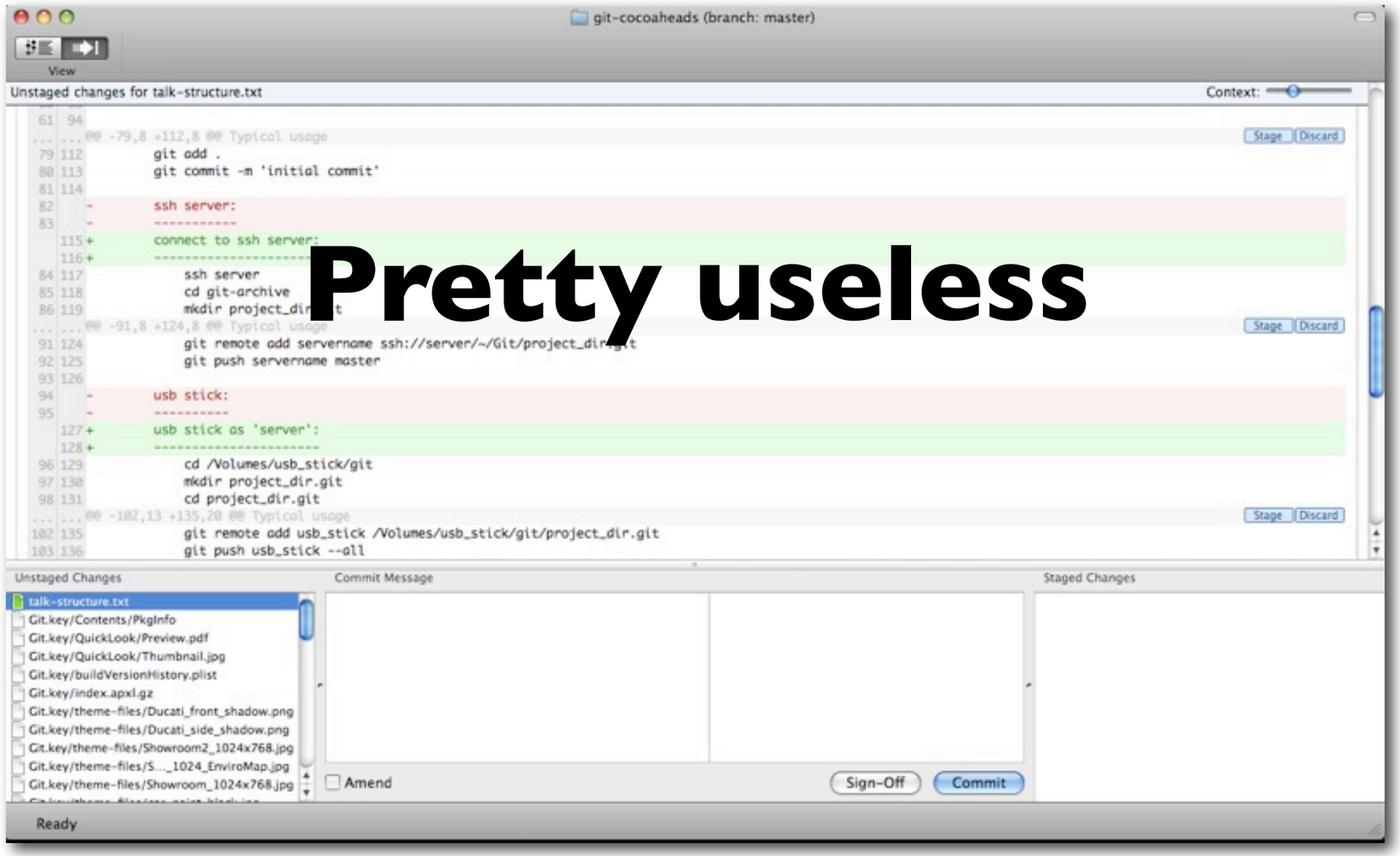

git-cocoaheads (branch: master)
View
Unstaged changes for talk-structure.txt
Context:
Stage
Discard
git add .
git commit -m 'initial commit'
ssh server:
connect to ssh server:
ssh server
cd git-archive
mkdir project_dir.git
git remote add servername ssh://server/~/Git/project_dir.git
git push servername master
usb stick:
usb stick as 'server':
cd /Volumes/usb_stick/git
mkdir project_dir.git
cd project_dir.git
git remote add usb_stick /Volumes/usb_stick/git/project_dir.git
git push usb_stick --all
Unstaged Changes
Commit Message
Staged Changes
talk-structure.txt
Git.key/Contents/PkgInfo
Git.key/QuickLook/Preview.pdf
Git.key/QuickLook/Thumbnail.jpg
Git.key/buildVersionHistory.plist
Git.key/index.apxl.gz
Git.key/theme-files/Ducati_front_shadow.png
Git.key/theme-files/Ducati_side_shadow.png
Git.key/theme-files/Showroom2_1024x768.jpg
Git.key/theme-files/S..._1024_EnviroMap.jpg
Git.key/theme-files/Showroom_1024x768.jpg
Amend
Sign-Off
Commit
Ready

gitx


git-cocoaheads (branch: master)
View
Unstaged changes for talk-structure.txt
Context:
Stage
Discard
@@ -79,8 +112,8 @@ Typical usage
git add .
git commit -m 'initial commit'
- ssh server:
- ----------
+ connect to ssh server:
+ ----------------------
ssh server
cd git-archive
mkdir project_dir.git
@@ -91,8 +124,8 @@ Typical usage
git remote add servername ssh://server/~/Git/project_dir.git
git push servername master
- usb stick:
- ----------
+ usb stick as 'server':
+ ----------------------
cd /Volumes/usb_stick/git
mkdir project_dir.git
cd project_dir.git
@@ -102,13 +135,20 @@ Typical usage
git remote add usb_stick /Volumes/usb_stick/git/project_dir.git
git push usb_stick --all
Unstaged Changes
Commit Message
Staged Changes
talk-structure.txt
Git.key/Contents/PkgInfo
Git.key/QuickLook/Preview.pdf
Git.key/QuickLook/Thumbnail.jpg
Git.key/buildVersionHistory.plist
Git.key/index.apxl.gz
Git.key/theme-files/Ducati_front_shadow.png
Git.key/theme-files/Ducati_side_shadow.png
Git.key/theme-files/Showroom2_1024x768.jpg
Git.key/theme-files/S..._1024_EnviroMap.jpg
Git.key/theme-files/Showroom_1024x768.jpg
Amend
Sign-Off
Commit
Ready

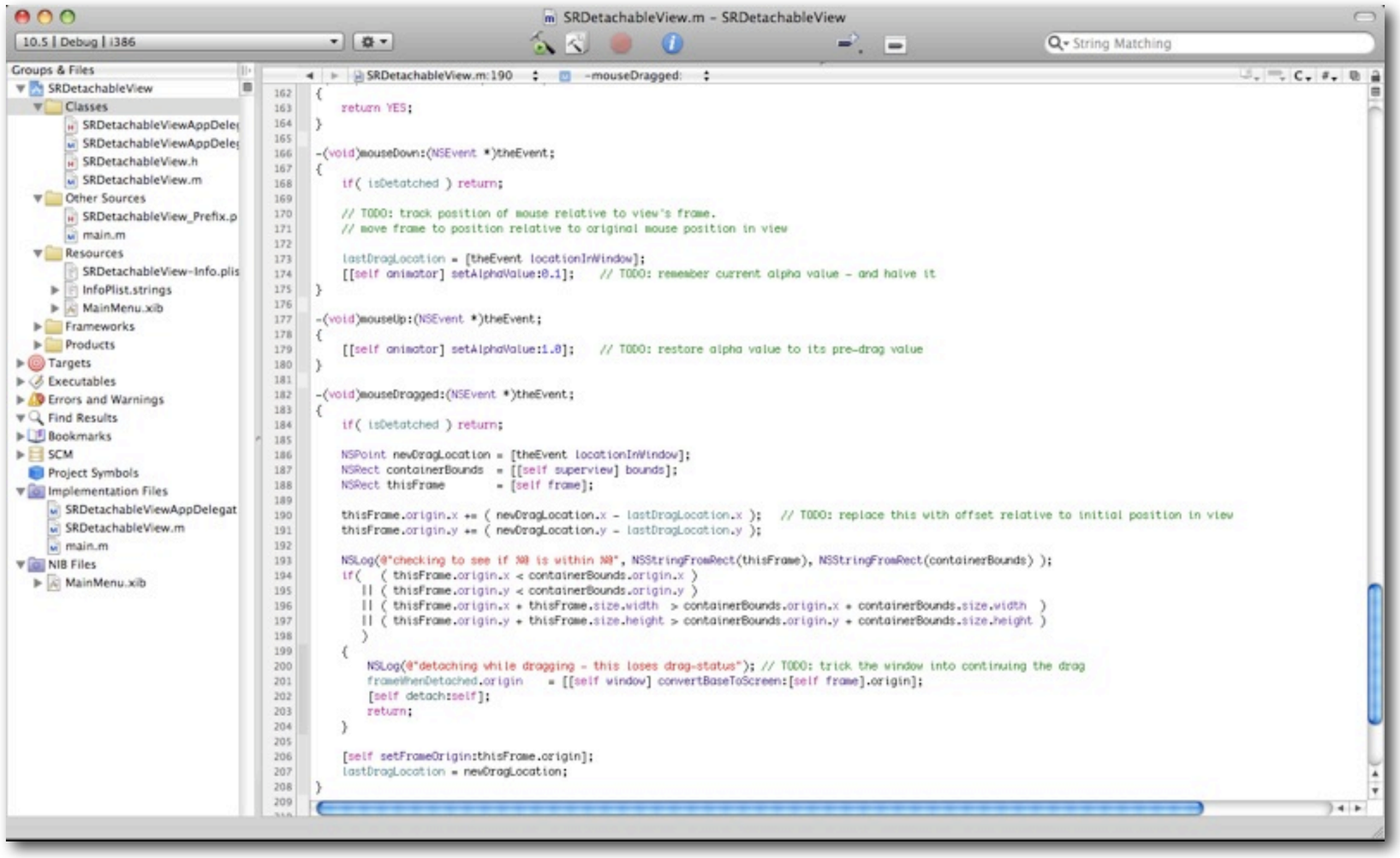
Pretty

gitx

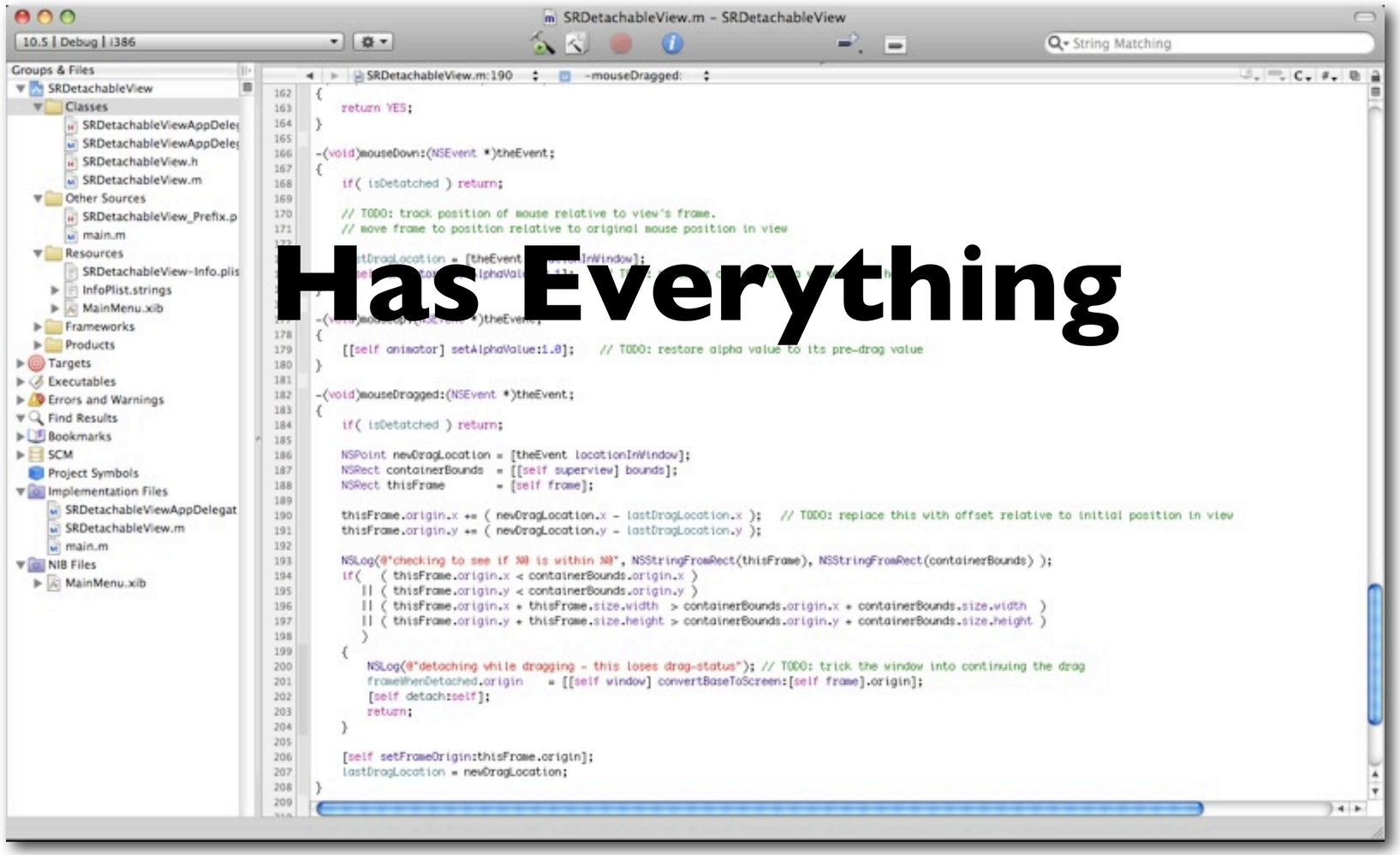


Pretty useless

XCode


SRDetachableView.m – SRDetachableView
10.5 | Debug | i386
String Matching
Groups & Files
SRDetachableView
Classes
SRDetachableViewAppDele
SRDetachableViewAppDele
SRDetachableView.h
SRDetachableView.m
Other Sources
SRDetachableView_Prefix.p
main.m
Resources
SRDetachableView-Info.plis
InfoPlist.strings
MainMenu.xib
Frameworks
Products
Targets
Executables
Errors and Warnings
Find Results
Bookmarks
SCM
Project Symbols
Implementation Files
SRDetachableViewAppDelegat
SRDetachableView.m
main.m
NIB Files
MainMenu.xib
SRDetachableView.m:190
-mouseDragged:
{
return YES;
}
-(void)mouseDown:(NSEvent *)theEvent;
{
if(isDetatched) return;
// TODO: track position of mouse relative to view's frame.
// move frame to position relative to original mouse position in view
lastDragLocation = [theEvent locationInWindow];
[[self animator] setAlphaValue:0.1]; // TODO: remember current alpha value - and halve it
}
-(void)mouseUp:(NSEvent *)theEvent;
{
[[self animator] setAlphaValue:1.0]; // TODO: restore alpha value to its pre-drag value
}
-(void)mouseDragged:(NSEvent *)theEvent;
{
if(isDetatched) return;
NSPoint newDragLocation = [theEvent locationInWindow];
NSRect containerBounds = [[self superview] bounds];
NSRect thisFrame   = [self frame];
thisFrame.origin.x += (newDragLocation.x - lastDragLocation.x); // TODO: replace this with offset relative to initial position in view
thisFrame.origin.y += (newDragLocation.y - lastDragLocation.y);
NSLog(@"checking to see if %@ is within %@", NSStringFromRect(thisFrame), NSStringFromRect(containerBounds));
if((thisFrame.origin.x < containerBounds.origin.x)
|| (thisFrame.origin.y < containerBounds.origin.y)
|| (thisFrame.origin.x + thisFrame.size.width > containerBounds.origin.x + containerBounds.size.width)
|| (thisFrame.origin.y + thisFrame.size.height > containerBounds.origin.y + containerBounds.size.height)
)
{
NSLog(@"detaching while dragging - this loses drag-status"); // TODO: trick the window into continuing the drag
frameWhenDetached.origin = [[self window] convertBaseToScreen:[self frame].origin];
[self detach:self];
return;
}
[self setFrameOrigin:thisFrame.origin];
lastDragLocation = newDragLocation;
}

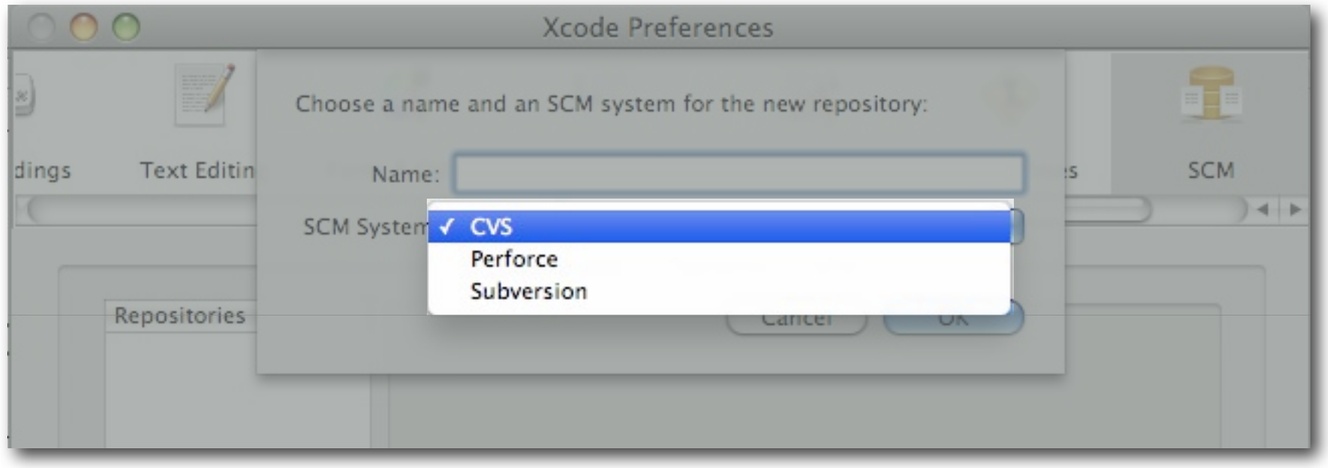
XCode



Has Everything

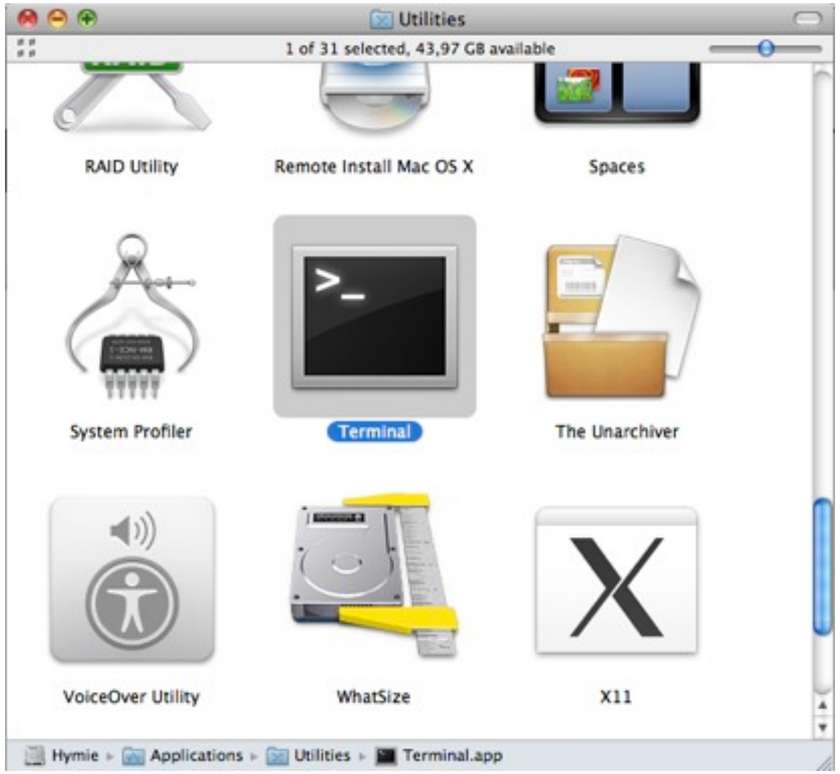
XCode

Has Everything



except git support

Git your hands dirty



Git your hands dirty

```
~/ > echo "you're going to need the command line :-)"
```

First Steps

global Configuration

```
~/ > $EDITOR ~/.gitconfig

[core]
    pager = more
    excludesfile = /Users/me/.gitignore
[user]
    name = My Full Public Identity
    email = h4x0r@example.com
[format]
    pretty = format:%h %ci [%aN] %s
```

pager stops long lists from flying past your nose uncontrollably

excludesfile specifies files should never be checked into a git repository

format:
- %h = hash id
- %ci = commit date, iso 8601 format
- %aN = author name
- %s = summary

more info: `git log --help`

global Configuration

```
~/ > $EDITOR ~/.gitignore

# apple typical files
.DS_Store
.Spotlight-V100
.com.apple.timemachine.supported
.fseventsdbuild

# XCode user state files
*.mode1v3
*.pbxuser
*.objc_sync

# other SCM systems
.svn

# editor temporary files
*~
*.swp

# files you generate while building
build/
version.txt
CHANGELOG
```

Things which git should probably ignore (for commands like `git add .` which just grab everything)

Where to look for Help

make sure you install git's man-pages.

Use the `man` branch of the git repository

```
~/ > git help <cmd>
```

```
~/ > git <cmd> --help
```

Where to look for Help

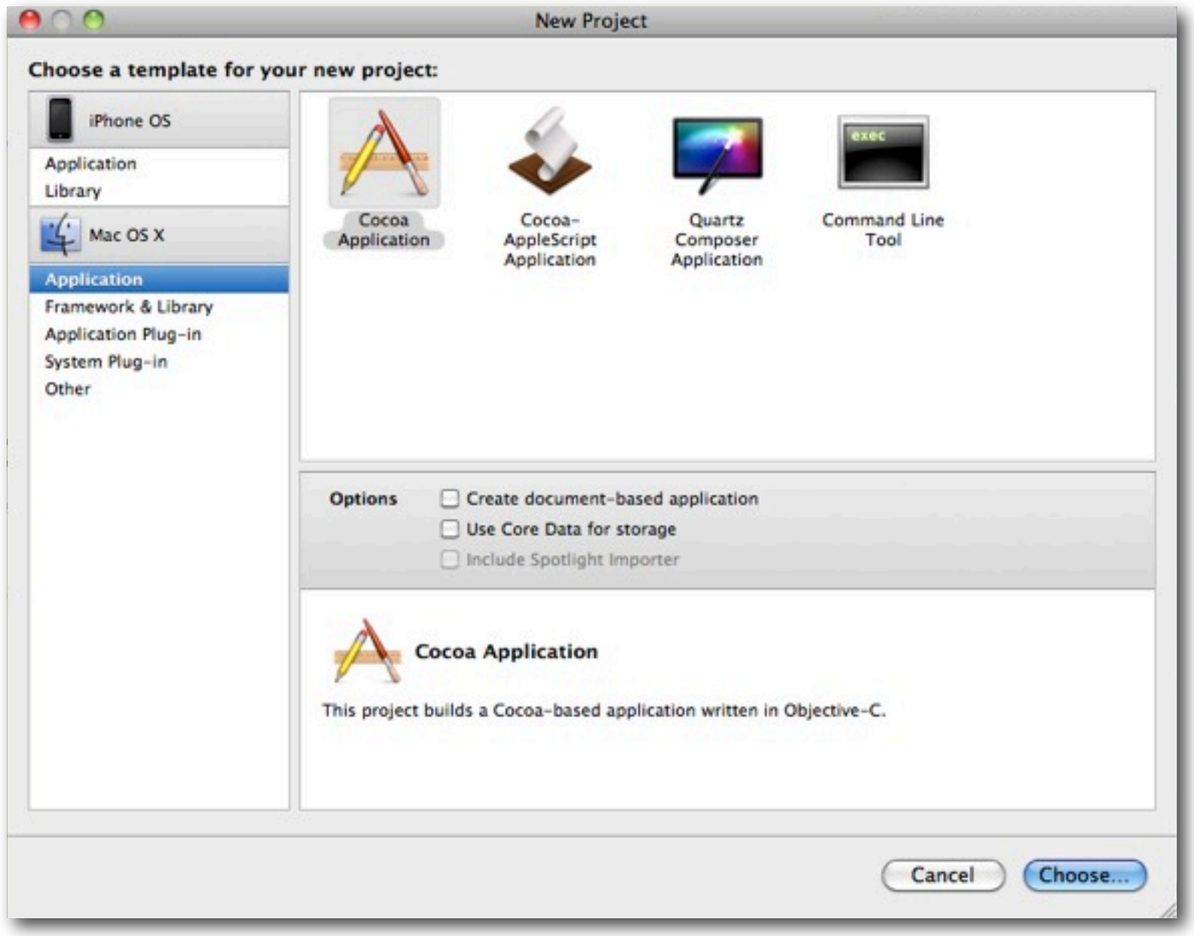
http://git-scm.com

http://github.com

http://gitready.com

http://google.com

A new Project



New Project in Git

```
~/>              cd project



~/project/ >  git init
Initialized empty Git repository in project_dir/.git/



~/project/ >  git add .



~/project/ >  git commit -m 'initial commit'
[master (root-commit) 64fb323] initial commit
 1 files changed, 1 insertions(+), 0 deletions(-)
 create mode 100644 hello.txt
```

In english:
- create your project in XCode
- create a new git repository
- add your files & directories to git
- commit your changes

Git Configuration for Xcode

```
~/project/ >  $EDITOR .gitattributes


*.pbxproj -crlf -diff -merge
*.nib     -crlf -diff -merge
*.xib     -crlf -diff -merge
*.graffle -crlf -diff -merge


~/project/ >  git add .gitattributes


~/project/ >  git commit -m 'add .gitattributes - prevent accidental merging of special XCode files'
[master (root-commit) 64fb323] initial commit
 1 files changed, 1 insertions(+), 0 deletions(-)
 create mode 100644 .gitattributes
```

Tell git to treat these files as if they were binaries.

XML files are notorious for being text, but "unmergable".

`.gitattributes` is project-specific
- must be checked into each project seperately
- will automatically be used by all project members

Joining An Existing Project

```
~/ > git clone -o cloned_repo URL/project.git
```

```
~/ > cd project
```

```
~/project/ > git checkout -b my_stuff cloned_repo/master
```

cloning a repository automatically sets up a remote repository called `origin`.

You can specify a different name for the remote repository with `-o name`

Clone a local repository

cloning a repository automatically sets up a remote repository called `origin`.

You can specify a different name for the remote repository with `-o name`

```
~/ > git clone ~/old_project_dir ~/new_project_dir
```

git with XCode

XCode & git

I warned you!
Grab your favourite terminal window and start typing...

```
~/project/ > open *.xcode*
```

XCode & git

I warned you!
Grab your favourite terminal window and start typing...

```
~/project/ > open *.xcode*
```

XCode & git

A typical sequence of commands

```
~/project/ > git status

~/project/ > git diff

~/project/ > git checkout -b fix

work work work…

~/project/ > git commit -am '…'

~/project/ > git checkout master

~/project/ > git merge fix

~/project/ > git push public
```

if this happens…

```
git checkout
```

if this happens…

```
git checkout
```

…switch to XCode…

if this happens…

`git checkout`

if this happens…

`git checkout`

everything's OK, XCode just doesn't want to lose your work…

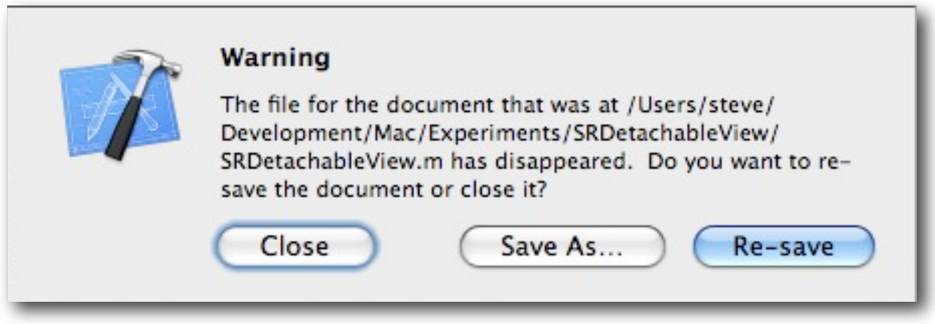
if this happens…

`git checkout`

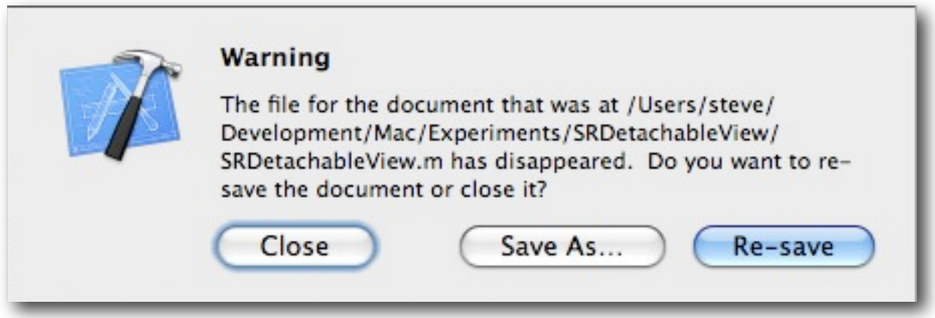
"**Read from Disk**" will bring XCode up-to-date with your git repository

However…

However…

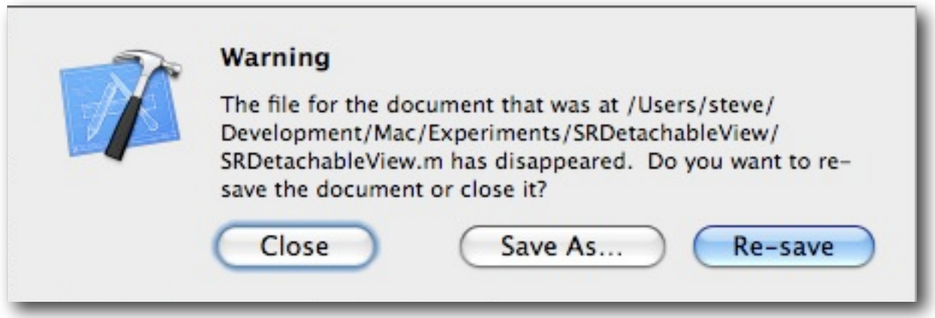

Warning
The file for the document that was at /Users/steve/Development/Mac/Experiments/SRDetachableView/SRDetachableView.m has disappeared. Do you want to re-save the document or close it?
Close
Save As…
Re-save

However…



If you get this message, you should:

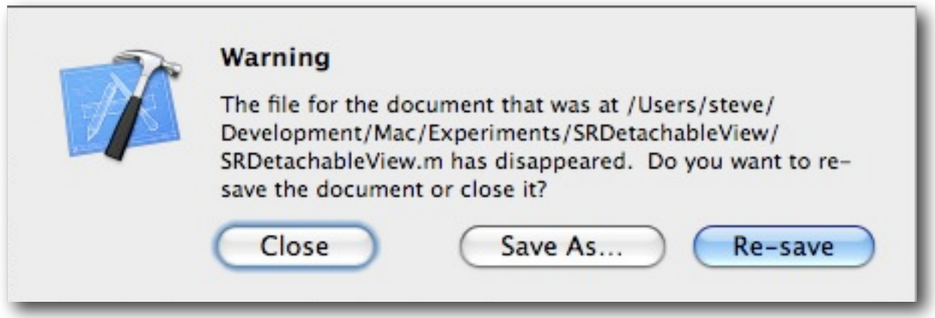
However…



If you get this message, you should:

Save your work (possibly in a Temporary Directory)

However…

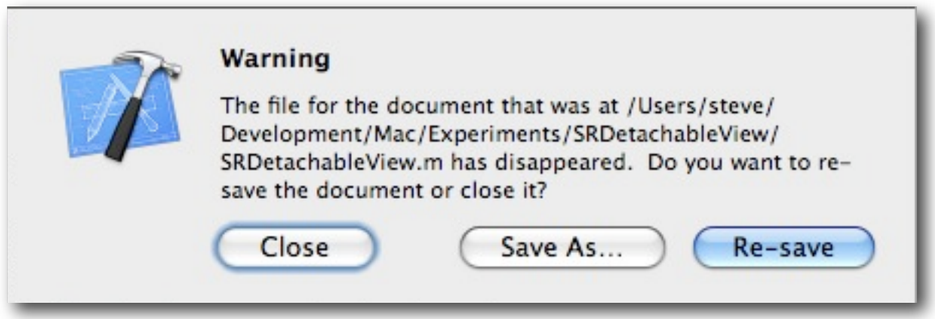


If you get this message, you should:

Save your work (possibly in a Temporary Directory)

Close XCode

However…



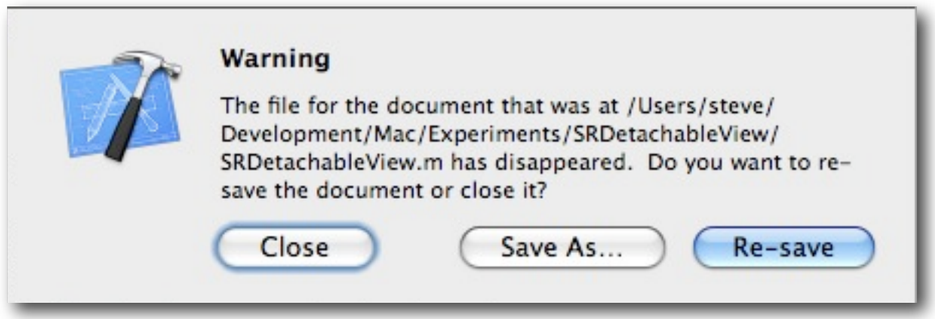
If you get this message, you should:

Save your work (possibly in a Temporary Directory)

Close XCode

Fix up your working directory

However…



If you get this message, you should:

Save your work (possibly in a Temporary Directory)

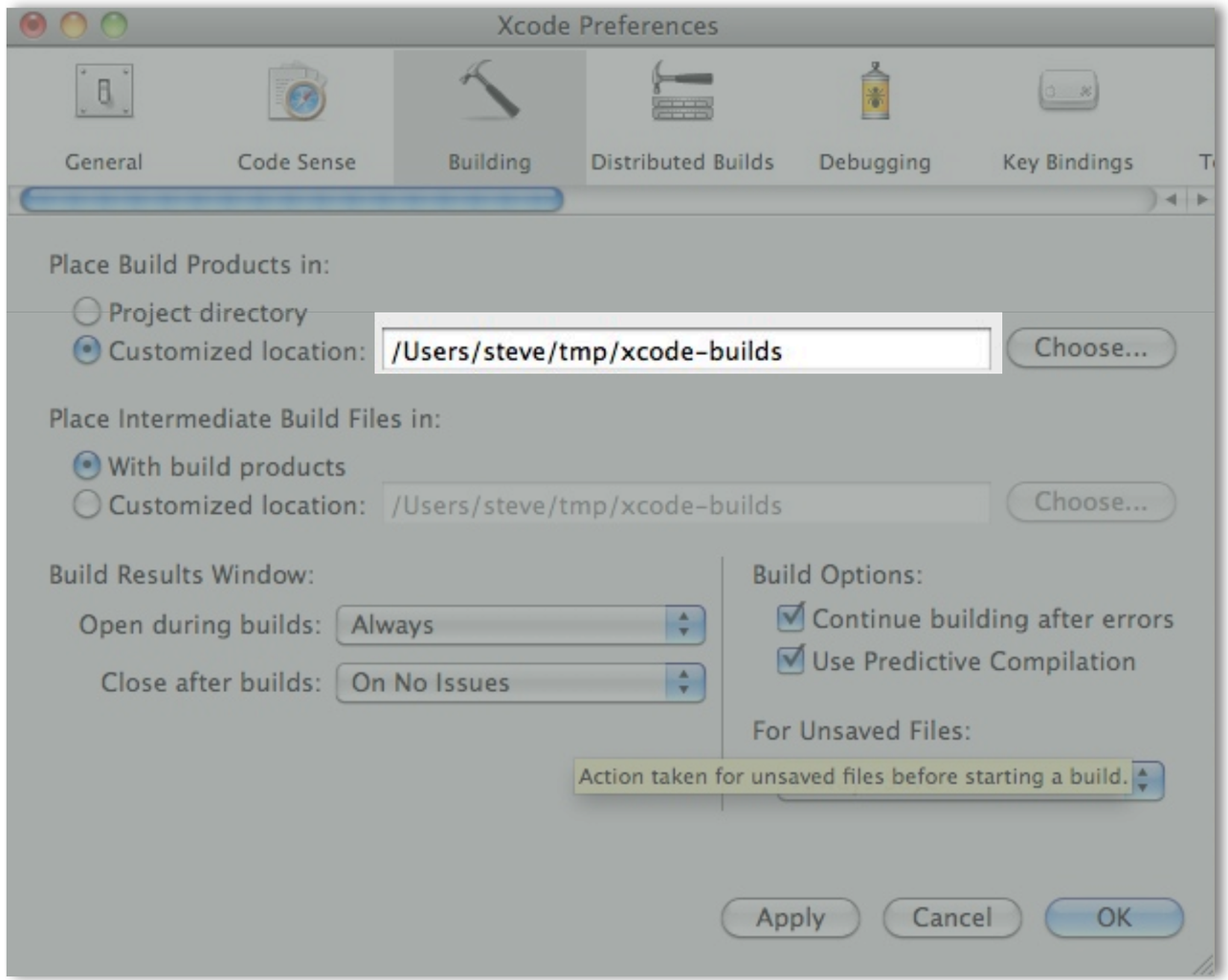
Close XCode

Fix up your working directory

Open XCode again

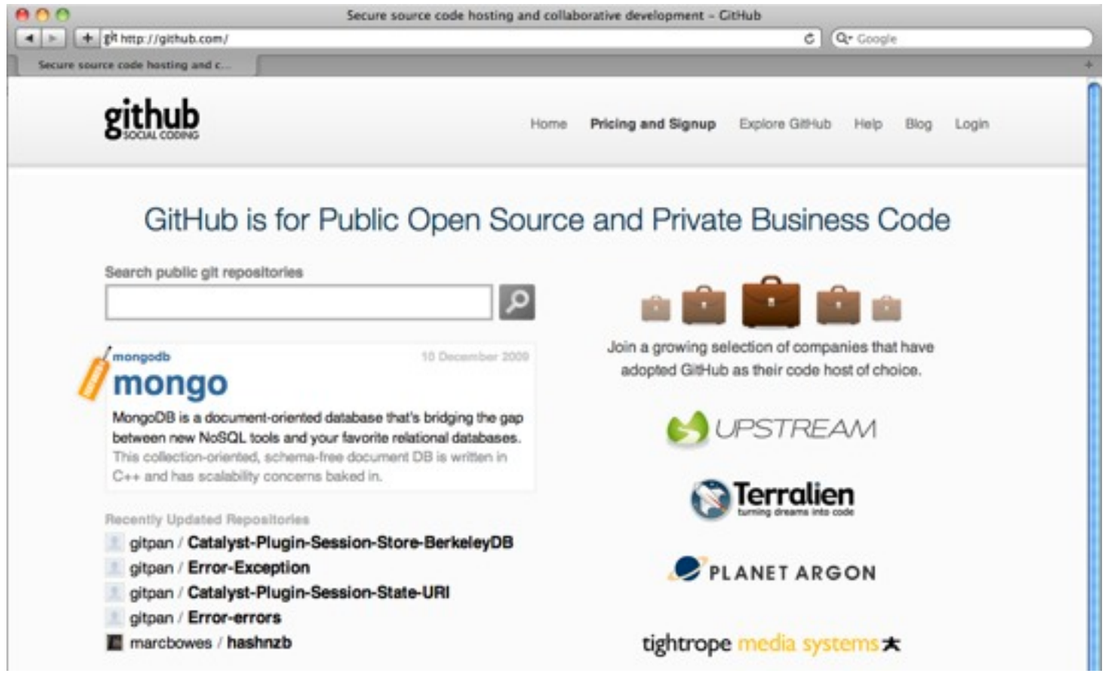
XCode - Tips

XCode - Tips


Xcode Preferences
General
Code Sense
Building
Distributed Builds
Debugging
Key Bindings
Place Build Products in:
Project directory
Customized location:
/Users/steve/tmp/xcode-builds
Choose...
Place Intermediate Build Files in:
With build products
Customized location:
/Users/steve/tmp/xcode-builds
Choose...
Build Results Window:
Open during builds:
Always
Close after builds:
On No Issues
Build Options:
Continue building after errors
Use Predictive Compilation
For Unsaved Files:
Action taken for unsaved files before starting a build.
Apply
Cancel
OK

github

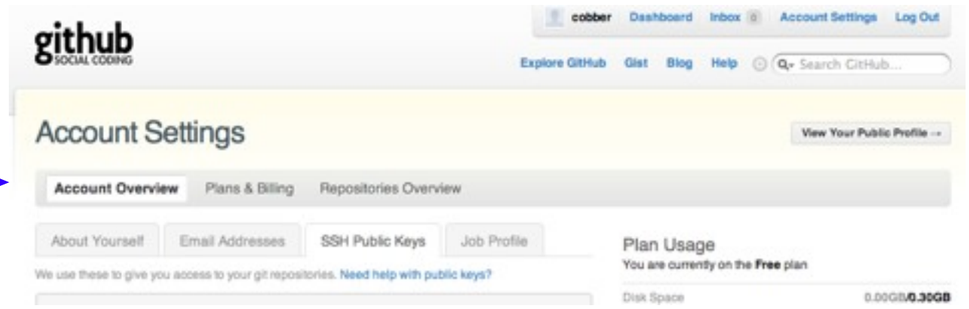
github


Secure source code hosting and collaborative development - GitHub
http://github.com/
Google
Secure source code hosting and c...
github
SOCIAL CODING
Home
Pricing and Signup
Explore GitHub
Help
Blog
Login
GitHub is for Public Open Source and Private Business Code
Search public git repositories
mongodb
10 December 2009
mongo
MongoDB is a document-oriented database that's bridging the gap between new NoSQL tools and your favorite relational databases. This collection-oriented, schema-free document DB is written in C++ and has scalability concerns baked in.
Recently Updated Repositories
gitpan / Catalyst-Plugin-Session-Store-BerkeleyDB
gitpan / Error-Exception
gitpan / Catalyst-Plugin-Session-State-URI
gitpan / Error-errors
marcbowes / hashnzb
Join a growing selection of companies that have adopted GitHub as their code host of choice.
UPSTREAM
Terralien
turning dreams into code
PLANET ARGON
tightrope media systems

github - ssh keys

Copy and paste your public key into the SSH Public Keys tab of your github account settings.

```
~/.ssh/ > ssh-keygen -t rsa -f github

Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase): password or just hit return
Enter same passphrase again: password or just hit return again

~/.ssh/ > ls

github
github.pub

~/.ssh/ > cat github.pub

ssh-rsa AAAAB3NzaC1yc2EAAAABIwAAAQEArkyf…
```



Daily Work

add & commit

work work work…

```
~/project/ > git status

~/project/ > git add file file file directory… or git add -A  or git add -u

~/project/ > git status

~/project/ > git commit -m 'what I just did'

~/project/ > git commit -a -m 'what I just did'
```

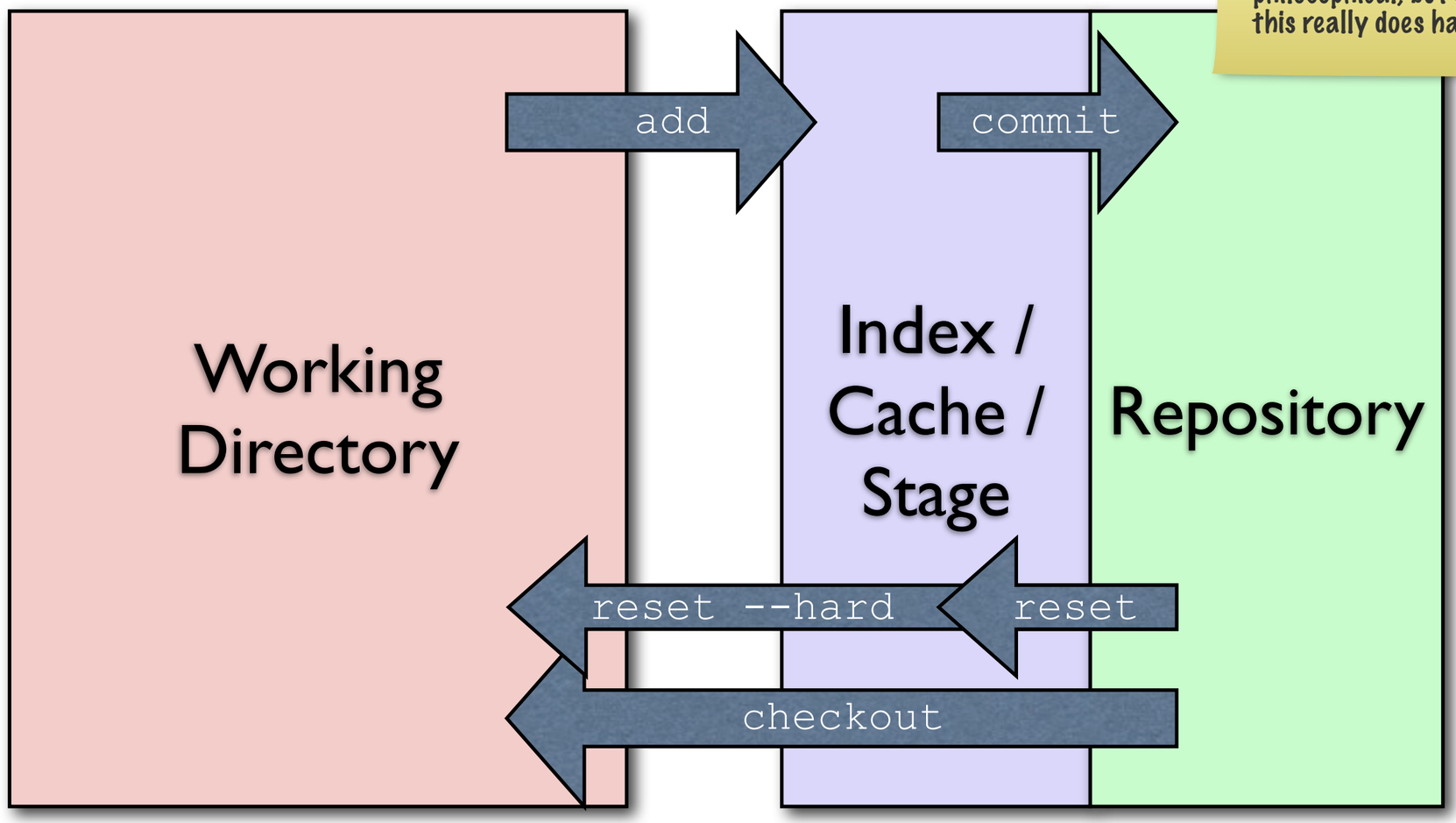
```
git add -A
   new files
   changed files
   removed files

git add -u
   changed files
   removed files

git commit -a
same as
git add -A; git commit
```

Why Add & Commit?

OK, so this is more the "how" than "why". Asking why very quickly gets philosophical, but splitting things up like this really does have its uses.

Why Add & Commit?

OK, so this is more the "how" than "why". Asking why very quickly gets philosophical, but splitting things up like this really does have its uses.



Branching

```
~/project/ > git checkout -b new_branch
```

TIP: you can create a new branch AFTER you have already made changes.

Just `checout -b new_branch` before you `git add`

```
~/project/ > git branch -a
```

```
~/project/ > git branch -d old_branch
```

Delete a branch which has become part of another branch (nothing will be lost)

```
~/project/ > git branch -D old_branch
```

Delete a branch that cannot be re-constructed without knowing the commit ID (if you didn't write it down, it's gone!)

Differences?

```
~/project/ > git diff

~/project/ > git diff --cached

~/project/ > git diff HEAD

~/project/ > git diff other_branch
```

Merging

git always merges into the working directory

merged files are added automatically

conflicts are not added - you need to resolve them first

```
~/project/ > git merge other_branch
```

fix conflicts…

```
~/project/ > git add -A
```

```
~/project/ > git commit -m 'merge changes from other_branch'
```

Throwing things away

```
~/project/ > git reset commit
```

`git reset` updates the cache to reflect the named commit. No changes are made to your working tree. (usefull if you want to un-add something)

```
~/project/ > git reset --hard commit
```

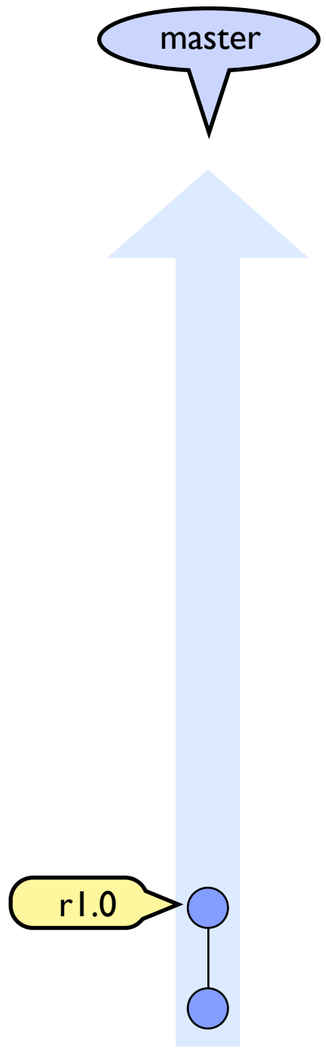
`git reset --hard` updates the cache and the working tree to match the named branch (by default `HEAD`).
This will kill any uncommitted changes!

Multiple Branches

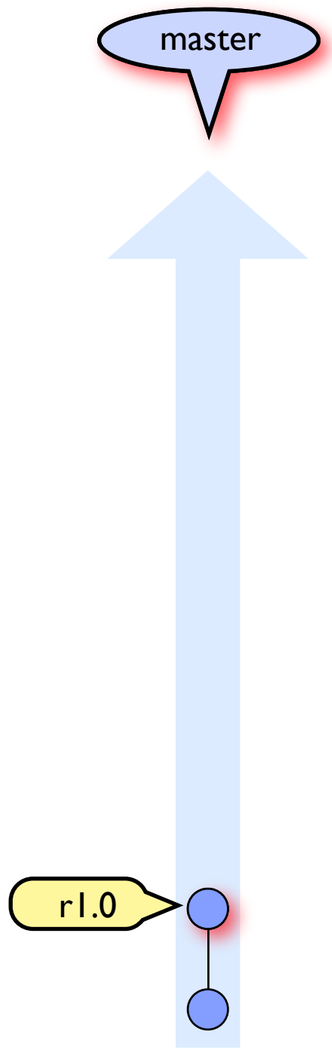
step by step…


master
r1.0

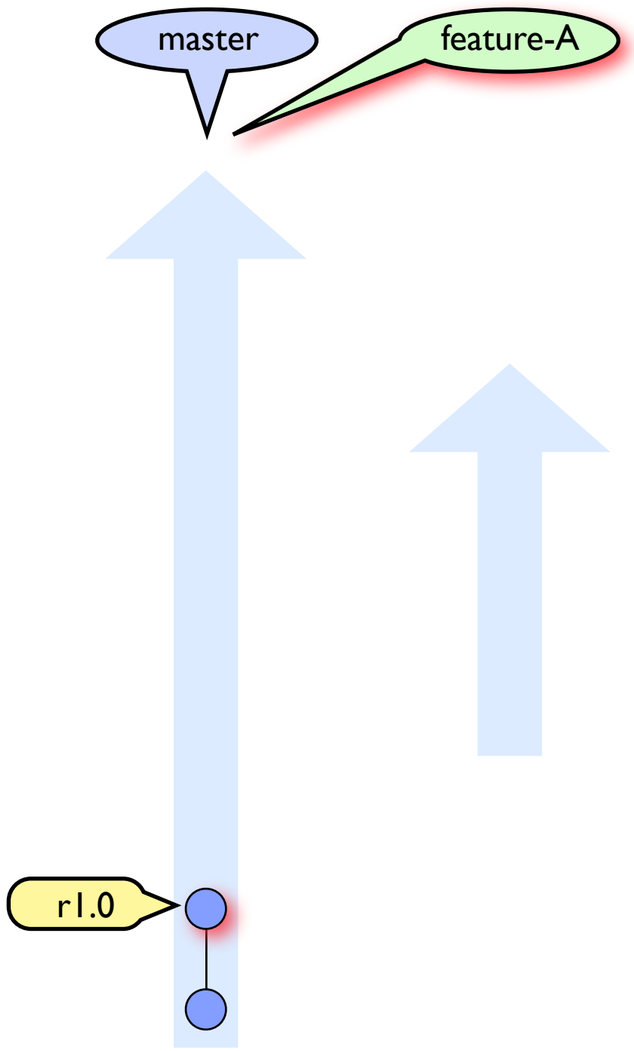
```
git checkout master
```



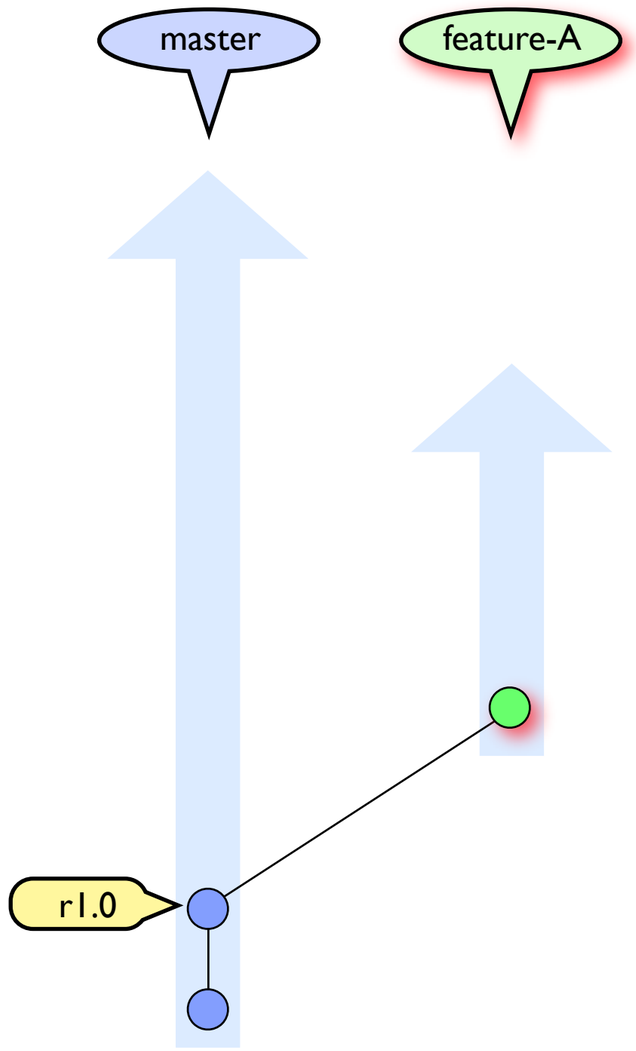
```
git checkout master
```



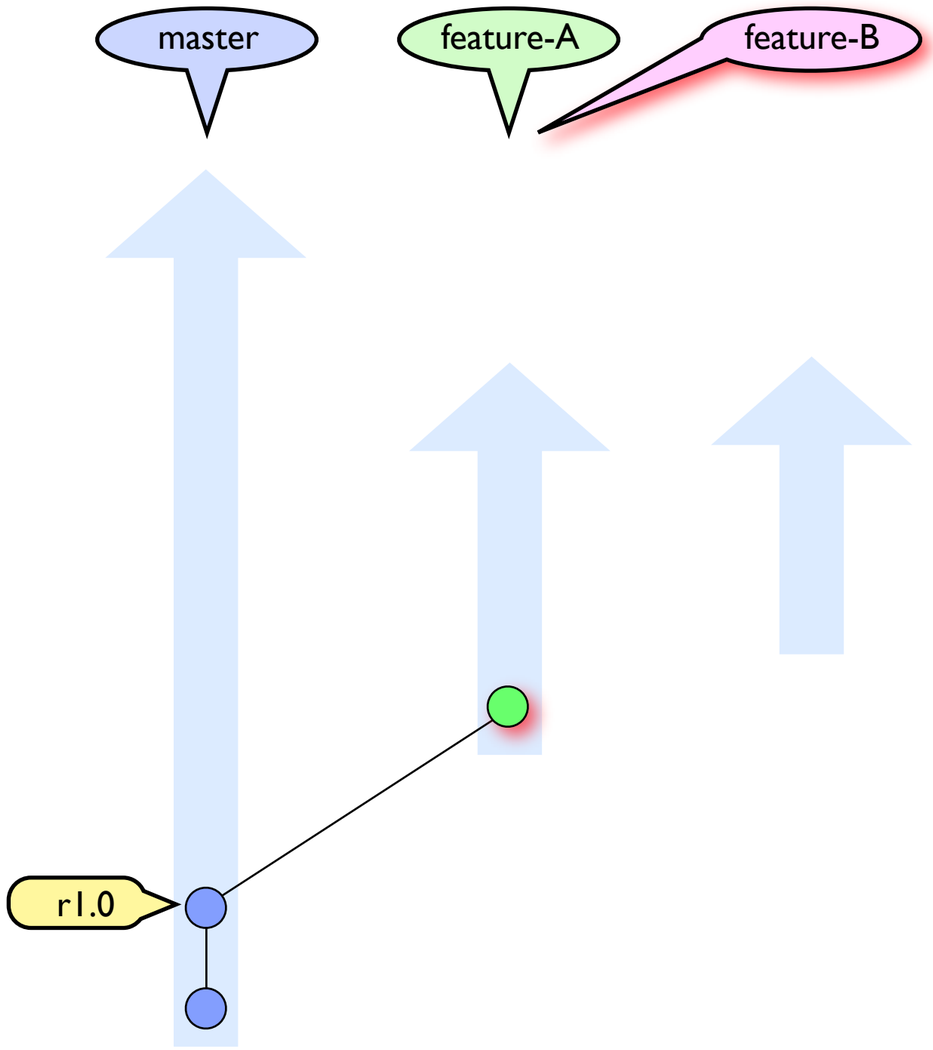
```
git checkout master
git checkout -b feature-A
```



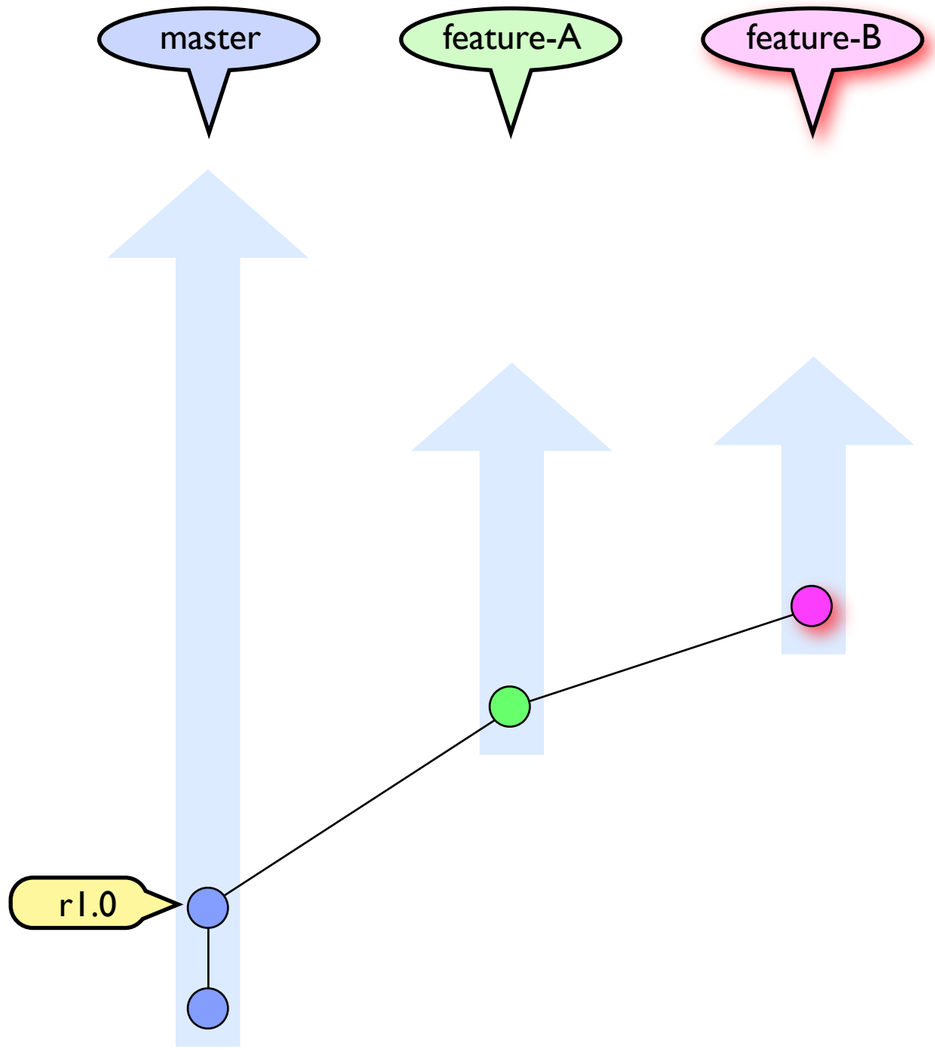
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
```



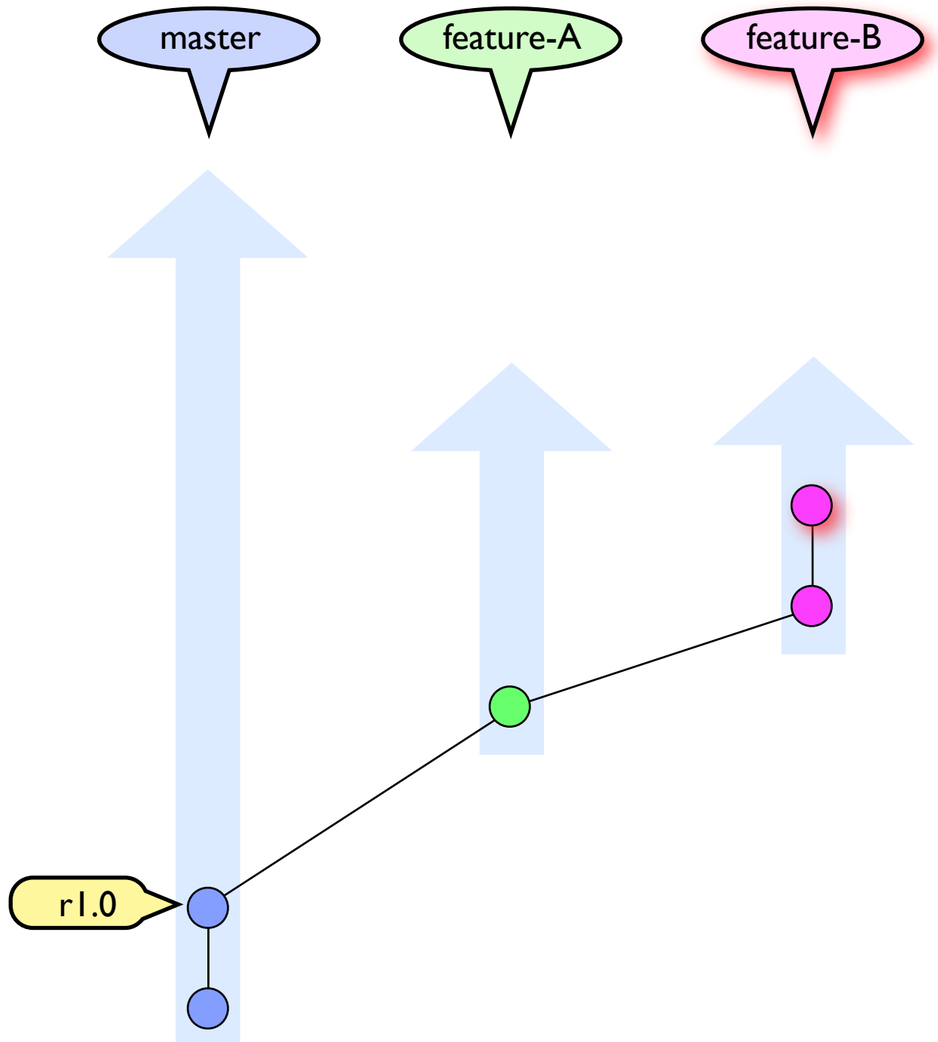
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
```



