

# Git Immersion

Rails Conf 2010 Tutorial

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## Setup

```
git config --global user.name "Jim Weirich"  
git config --global user.email "jim.weirich@gmail.com"
```

also

```
git config --global core.autocrlf true      (Windows)  
git config --global core.autocrlf input    (Unix/Mac)  
git config --global core.safecrlf true
```

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# Creating a Git Repo

```
$ mkdir demo  
$ (edit files)  
$ git init
```

# Checking In

```
$ git status  
$ git add .  
$ git commit -m "message"
```

# Labs Can be found at ...

[http://onestepback.org/download/git\\_tutorial.zip](http://onestepback.org/download/git_tutorial.zip)

# Source Control Made Easy

# Why?

What we are **not**  
going to talk about ...

# Your Mission

# Your Mission

Design and Build  
A Source Code  
Control System

# Custom Source Control

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# Custom Source Control

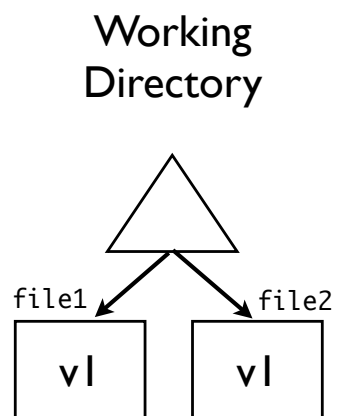
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# In the *Old Days* ...

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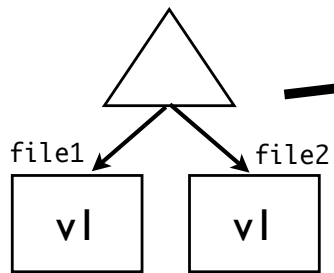
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Working  
Directory



Project Archive

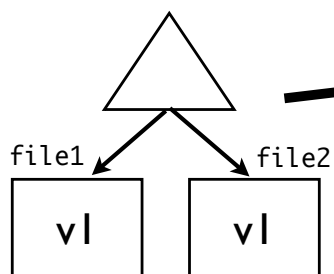
001.tar



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Working  
Directory



Manifest Project Archive

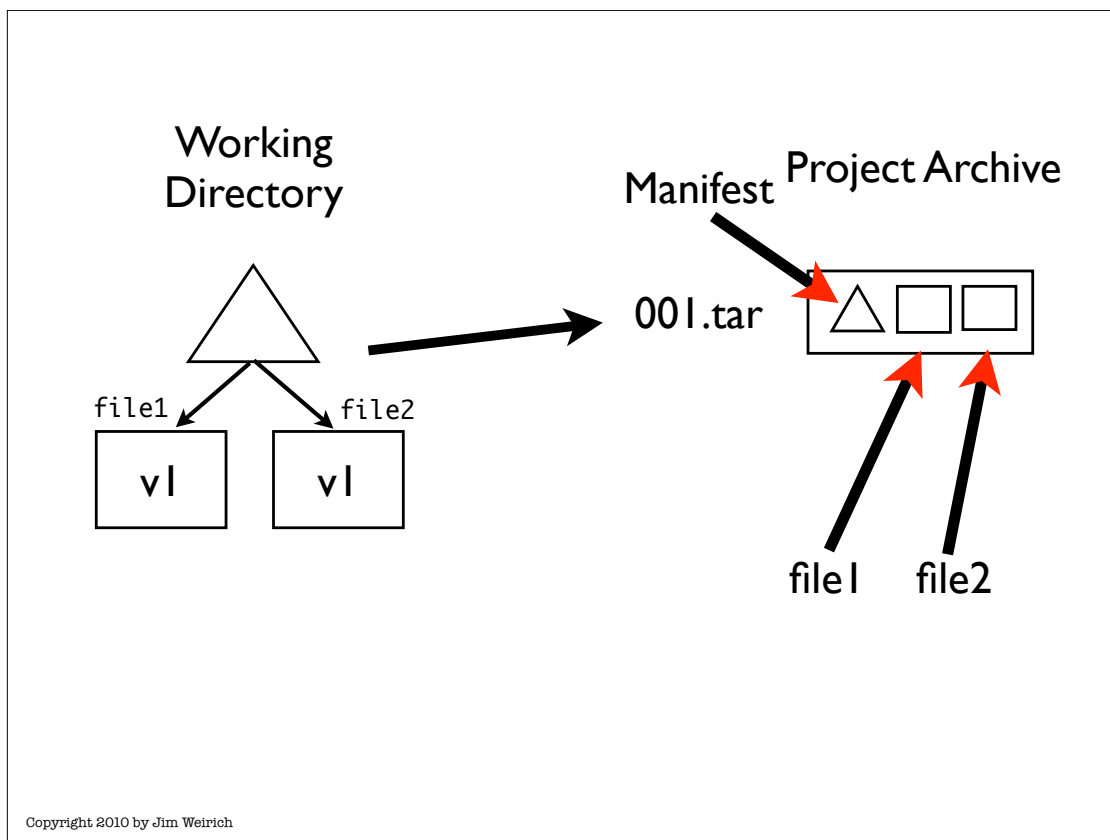
001.tar



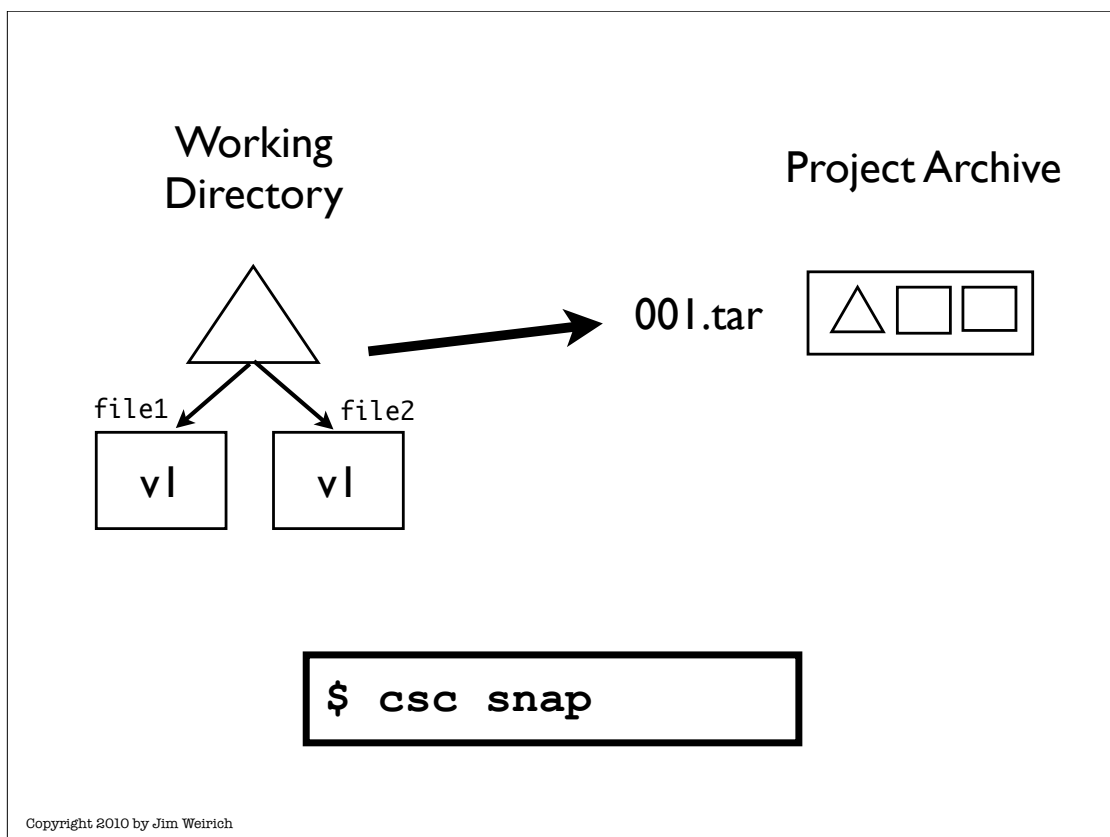
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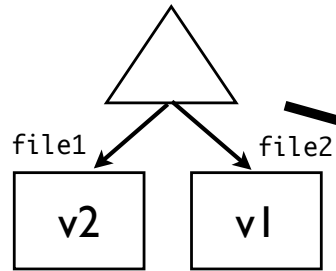


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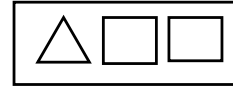
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## Working Directory

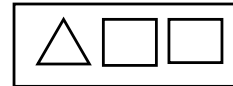


## Project Archive

001.tar



002.tar

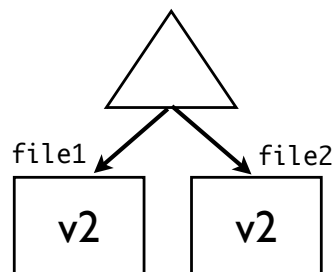


```
$ csc snap
```

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## Working Directory



## Project Archive

001.tar



002.tar



003.tar

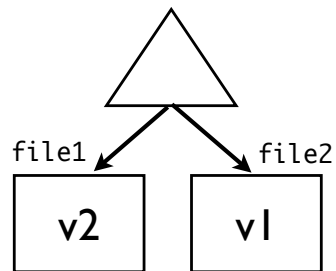


```
$ csc snap
```

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Working  
Directory



Project Archive

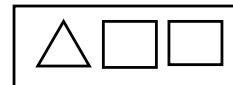
001.tar



002.tar



003.tar



```
$ csc checkout 002
```

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## Two Basic Commands

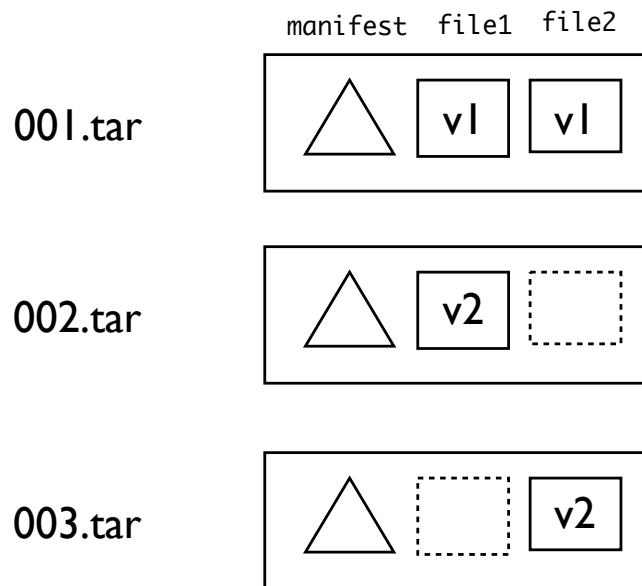
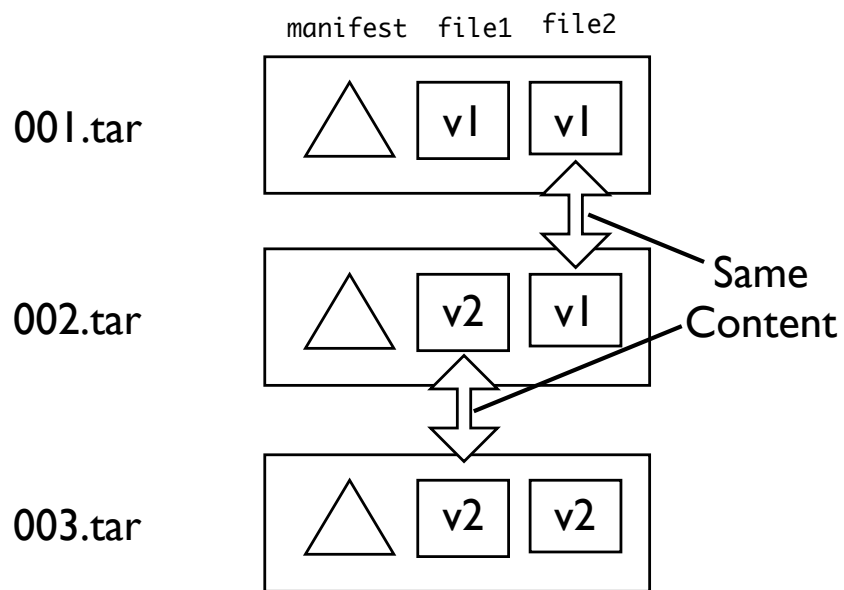
- Snap
- Checkout

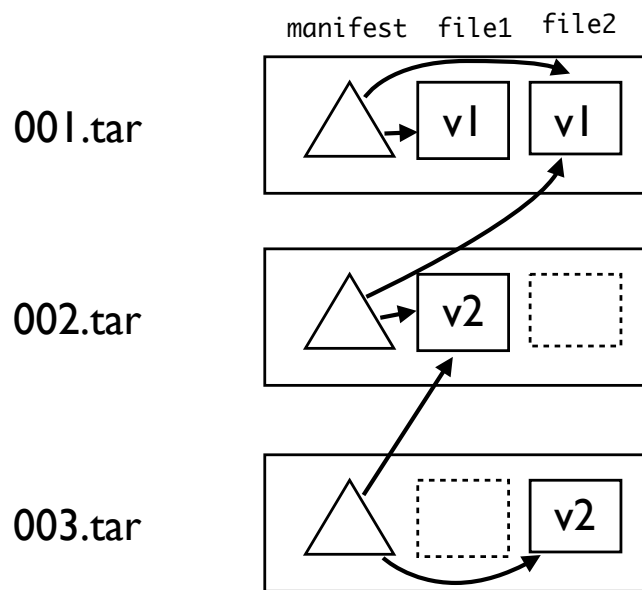
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Very Easy /  
Very Simple

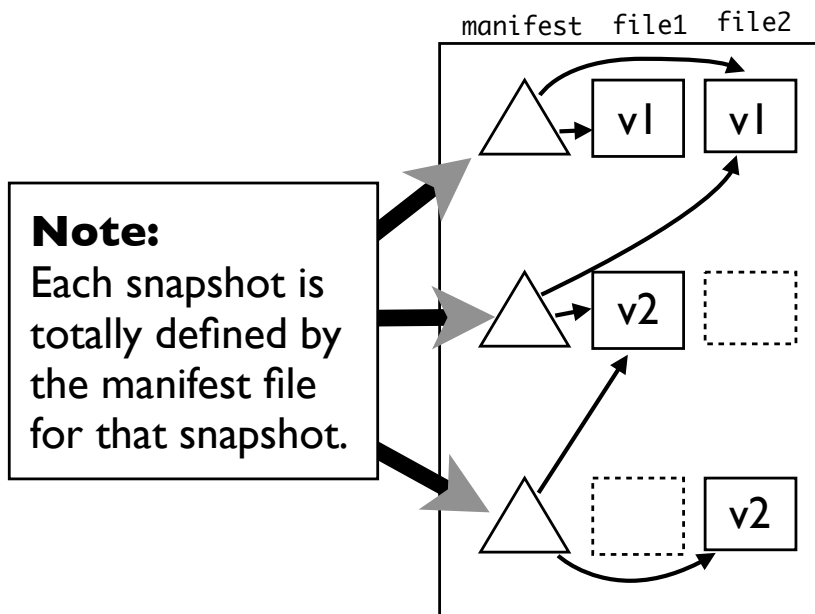
Rather Wasteful





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File Name	Contents
manifest	△ / (001)
<b>file1</b>	□ file1 (V1)
file2	□ file2 (V1)
manifest	△ /
manifest	△ /
<b>file1</b>	□ file1 (V2)
file2	□ file2 (V2)

**CONFLICT!**

File Name	Contents
-----------	----------

?	△ / (001)
?	□ file1 (V1)
?	□ file2 (V1)
?	△ /
?	△ /
?	□ file1 (V2)
?	□ file2 (V2)

File Name	Contents
-----------	----------

aaaa	△ / (001)
aaab	□ file1 (V1)
aaac	□ file2 (V1)
aaad	△ /
aaae	△ /
aaaf	□ file1 (V2)
aaag	□ file2 (V2)

**Note:**

The Project Archive is just a directory with files in it.

File Name	Contents
-----------	----------

aaaa	△ / (001)
aaab	□ file1 (V1)
aaac	□ file2 (V1)
aaad	△ /
aaae	△ /
aaaf	□ file1 (V2)
aaag	□ file2 (V2)

\$ ls

aaaa aaab aaac aaad aae aaaf aaag

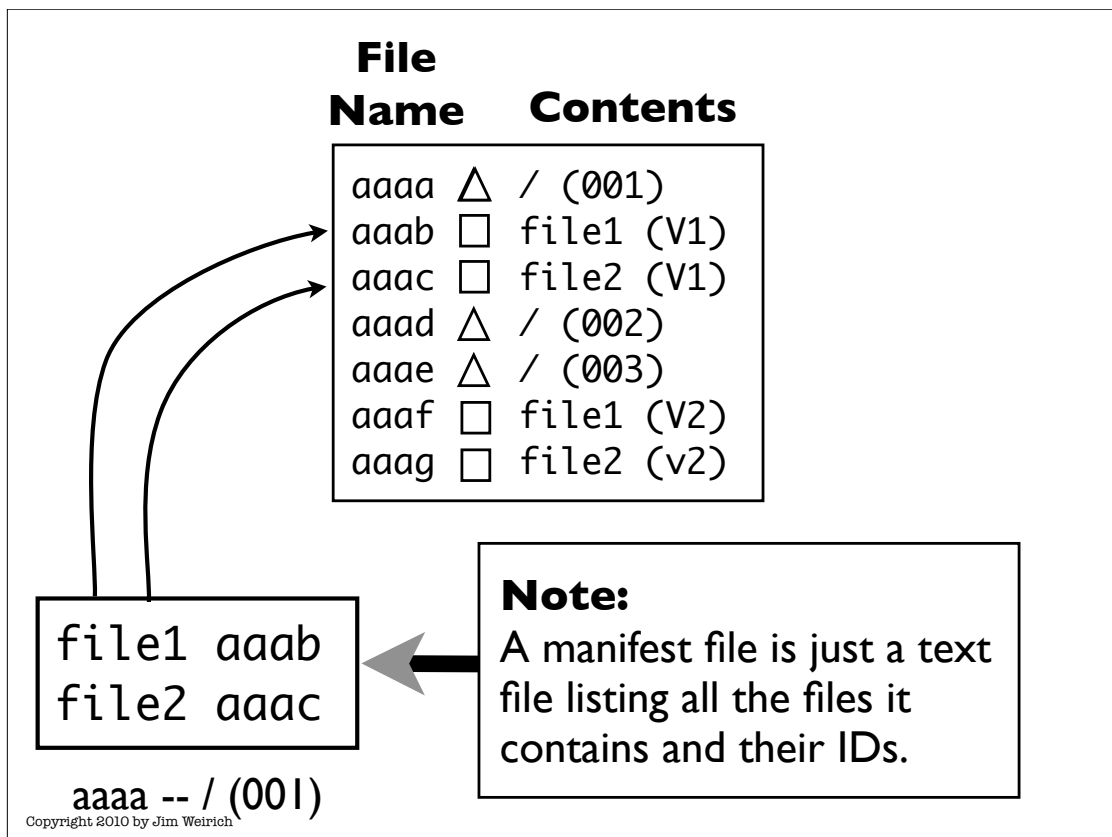


# Project Archive

- Is just a **directory with files** in it
- The archive files have **arbitrary** names.
  - The file names can be anything as long as they are **unique**
- We track the **real file** names in the manifest files.