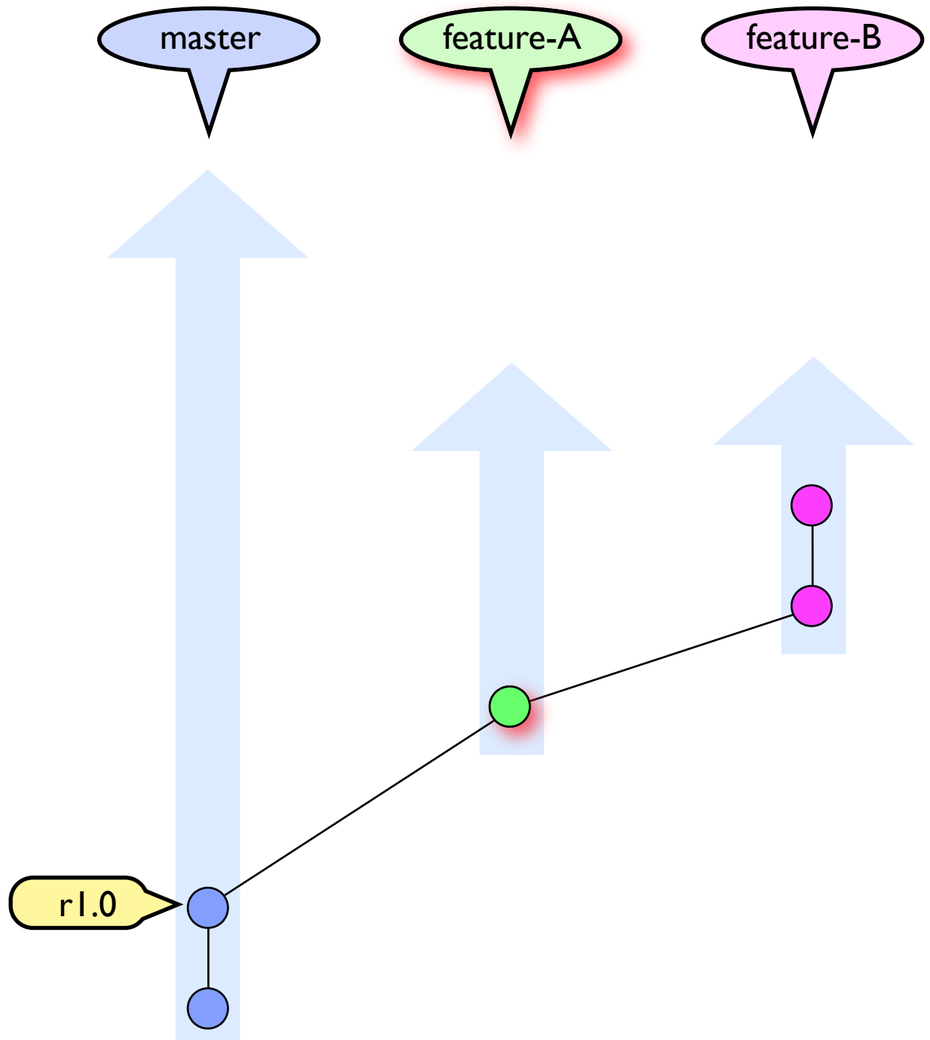
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
```



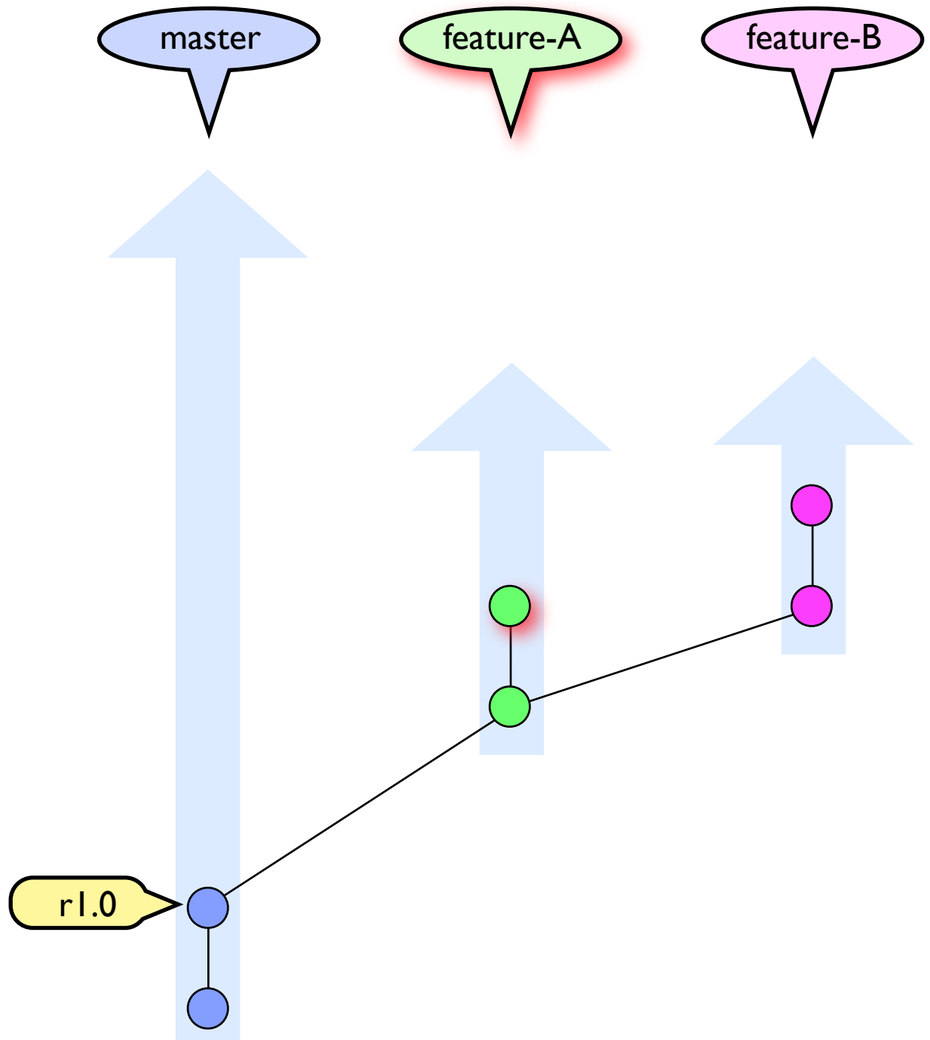
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
```



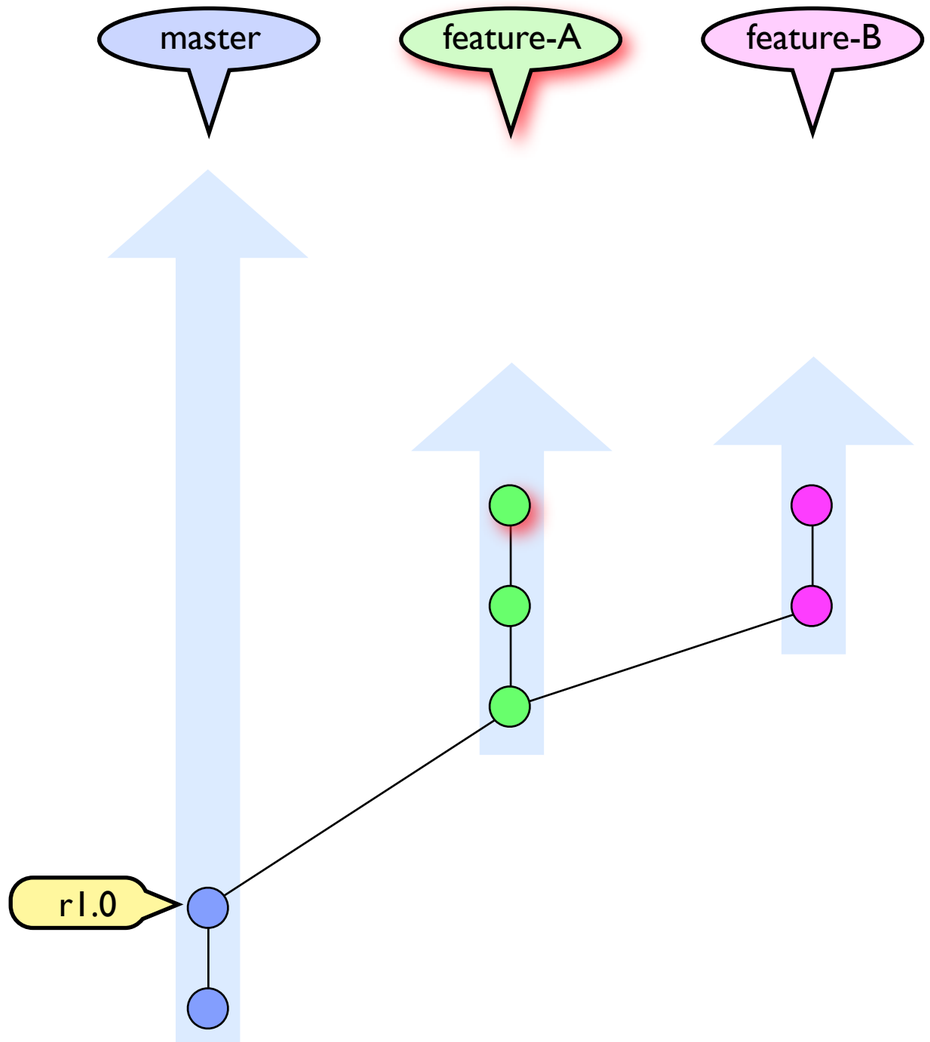
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
```



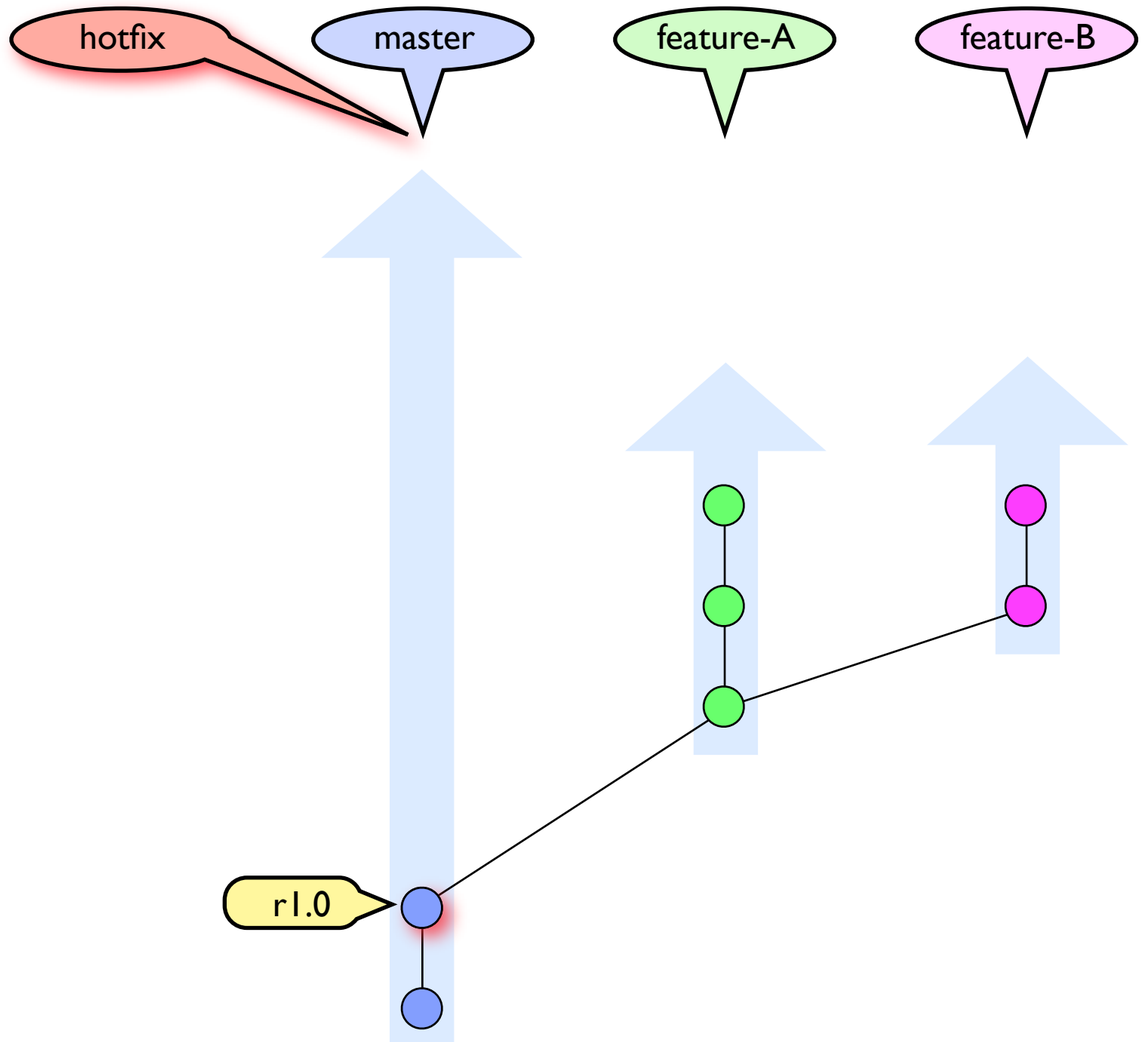
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
```



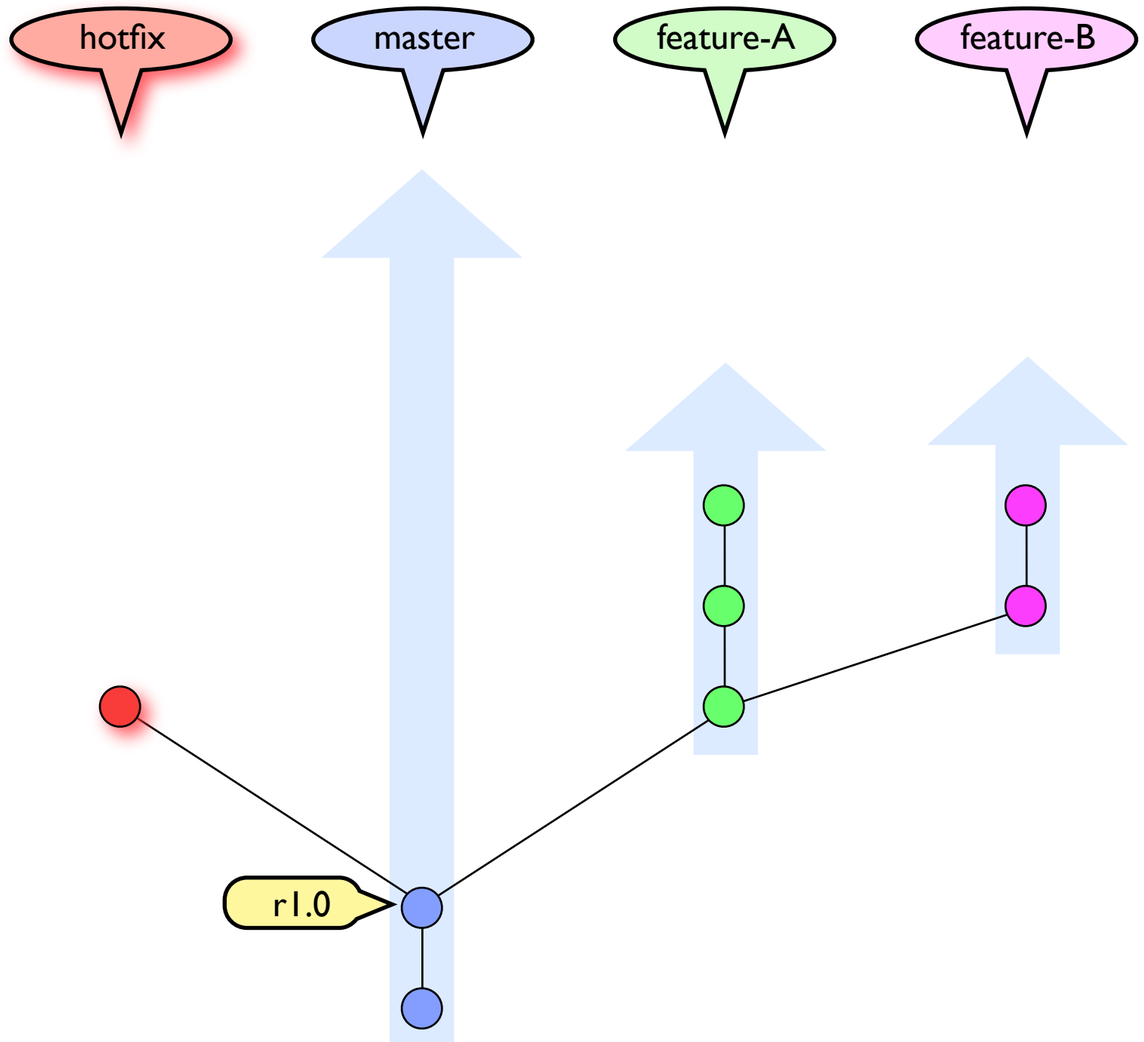
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
```



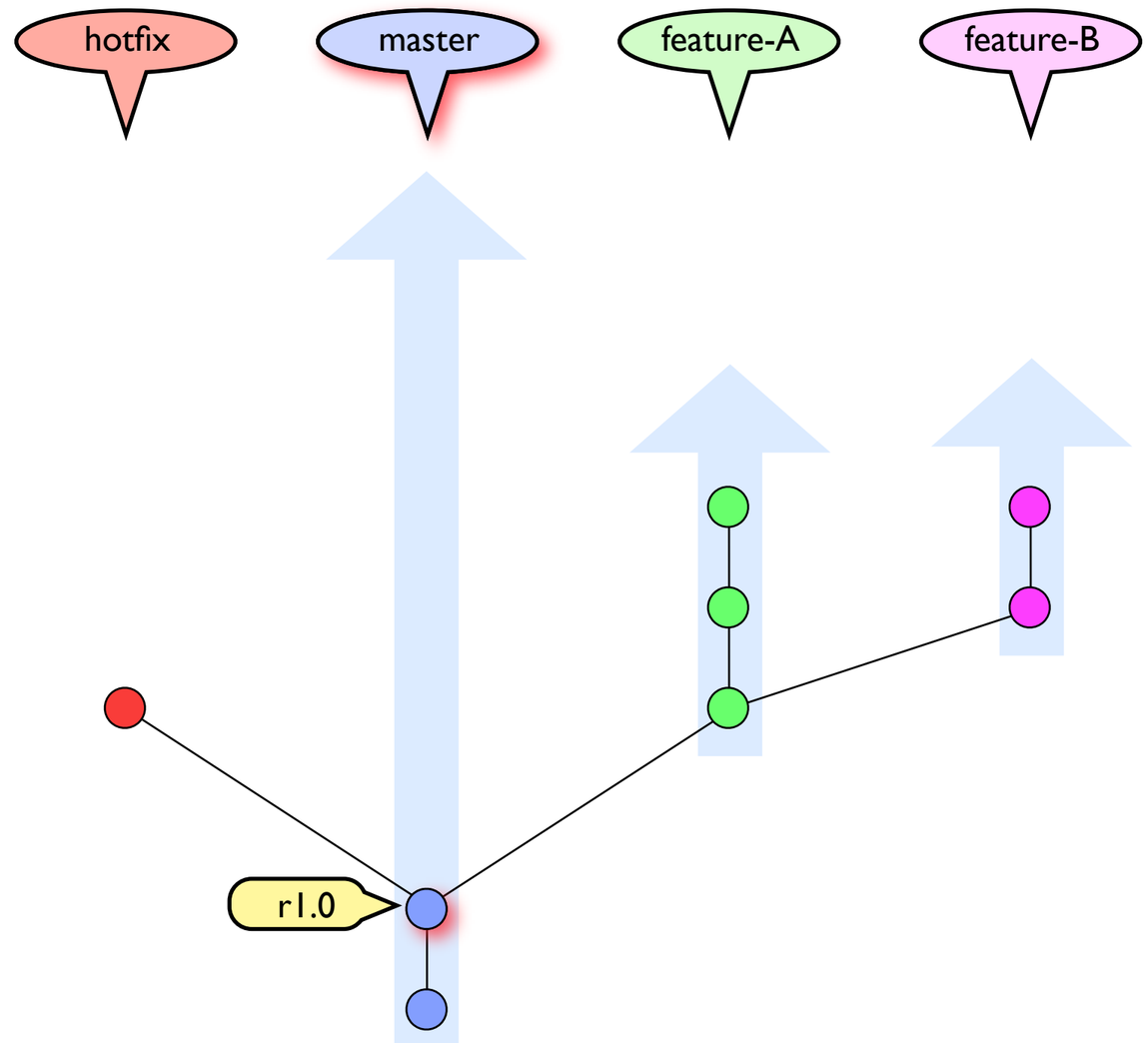
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
```



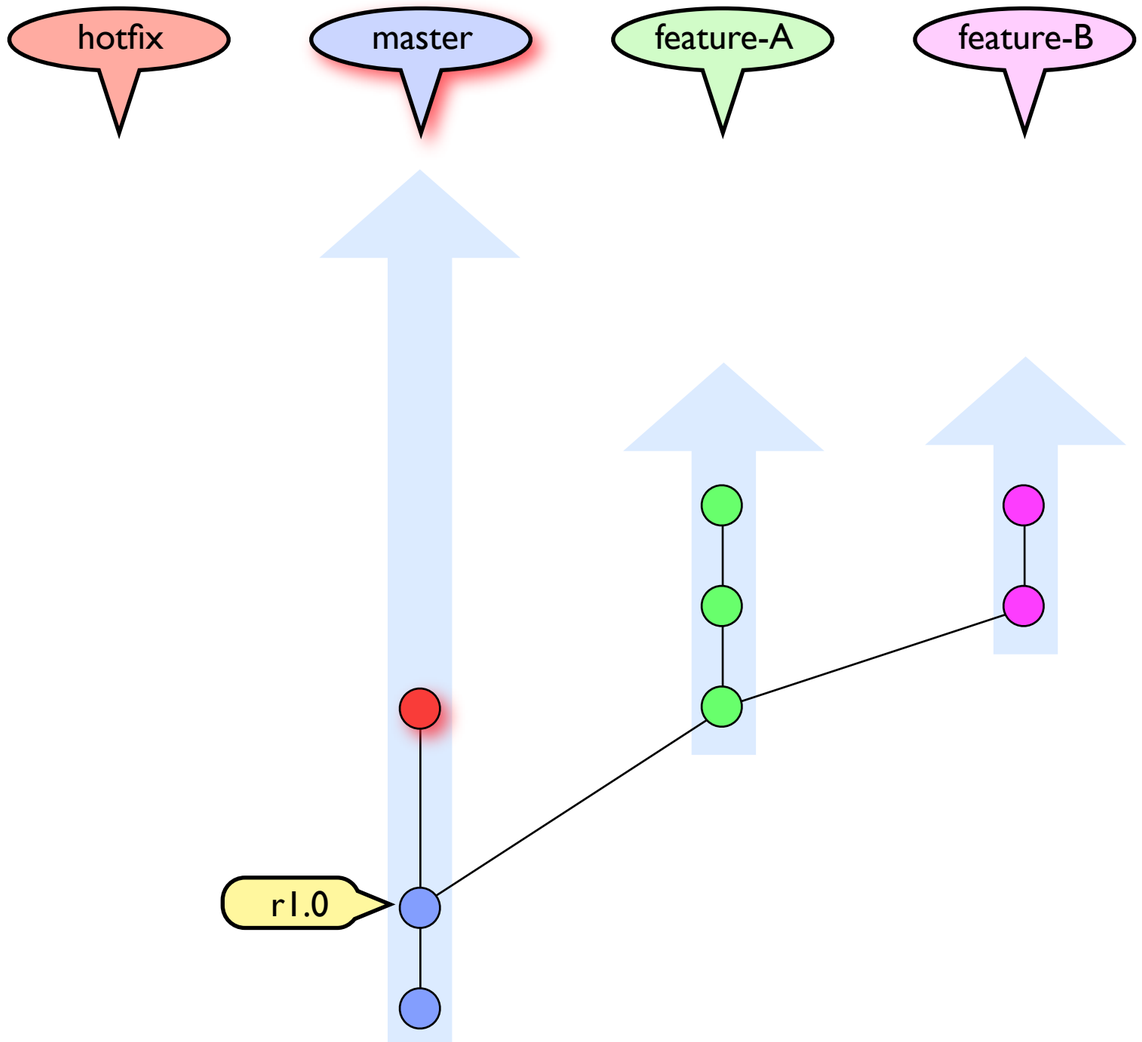
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
```

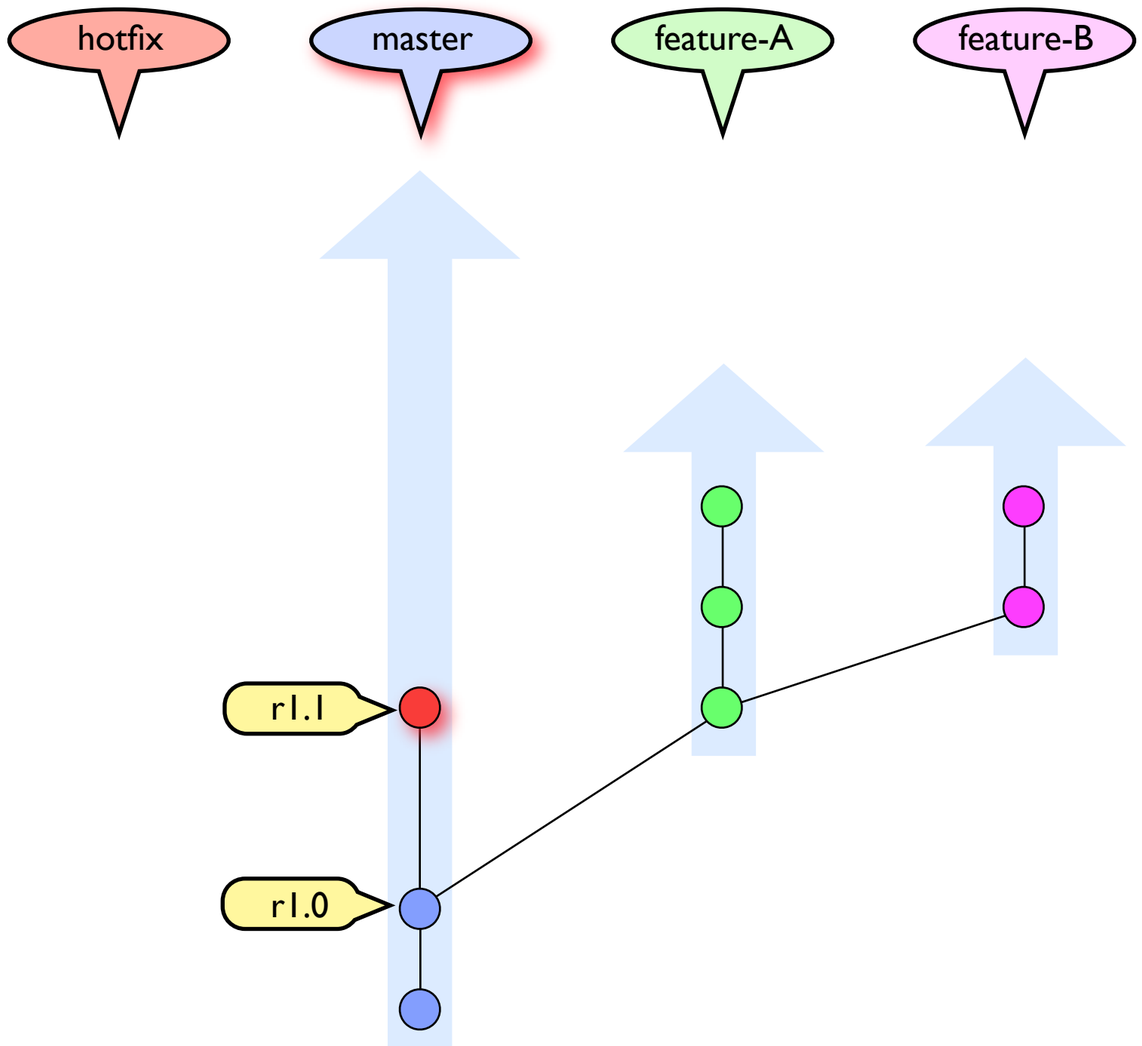


```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
```

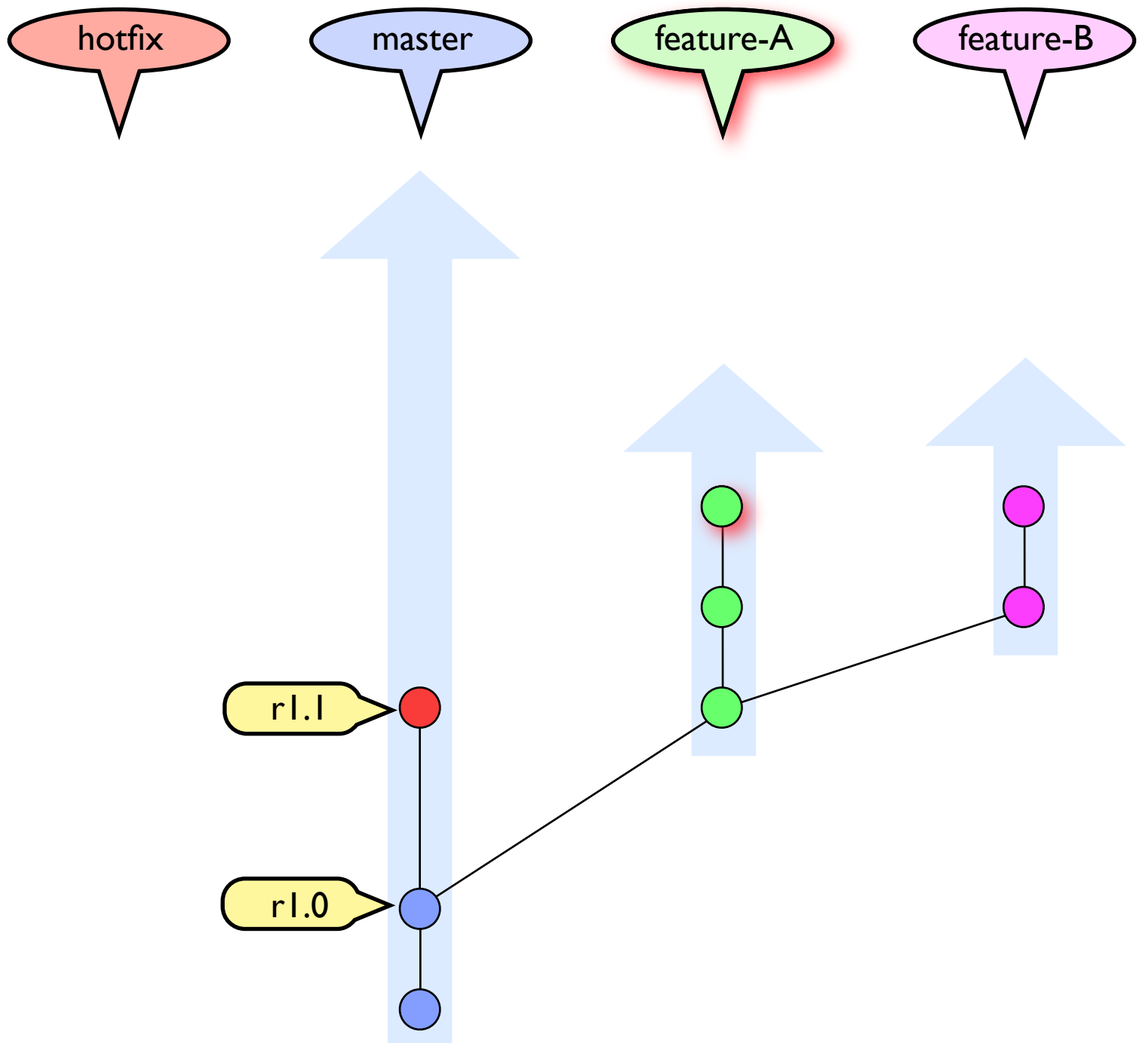


This is a "fast forward" merge.
No *merging* actually takes place.
Instead, the current branch is simply updated to the head of the branch being merged.

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
```



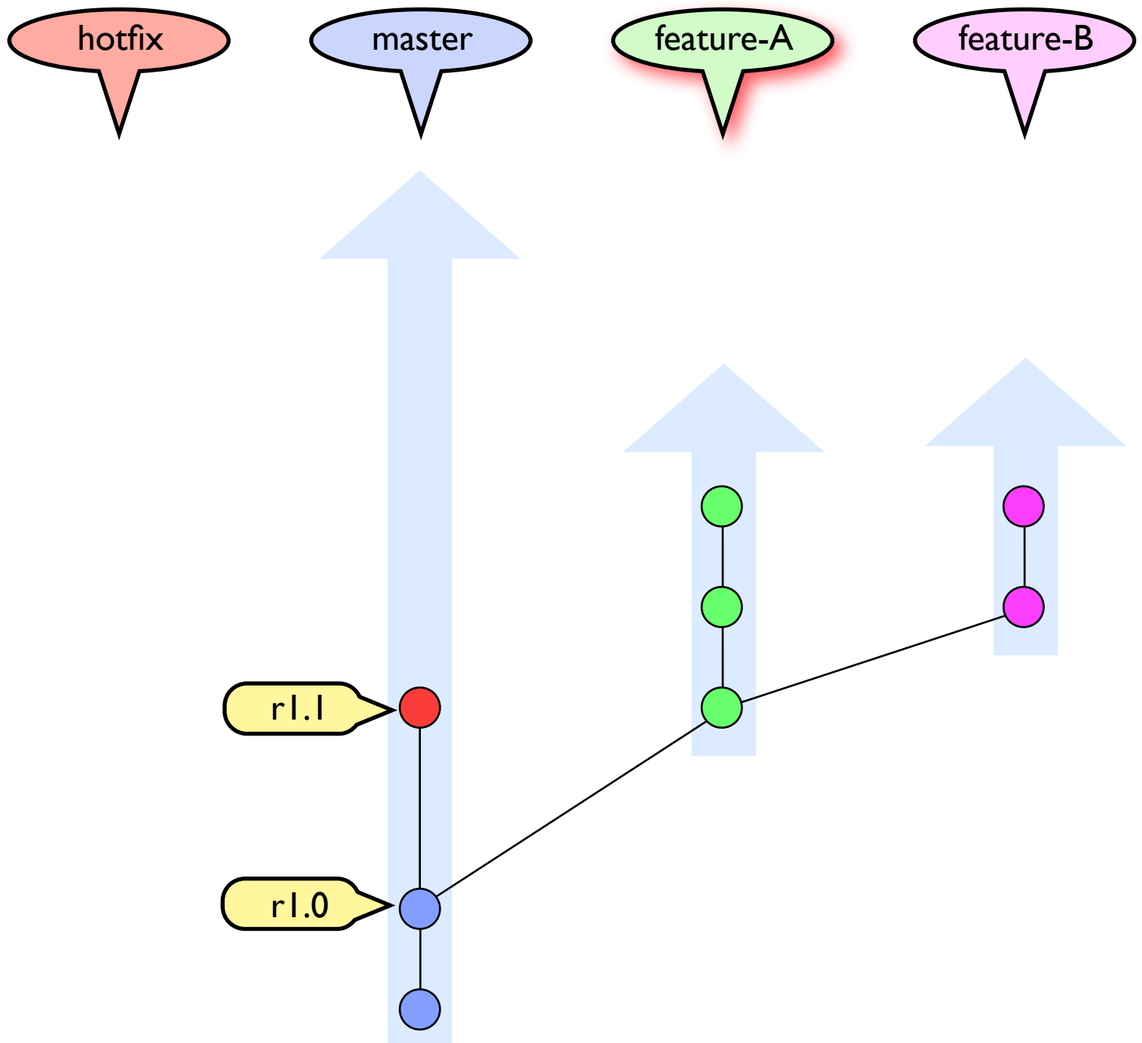
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git merge master
```

…resolve conflicts…

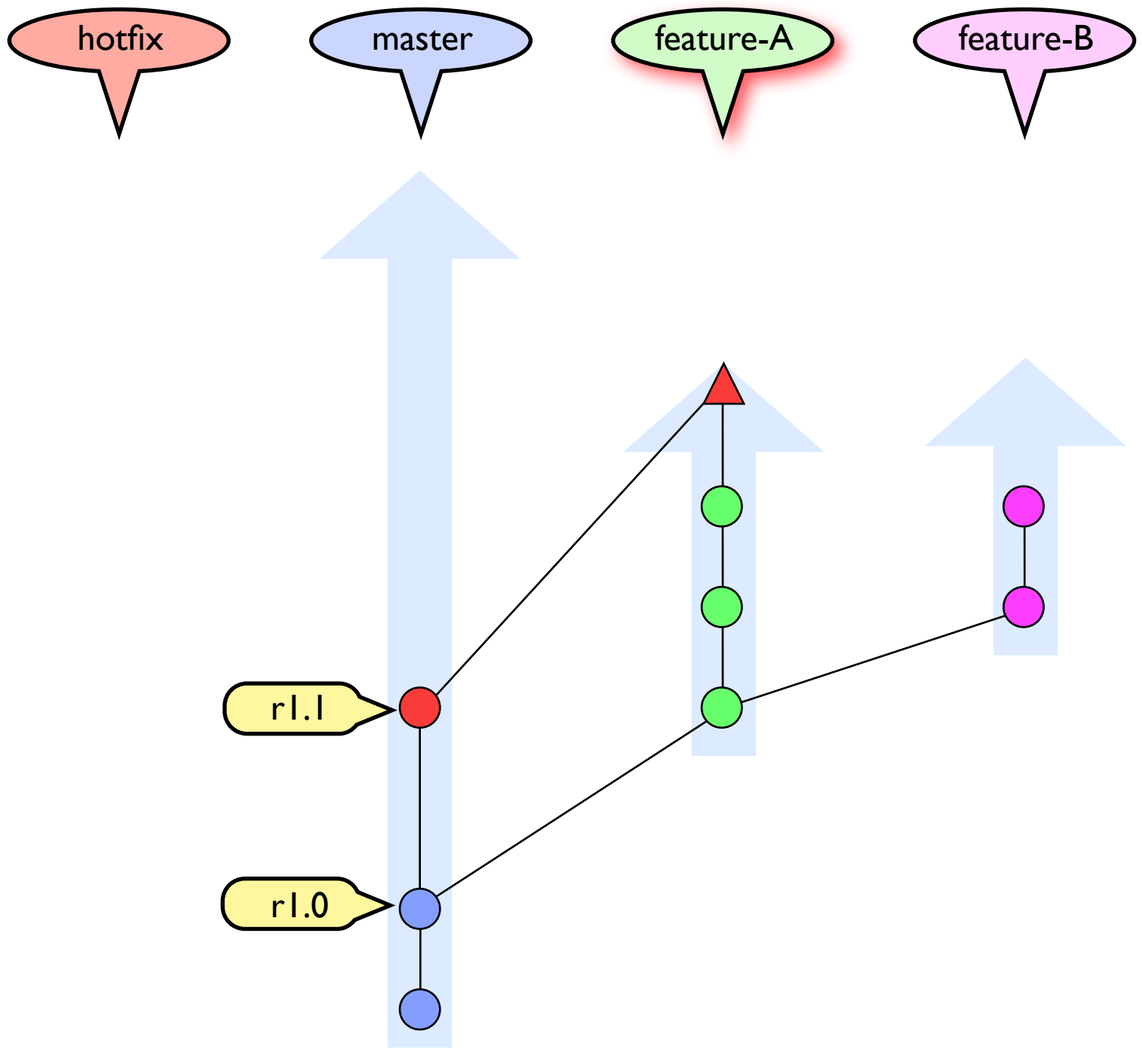
```
git commit -m 'merge from r1.1'
```



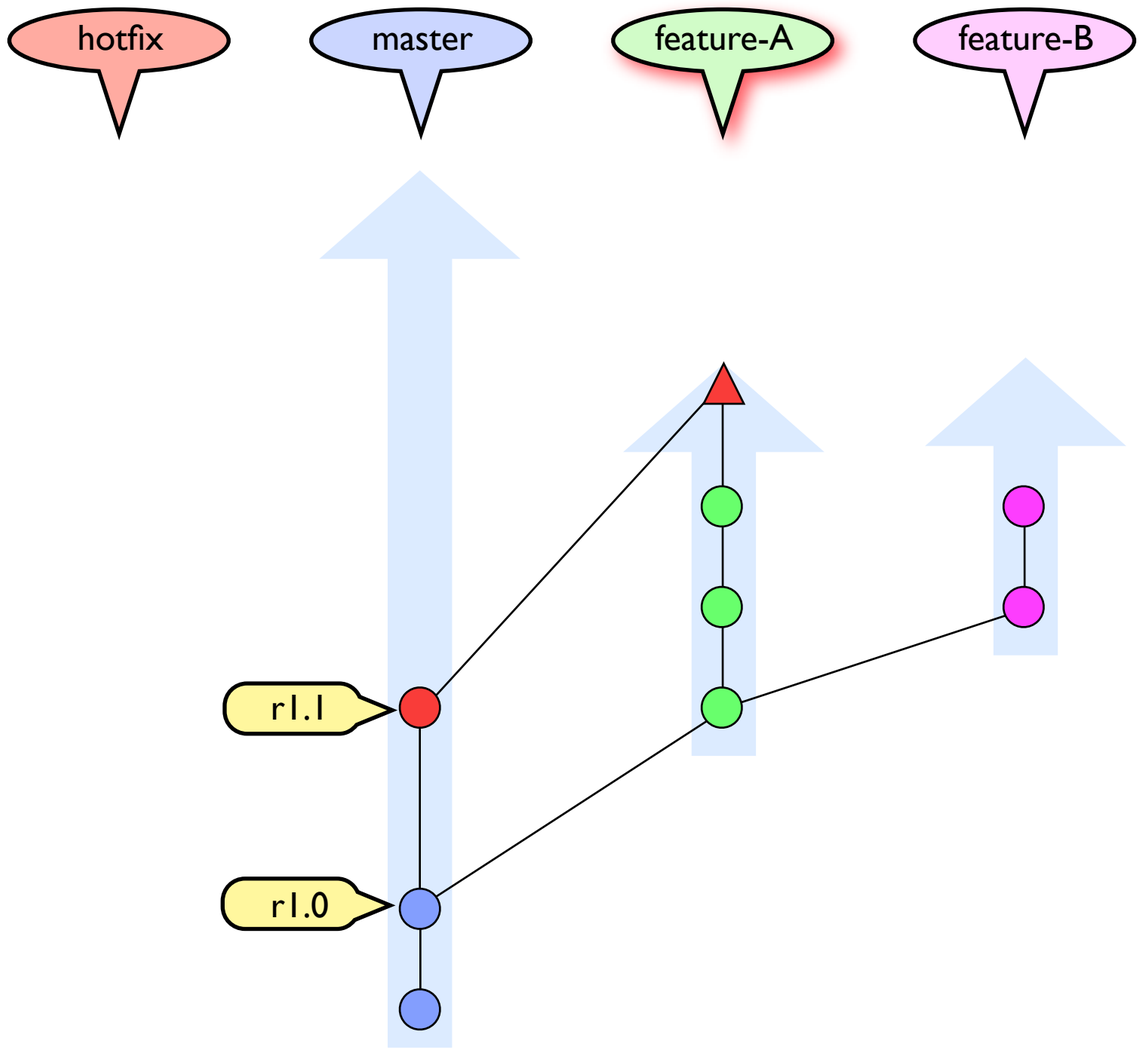
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git merge master
```

…resolve conflicts…

```
git commit -m 'merge from r1.1'
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git merge master
…resolve conflicts…
git commit -m 'merge from r1.1'
```

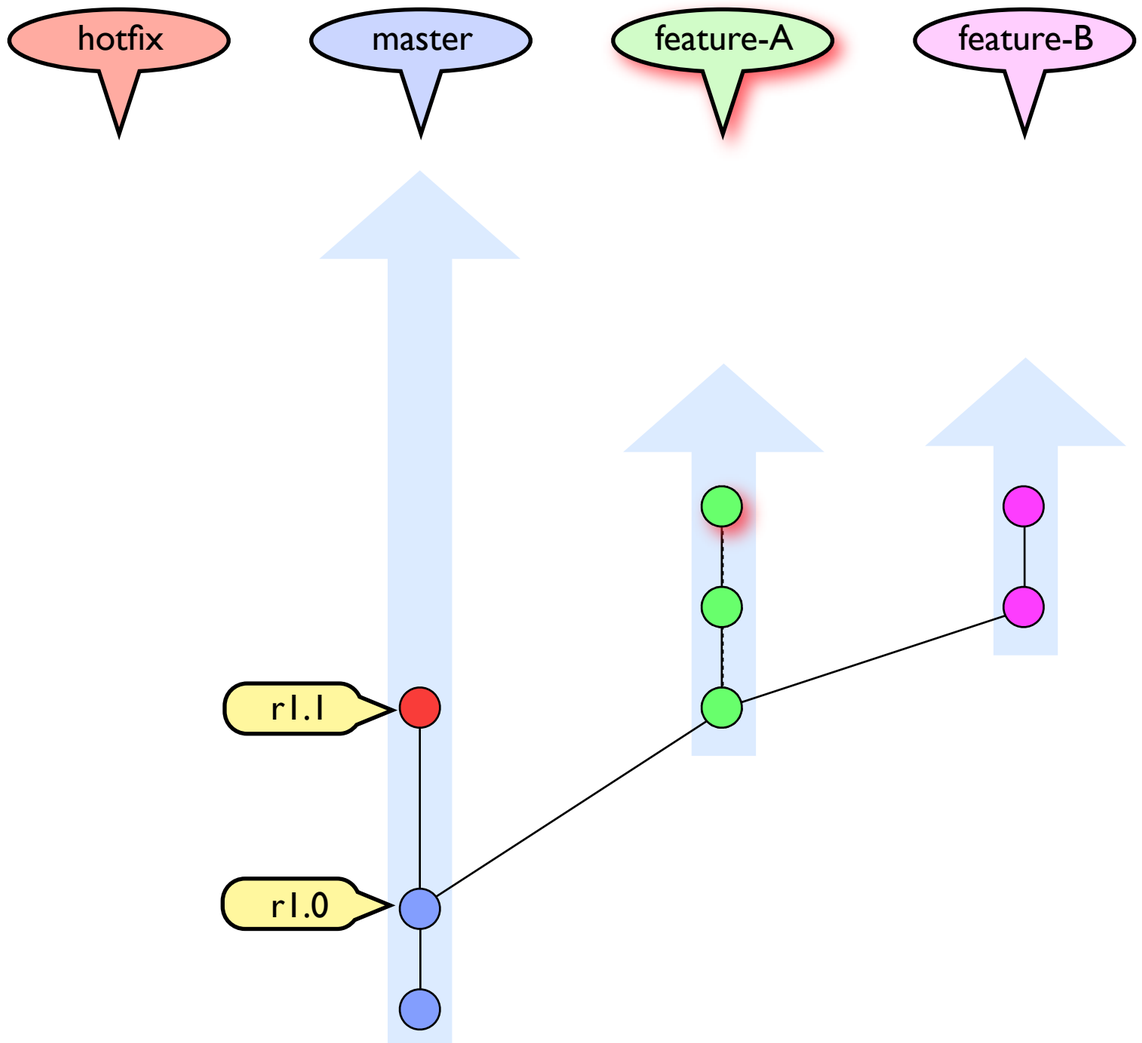


merging applies the changes from the source branch onto the head of the target branch.
Existing commits remain effective, the merged commits are duplicated.
DO use merge if your commits have been published!

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

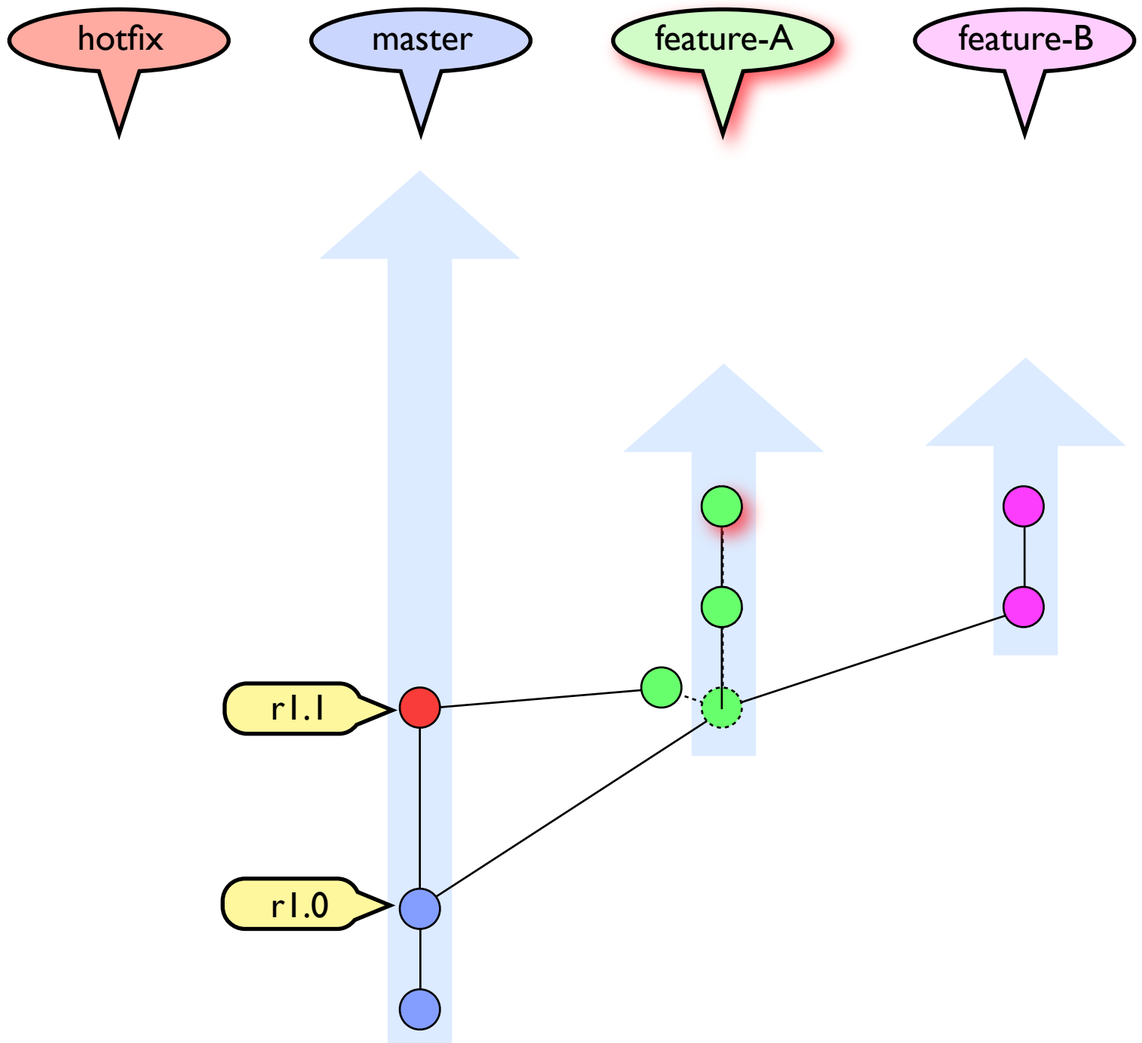
```
git rebase --continue
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

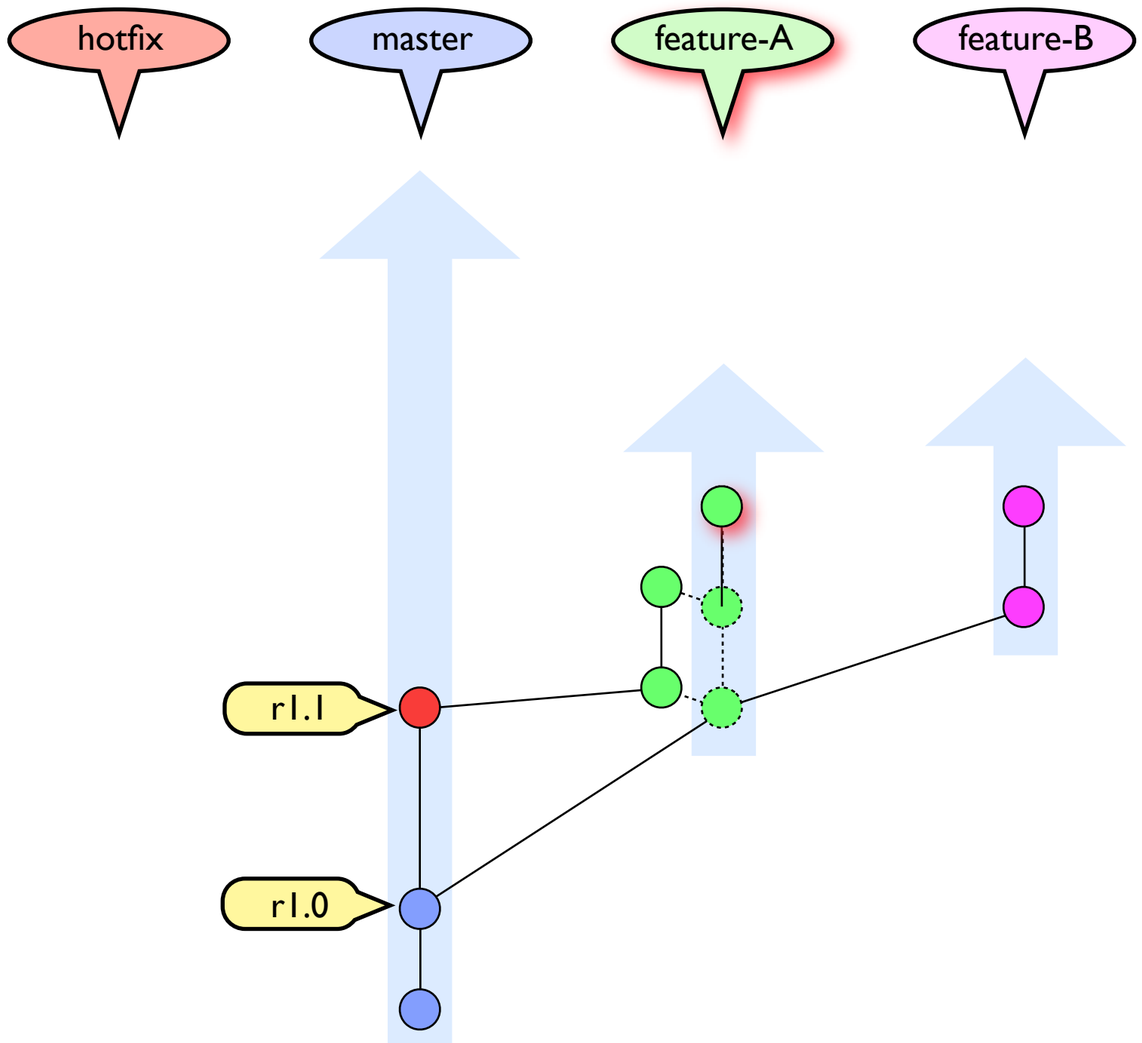
```
git rebase --continue
```



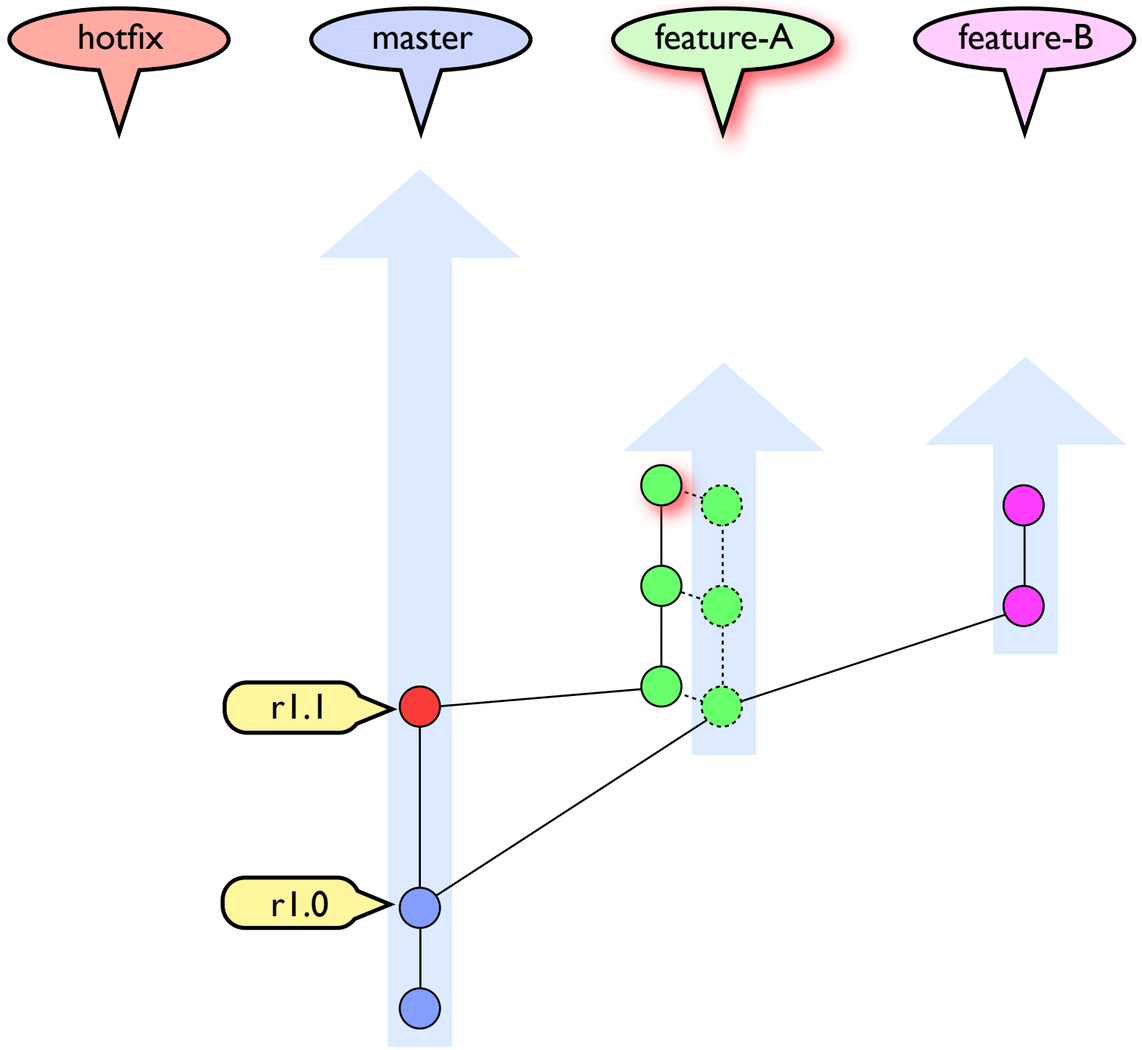
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

```
git rebase --continue
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
```

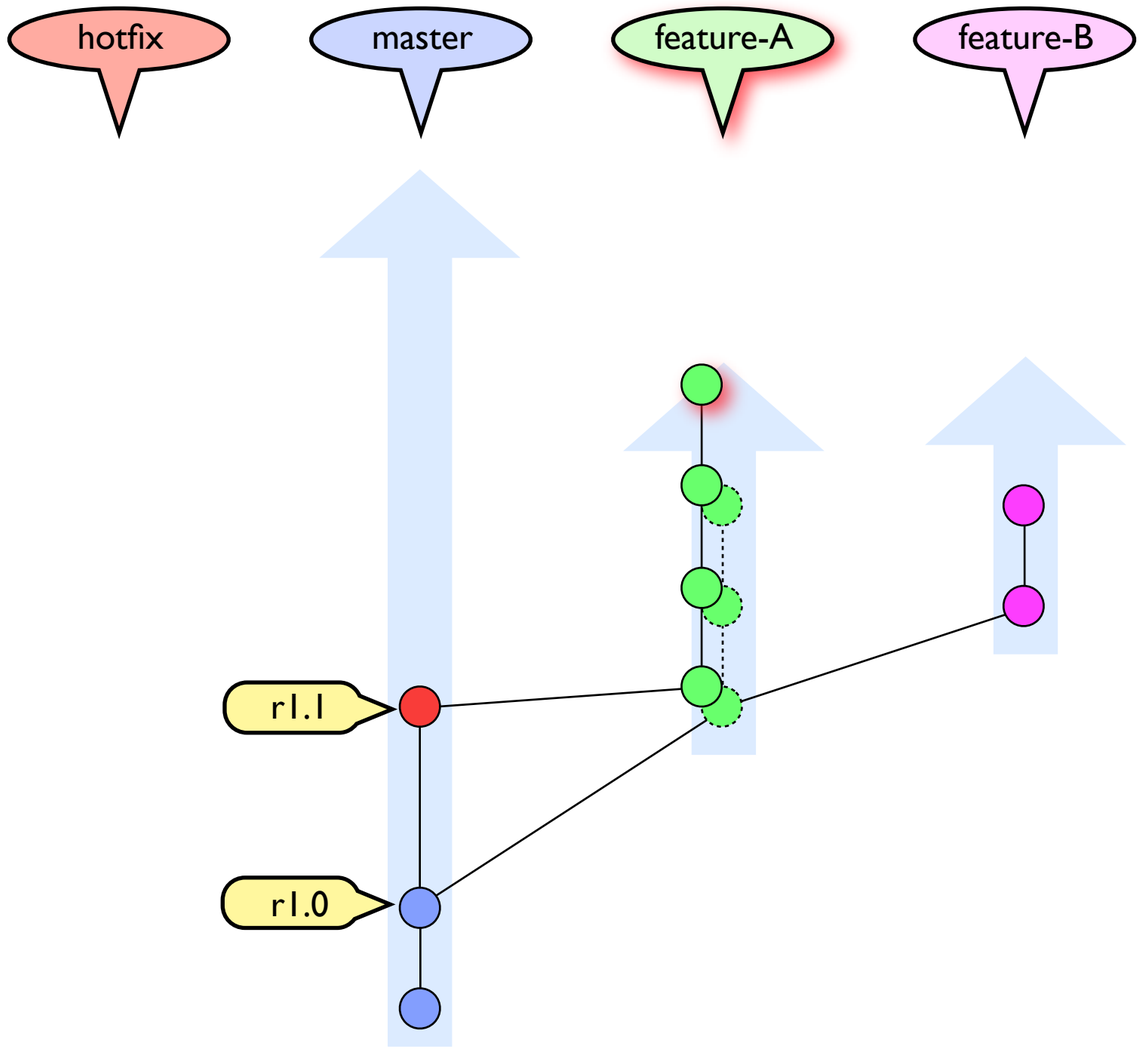


rebasing creates new copies of ***every*** commit between the base and the head!

DO use rebase if you are about to synchronise your work with a public repository.

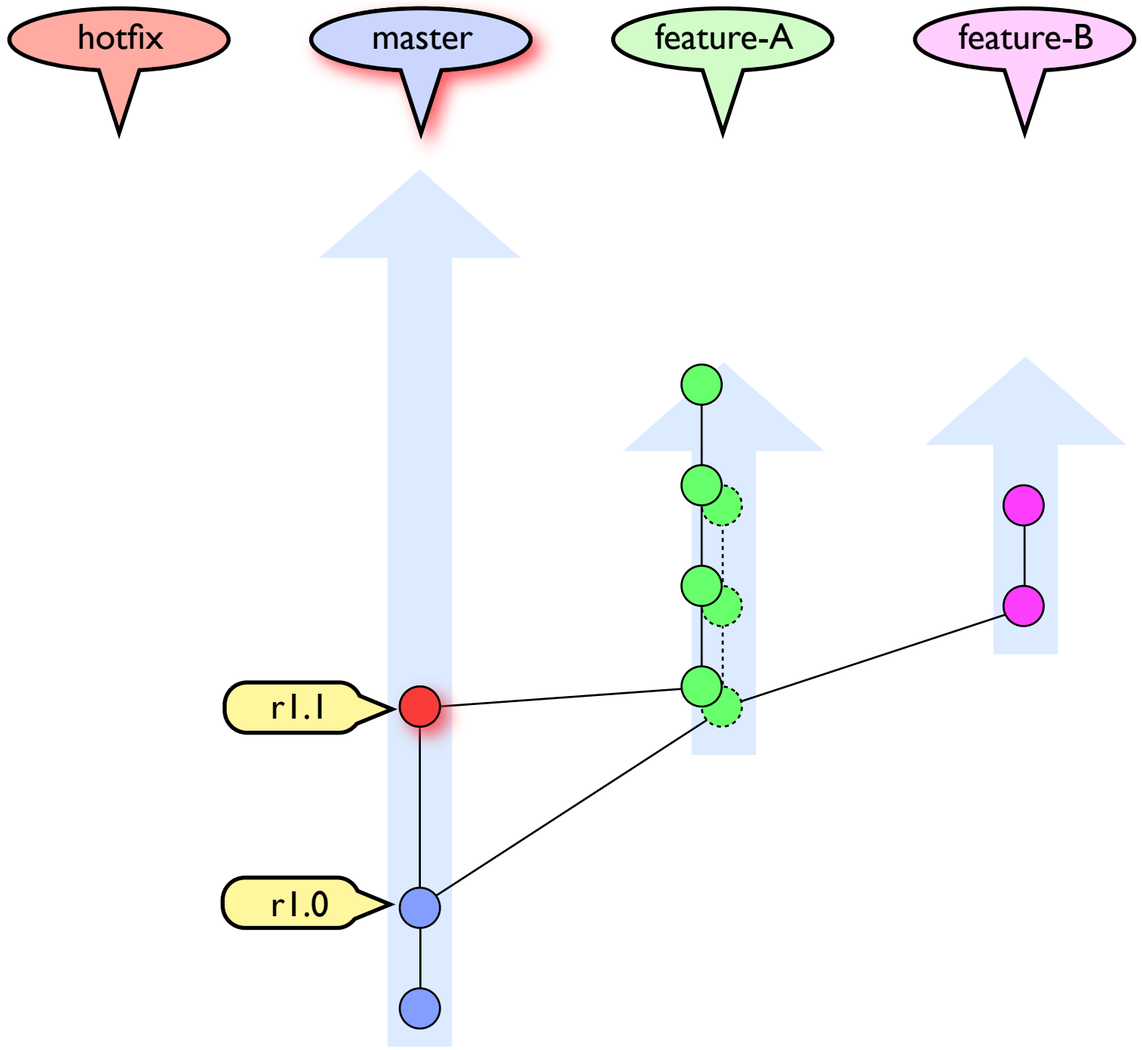
DO NOT use rebase if the effected commits have already been published!

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
```

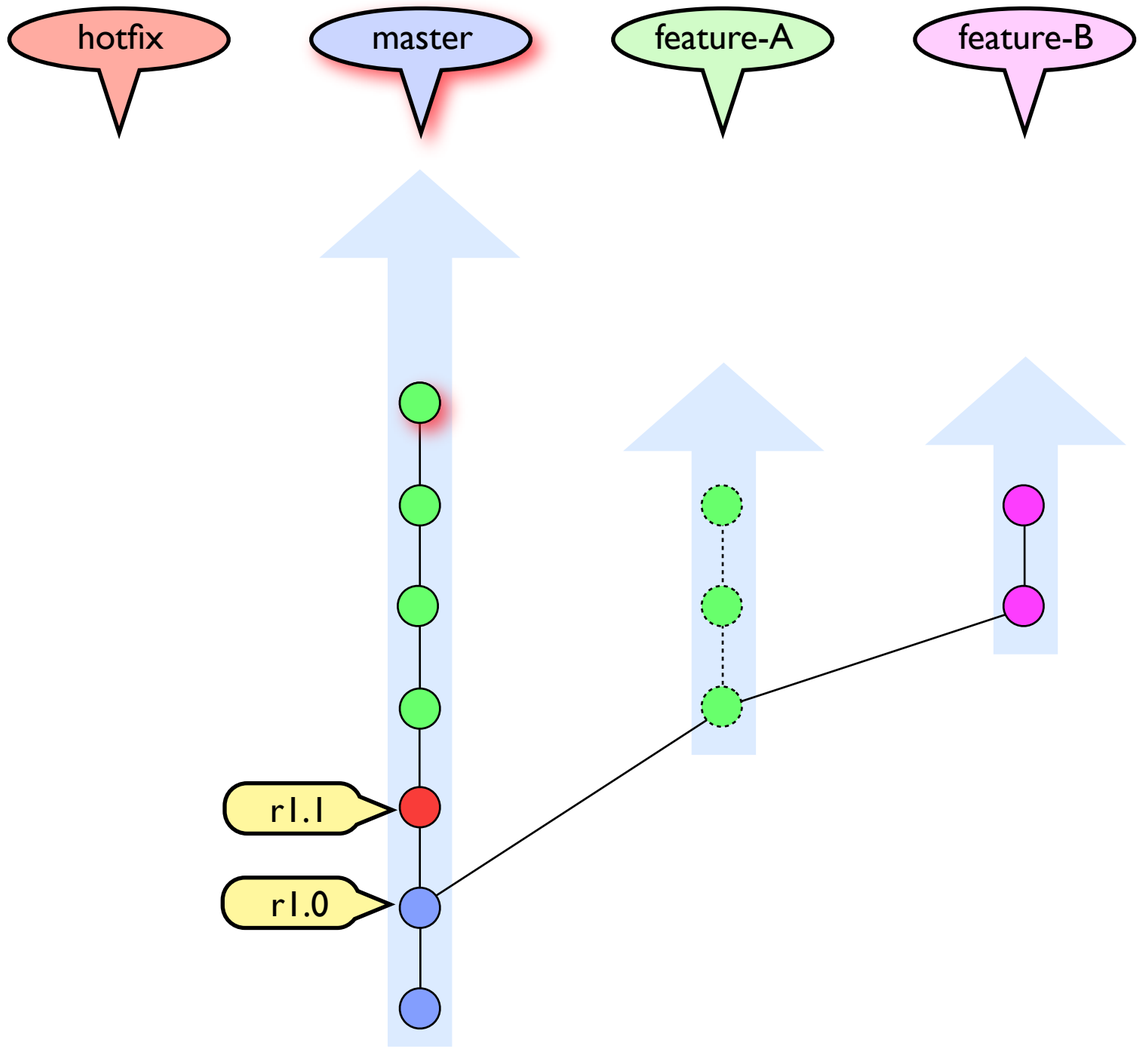


The original commits are no longer accessible via the branch.
Branches stemming from an original commit still reference it!