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## File Name Contents

aaaa	△	/ (001)
aaab	□	file1 (V1)
aaac	□	file2 (V1)
aaad	△	/ (002)
aaae	△	/ (003)
aaaf	□	file1 (V2)
aaag	□	file2 (v2)

file1	aaaf
file2	aaac

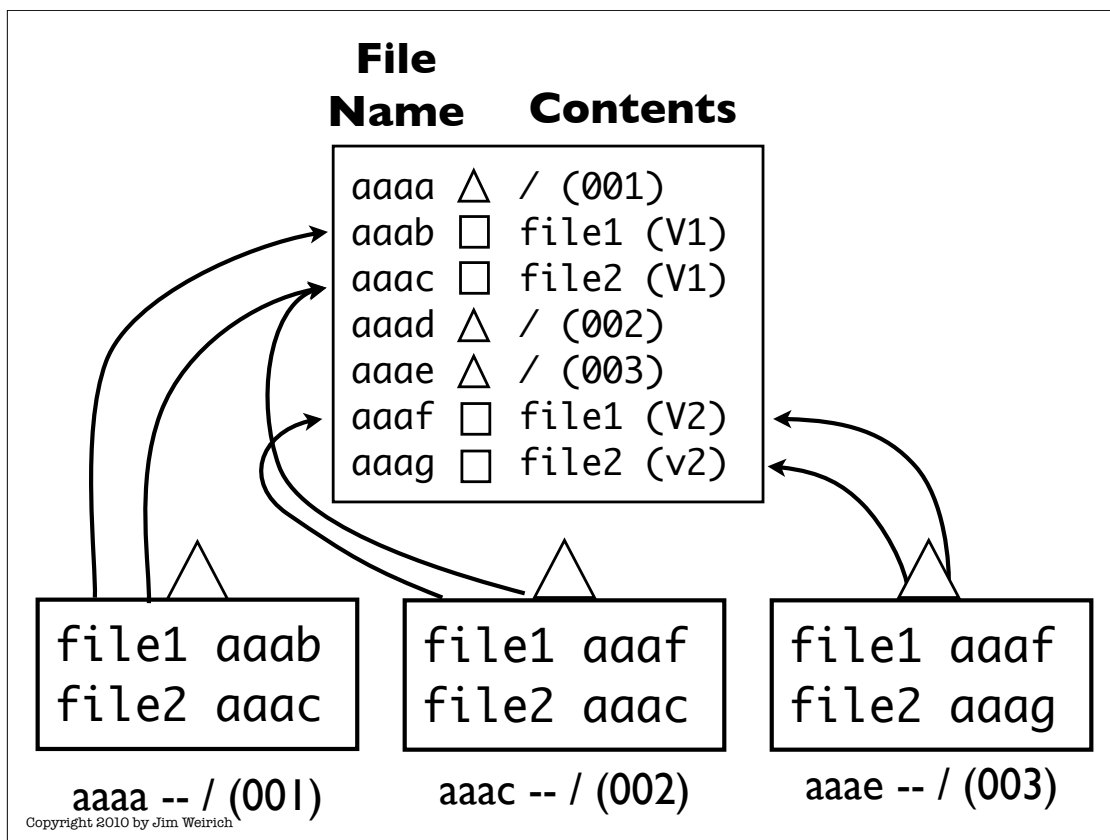
aaad -- / (002)

## File Name Contents

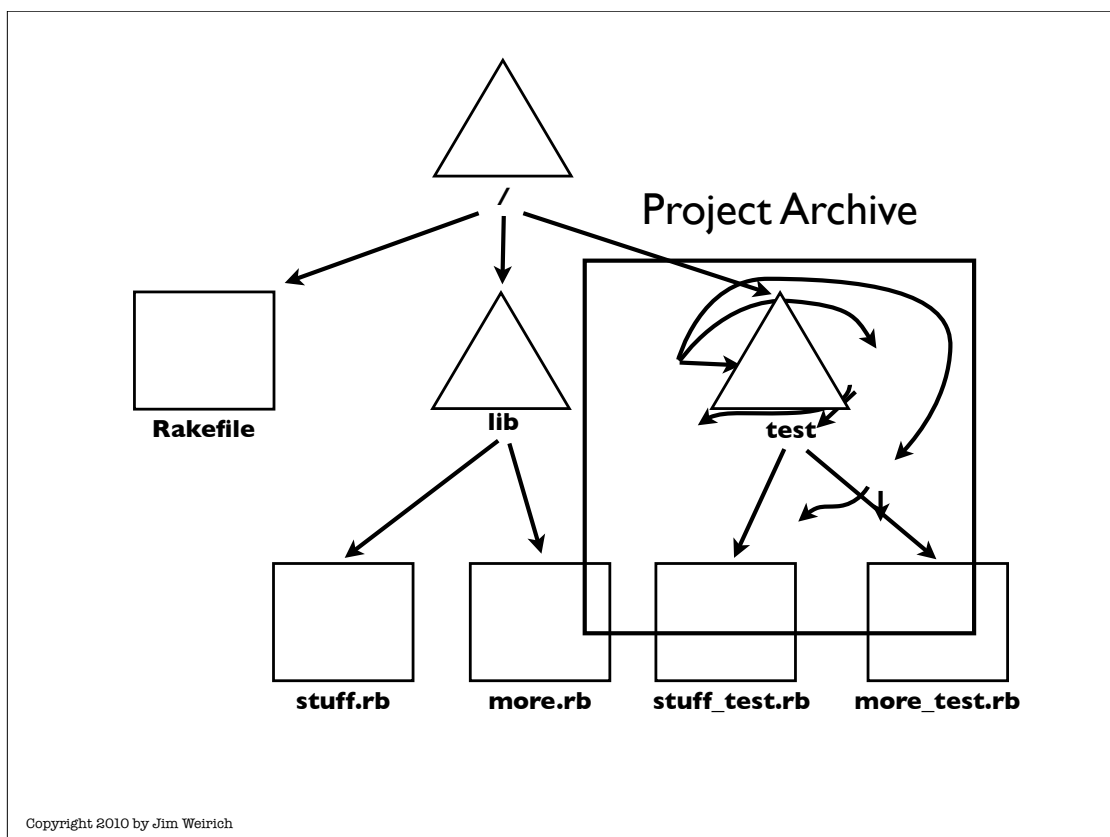
aaaa	△	/ (001)
aaab	□	file1 (V1)
aaac	□	file2 (V1)
aaad	△	/ (002)
aaae	△	/ (003)
aaaf	□	file1 (V2)
aaag	□	file2 (v2)

file1	aaaf
file2	aaag

aaae -- / (003)



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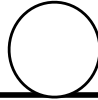


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# Metadata would be nice

## What Metadata?

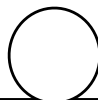
- The Root manifest of the snapshot
- Name/EMail of the person committing the snapshot
- Date/Time of the snapshot
- Some comments describing the snapshot



```
tree aaae  
author Jim <me@email.com> 1246996320 -0400
```

Comments describing this snapshot.

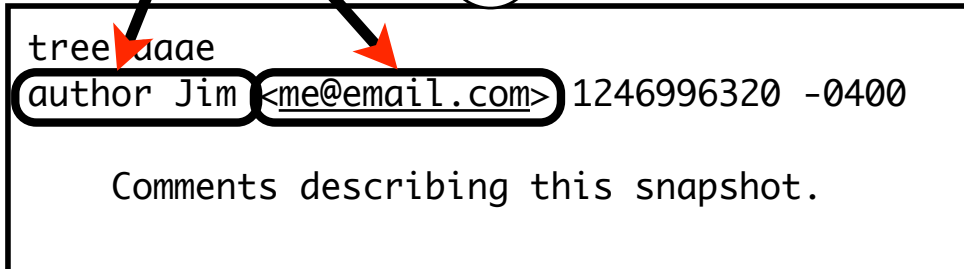
Root Manifest  
for Snapshot



```
tree aaae  
author Jim <me@email.com> 1246996320 -0400
```

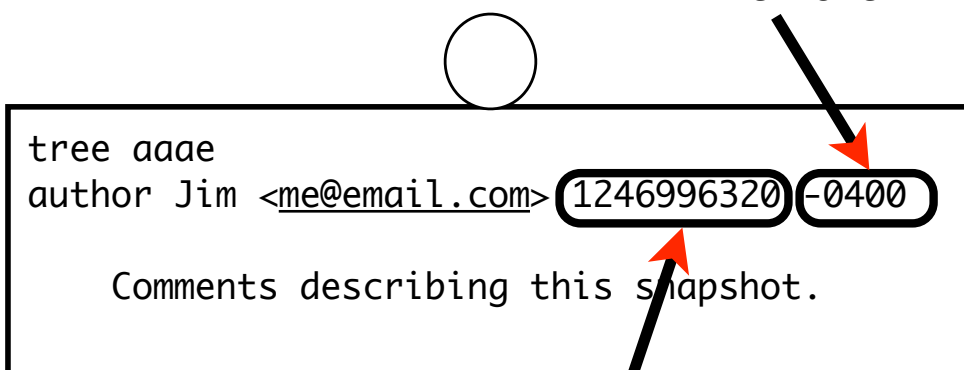
Comments describing this snapshot.

Author & EMail



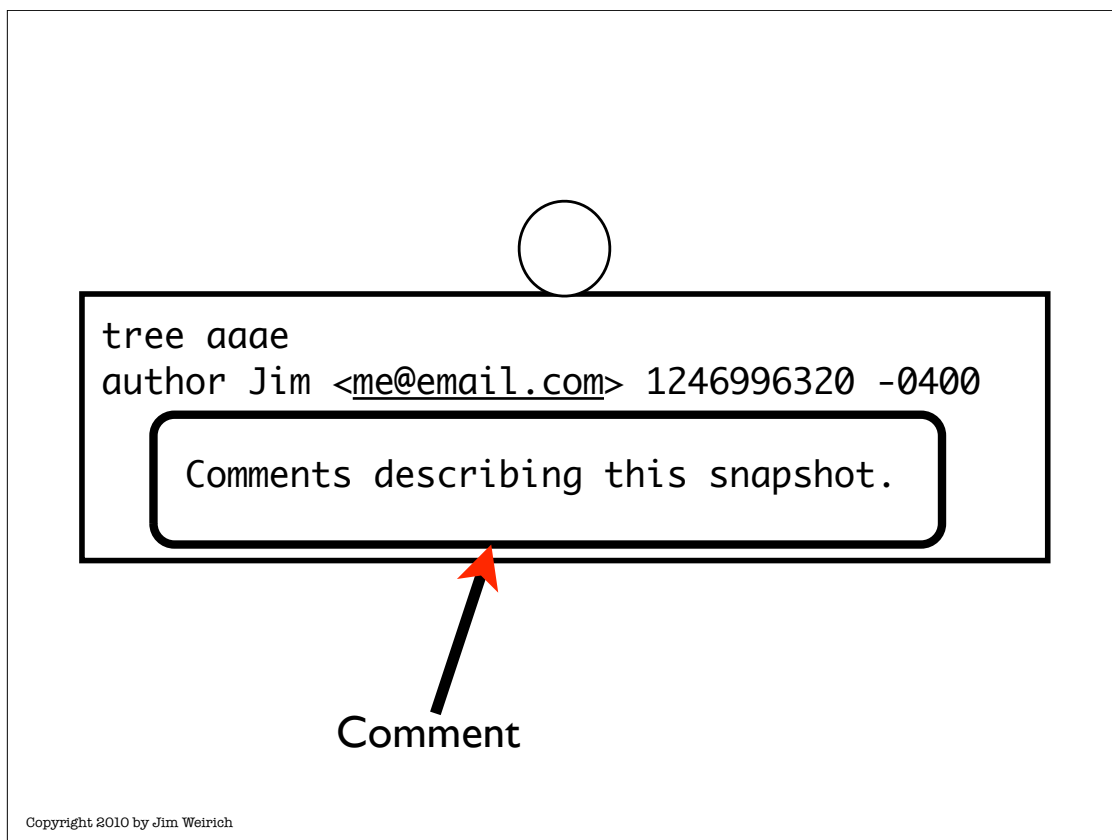
```
tree aaae
author Jim <me@email.com> 1246996320 -0400
Comments describing this snapshot.
```

Time Zone

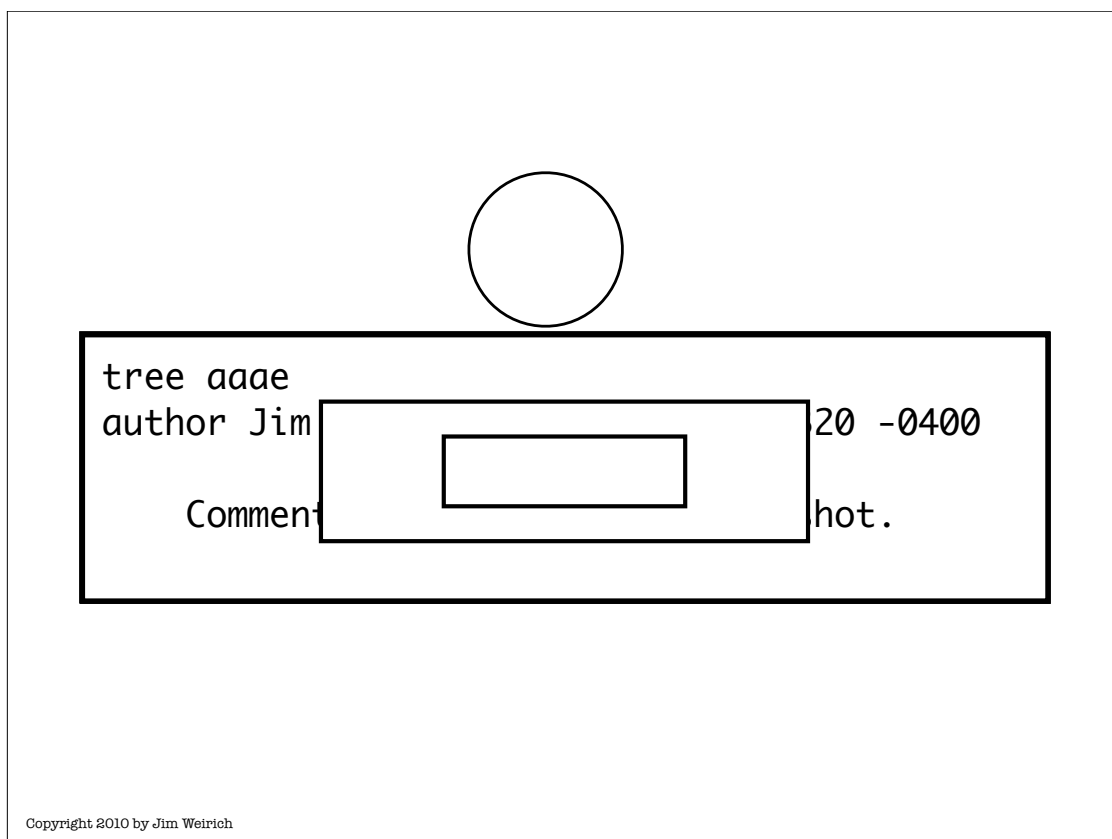


```
tree aaae
author Jim <me@email.com> 1246996320 -0400
Comments describing this snapshot.
```

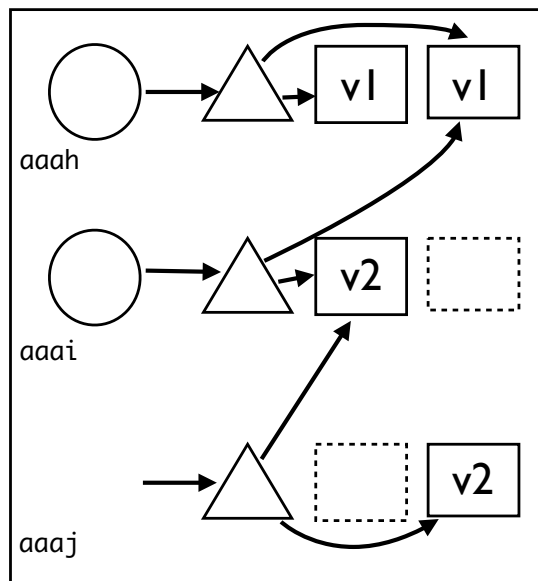
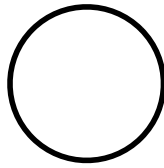
Date/Time  
(seconds since 1970)



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tree aaae  
author Jim <[me@email.com](mailto:me@email.com)> 1246996320 -0400

Comments describing this snapshot.

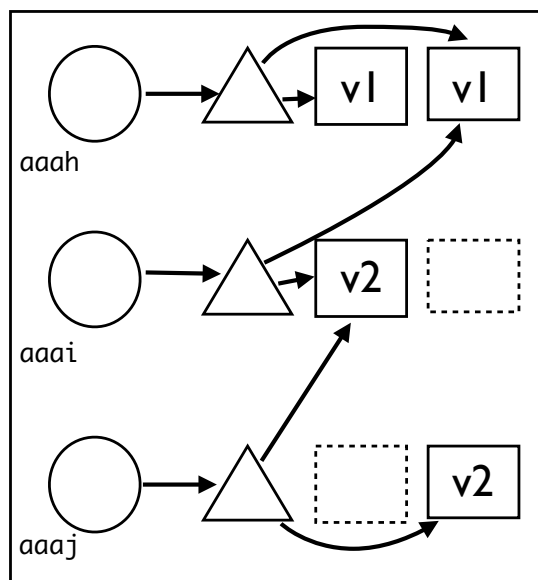


previous snapshot

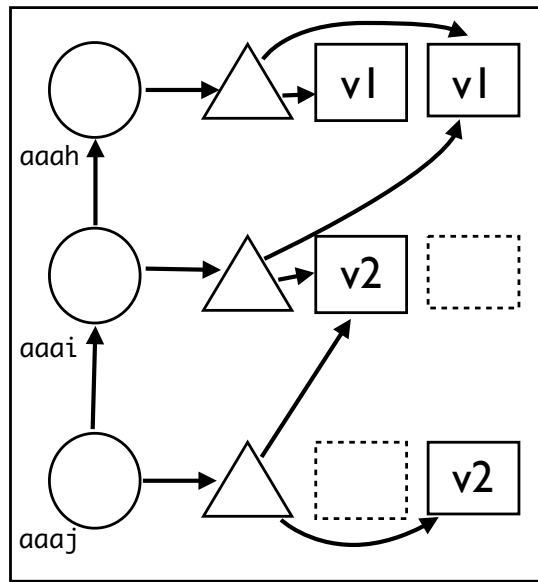
```
tree aaae  
parent aaai  
author Jim <me@email.com> 1246996320 -0400
```

Comments describing this snapshot.