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
```

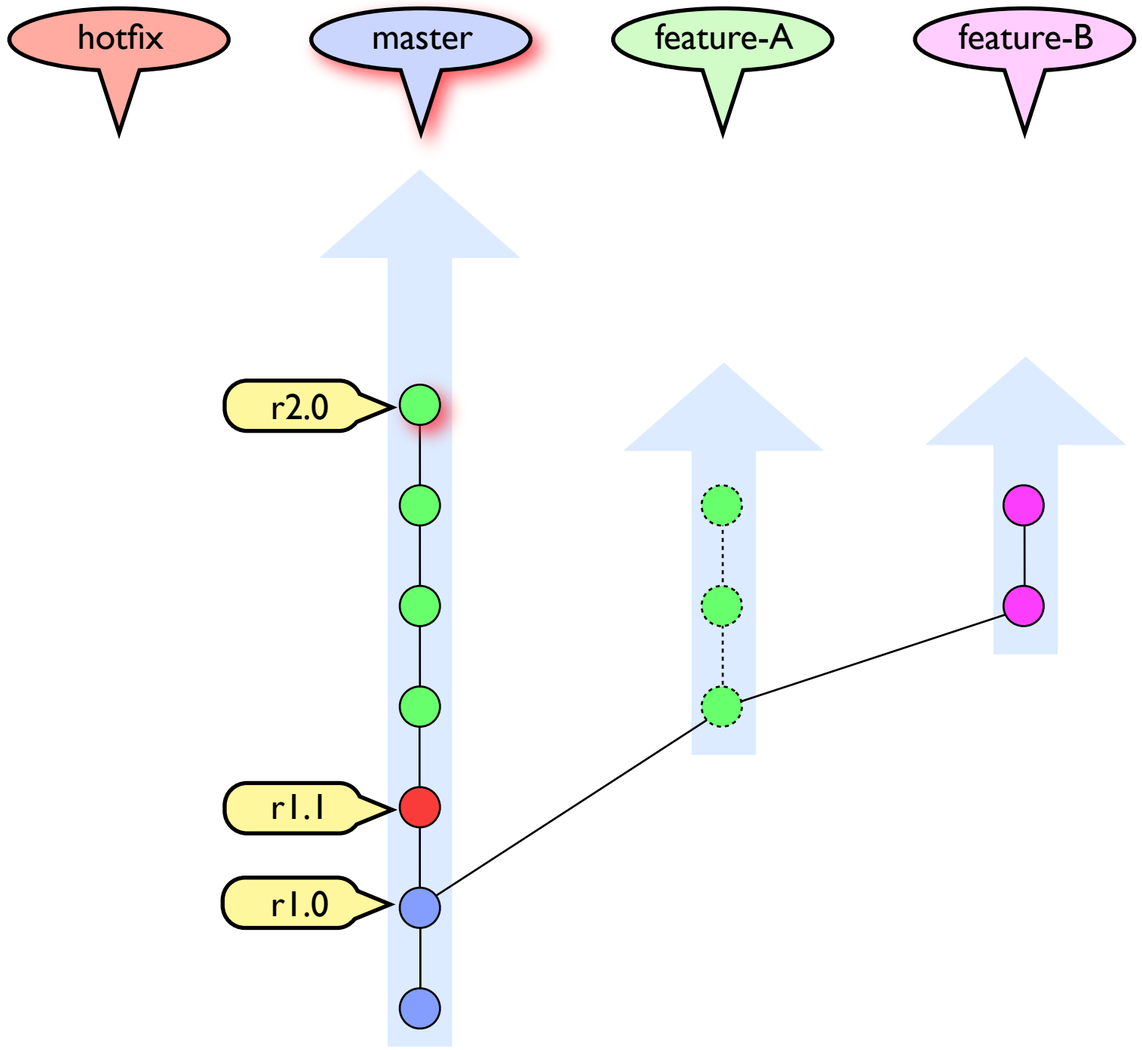


```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
```

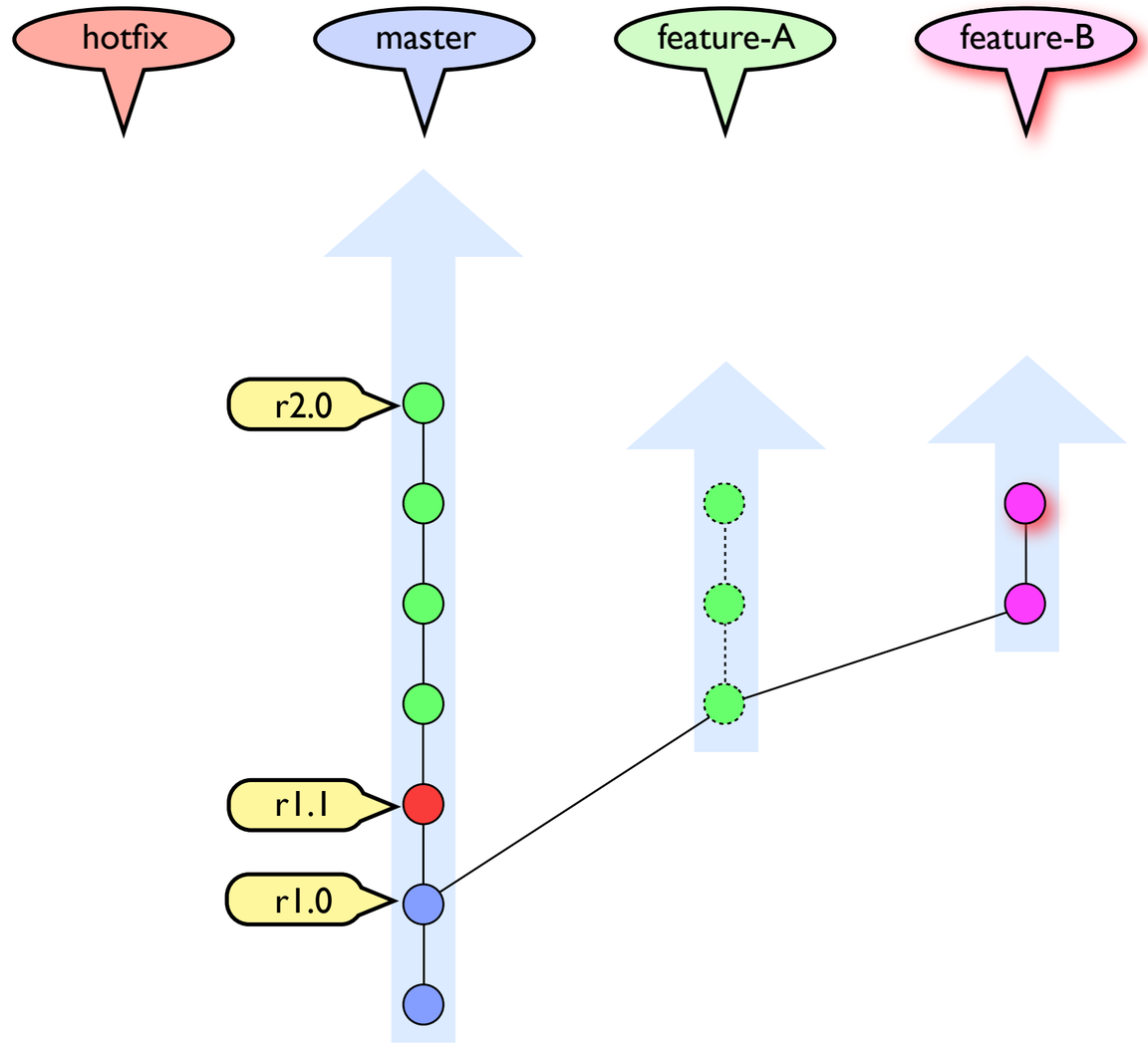


fast forward merge again

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
```



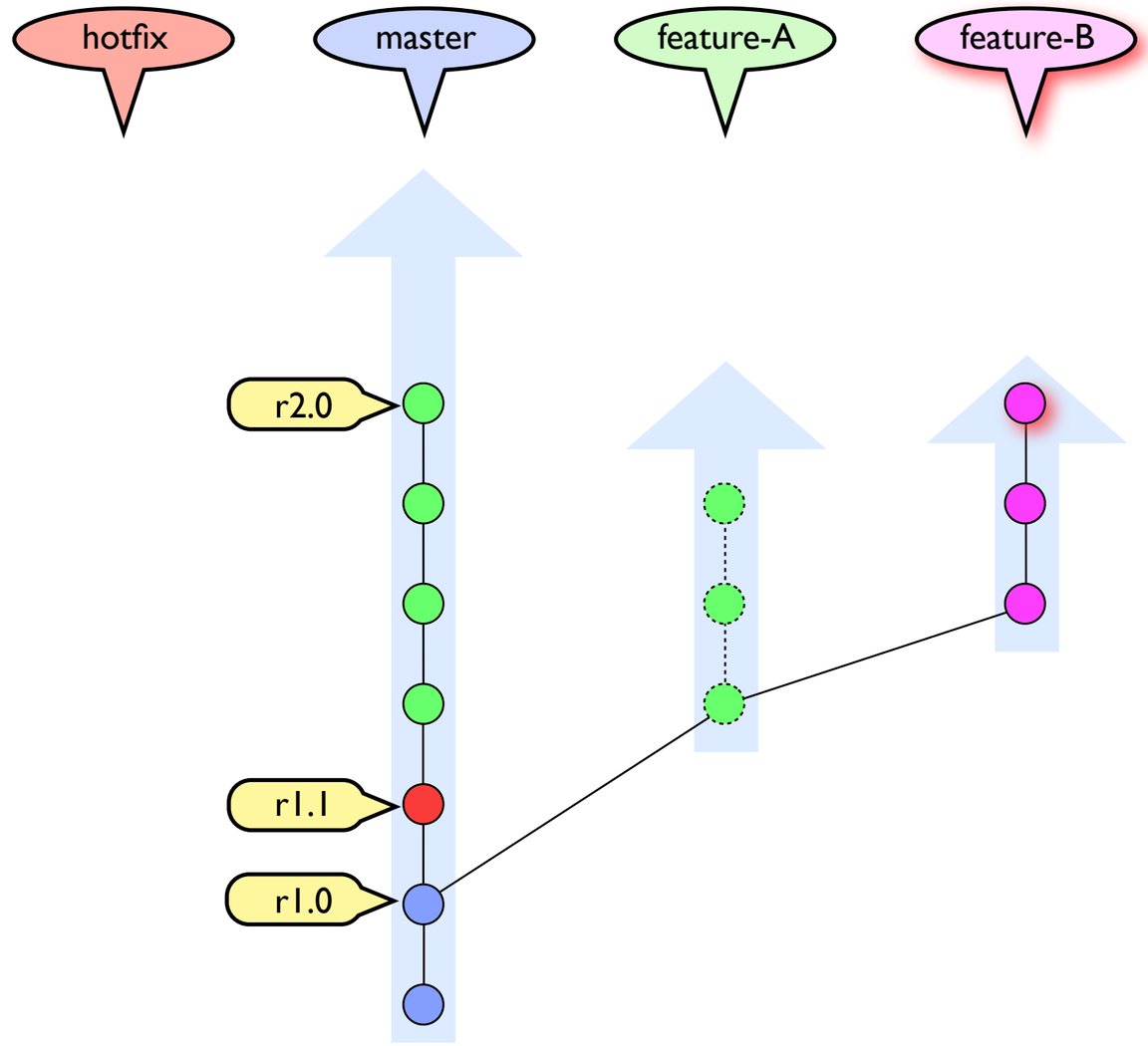
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
```



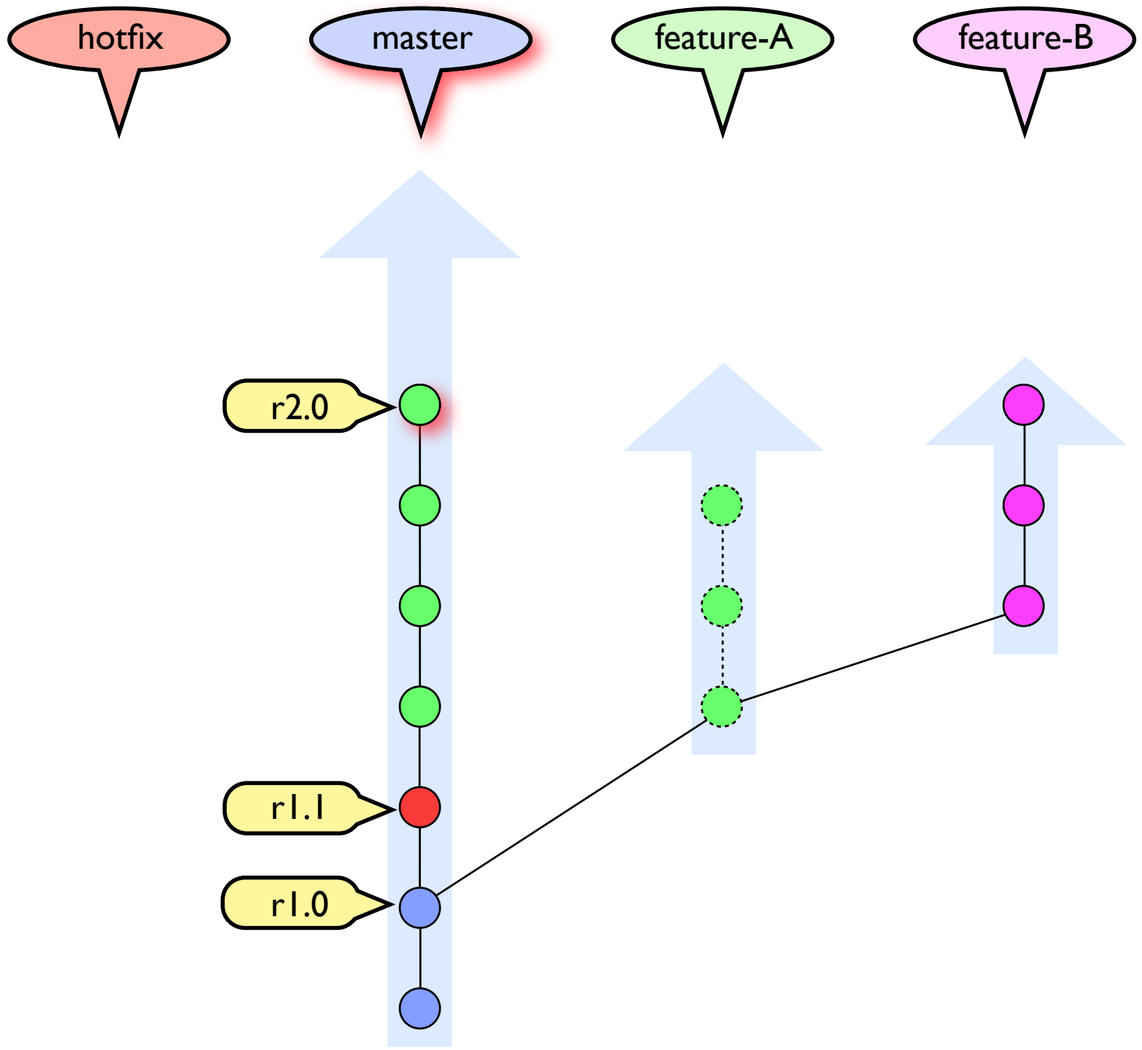
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

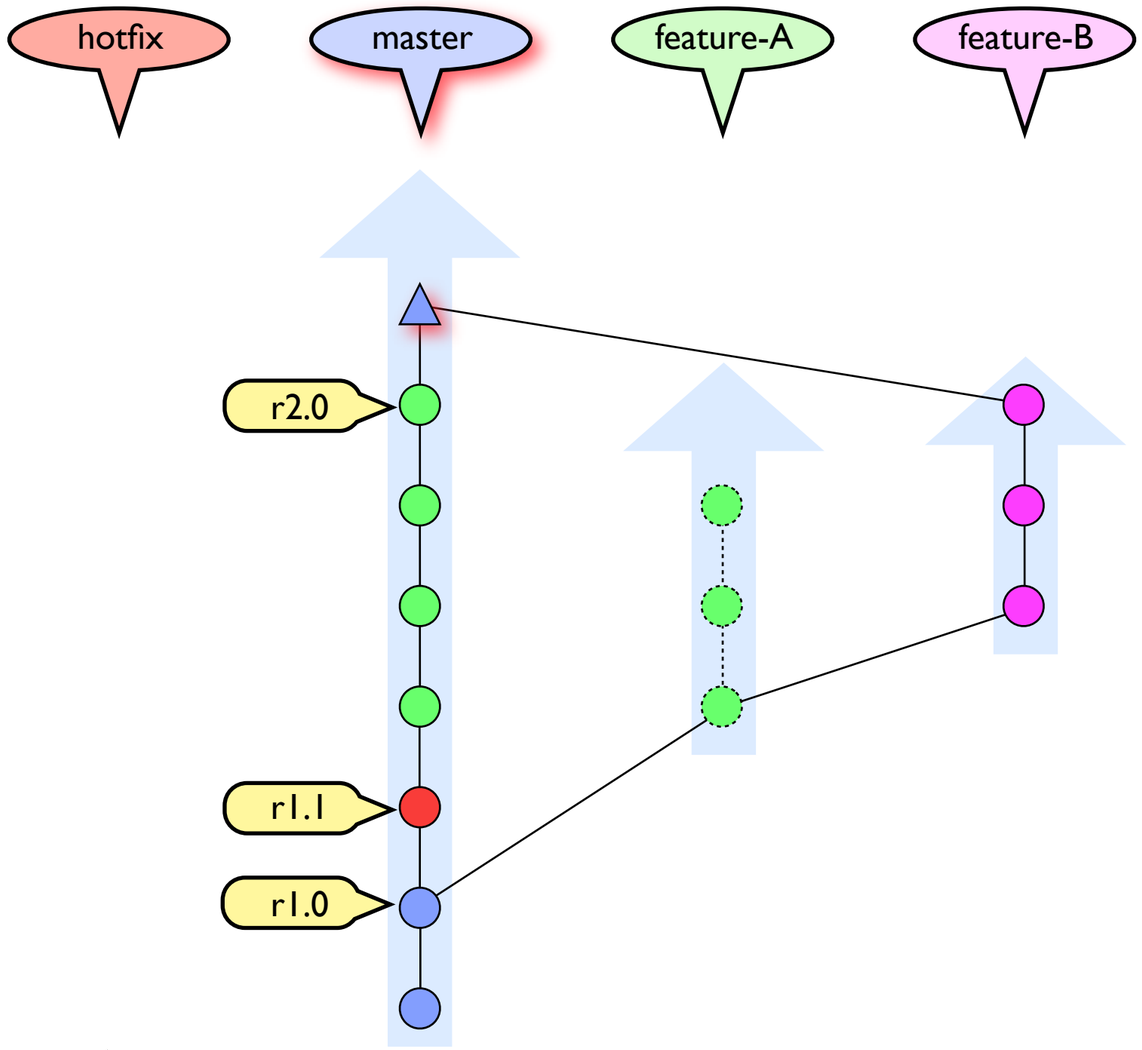
```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
```



```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
…resolve conflicts…
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
…resolve conflicts…
git commit -a -m 'merge feature-B into master'
```



divergent branches require a new commit with 2 parents.

The new commit tracks conflict resolutions.

`git merge` automatically detects if a fast forward merge is possible or not.

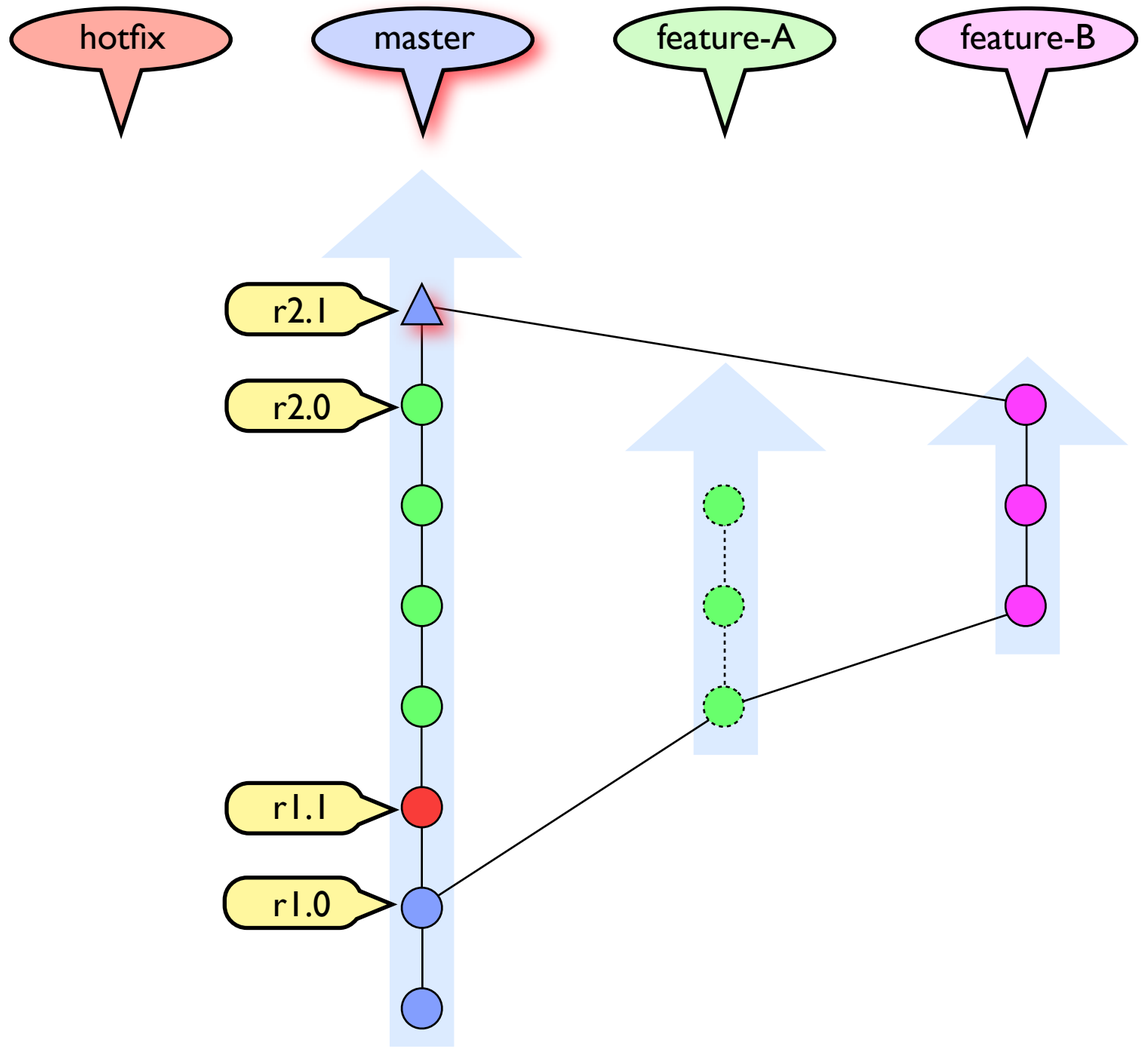
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```

…resolve conflicts…

```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
```



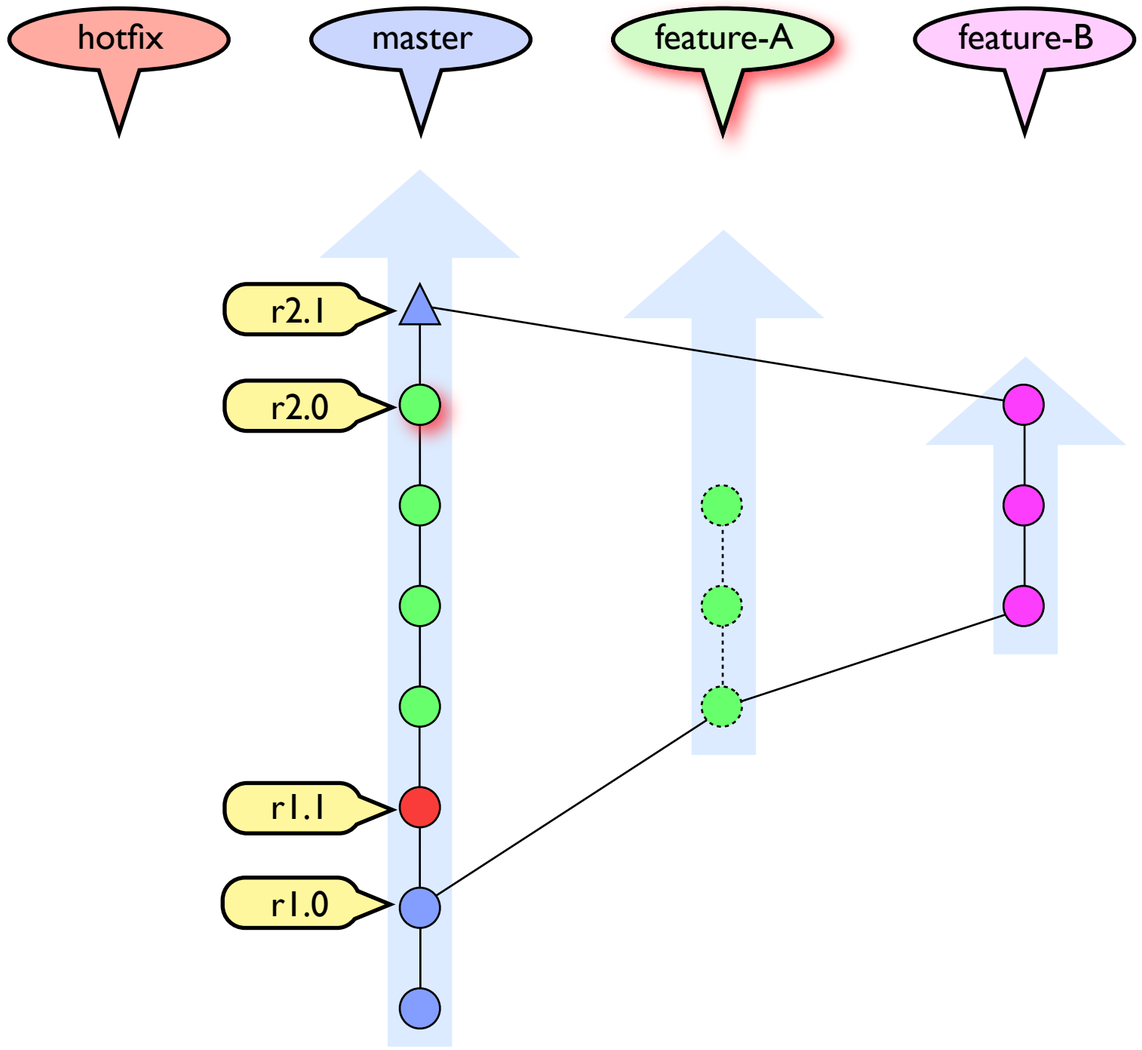
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```

…resolve conflicts…

```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
```



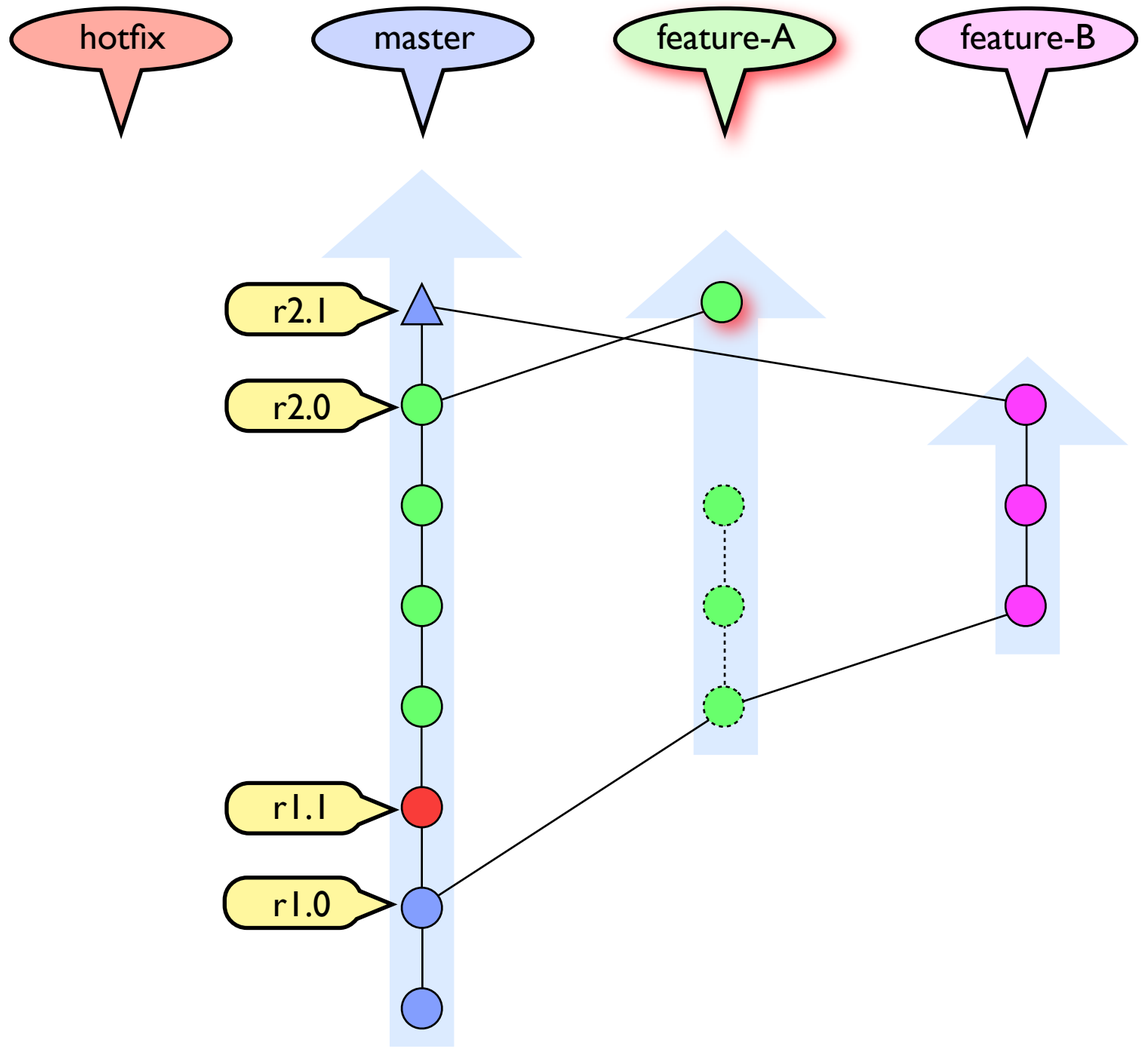
```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```

…resolve conflicts…

```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```

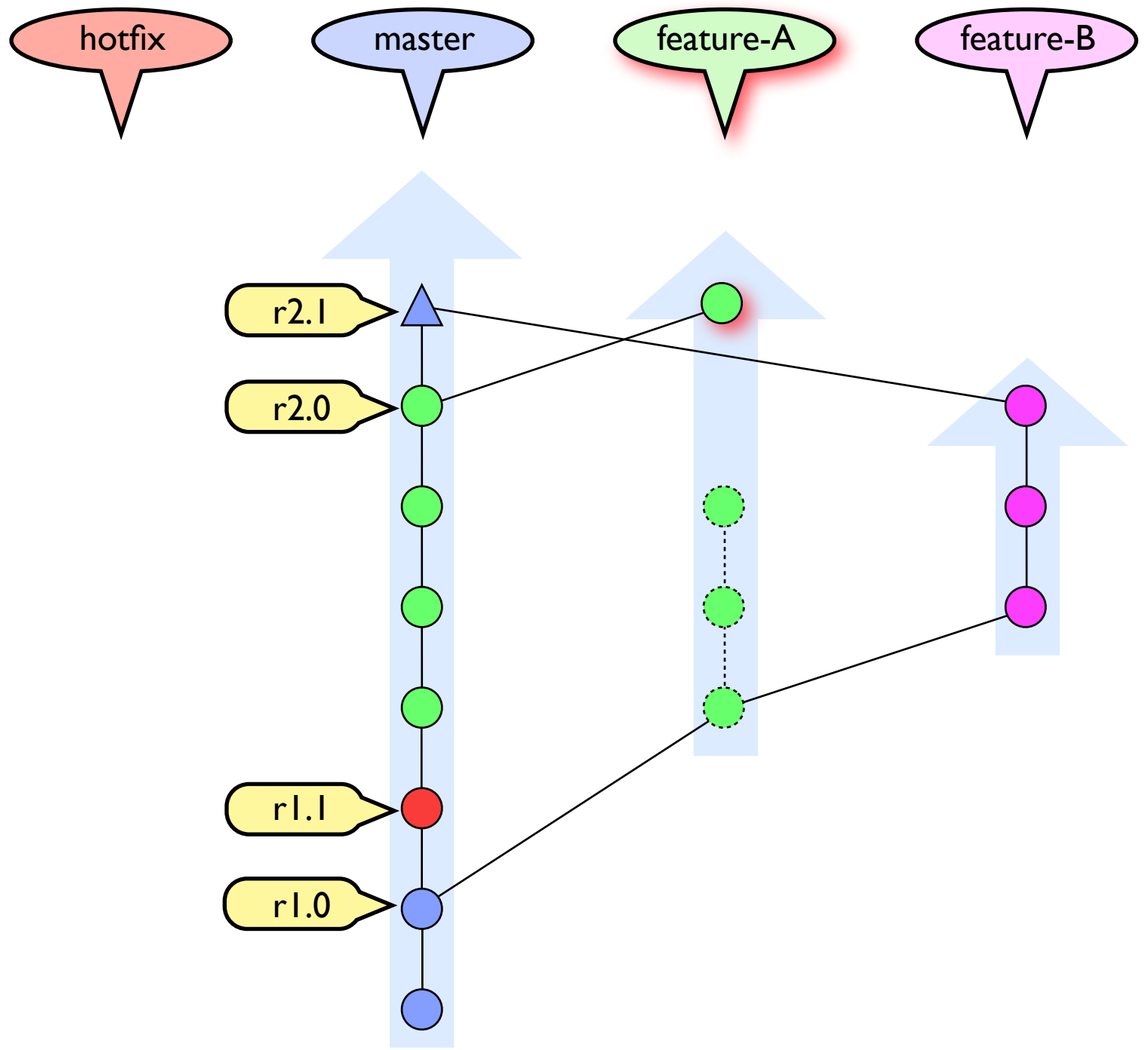
…resolve conflicts…

```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
```

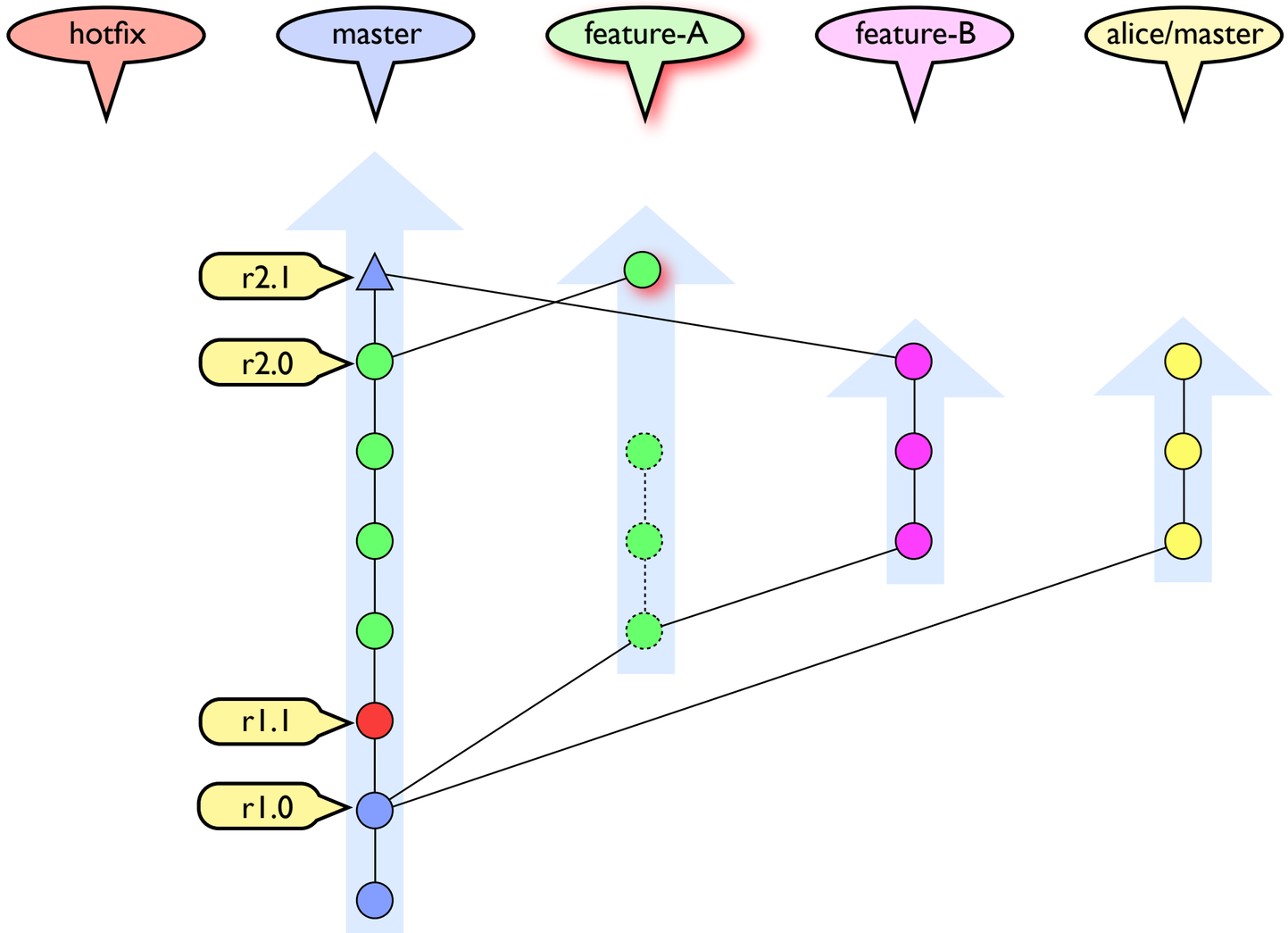


Multiple Repositories

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```
…resolve conflicts…
```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```
…resolve conflicts…
```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
```

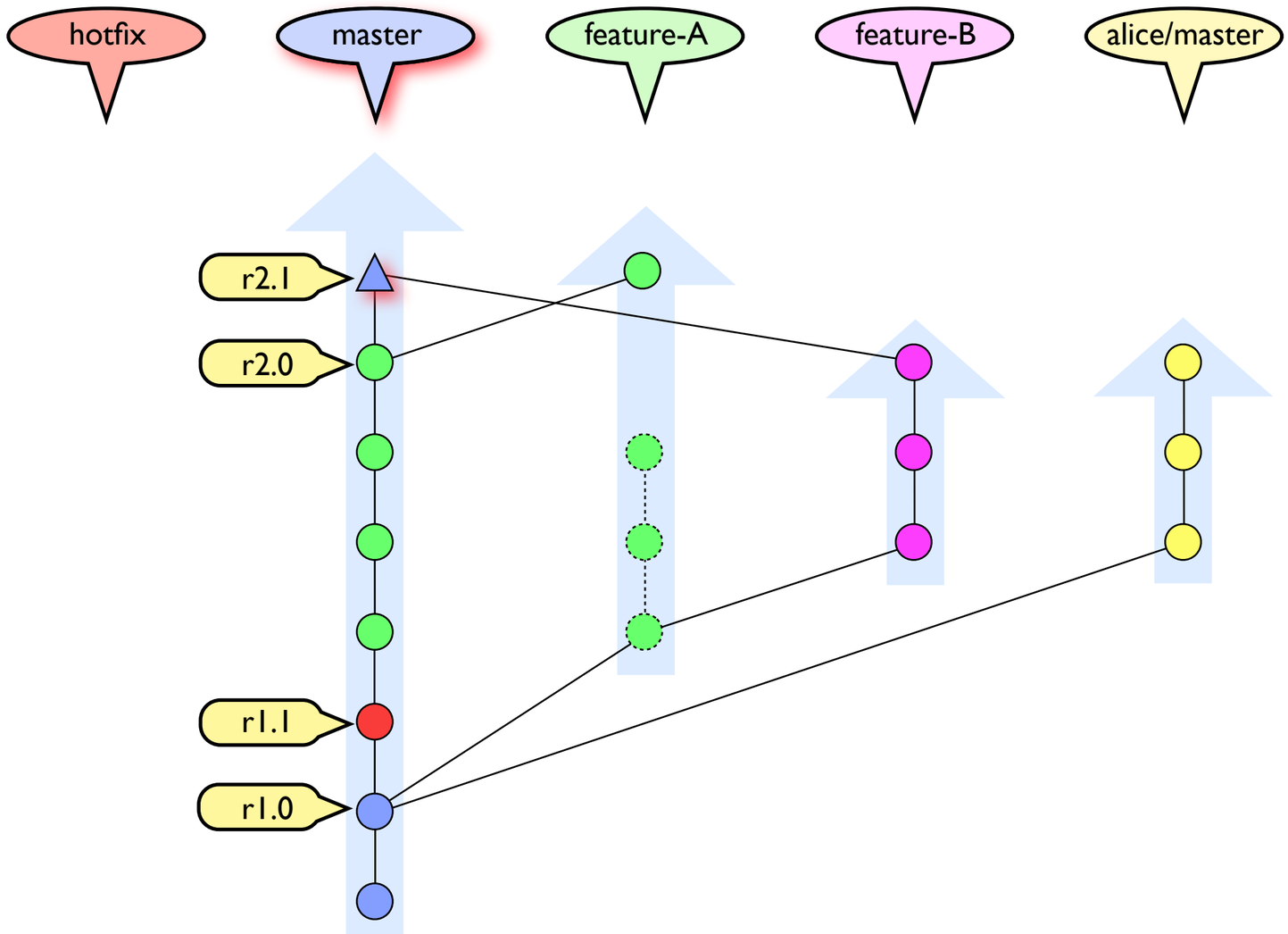


```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
...resolve conflicts...
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
...resolve conflicts...
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
git fetch alice
```

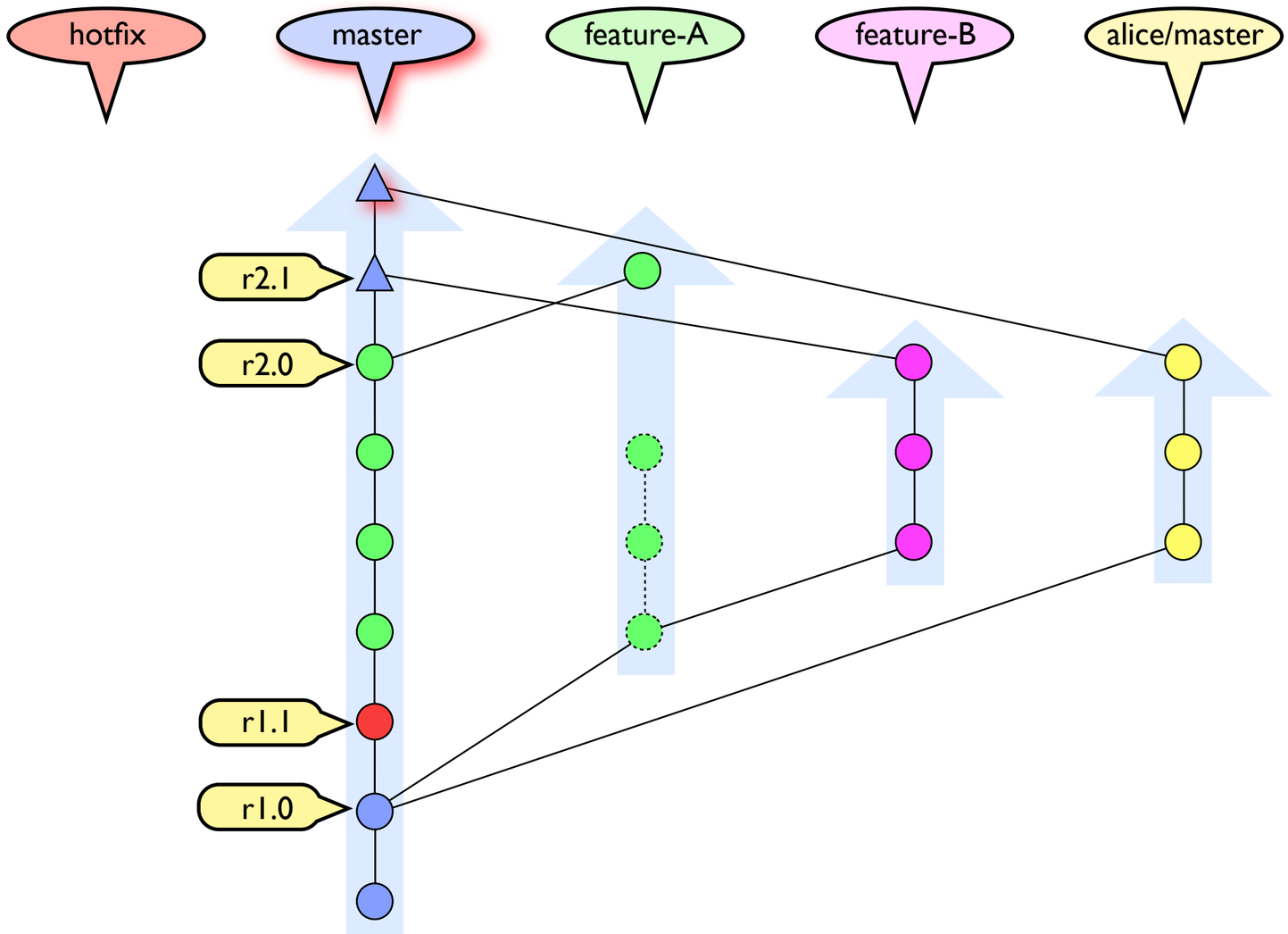


Fetching from a remote repository doesn't change your commit tree!

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```
…resolve conflicts…
```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```
…resolve conflicts…
```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
git fetch alice
git checkout master
```

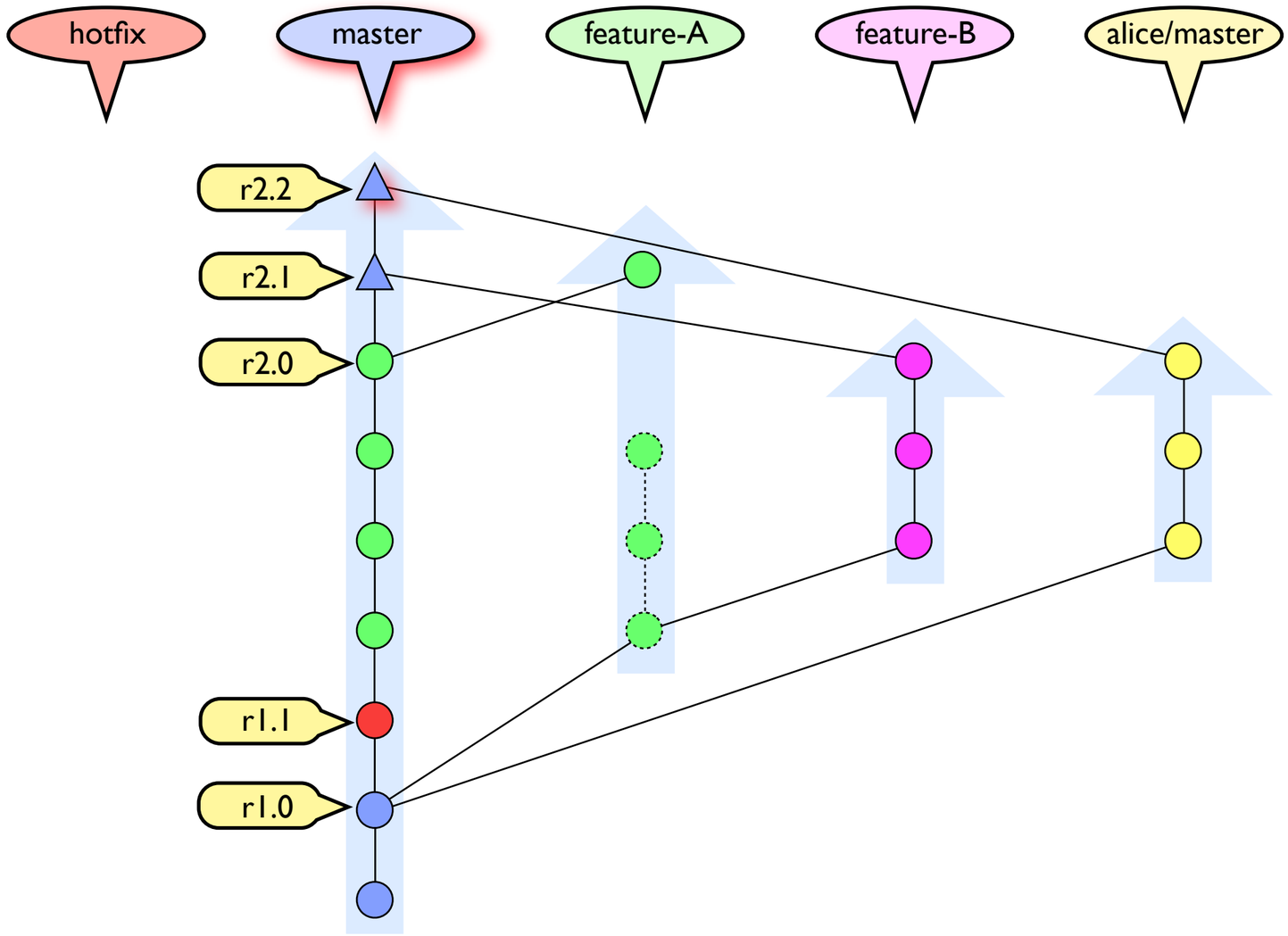


```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```
…resolve conflicts…
```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```
…resolve conflicts…
```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
git fetch alice
git checkout master
git merge alice/master
```
…resolve conflicts…
```
git commit -a -m 'merge alice/master into master'
```



`git pull` **combines fetch and merge!**

```
git checkout master
git checkout -b feature-A
git commit -a -m 'basic feature A structure'
git checkout -b feature-B
git commit -a -m 'basic feature B structure'
git commit -a -m 'debug feature B'
git checkout feature-A
git commit -a -m 'finish feature A'
git commit -a -m 'debug feature A'
git checkout -b hotfix r1.0
git commit -a -m 'keep customer happy'
git checkout master
git merge hotfix
git tag -a r1.1 -m 'security update'
git checkout feature-A
git rebase master
```
…resolve conflicts…
```
git rebase --continue
git commit -a -m 'polish feature A'
git checkout master
git merge feature-A
git tag -a 2.0 -m 'new and improved release'
git checkout feature-B
git commit -a -m 'polish feature-B'
git checkout master
git merge feature-B
```
…resolve conflicts…
```
git commit -a -m 'merge feature-B into master'
git tag -a r2.1 -m 'wow release'
git checkout feature-A
git commit -a -m 'feature-A extension'
git checkout master
git fetch alice
git merge alice/master
```
…resolve conflicts…
```
git commit -a -m 'merge alice/master into master'
git tag -a r2.2 -m 'insecurity update'
```



Publishing your repository

```
local ~/project/ >          ssh me@remote.com

remote ~/ >                 mkdir project.git

remote ~/project.git/ >     cd project.git

remote ~/project.git/ >     git init --bare

remote ~/project.git/ >     logout

local ~/project/ >          git remote add public_repo ssh://me@remote.com/~/project.git

local ~/project/ >          git push public_repo release_branch
```

you should NOT publish your private directories (basic security)

create a `bare repository` on a public server

push only the branches your wish to publish

USB-Stick

```
~/project/ > git clone --bare . /Volumes/usb_stick/project.git
```

```
~/project/ > git remote add usb_stick /Volumes/usb_stick/project.git
```

```
~/project/ > git push usb_stick
```

USB stick, external disk

great for ad-hoc sharing

great for backup

treat like a public repository

Which Repos Am I connected to?

```
~/project_dir/ > git remote -v

public_repo    ssh://me@remote.com/~/project.git (fetch)
public_repo    ssh://me@remote.com/~/project.git (push)
usb_stick      /Volumes/usb_stick/project.git (fetch)
usb_stick      /Volumes/usb_stick/project.git (push)
```

Updates From Multiple Repos

```
~/project/ > $EDITOR .git/config

...
[remote "steve"]
        url = ssh://steveserve.com/~/Git/project.git
        fetch = +refs/heads/*:refs/remotes/steve/*
[remote "mac"]
        url = git@github.com:mac/project.git
        fetch = +refs/heads/*:refs/remotes/mac/*
[remotes]
        buddies = steve mac
...

~/project/ > git remote update buddies
Updating steve
...
Updating mac
...
```

Working With Others

Publish your changes via a bare repository

Never push to someone else's repository

Use `git remote update` to track multiple repositories

Use `git show-branch` or `git whatchanged` to see what's new

Rewriting History

What if you want to…

…find the commit that introduced a problem…

…remove some commits from the history…

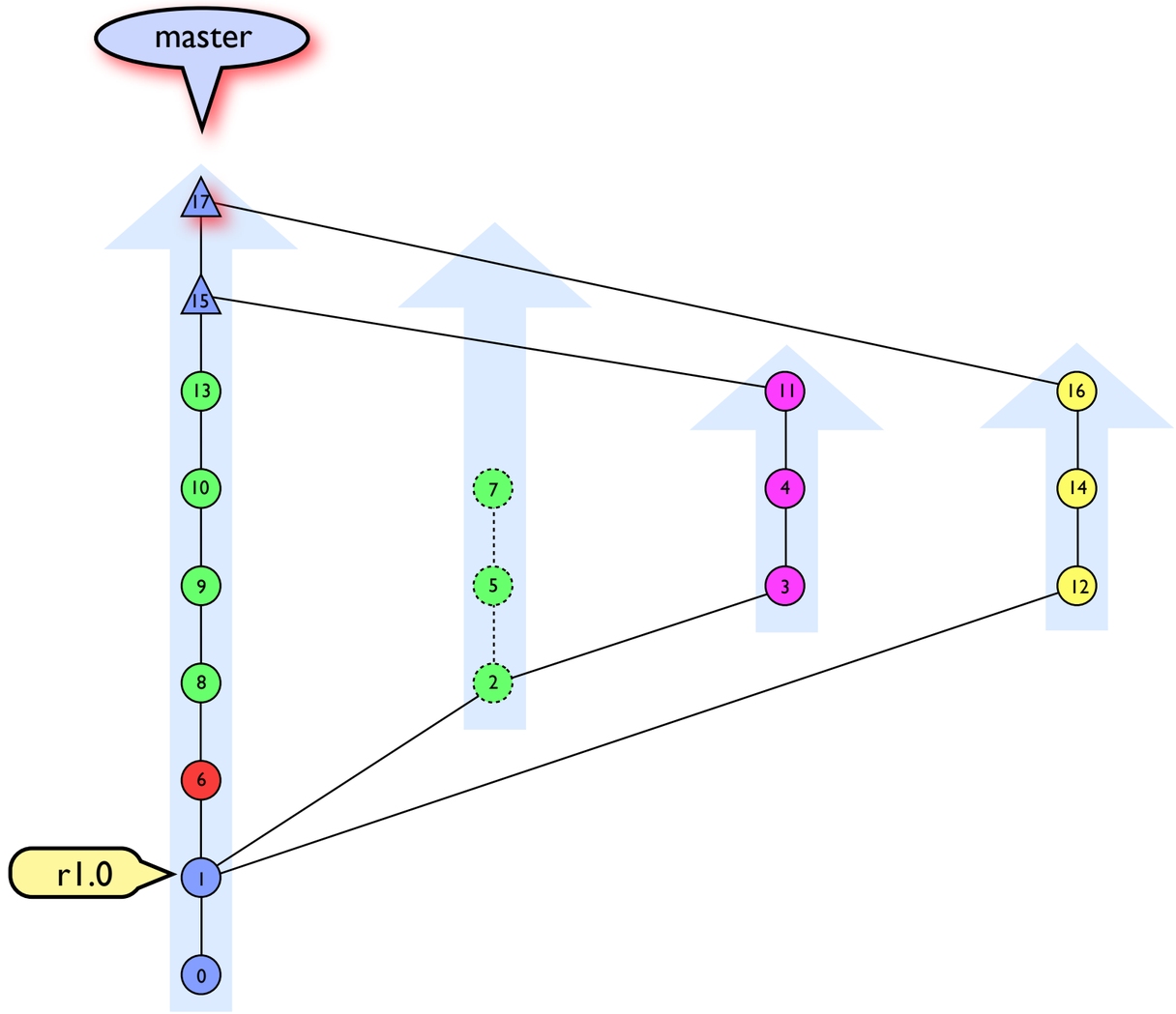
…add one or more commits from one branch to another…

…work on a branch for a long time…

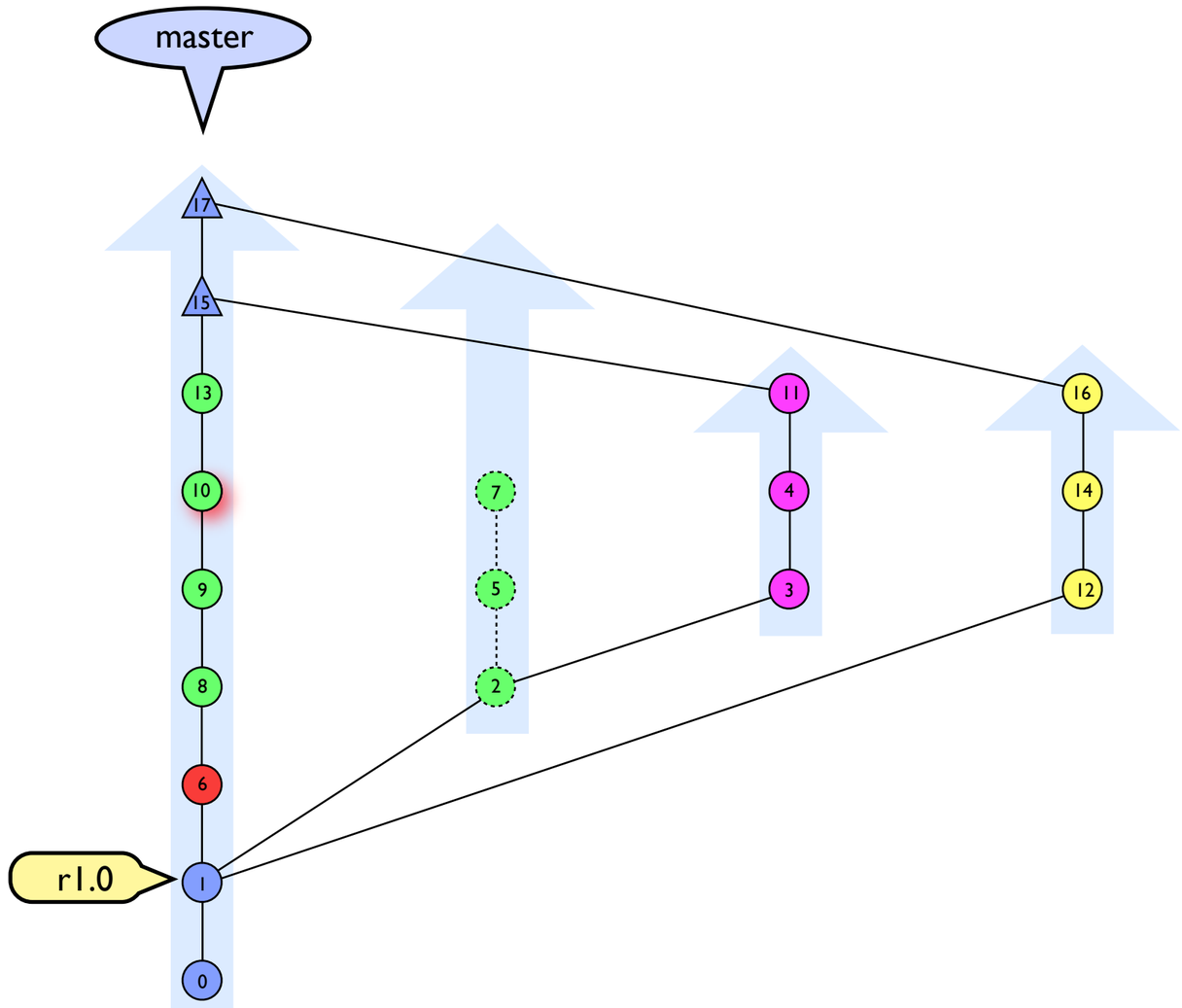
finding bad commits

git bisect