## Project Archive



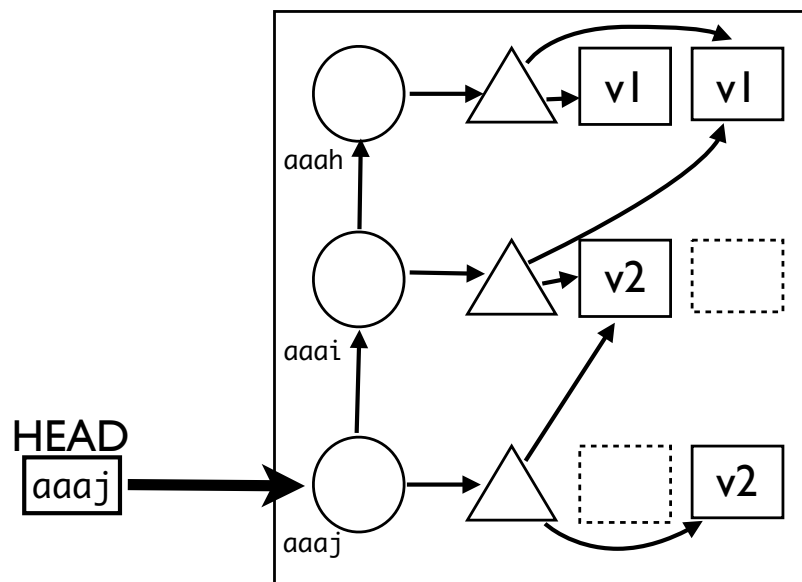
## Project Archive



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## Project Archive

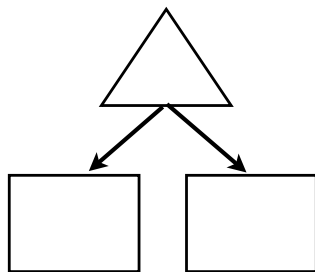


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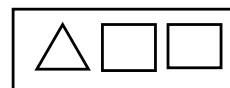
# Summary So Far ...

Working  
Directory

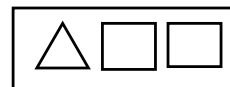


Project Archive

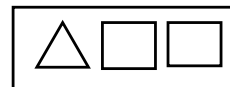
001.tar



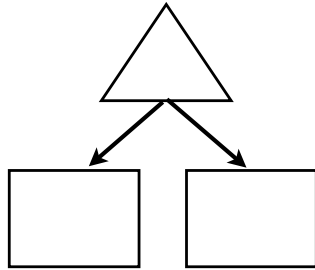
002.tar



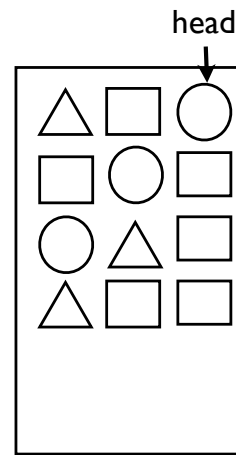
003.tar



## Working Directory



## Project Archive



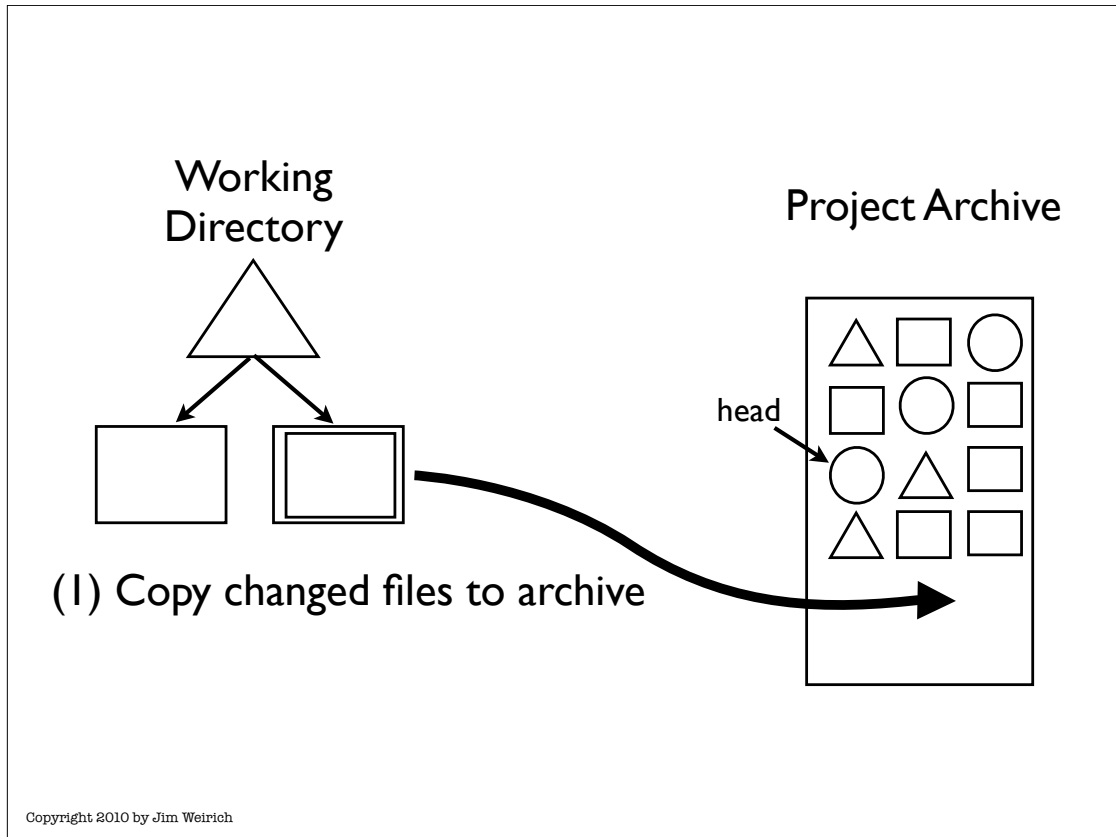
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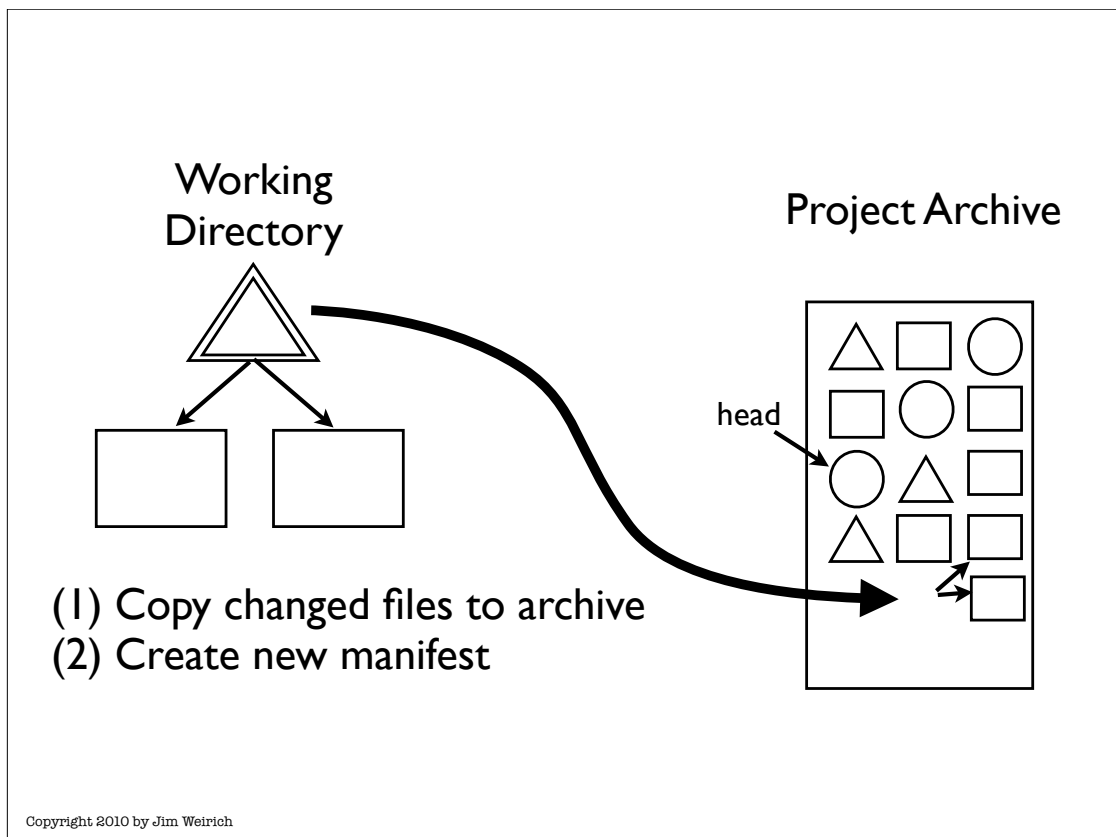
# How do we create a snapshot now?

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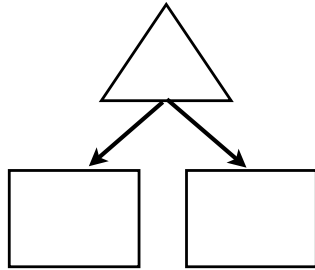


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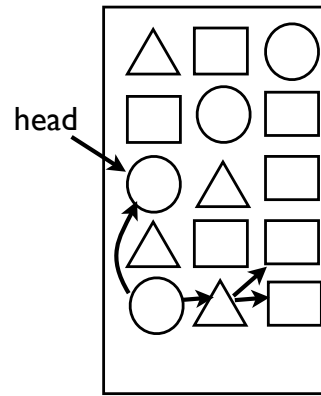
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## Working Directory



- (1) Copy changed files to archive
- (2) Create new manifest
- (3) Create new snapshot record

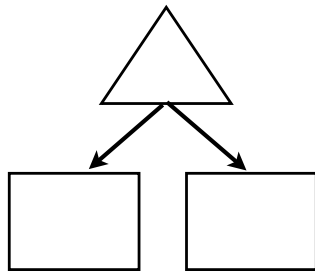
## Project Archive



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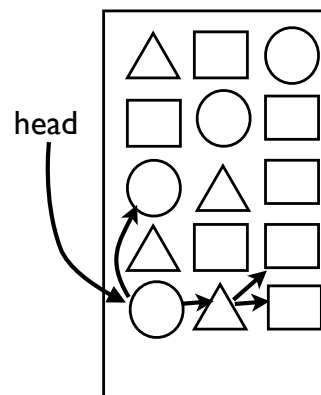
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## Working Directory



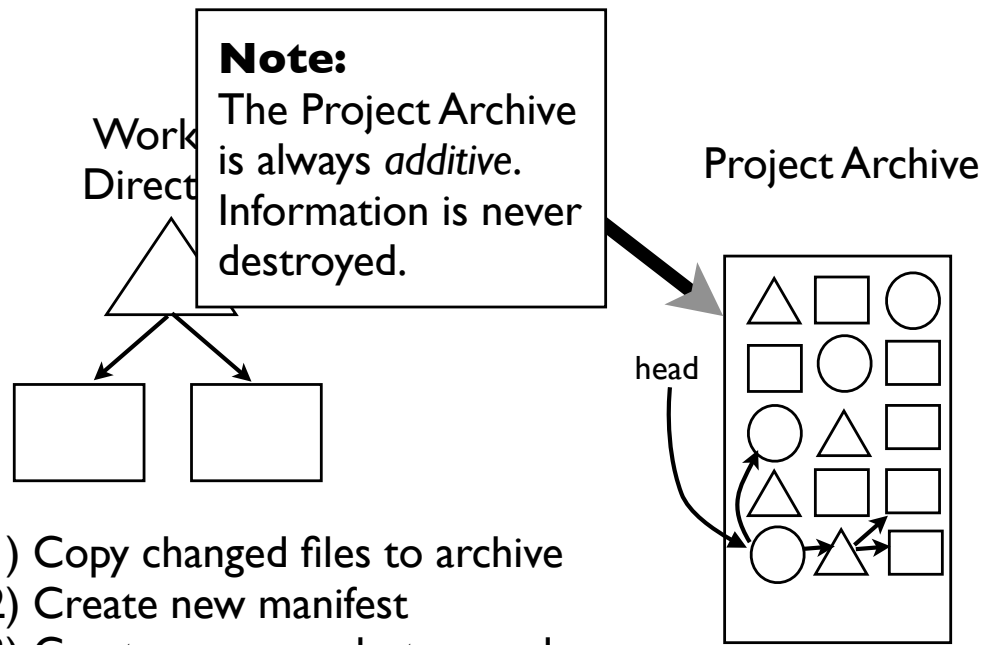
- (1) Copy changed files to archive
- (2) Create new manifest
- (3) Create new snapshot record
- (4) Readjust HEAD

## Project Archive



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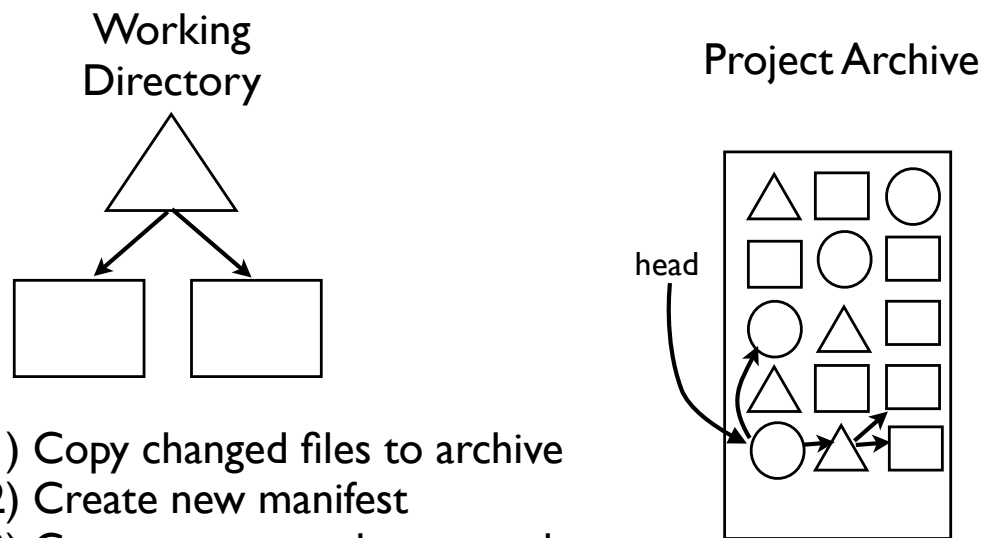
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- (1) Copy changed files to archive
- (2) Create new manifest
- (3) Create new snapshot record
- (4) Readjust HEAD

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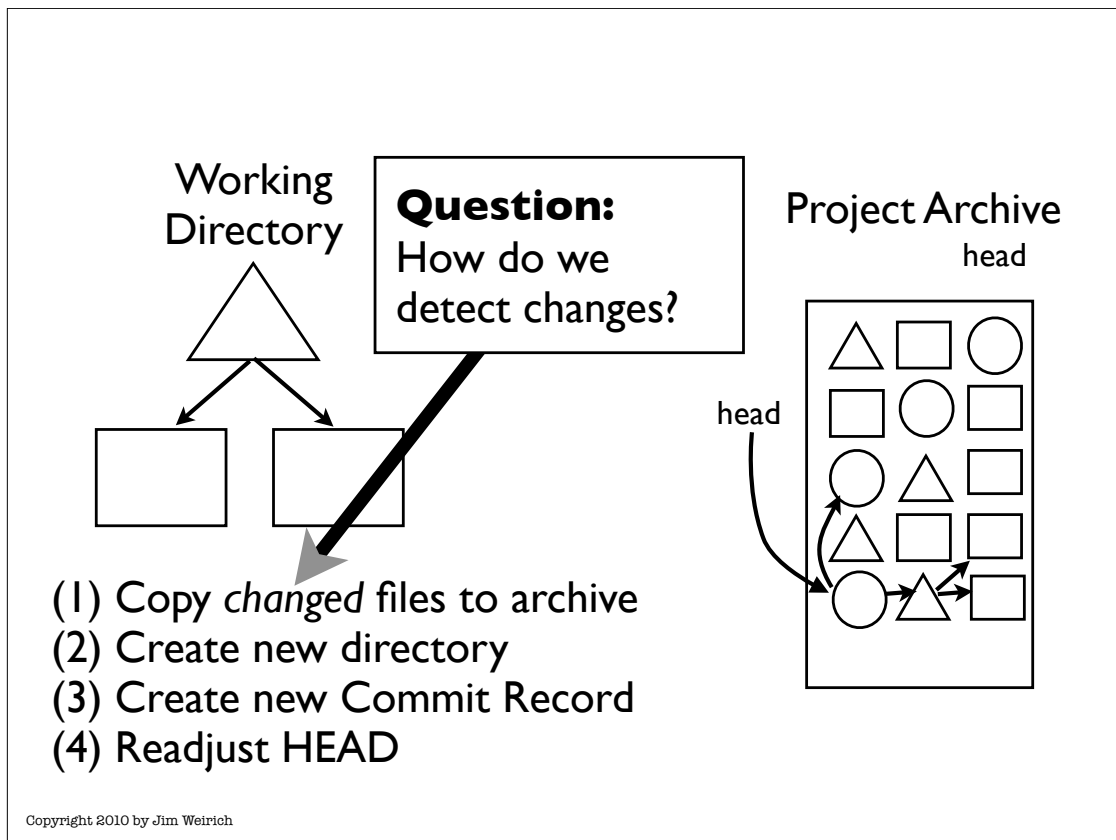
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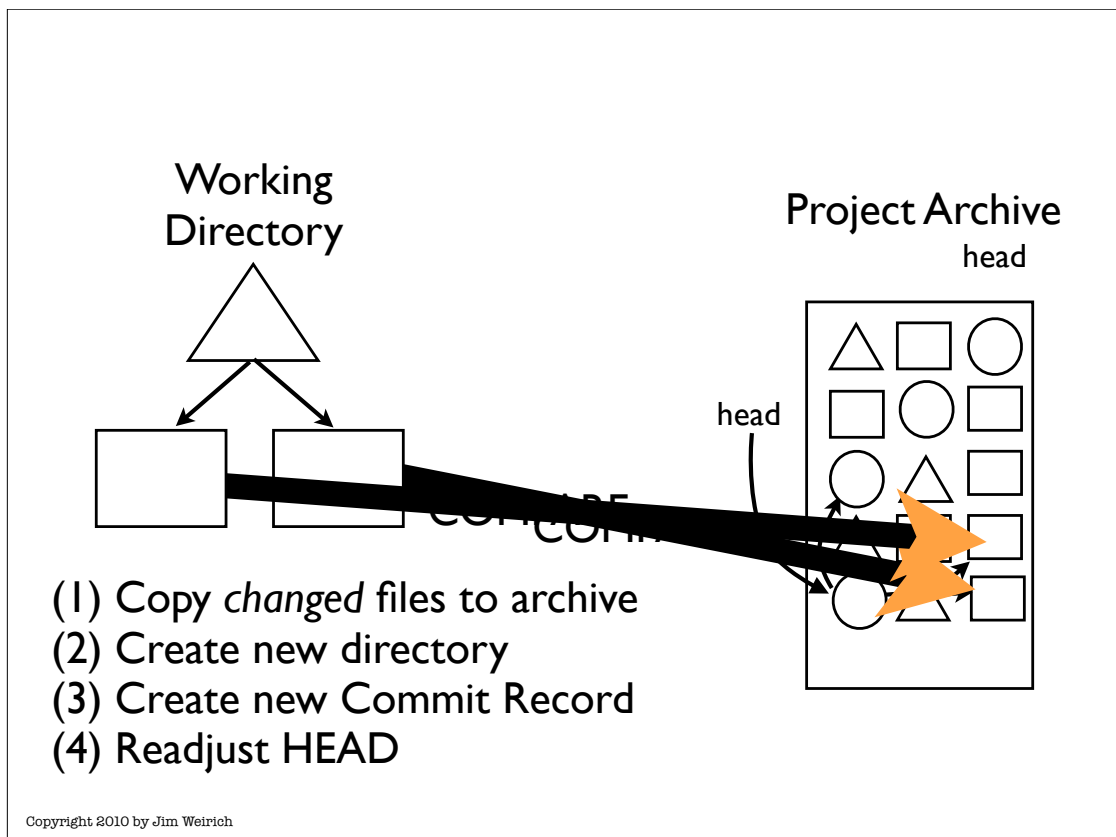
- (1) Copy changed files to archive
- (2) Create new manifest
- (3) Create new snapshot record
- (4) Readjust HEAD