```
git checkout master
```

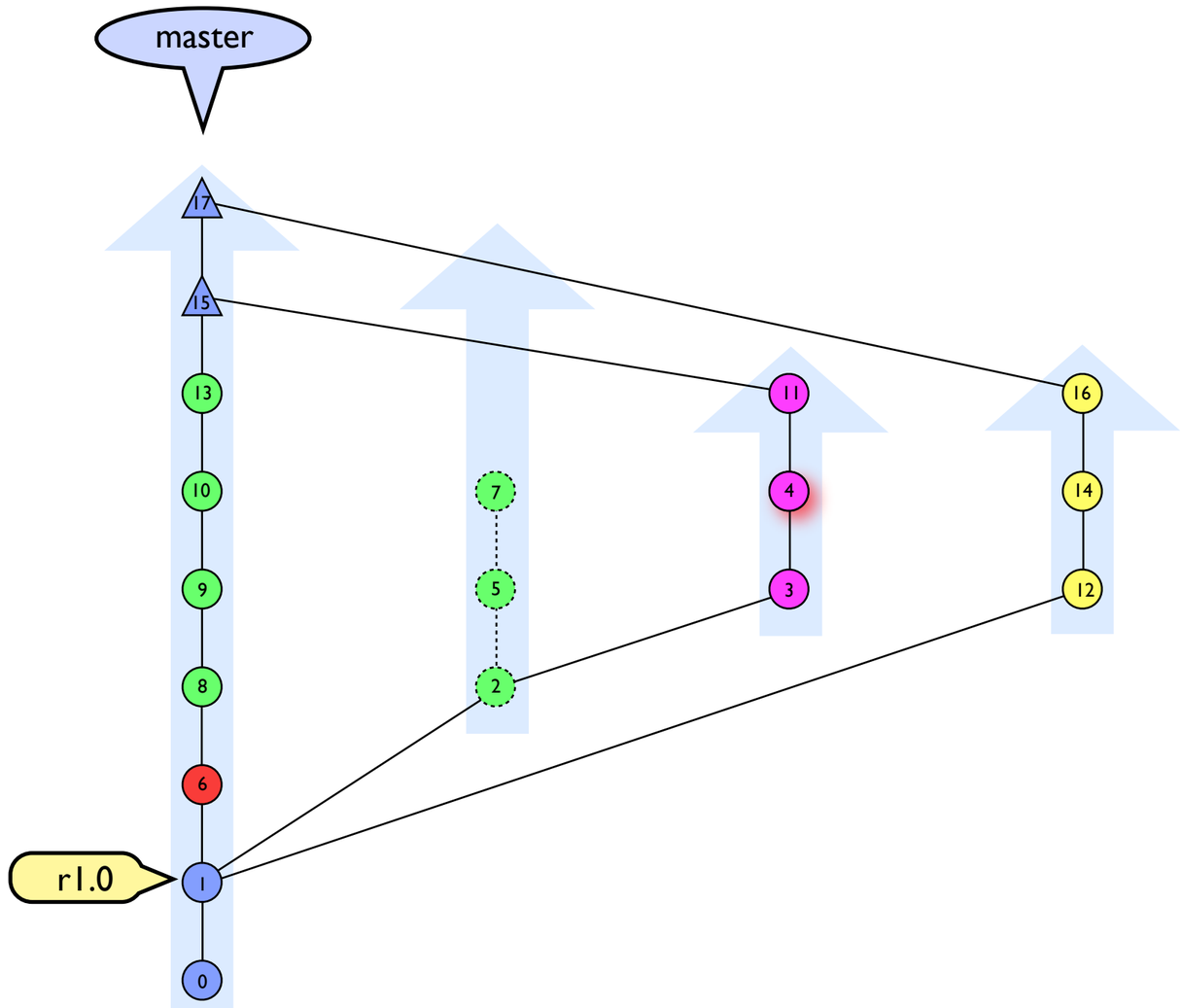


```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message
```



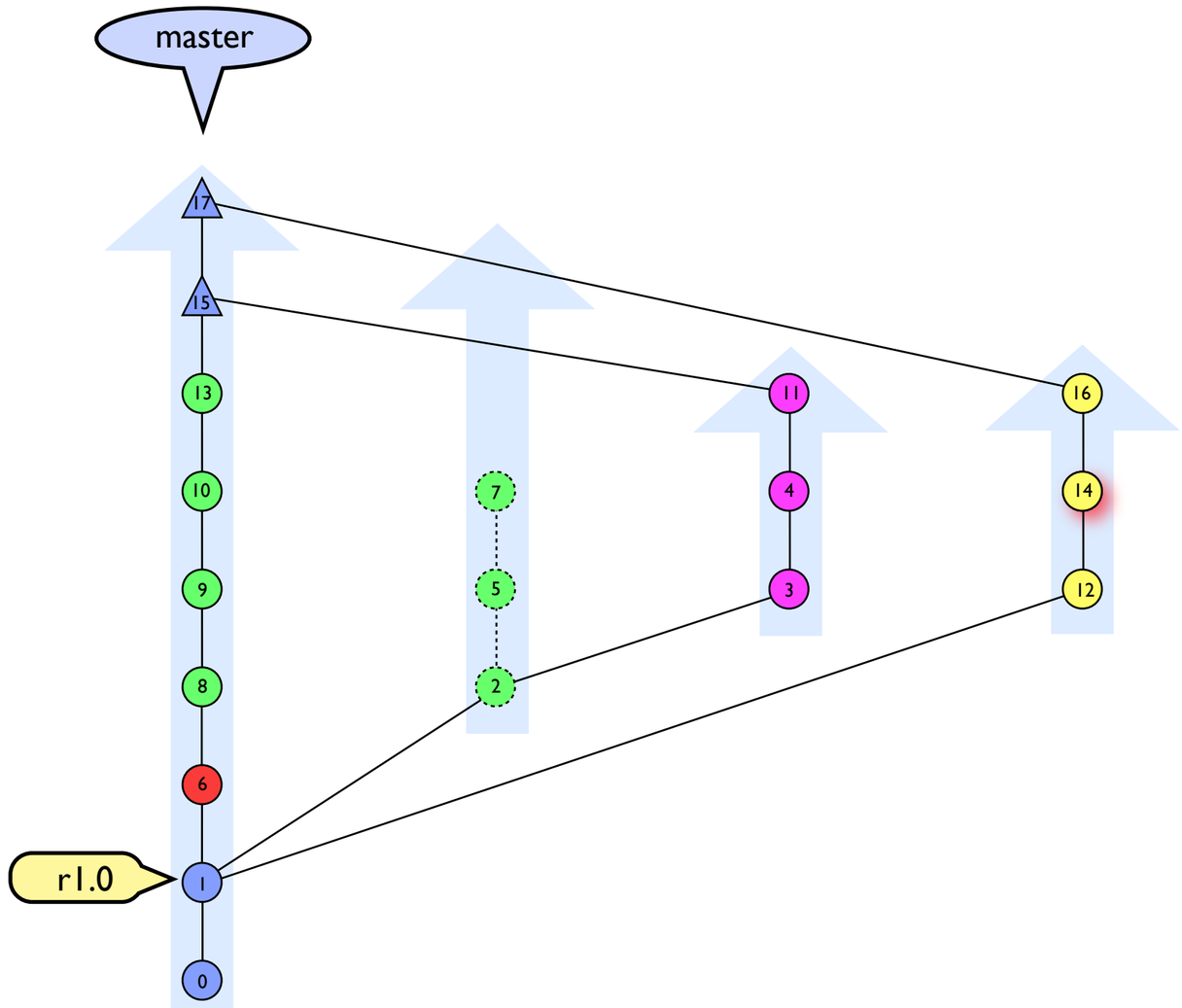
git has checked out a commit for you to test…
Is the problem currently checked out?
If not call `git bisect good`

```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message

git bisect good

Bisecting: ## revisions left to test after this
[4] commit message
```



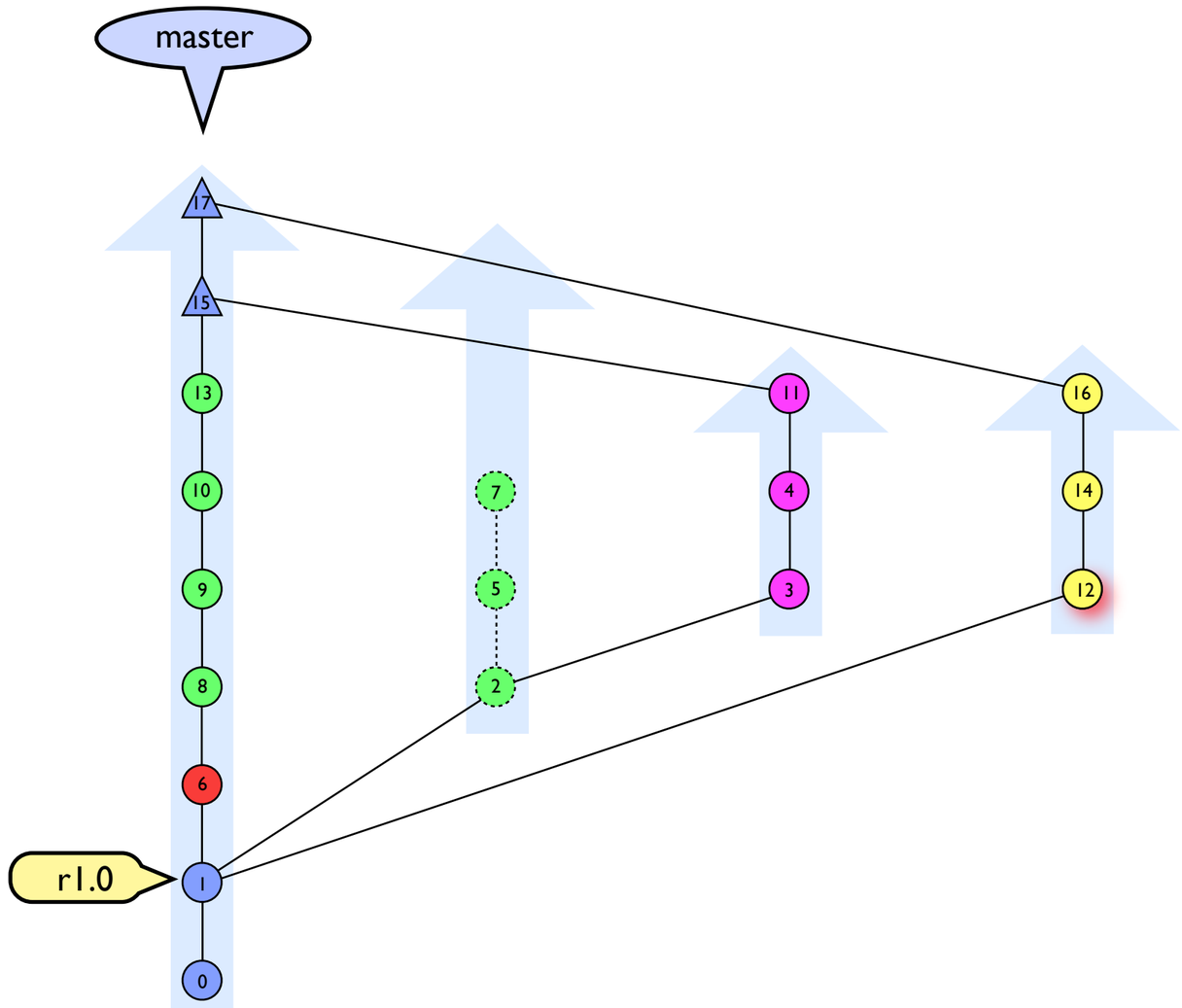
git has checked out another commit for you to test…
Can't test this version? (doesn't compile?)
If so call `git bisect skip`

```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message

git bisect good

Bisecting: ## revisions left to test after this
[4] commit message

git bisect skip

Bisecting: ## revisions left to test after this
[14] commit message
```



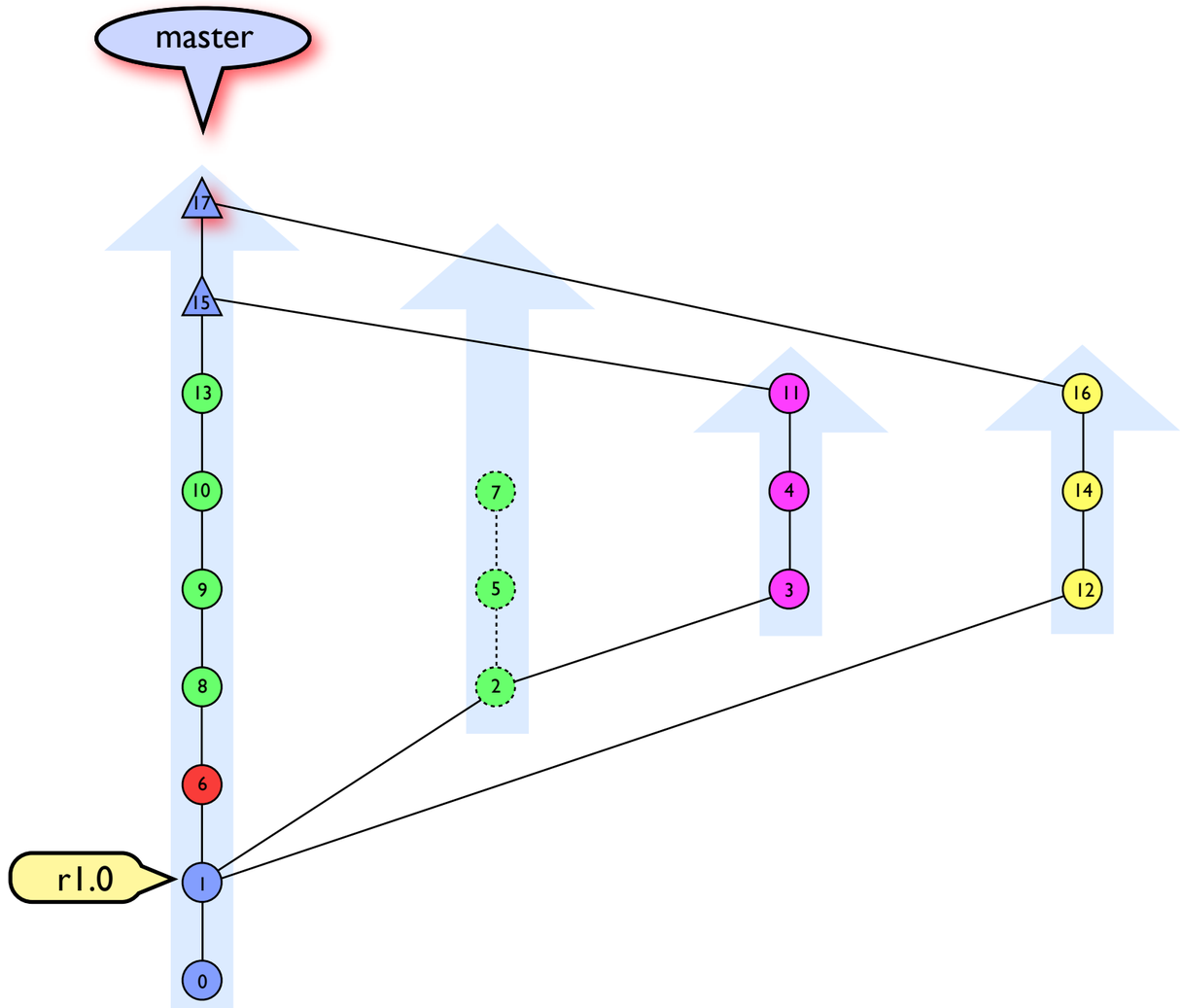
Another commit for you to test…
Is the problem currently checked out?
If so call `git bisect bad`

```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message

git bisect good

Bisecting: ## revisions left to test after this
[4] commit message

git bisect skip

Bisecting: ## revisions left to test after this
[14] commit message

git bisect bad

12 is the first bad commit
```

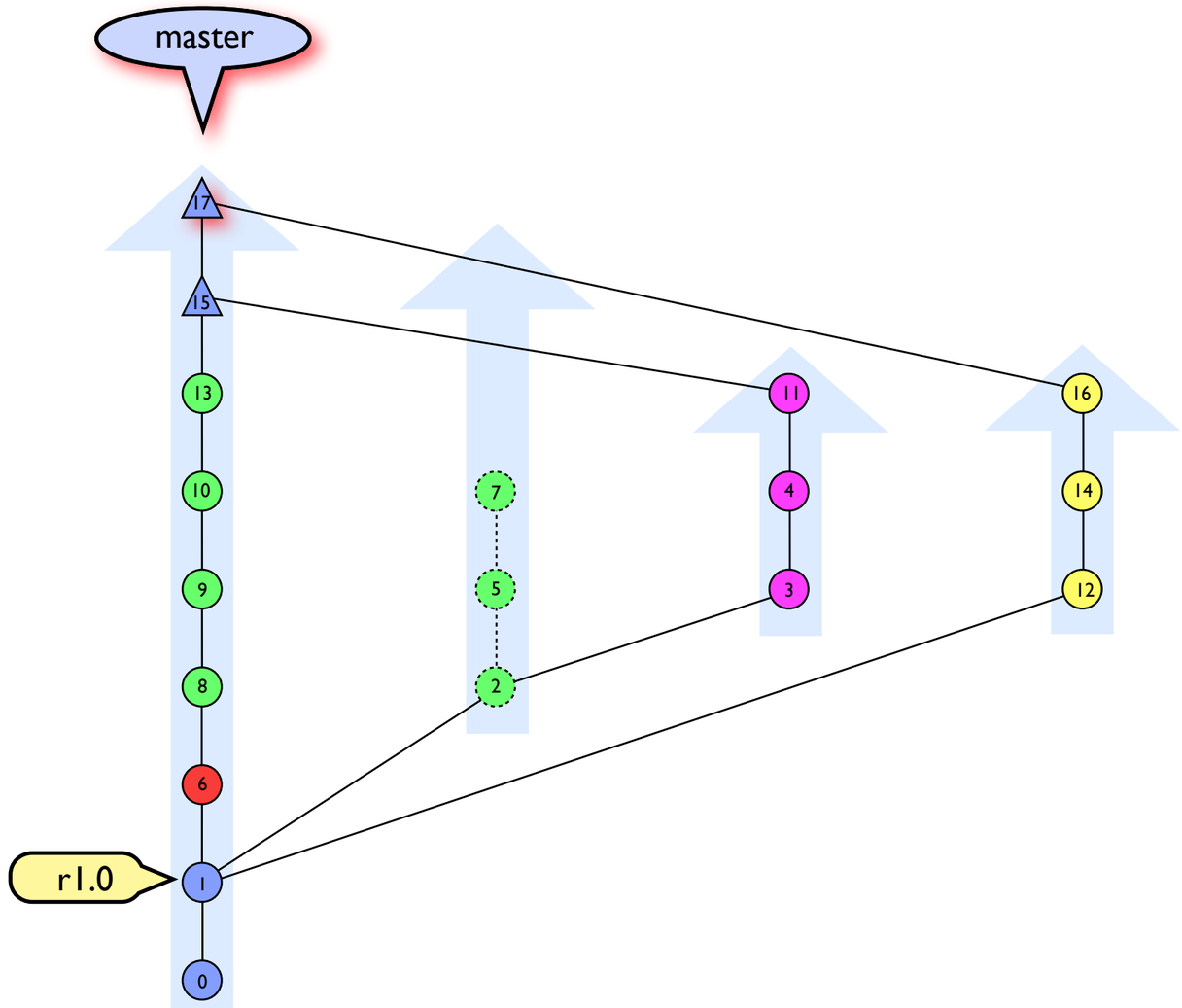


Now you know where the problem is.
Go back to your branch and fix it with a normal commit.

```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message

git bisect good

Bisecting: ## revisions left to test after this
[4] commit message

git bisect skip

Bisecting: ## revisions left to test after this
[14] commit message

git bisect bad

12 is the first bad commit

git bisect reset
```



```
git checkout master
git bisect start
git bisect bad master
git bisect good r1.0

Bisecting: ## revisions left to test after this
[10] commit message

git bisect good

Bisecting: ## revisions left to test after this
[4] commit message

git bisect skip

Bisecting: ## revisions left to test after this
[14] commit message

git bisect bad

12 is the first bad commit

git bisect reset
```



git bisect automation

git bisect start *bad_commit good_commit*

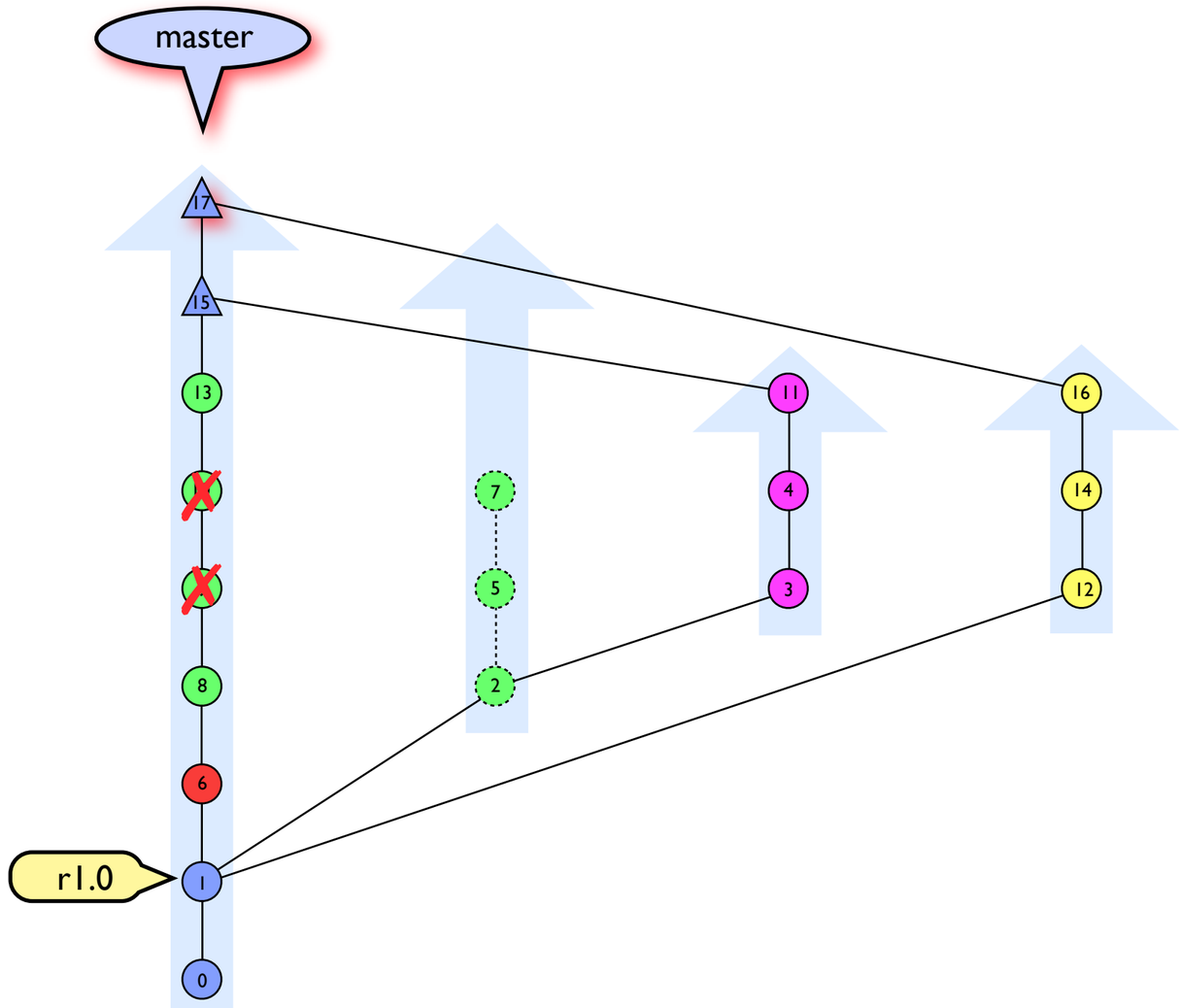
git bisect run *test_script options…*

Test script exit codes:

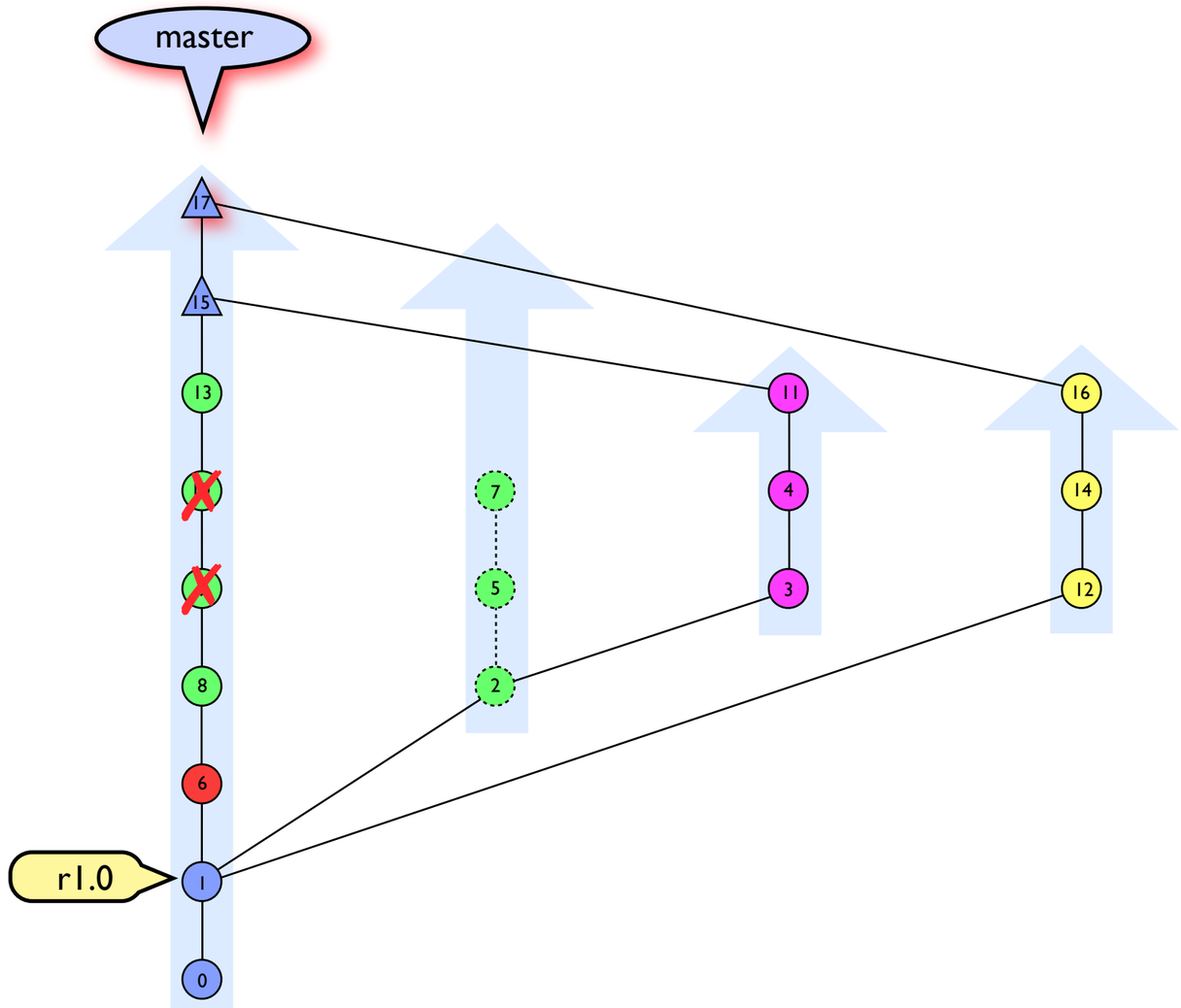
```
exit 0          => good

exit 125        => skip

exit 1 .. 127 => bad
```

removing bad commits

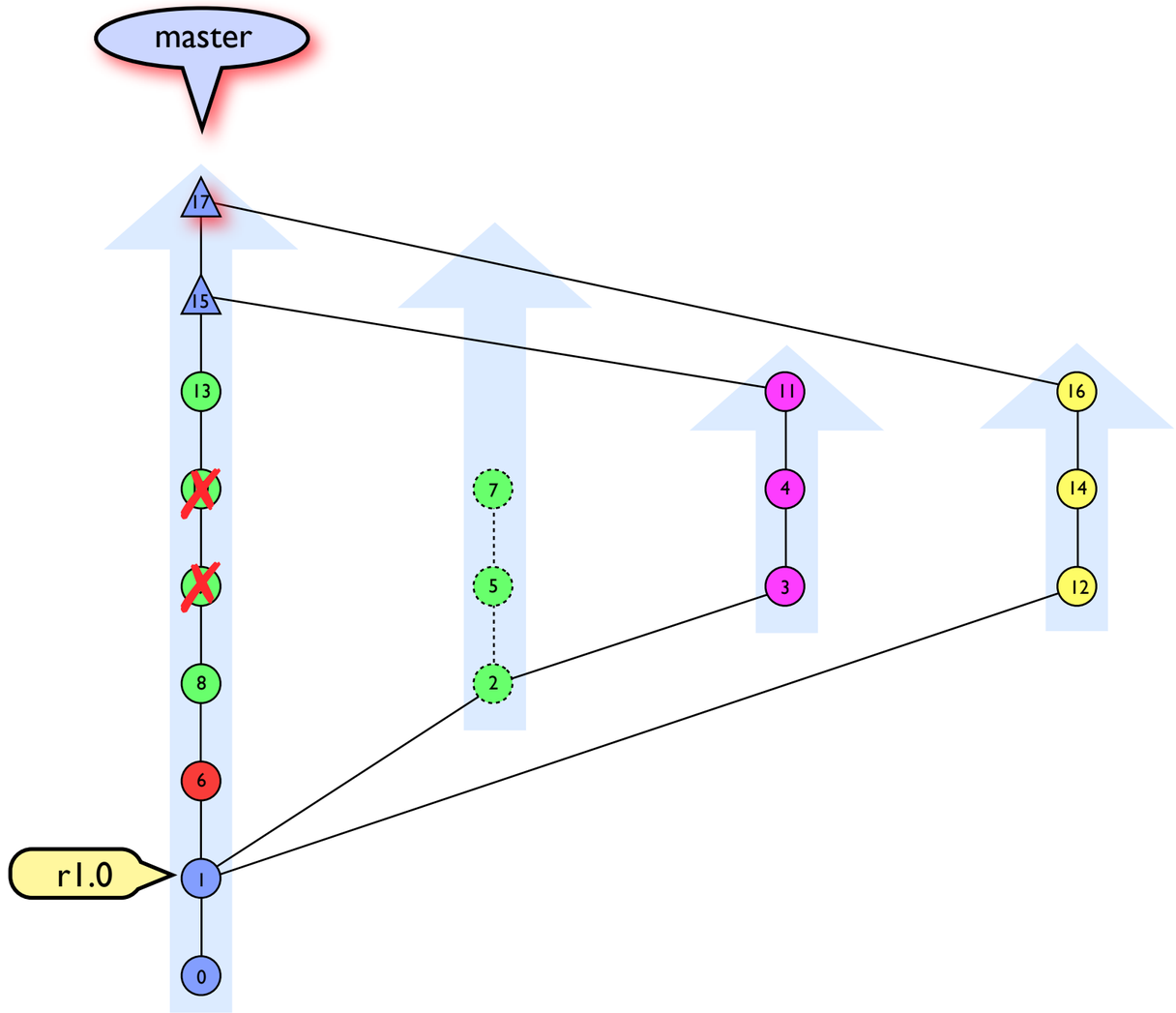
interactive rebasing


master
17
15
13
7
4
16
14
5
3
12
2
8
6
rl.0
1
0

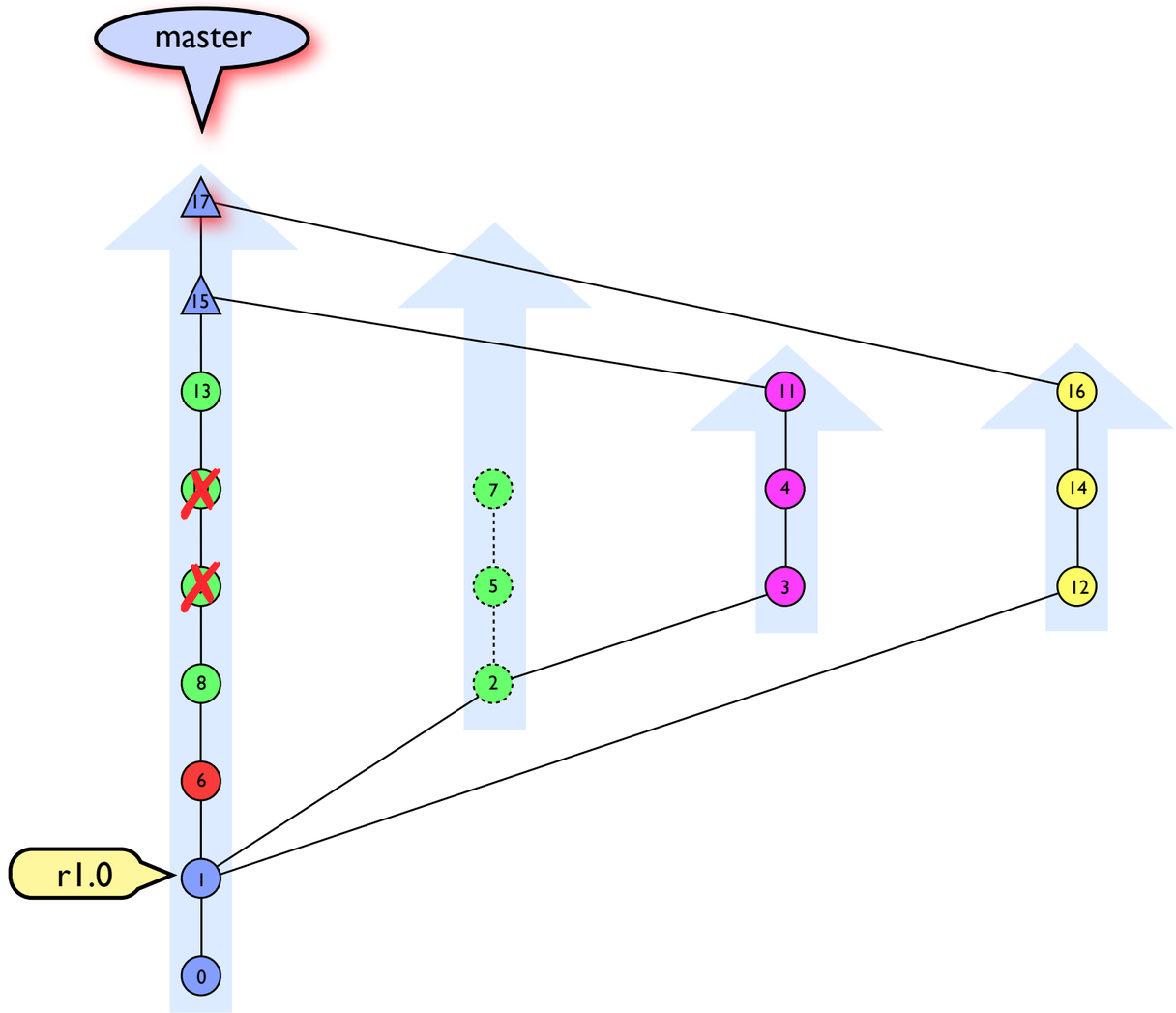
```
git checkout master
git rebase --interactive r1.0
```