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file.txt

Hi, my name is Bob.

SHA1

"55dc96ede241511e35f1973957bbd51f37f3762b"

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file.txt

Hi, my name is Joe.

SHA1

~~"55dc96ede241511e35f1973957bbd51f37f3762b"~~  
"53f2509e877de3cad85c547a0c2a22b43c5d81eb"

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file1.txt

Hi, my name is Bob.

file2.txt

Hi, my name is Bob.

**Identical Content  
Produces  
Identical Hashes**

"55dc96ede241511e35f1973957bbd51f37f3762b"

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## File Names in the Archive

- Arbitrary
- Unique

aaaa	△ / (001)
aaab	□ file1 (V1)
aaac	□ file2 (V1)
aaad	△ /
aaae	△ /
aaaf	□ file1 (V2)
aaag	□ file2 (V2)

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# Idea:

## Use the SHA1 Hash for the File Name

### Project Archive

aaaa	○
aaab	□
aaac	□
aaad	△
aaae	○
aaaf	□
aaag	△
aaah	□
aaai	□

## Project Archive

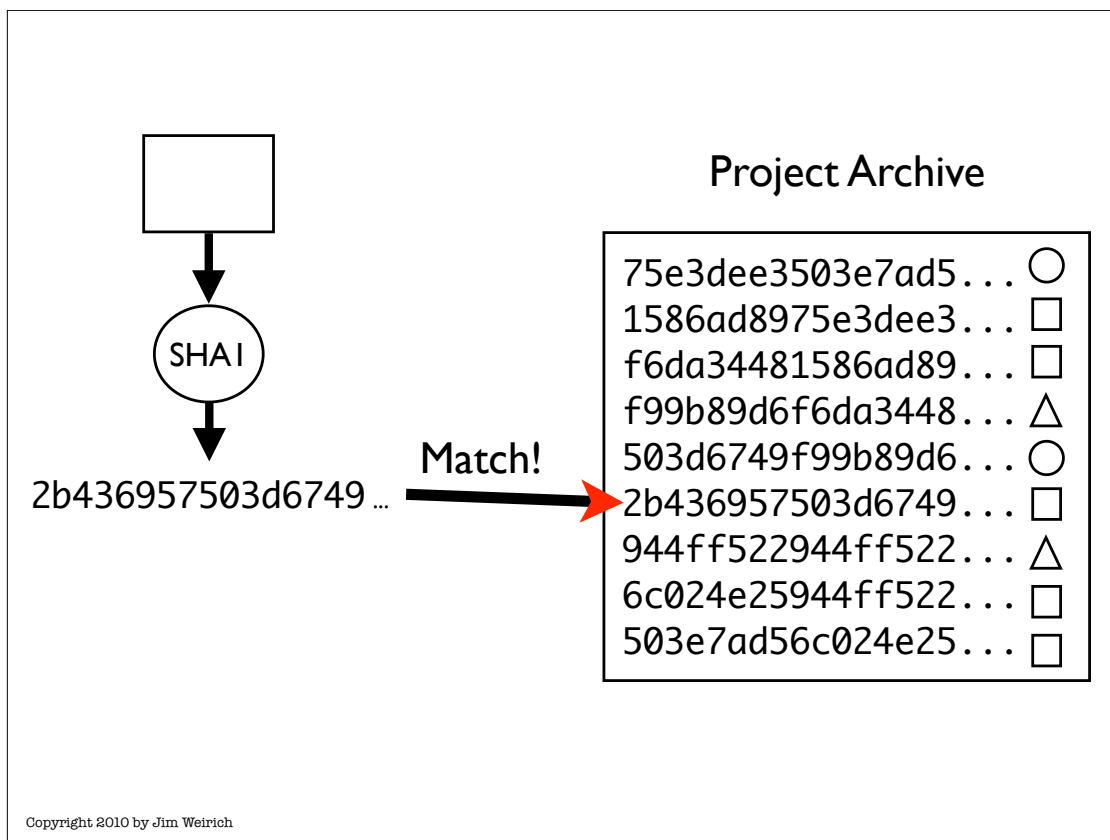
75e3dee3503e7ad5...	○
1586ad8975e3dee3...	□
f6da34481586ad89...	□
f99b89d6f6da3448...	△
503d6749f99b89d6...	○
2b436957503d6749...	□
944ff522944ff522...	△
6c024e25944ff522...	□
503e7ad56c024e25...	□

## Project Archive

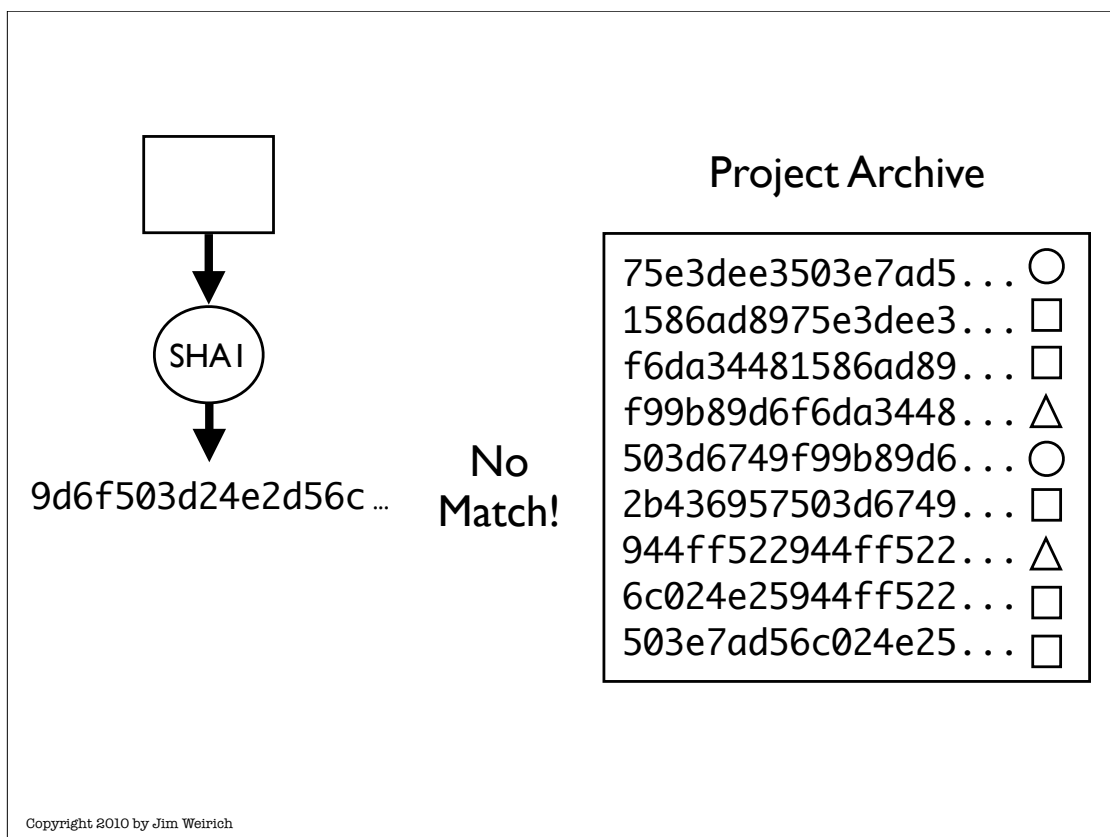
HEAD

75e3dee3503e7ad5...

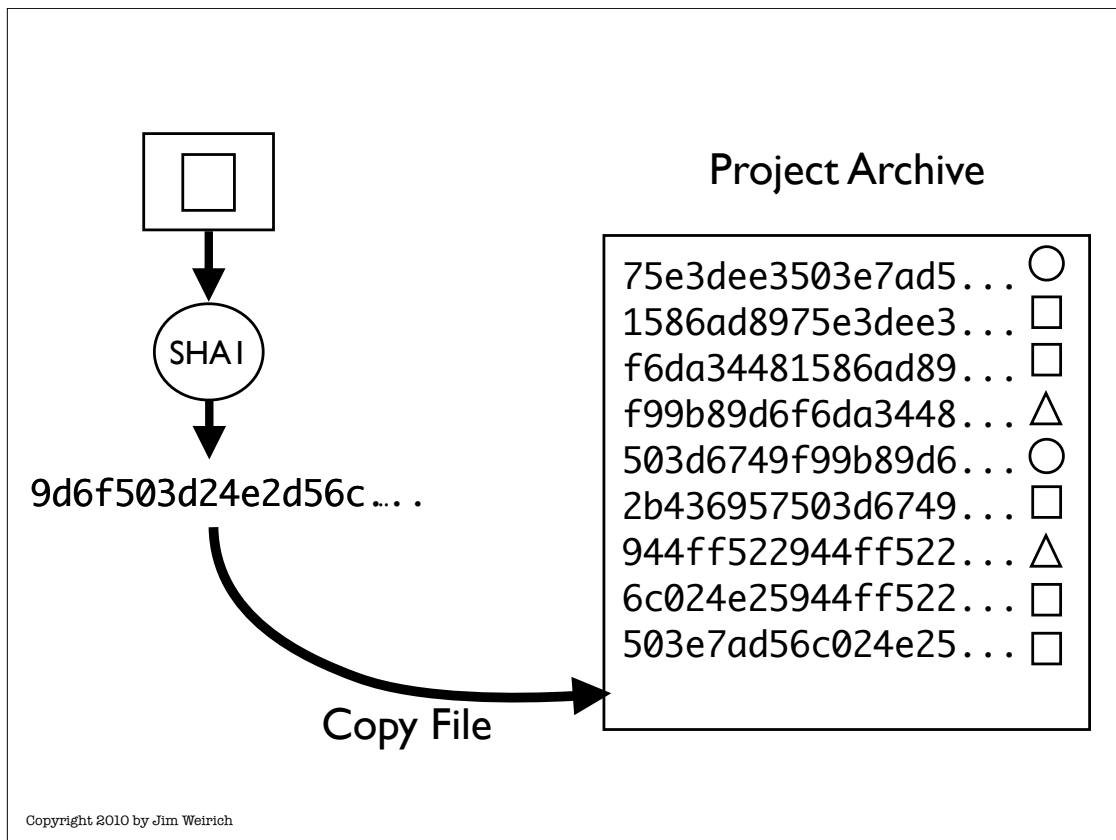
75e3dee3503e7ad5...	○
1586ad8975e3dee3...	□
f6da34481586ad89...	□
f99b89d6f6da3448...	△
503d6749f99b89d6...	○
2b436957503d6749...	□
944ff522944ff522...	△
6c024e25944ff522...	□
503e7ad56c024e25...	□



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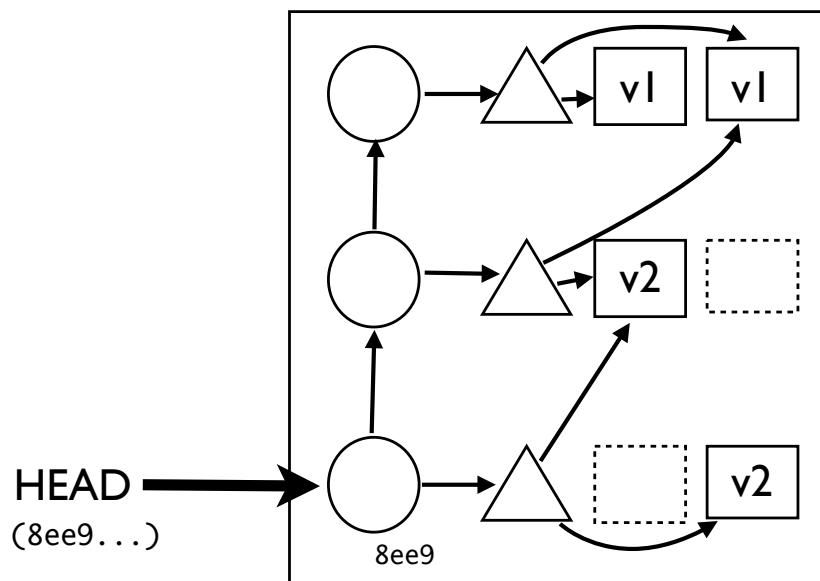
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# Project Archive Integrity

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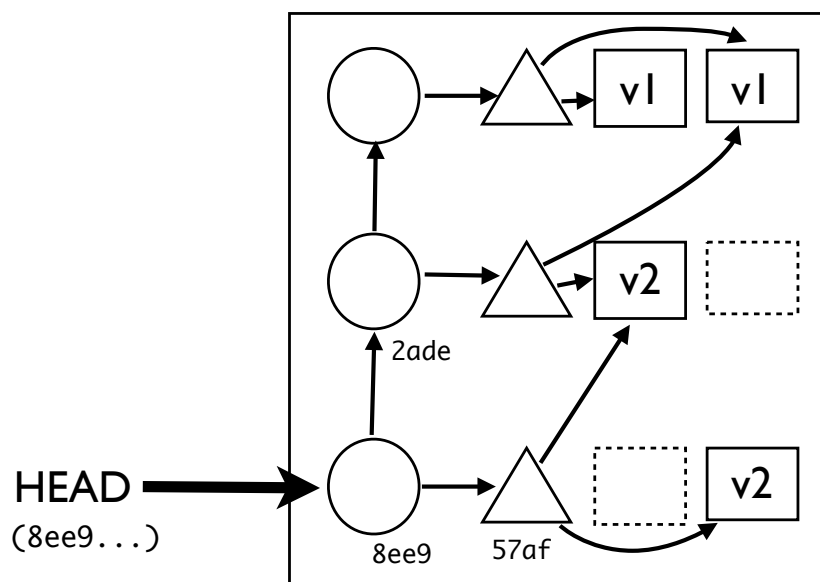
## Project Archive



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## Project Archive

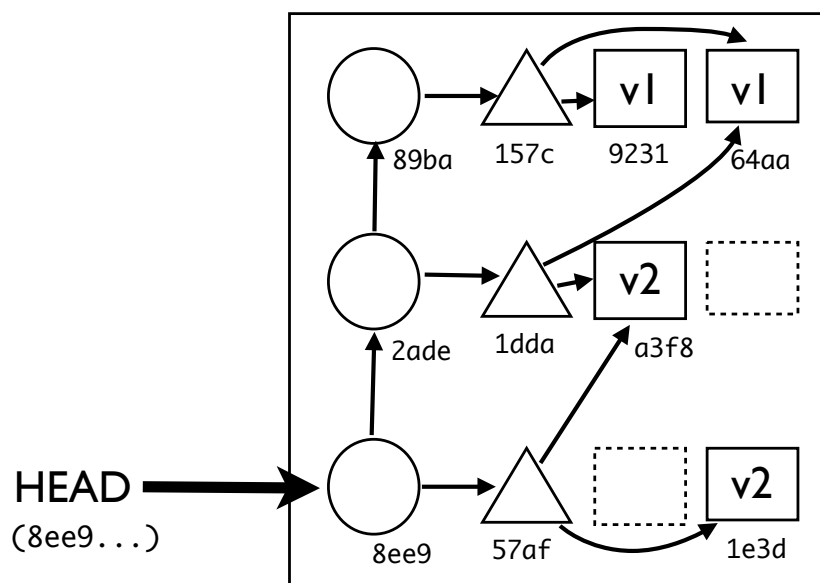


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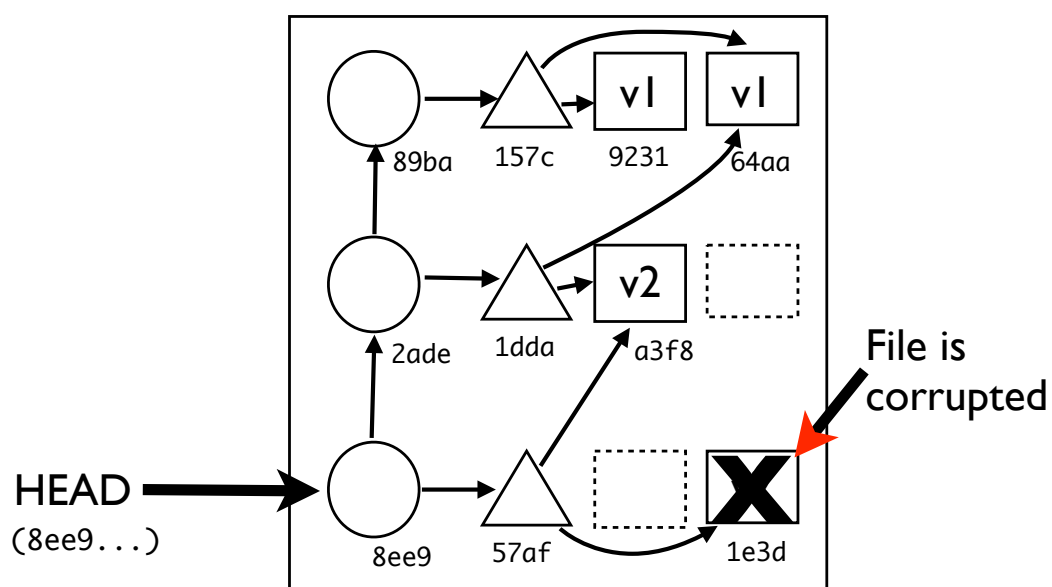


## Project Archive



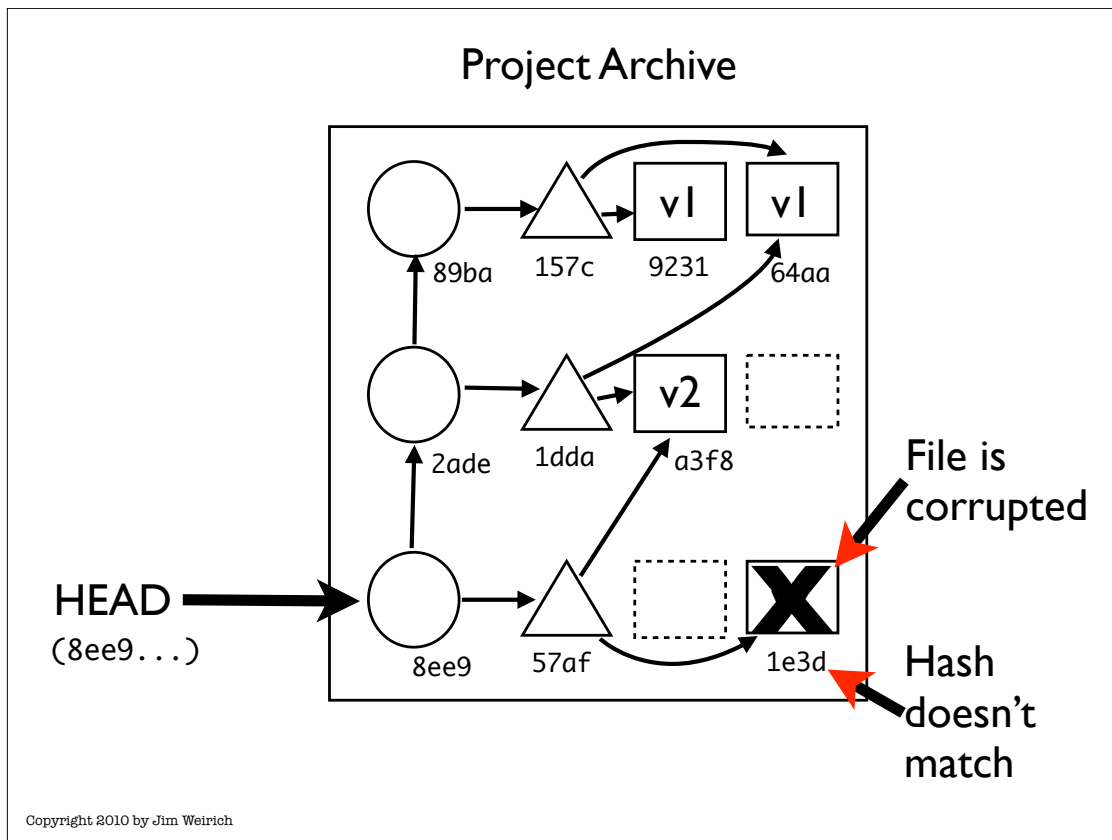
Copyright 2010 by Jim Weirich

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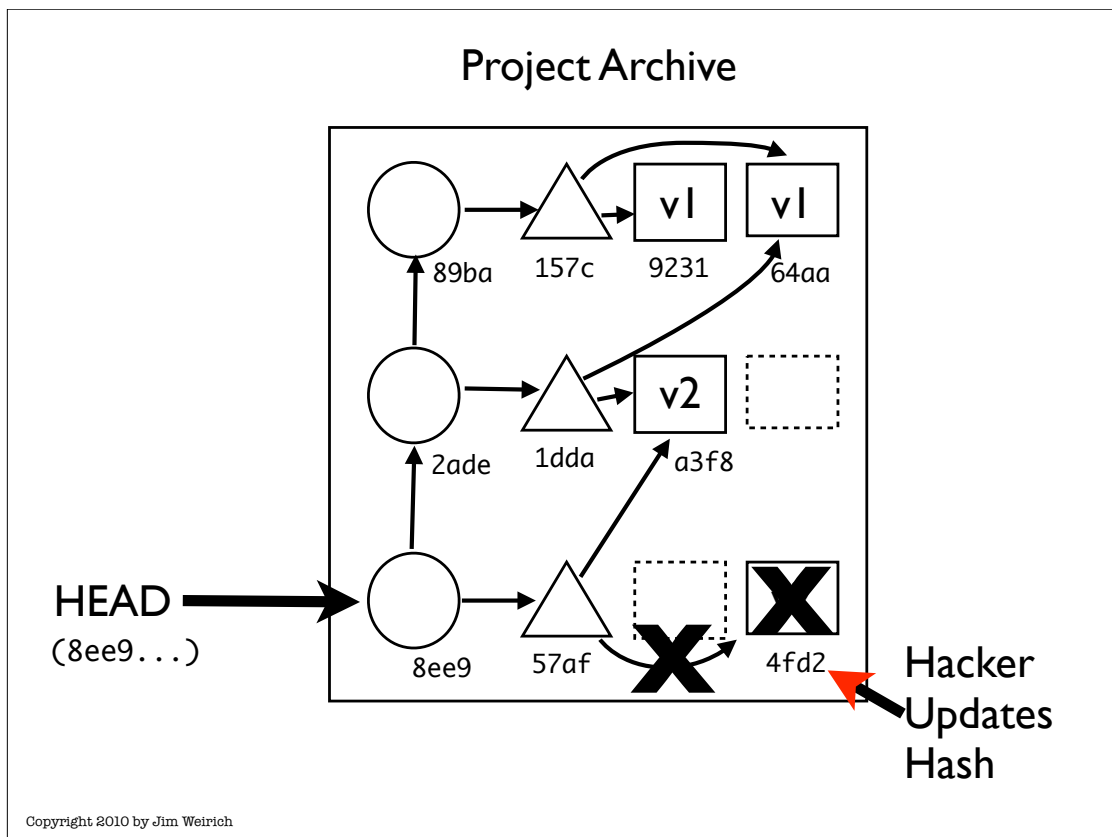


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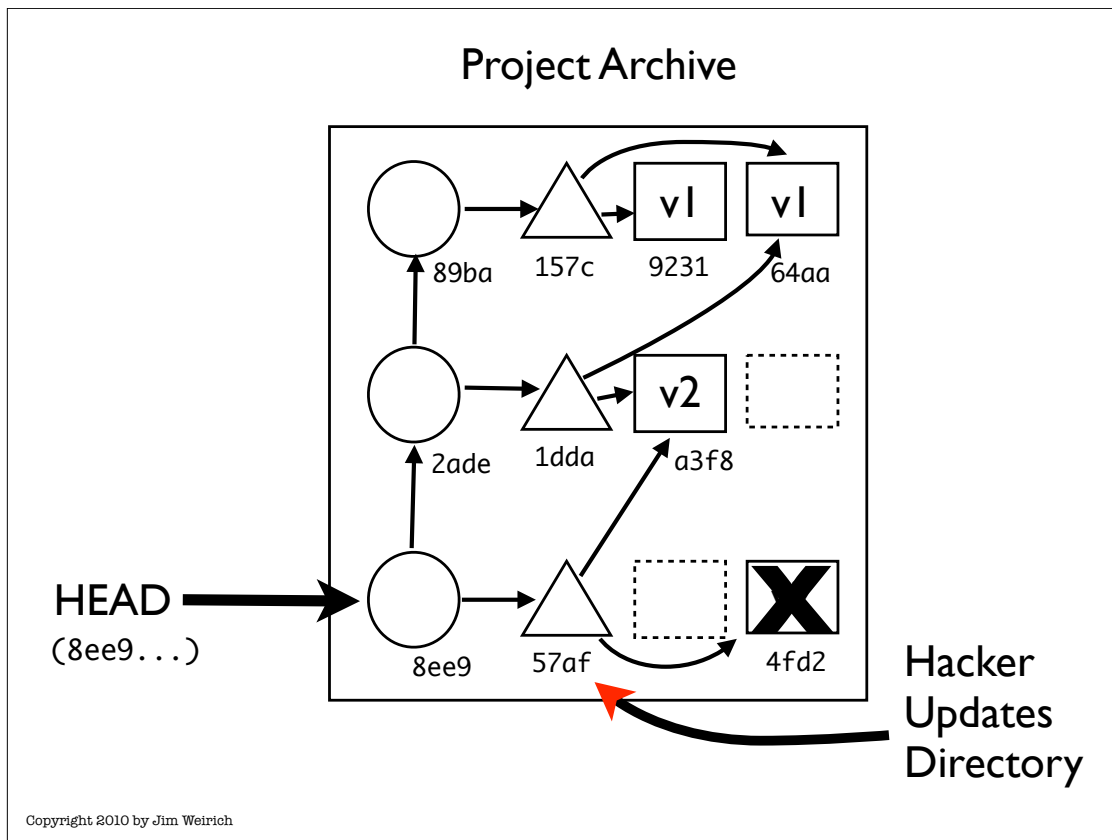
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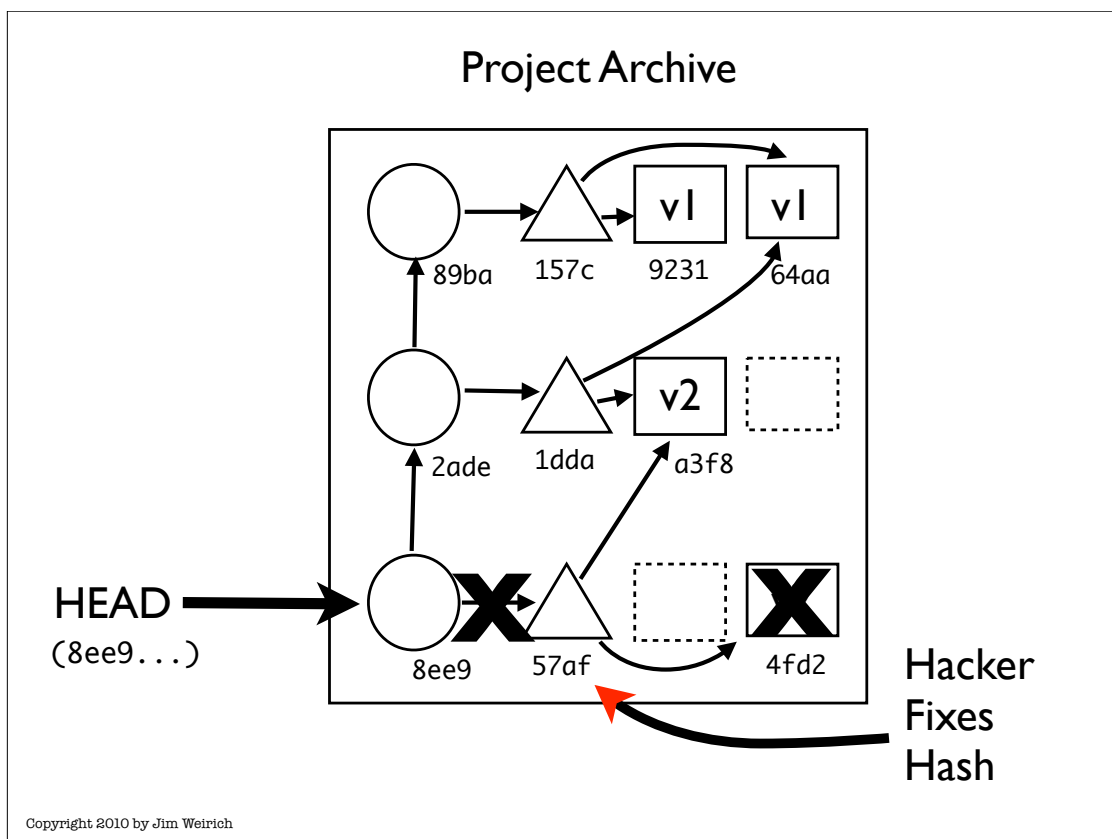
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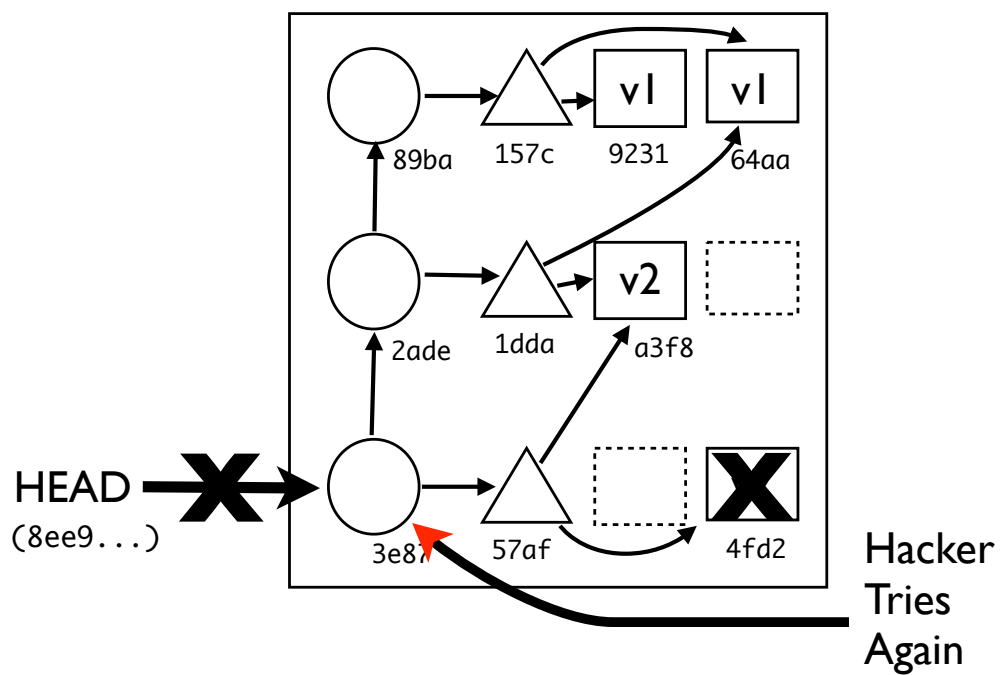


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## Project Archive



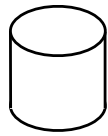
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## Tracking Snapshots

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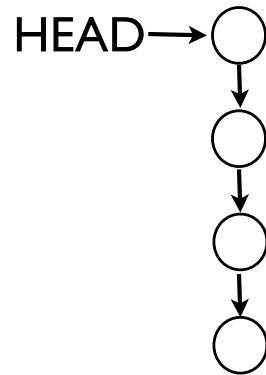
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Need to keep track of  
versions by name.

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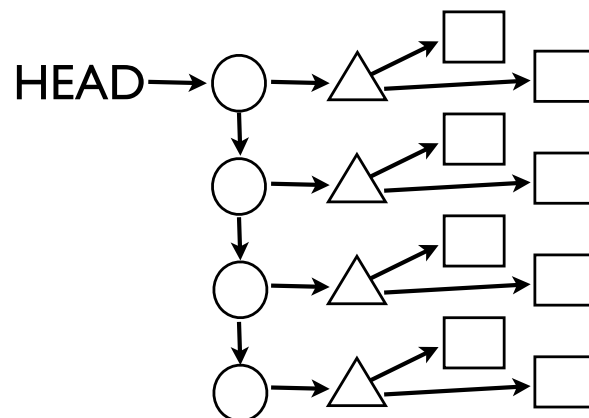
## Project Archive (snapshots only)



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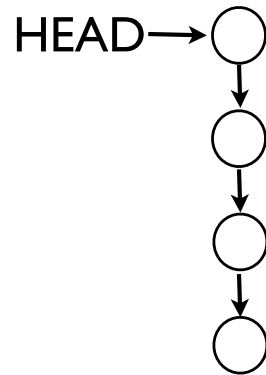
## Project Archive



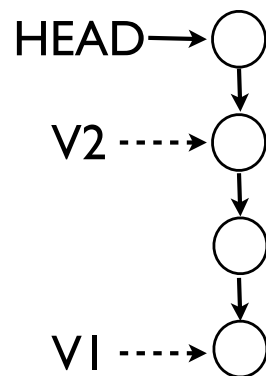
Copyright 2010 by Jim Weirich

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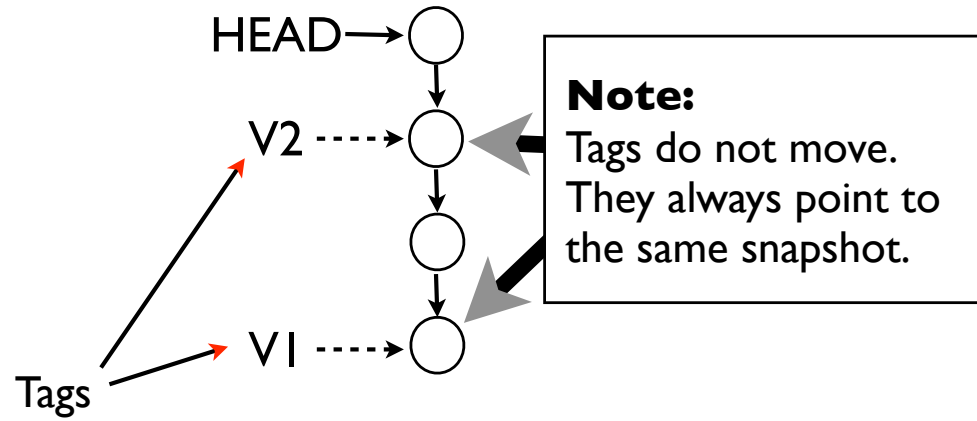
## Project Archive (snapshots only)



## Project Archive (snapshots only)



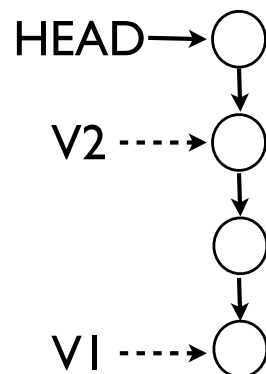
## Project Archive (snapshots only)



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## Project Archive (snapshots only)



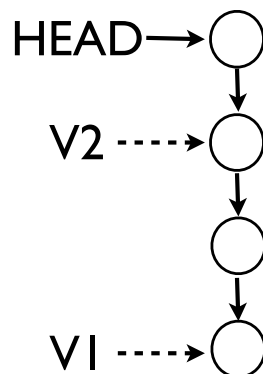
Copyright 2010 by Jim Weirich

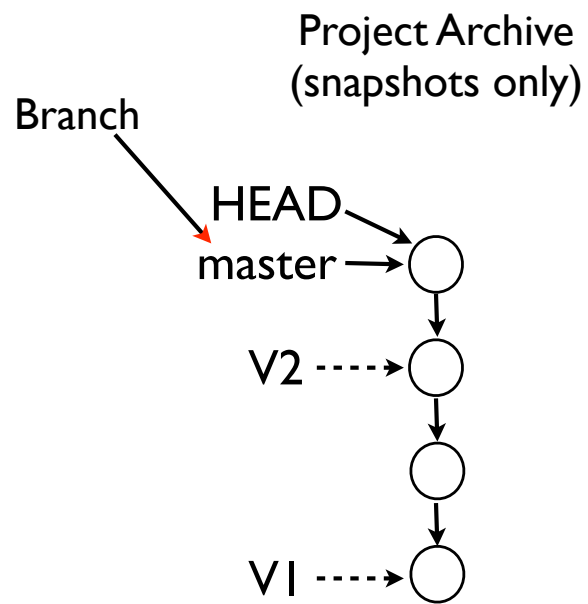
96



Need to handle  
changes to older  
versions while  
allowing  
development on  
the latest version.