```
pick ca4f103  6 hotfix
pick 1f85820  8 feature_A - first try
pick 9b6e08e  9 feature_A - with signature
pick 7d86f88 10 feature_A with more detail
pick e29b897  2 feature_A - first try
pick 39f4215  3 first attempt at feature B
pick f4449ad  4 feature_B comments
pick 27c2b4c 11 feature_B fix wrong spellt world

# Rebase 2aa3032..5af9beb onto 2aa3032
#
# Commands:
#  p, pick = use commit
#  e, edit = use commit, but stop for amending
#  s, squash = use commit, but meld into previous commit
#
# If you remove a line here THAT COMMIT WILL BE LOST.
# However, if you remove everything, the rebase will be aborted.
#
```

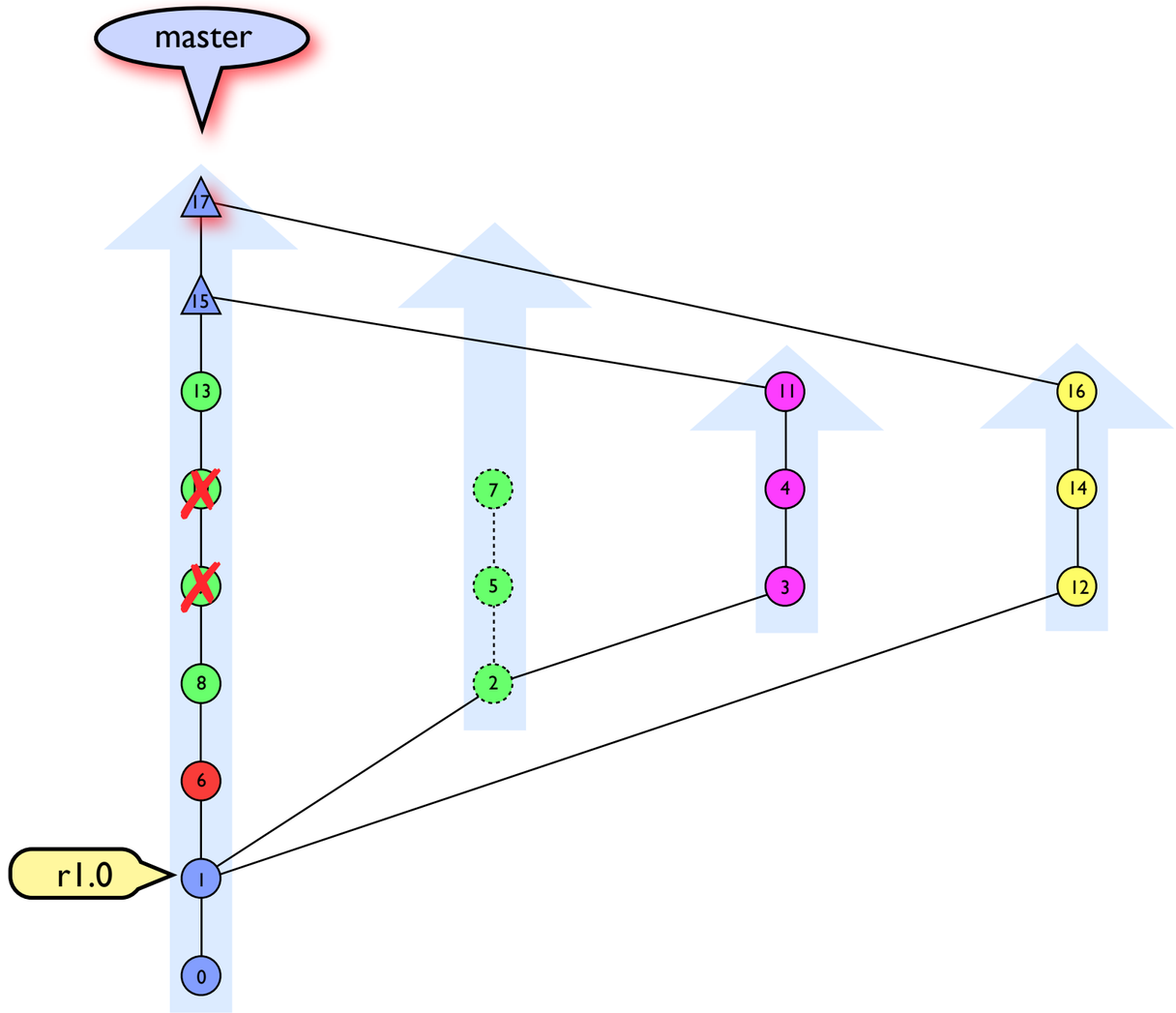


```
pick ca4f103  6 hotfix
pick 1f85820  8 feature_A - first try
pick 9b6e08e  9 feature_A - with signature
pick 7d86f88 10 feature_A with more detail
pick e29b897  2 feature_A - first try
pick 39f4215  3 first attempt at feature B
pick f4449ad  4 feature_B comments
pick 27c2b4c 11 feature_B fix wrong spellt world

# Rebase 2aa3032..5af9beb onto 2aa3032
#
# Commands:
#  p, pick = use commit
#  e, edit = use commit, but stop for amending
#  s, squash = use commit, but meld into previous commit
#
# If you remove a line here THAT COMMIT WILL BE LOST.
# However, if you remove everything, the rebase will be aborted.
#
```



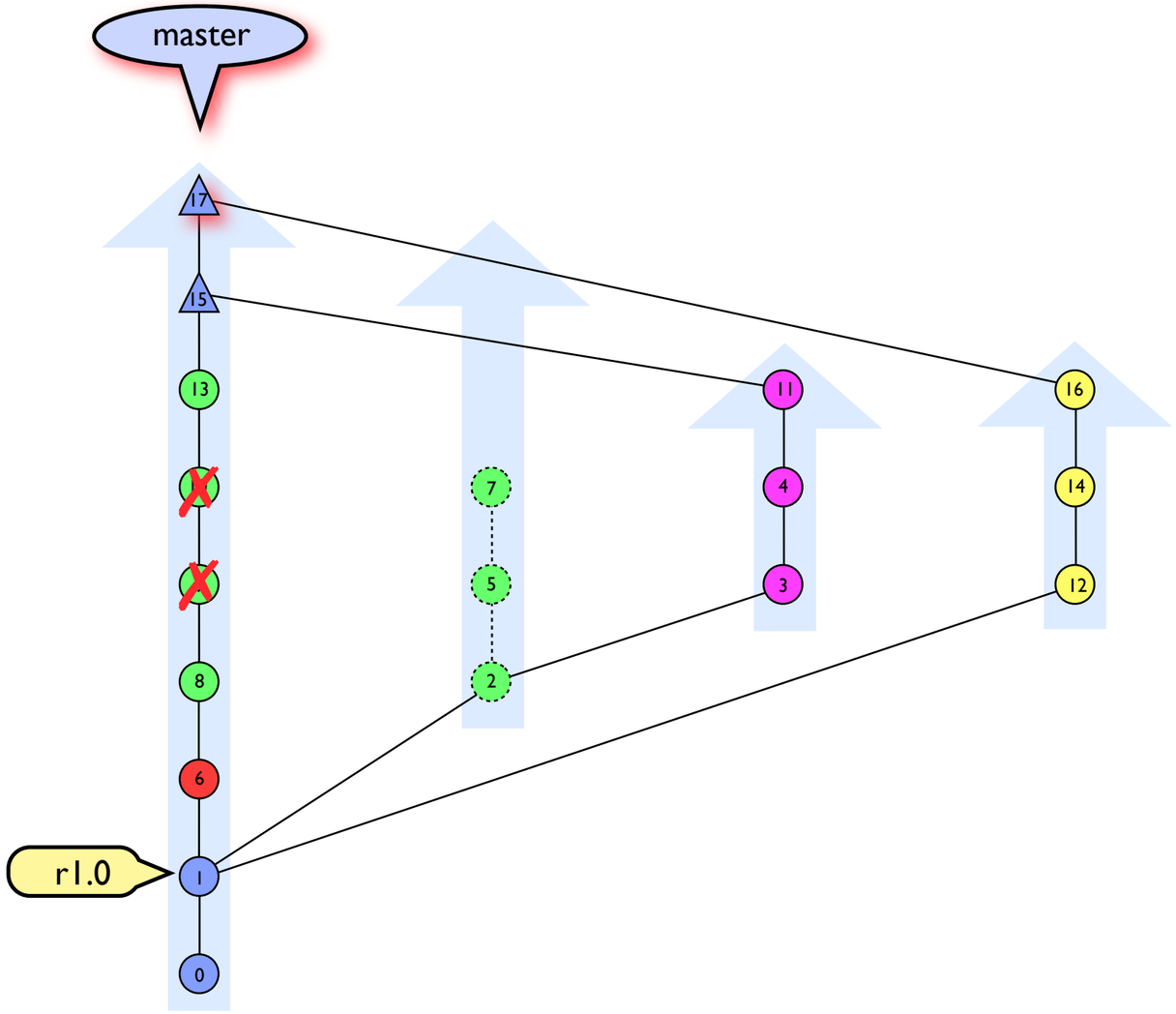
Warning!
Newest commits are at the bottom!
(most other git output has the newest commit at the top!)

```
pick ca4f103  6 hotfix
pick 1f85820  8 feature_A - first try
pick 9b6e08e  9 feature_A - with signature
pick 7d86f88 10 feature_A with more detail
pick e29b897  2 feature_A - first try
pick 39f4215  3 first attempt at feature B
pick f4449ad  4 feature_B comments
pick 27c2b4c 11 feature_B fix wrong spellt world

# Rebase 2aa3032..5af9beb onto 2aa3032
#
# Commands:
#  p, pick = use commit
#  e, edit = use commit, but stop for amending
#  s, squash = use commit, but meld into previous commit
#
# If you remove a line here THAT COMMIT WILL BE LOST.
# However, if you remove everything, the rebase will be aborted.
#
```

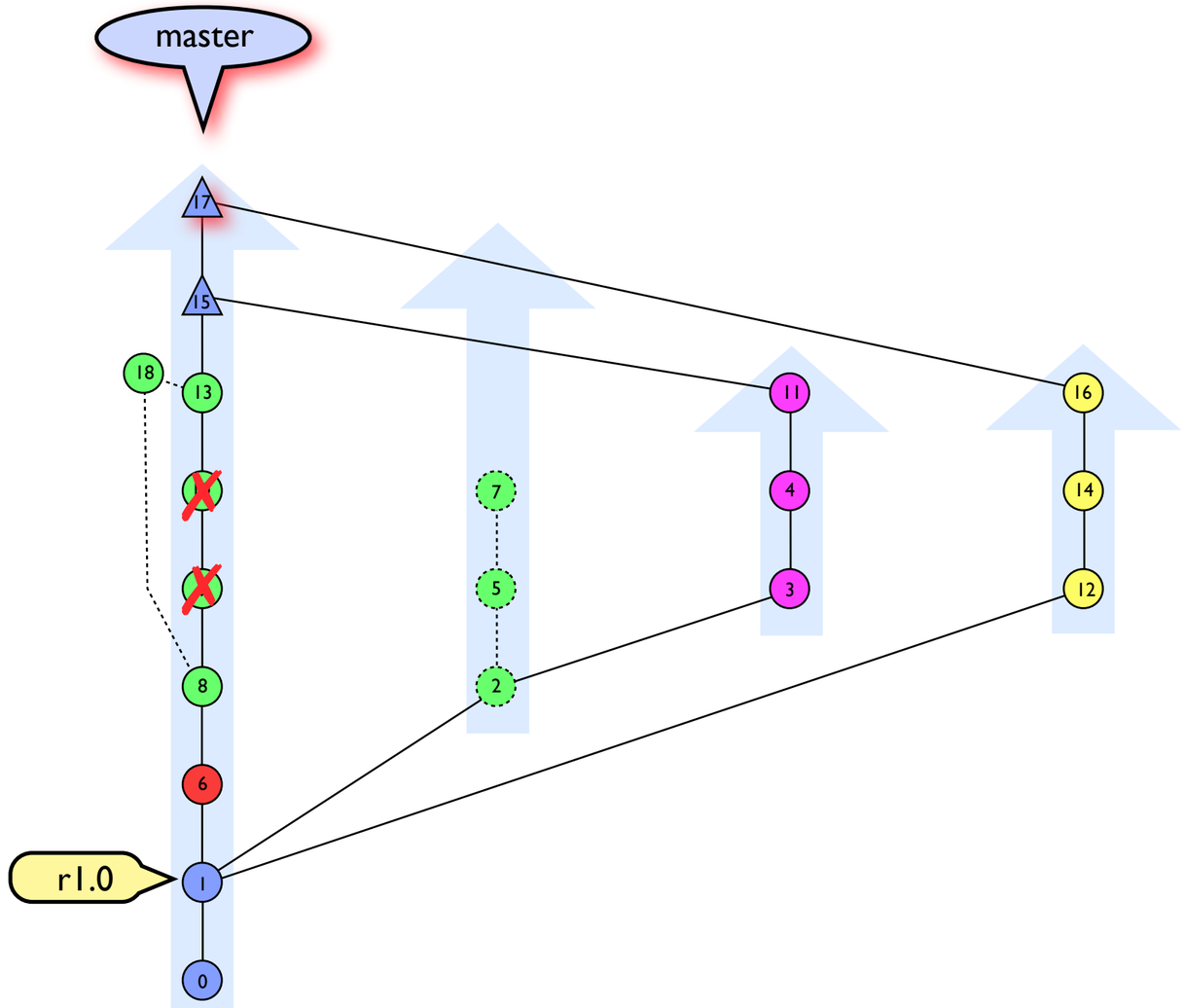


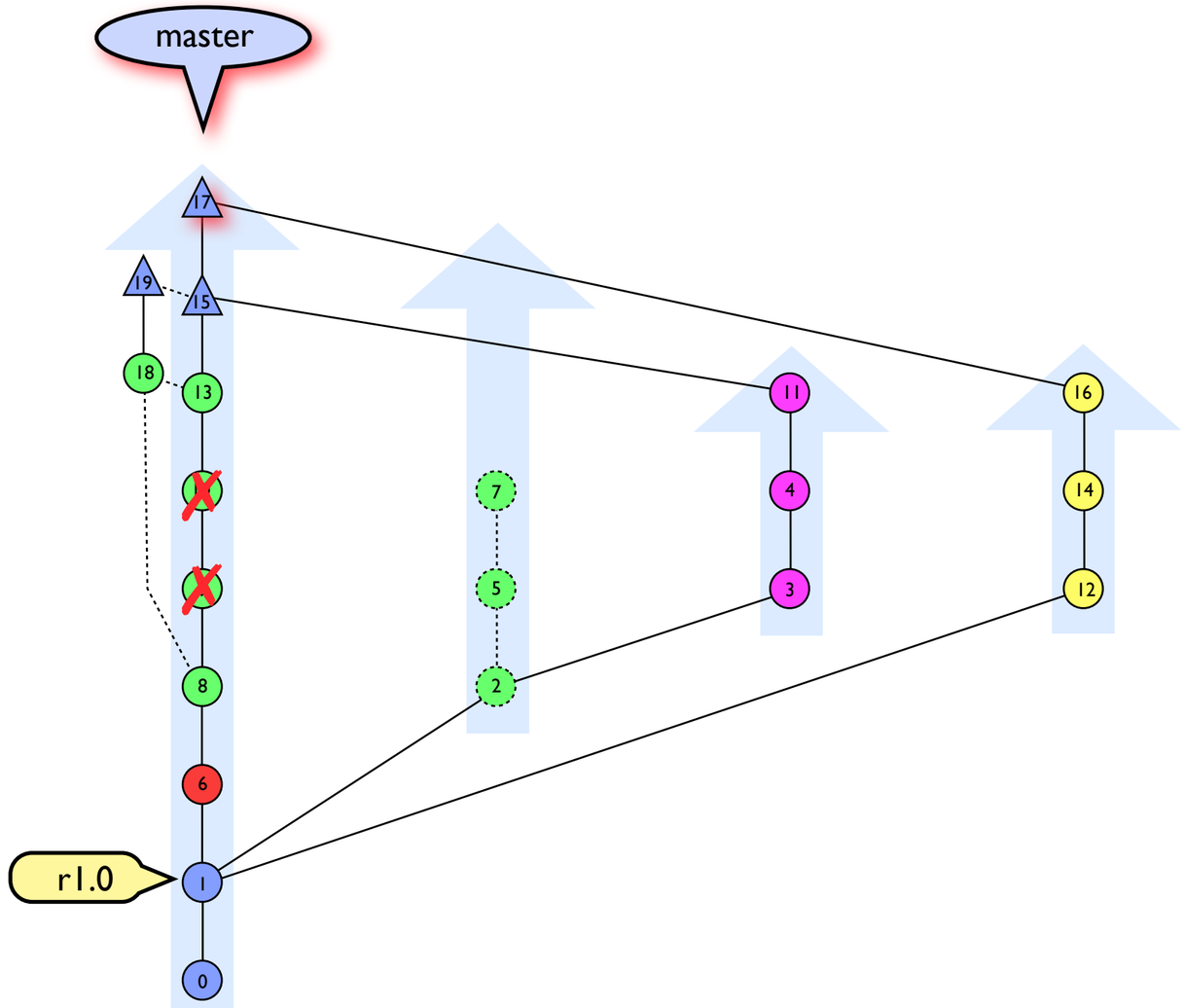
Delete the lines of commits you don't want.
Change `pick` to `squash` if you want merge commits,
or `edit` if you want to split a commit into smaller commits.

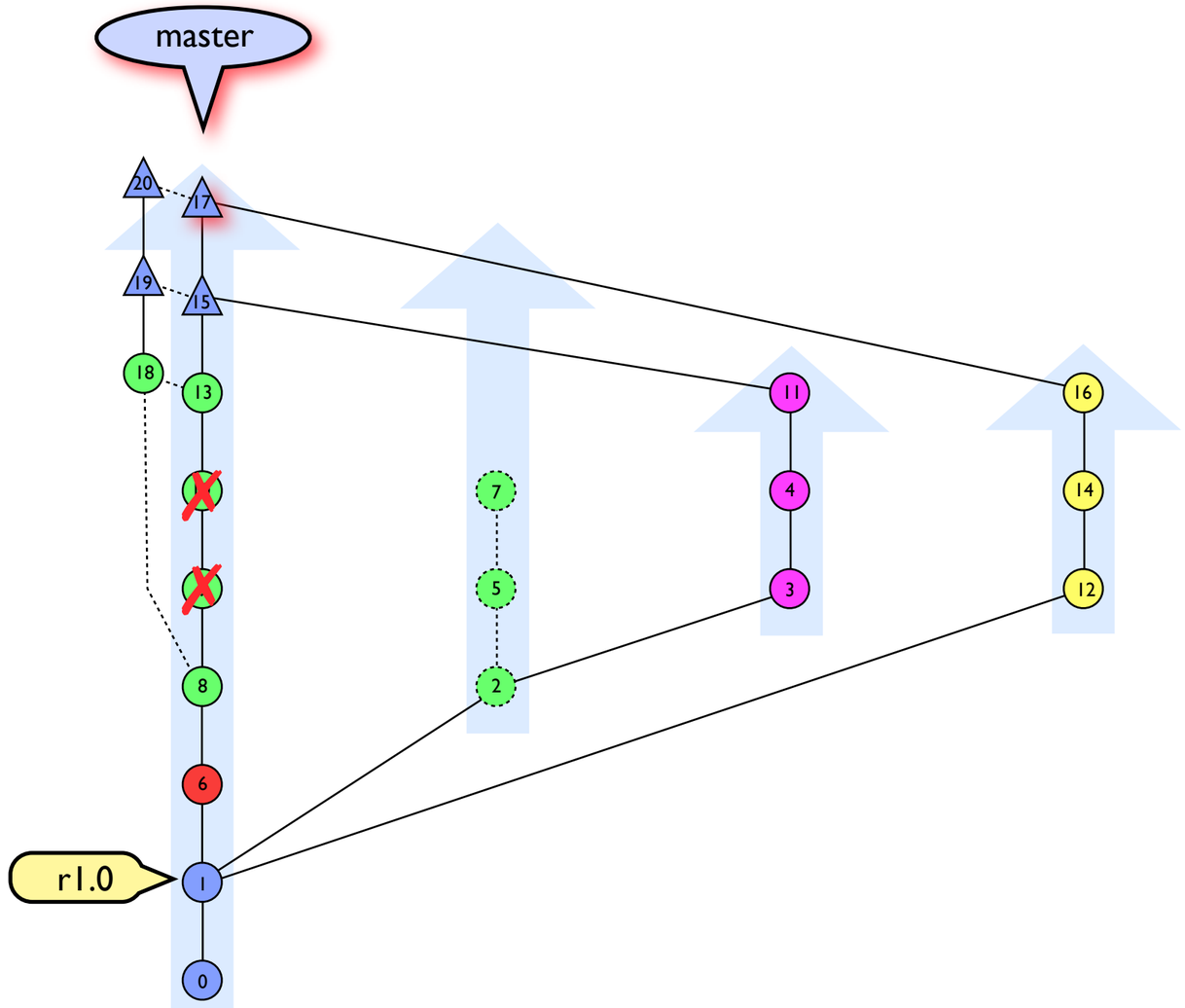
```
pick ca4f103  6 hotfix
pick 1f85820  8 feature_A - first try


pick e29b897  2 feature_A - first try
pick 39f4215  3 first attempt at feature B
pick f4449ad  4 feature_B comments
pick 27c2b4c 11 feature_B fix wrong spellt world

# Rebase 2aa3032..5af9beb onto 2aa3032
#
# Commands:
#  p, pick = use commit
#  e, edit = use commit, but stop for amending
#  s, squash = use commit, but meld into previous commit
#
# If you remove a line here THAT COMMIT WILL BE LOST.
# However, if you remove everything, the rebase will be aborted.
#
```

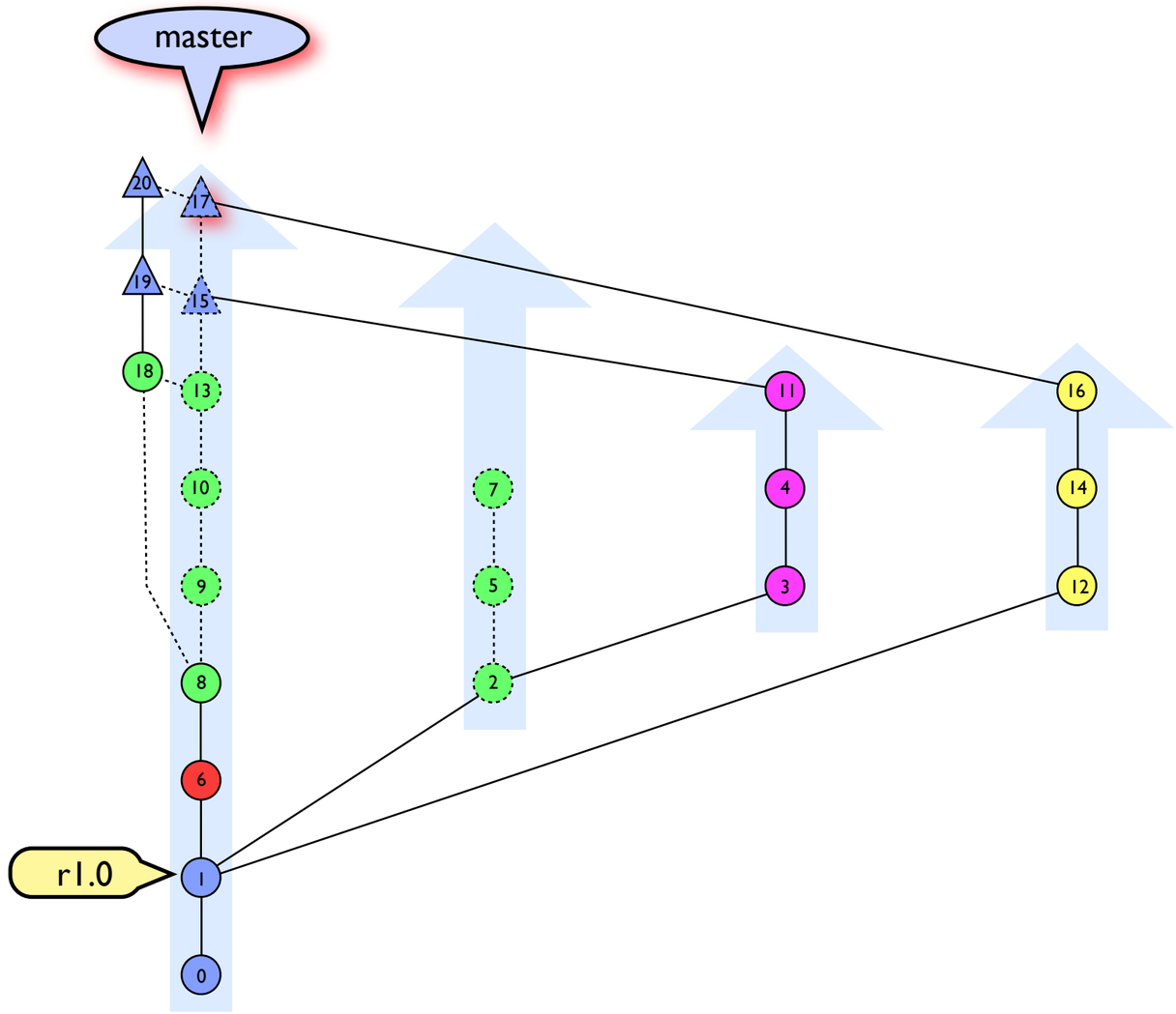


save the file and exit your editor…
git performs the rebase automatically


master
17
15
18
13
11
16
7
4
14
5
3
12
2
8
6
r1.0
1
0


master
17
19
15
18
13
11
16
7
4
14
5
3
12
2
8
6
r1.0
1
0


master
20
17
19
15
18
13
11
16
7
4
14
5
3
12
2
8
6
rl.0
1
0


master
20
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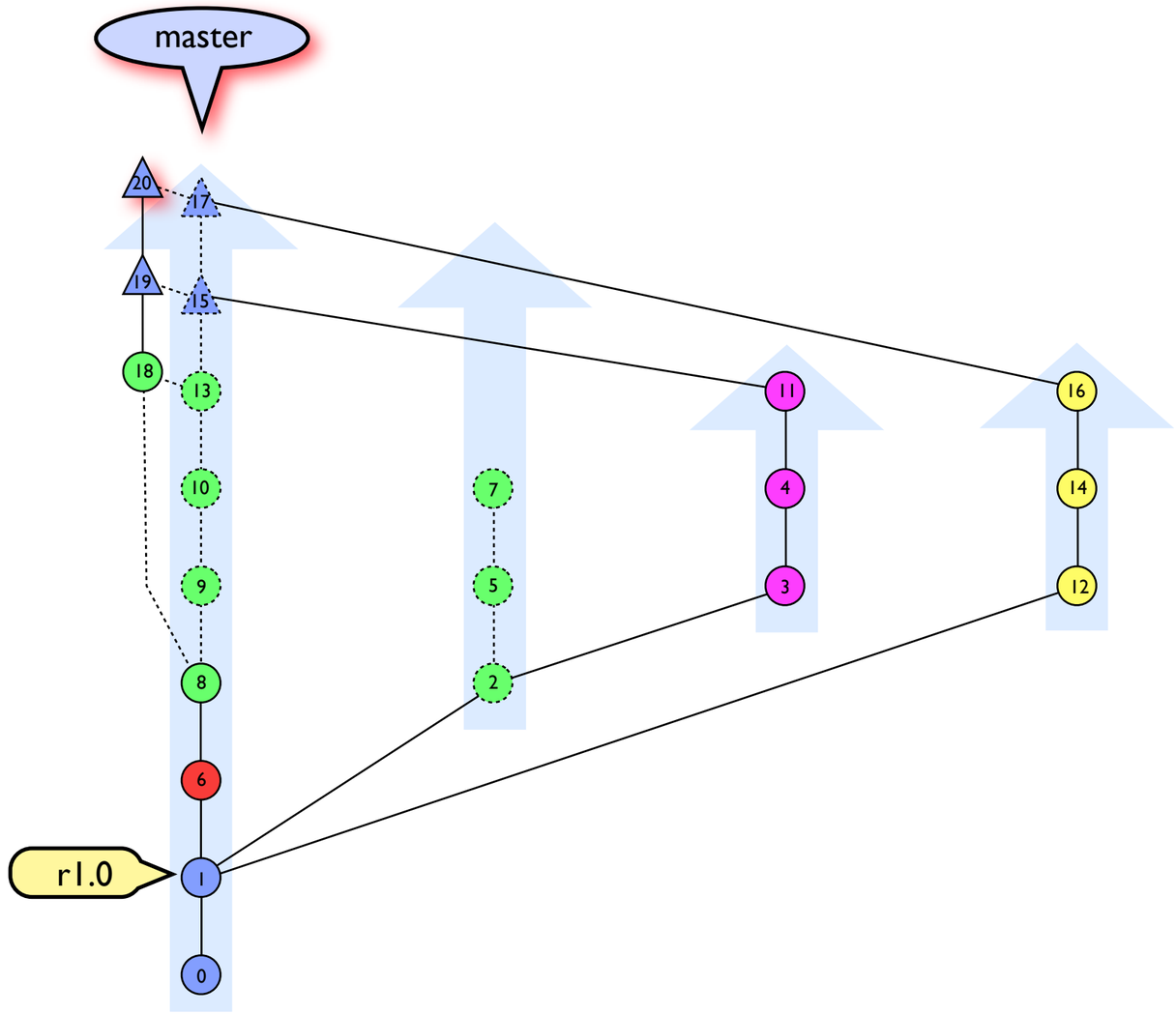
master
20
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r1.0
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0

adding commits to other branches

cherry picking

Add just one commit to the current branch:

```
git cherry-pick sha1
```

rebasing onto another branch

Add a chain of commits, not the whole branch:

```
git rebase --onto target_commit first_commit last_commit
```

long-term branches