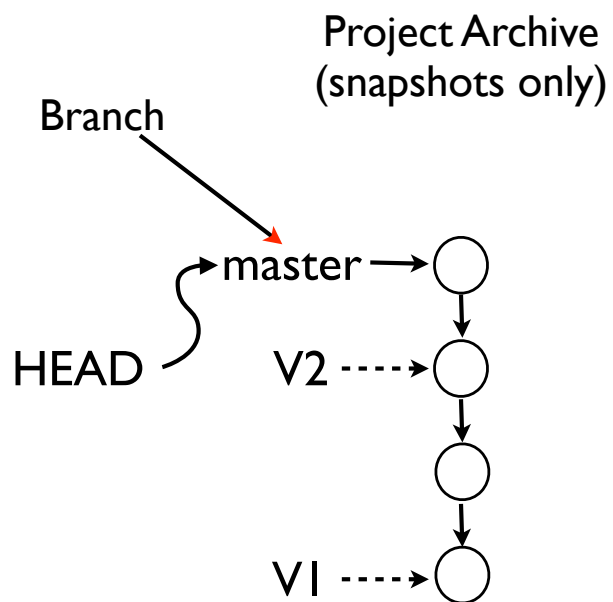
Project Archive  
(snapshots only)





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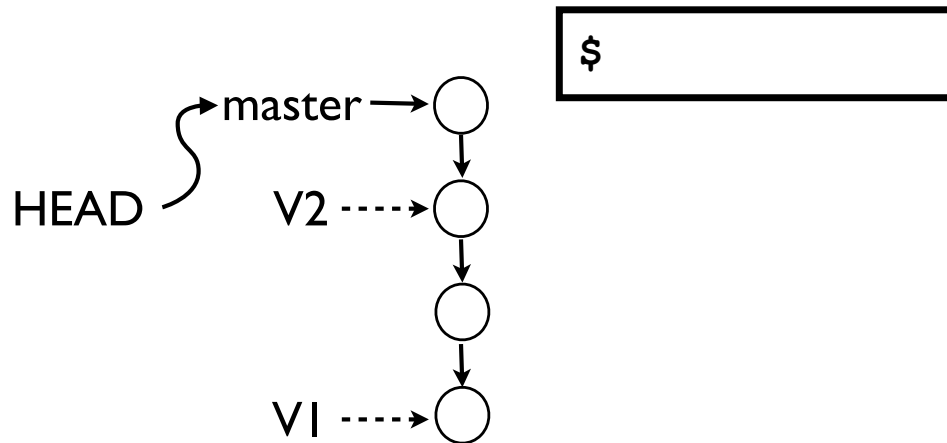
99



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100

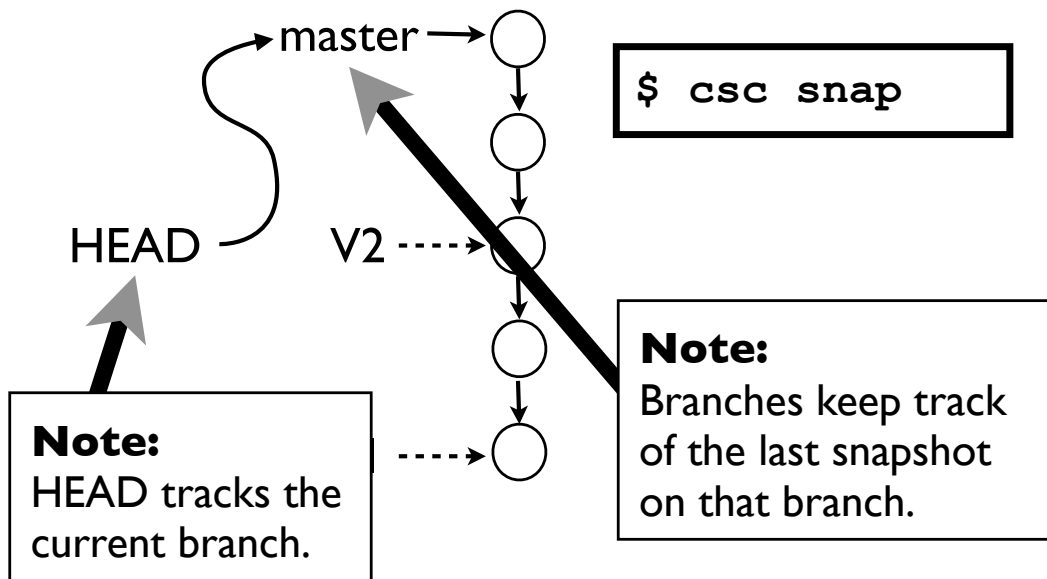
## Project Archive (snapshots only)



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## Project Archive (snapshots only)

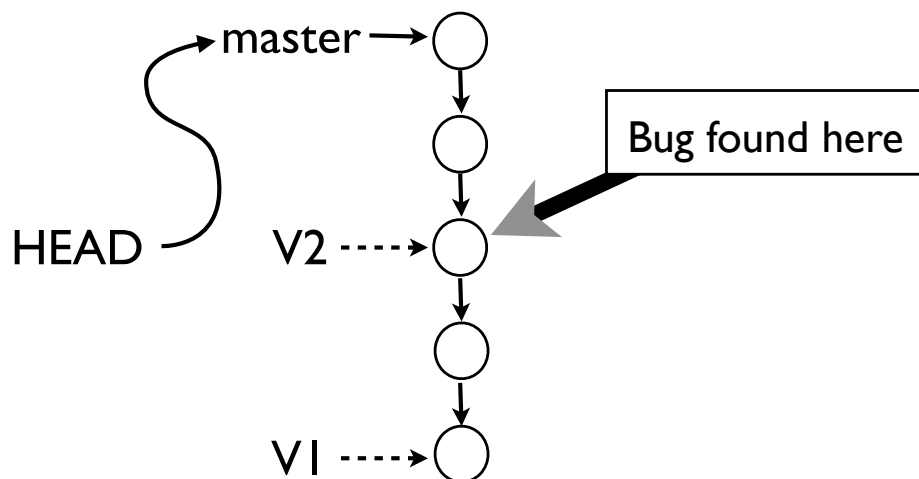


Copyright 2010 by Jim Weirich

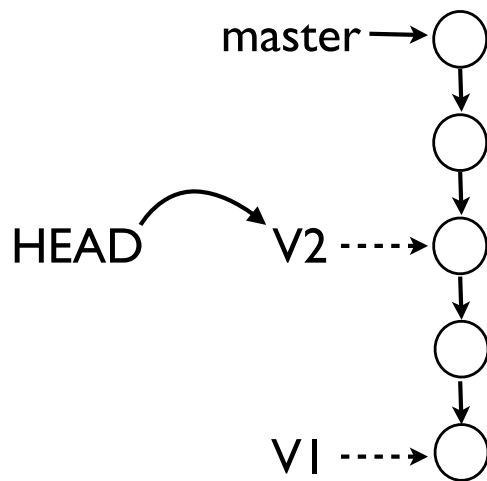
102

# Oops! We found a bug

## Project Archive

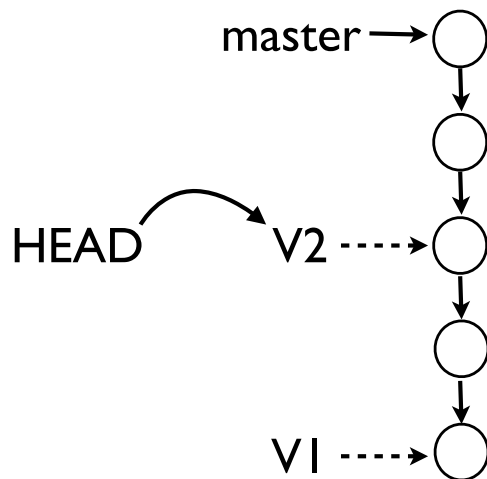


## Project Archive



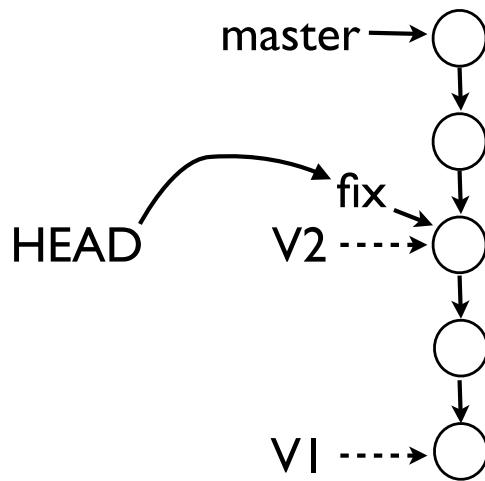
```
$ csc checkout V2
```

## Project Archive



```
$ csc checkout V2  
$ edit files
```

## Project Archive

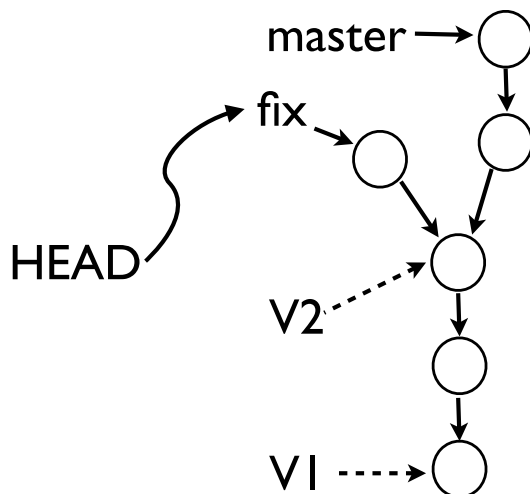


```
$ csc checkout V2
$ edit files
$ csc branch fix
```

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## Project Archive

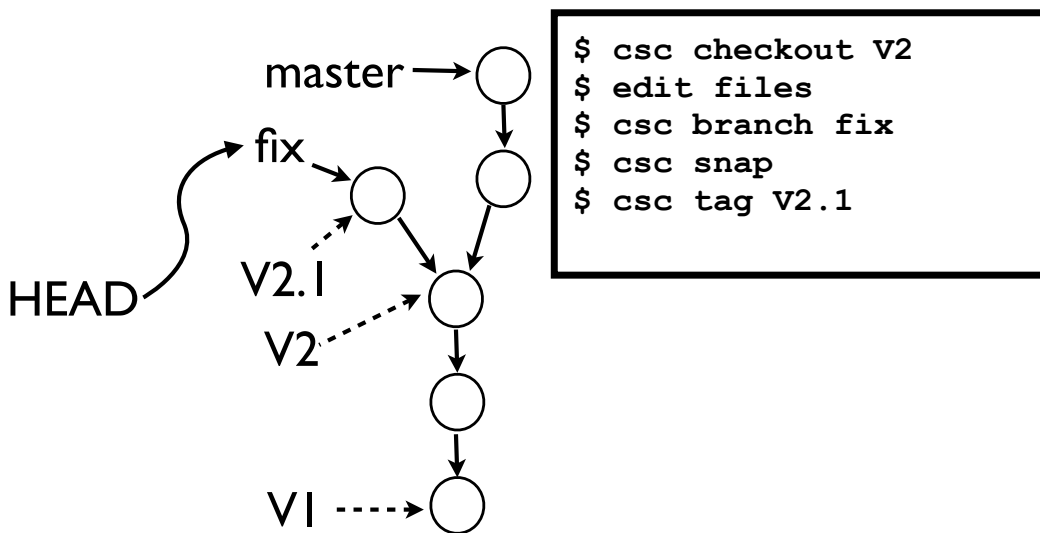


```
$ csc checkout V2
$ edit files
$ csc branch fix
$ csc snap
```

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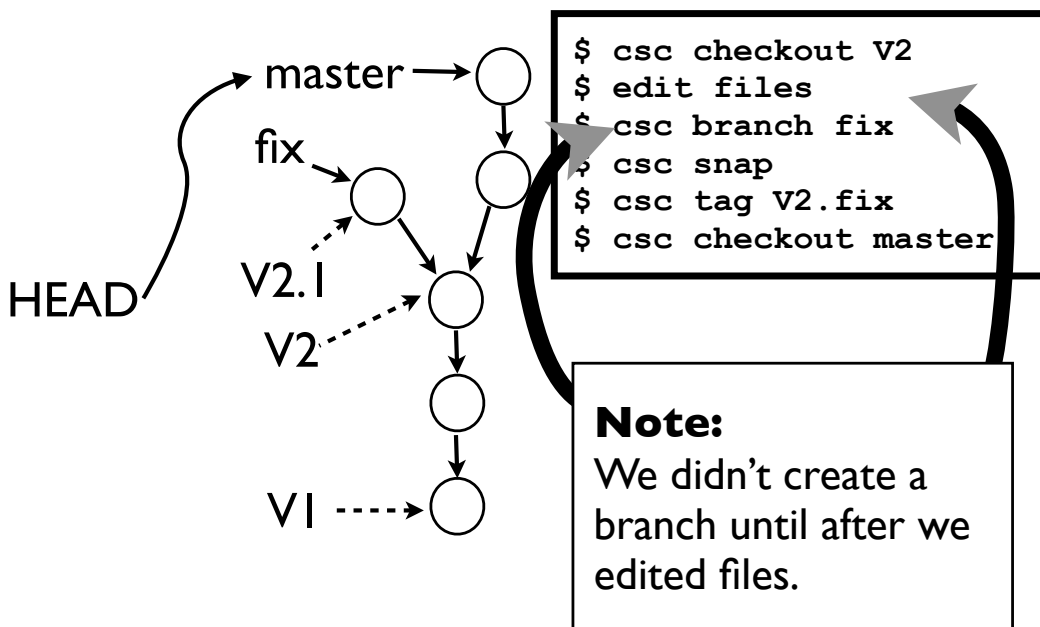
# Project Archive



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# Project Archive



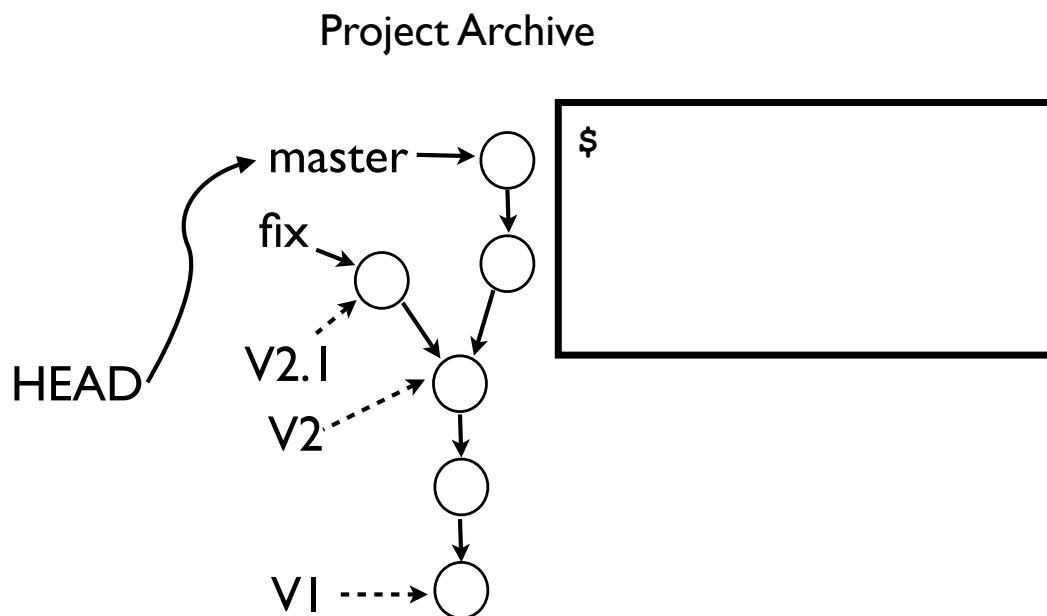
Copyright 2010 by Jim Weirich

110

# Merge Bug Fixes to Master

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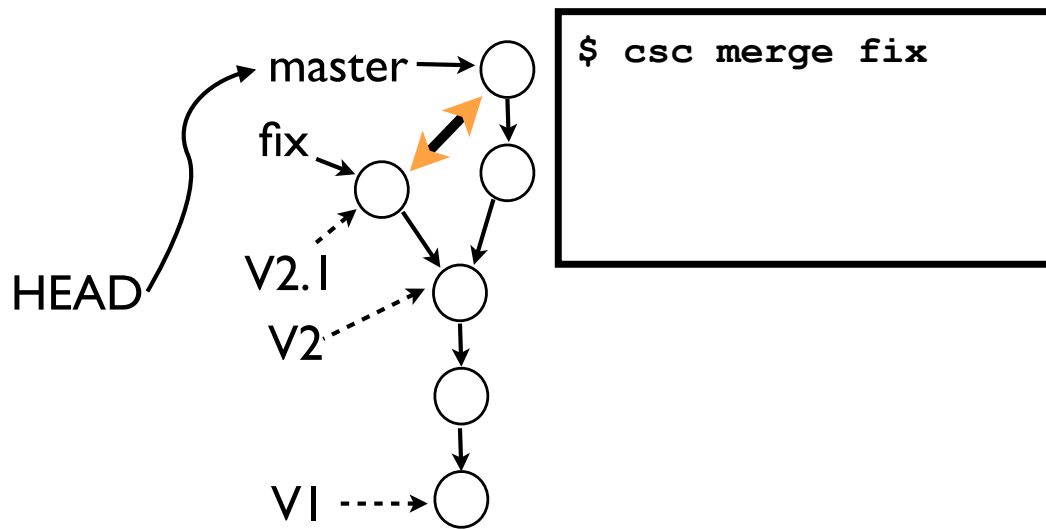


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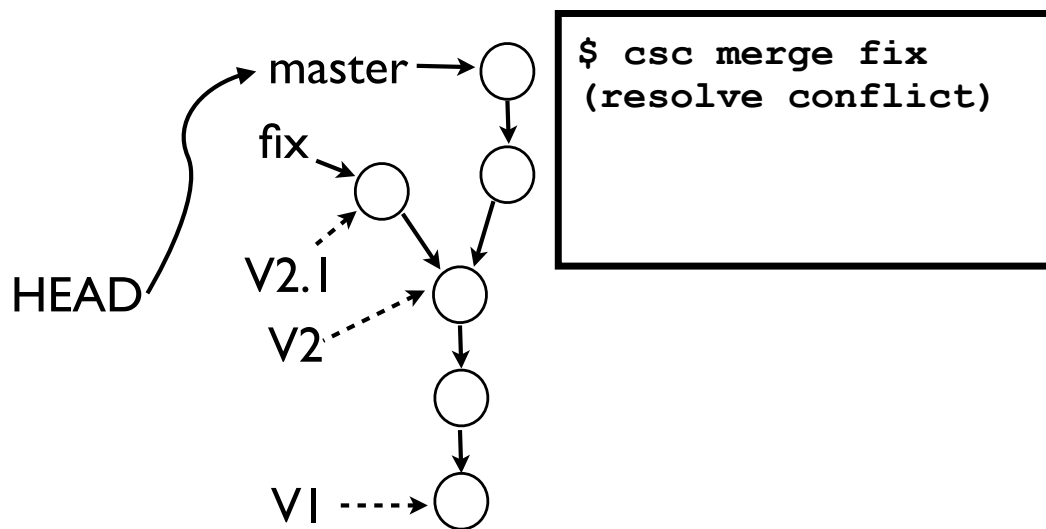
## Project Archive



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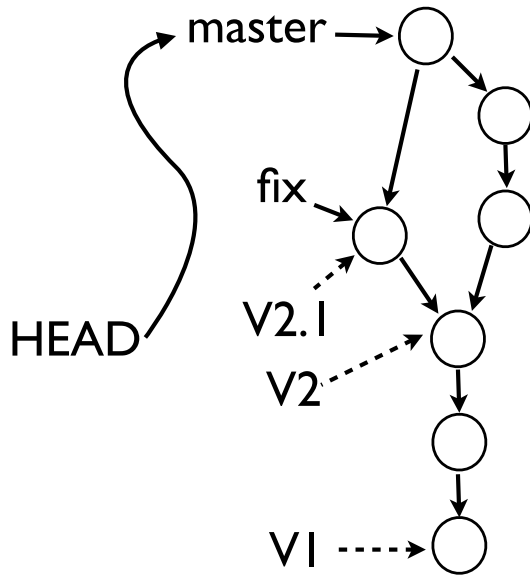
113

## Project Archive

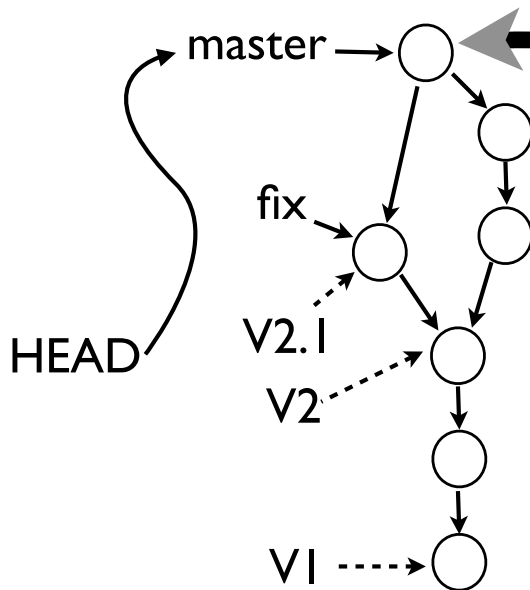


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```
$ csc merge fix
(resolve conflict)
$csc snap
```



```
$ csc merge fix
(resolve conflict)
$csc snap
```

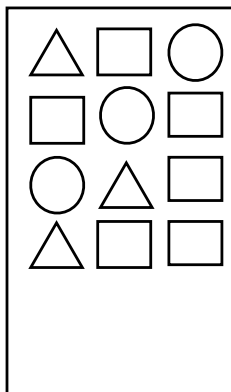
**Note:**  
This snapshot has two parents. The changes from both parents have been merged together.

# Sharing Code

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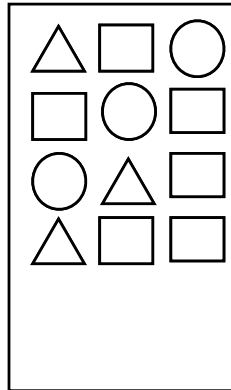
## My Archive



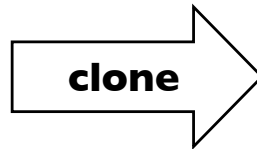
Copyright 2010 by Jim Weirich

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My Archive



Your Archive

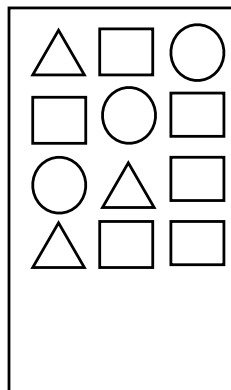


```
you$ csc clone url_for_my_repo
```

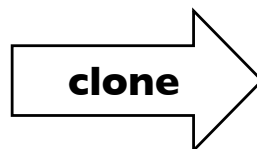
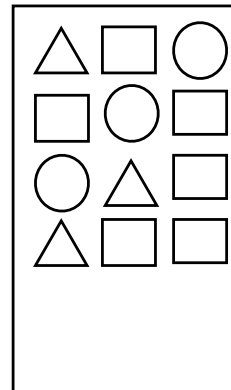
Copyright 2010 by Jim Weirich

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My Archive



Your Archive

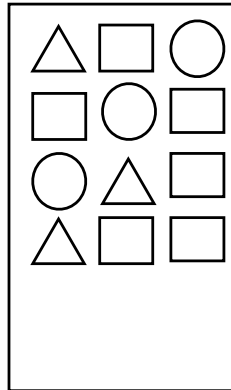


```
you$ csc clone url_for_my_repo
```

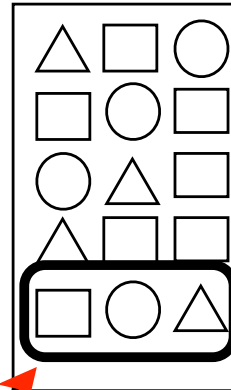
Copyright 2010 by Jim Weirich

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My Archive



Your Archive

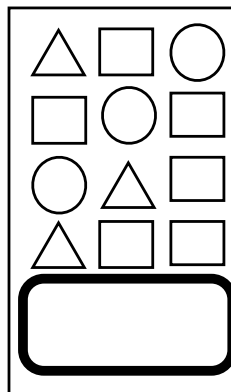


You make changes

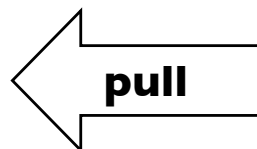
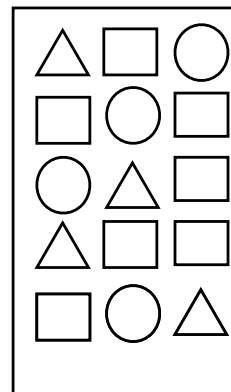
Copyright 2010 by Jim Weirich

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My Archive



Your Archive

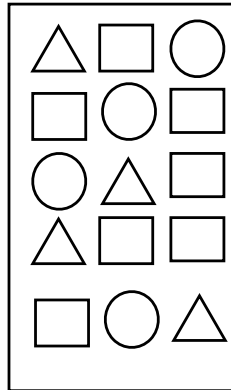


```
me$ csc pull url_for_my_repo
```

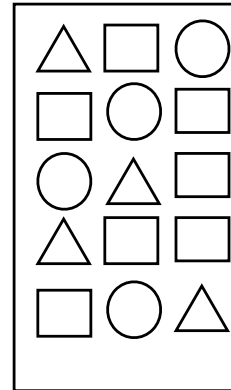
Copyright 2010 by Jim Weirich

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My Archive



Your Archive



**pull**

```
you$ csc pull url_for_my_repo
```

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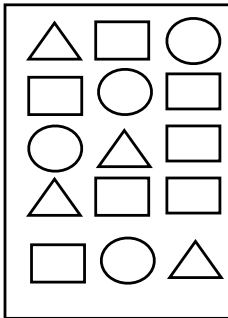
123

## Common Remote Uses

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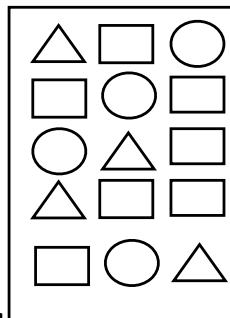
## My Archive



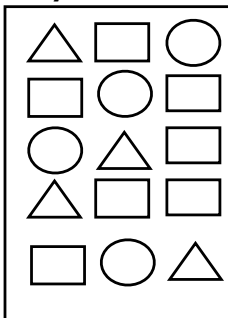
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## Remote Archive



## My Archive

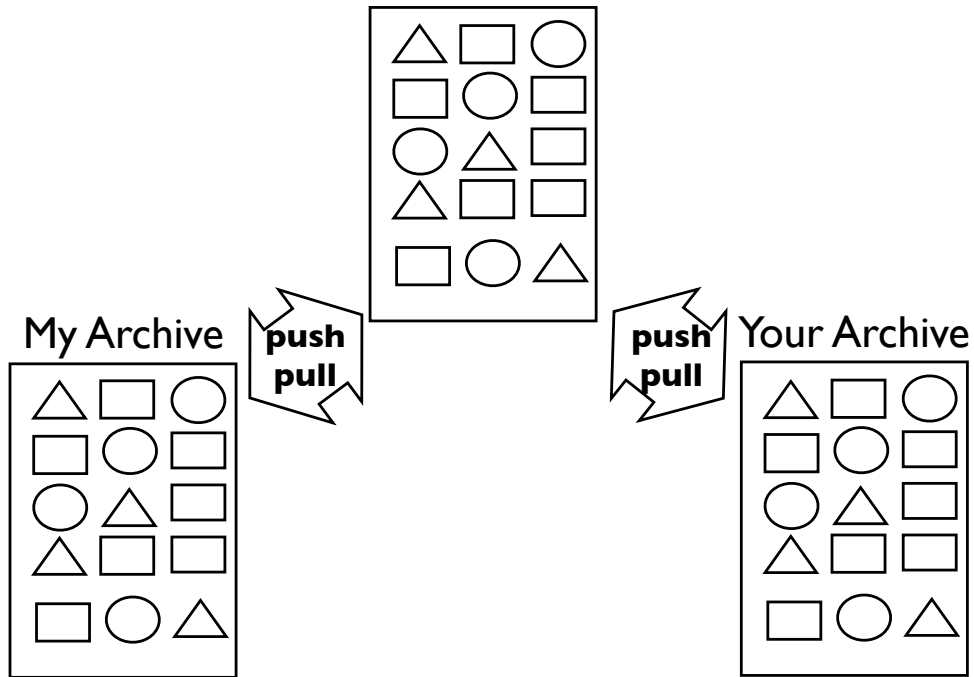


**push**  
**pull**

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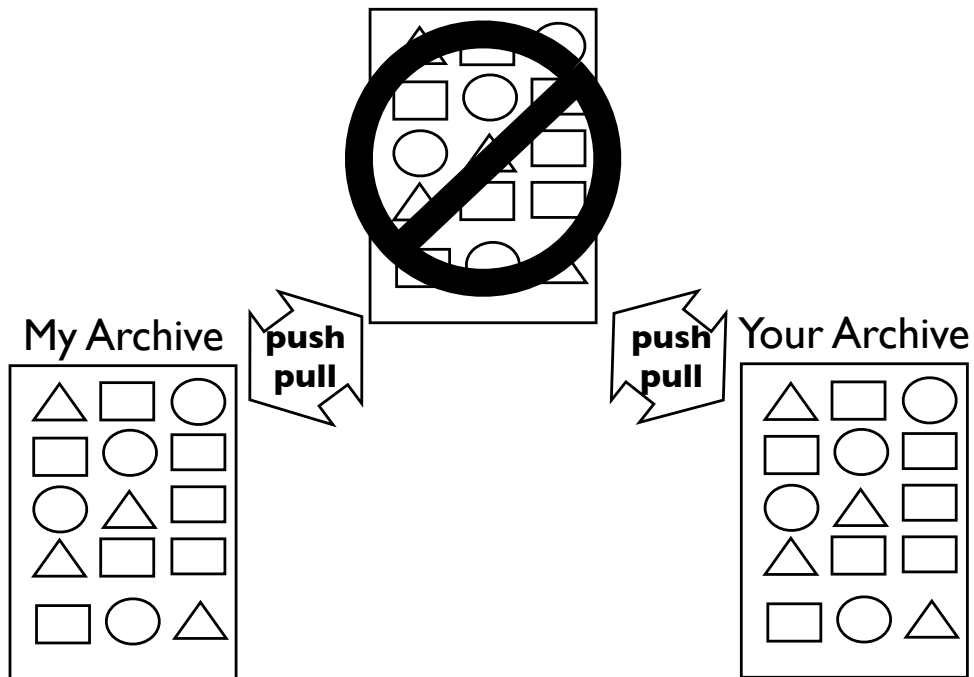
## Shared Remote Archive



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## Shared Remote Archive

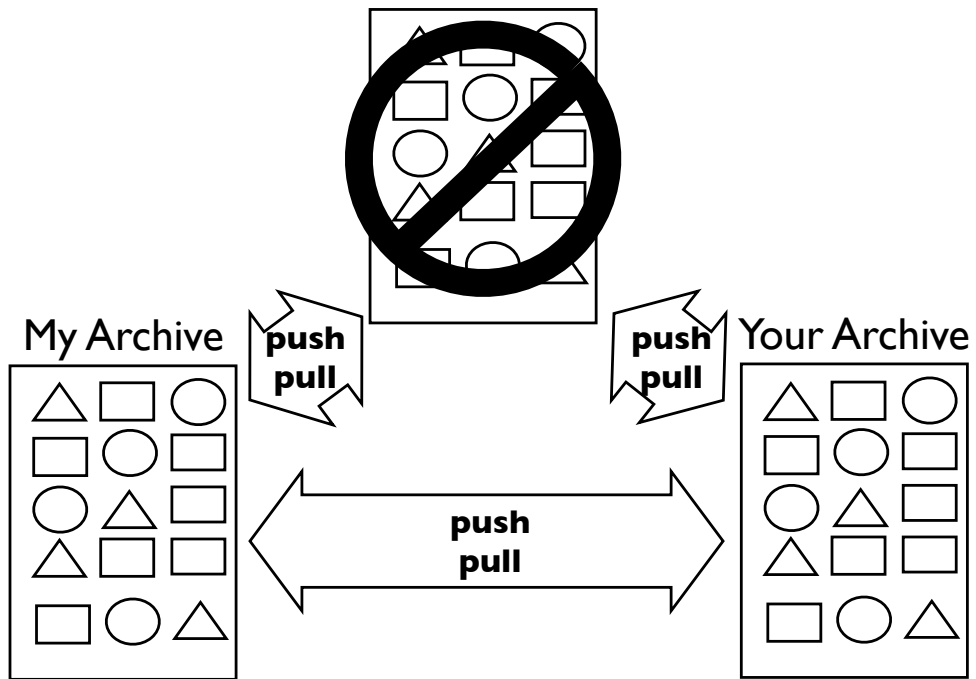


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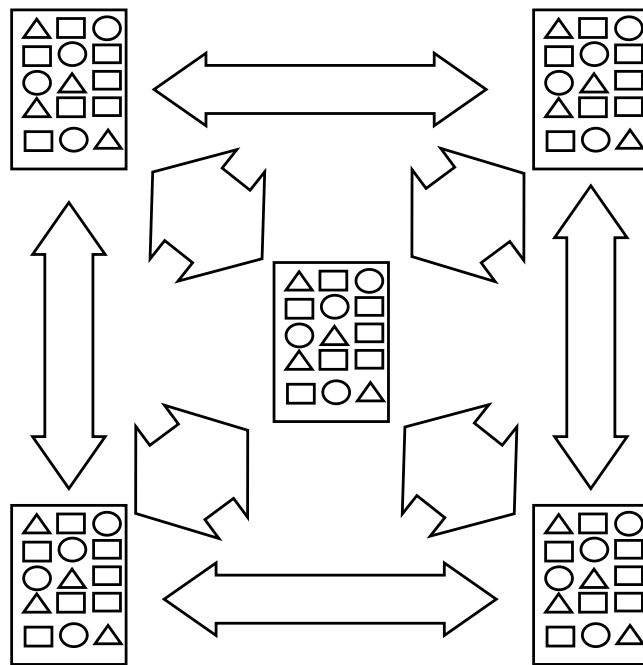


## Shared Remote Archive



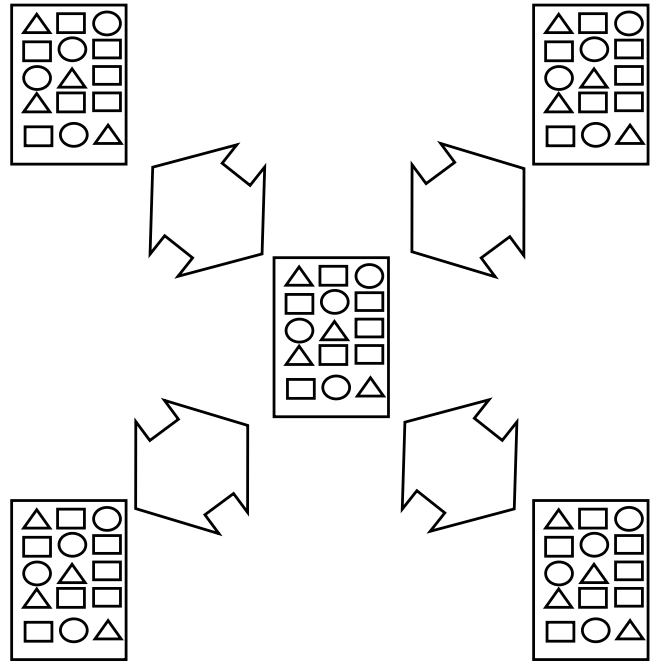
Copyright 2010 by Jim Weirich

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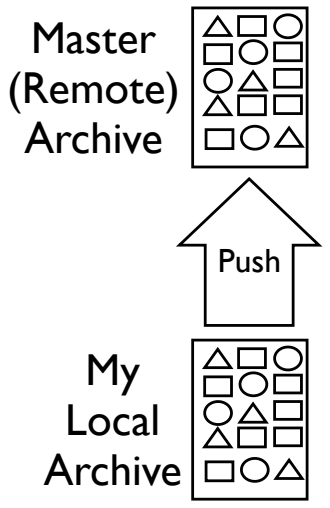


Copyright 2010 by Jim Weirich

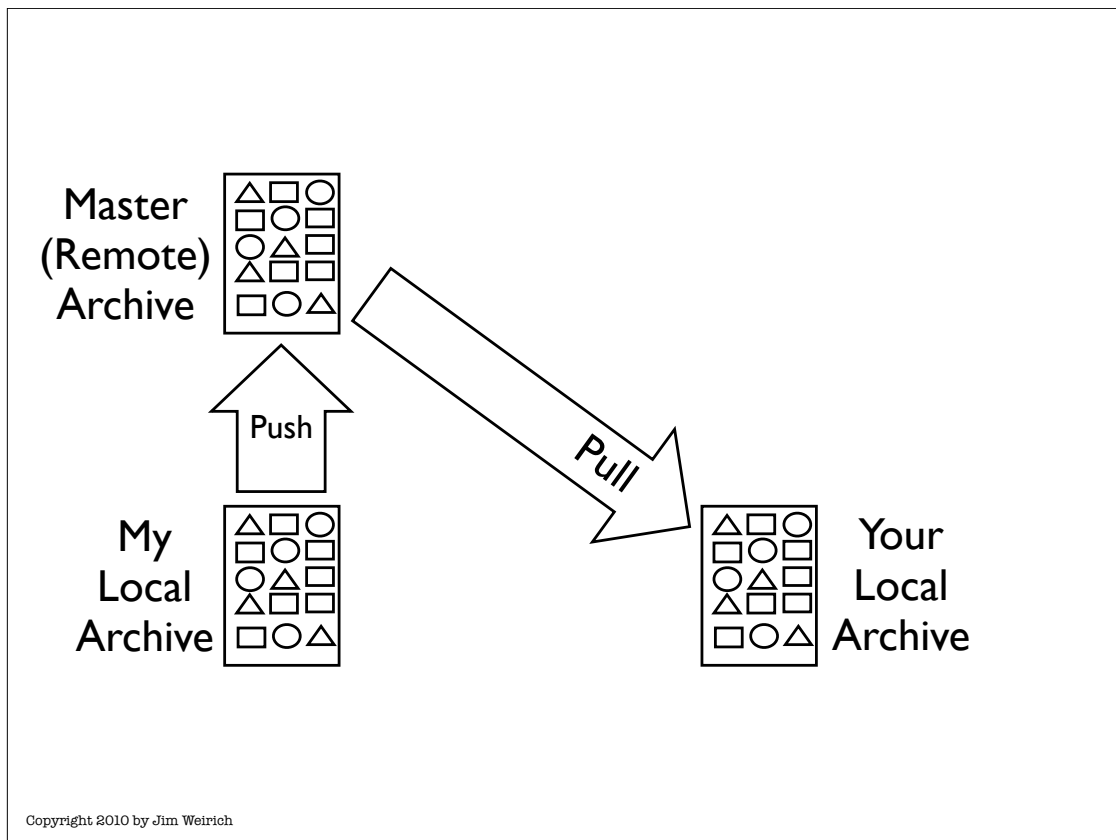
130



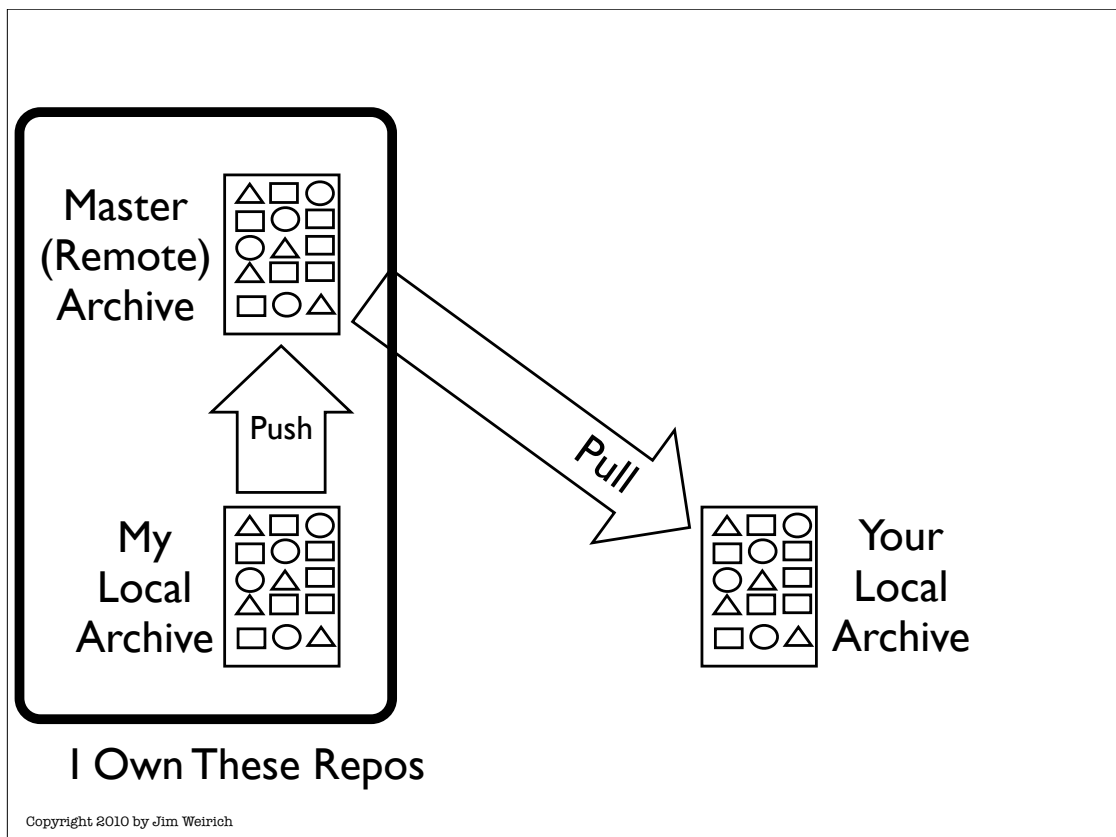
Copyright 2010 by Jim Weirich



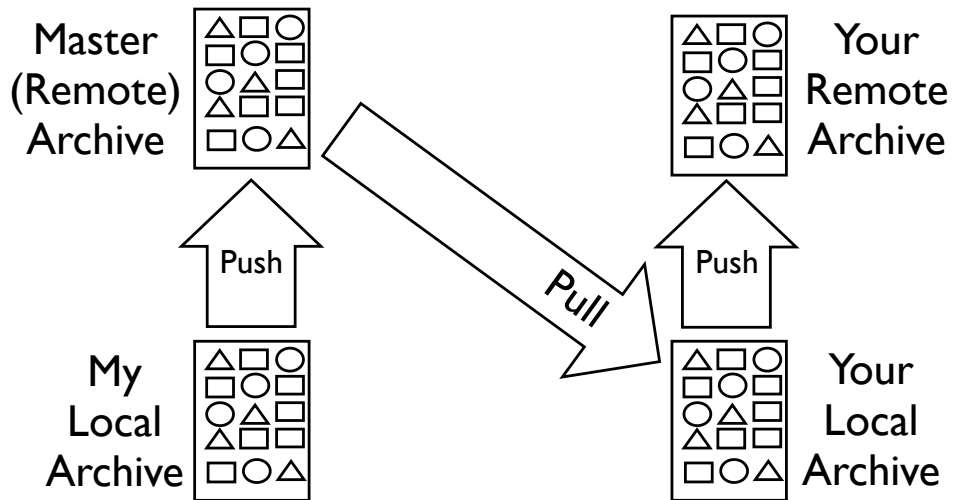
Copyright 2010 by Jim Weirich



133

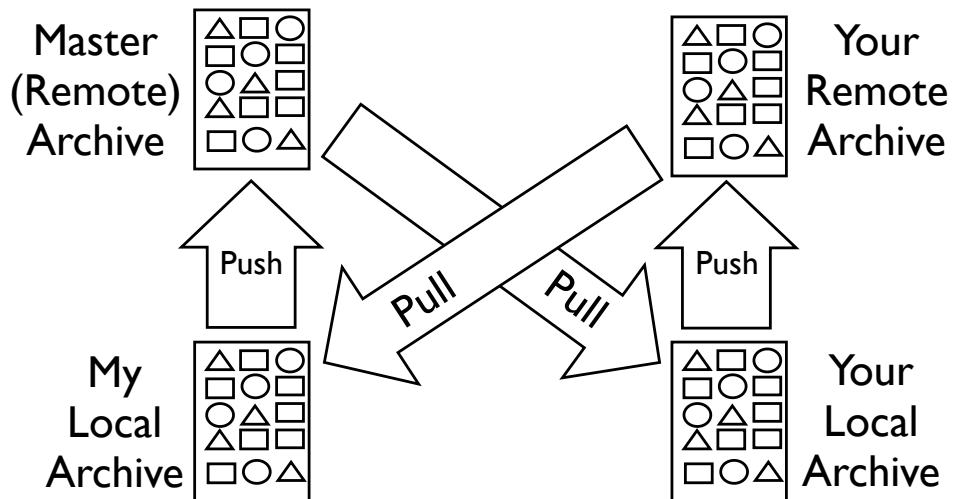


134



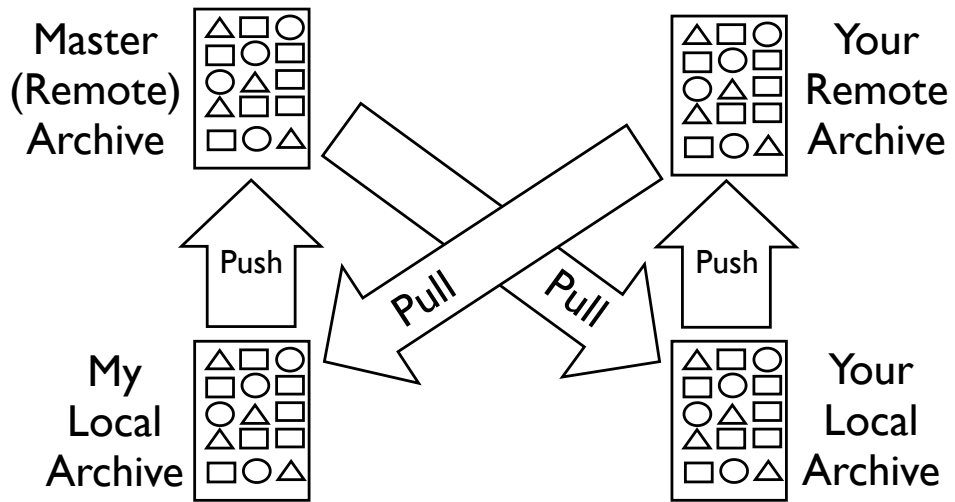
Copyright 2010 by Jim Weirich

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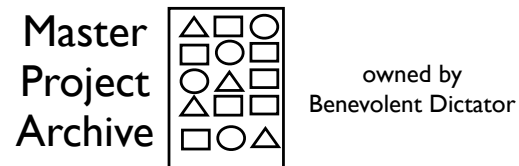
Copyright 2010 by Jim Weirich

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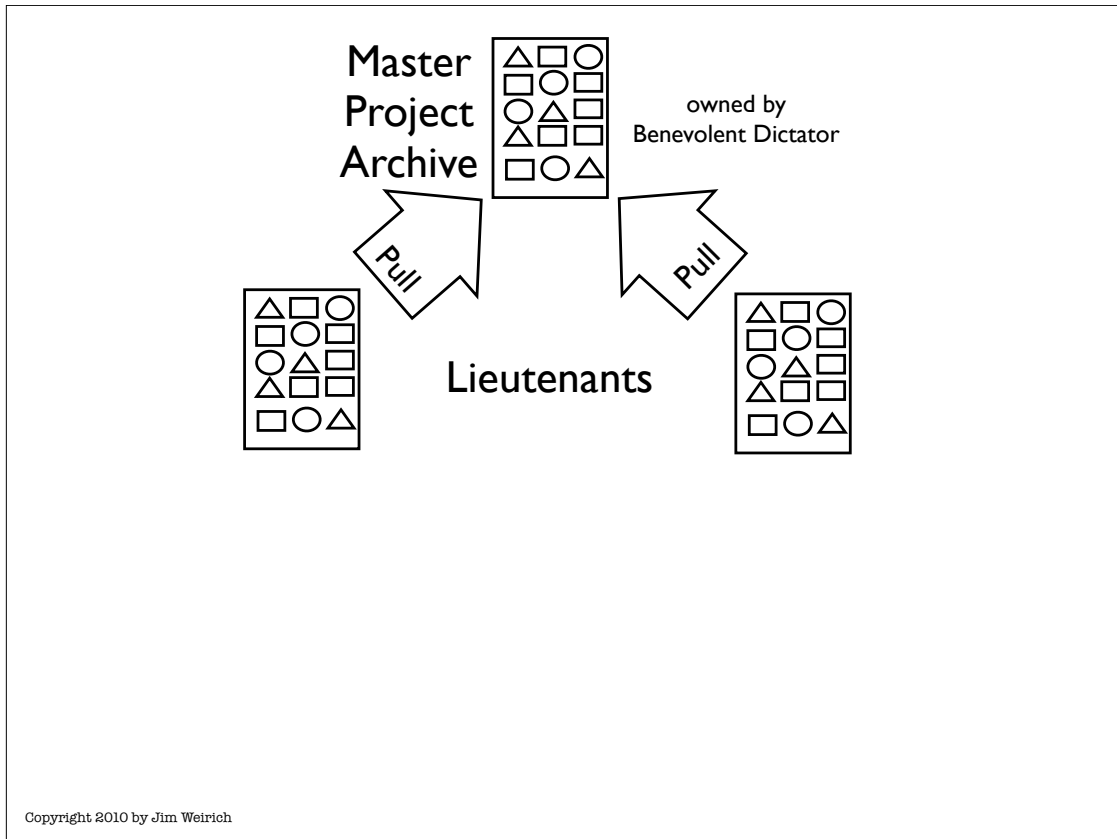
Copyright 2010 by Jim Weirich

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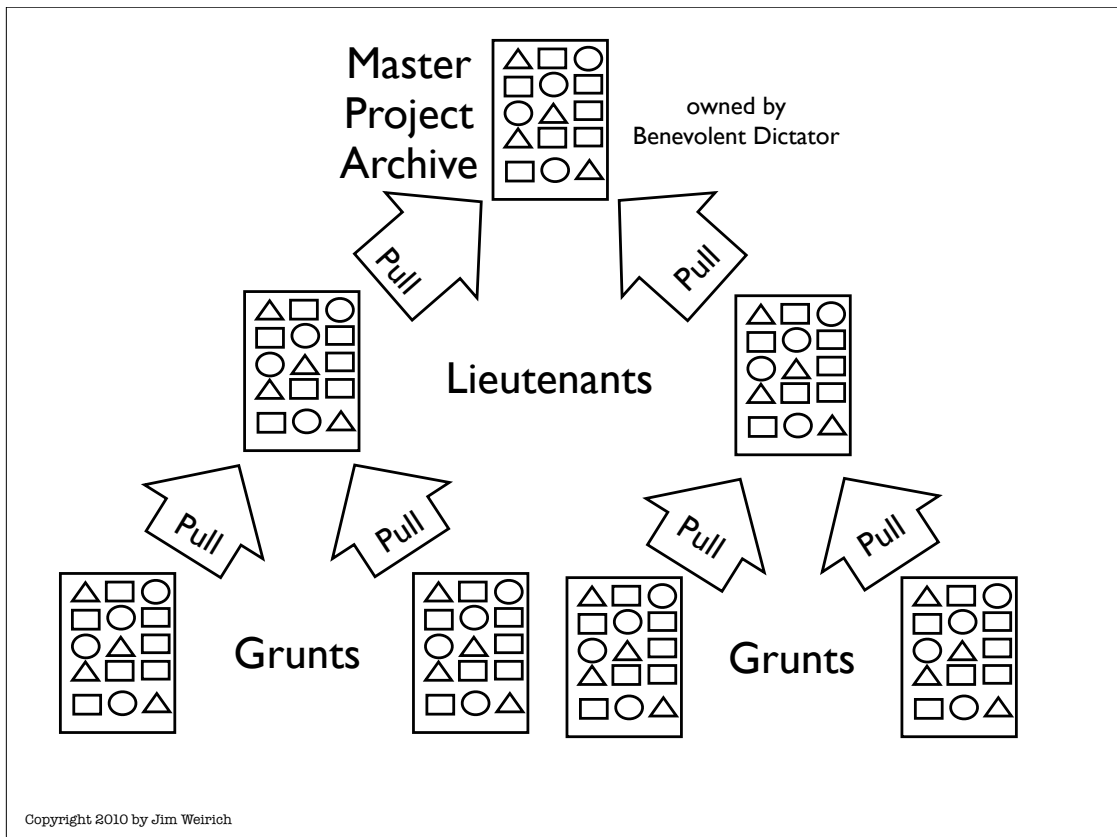


Copyright 2010 by Jim Weirich

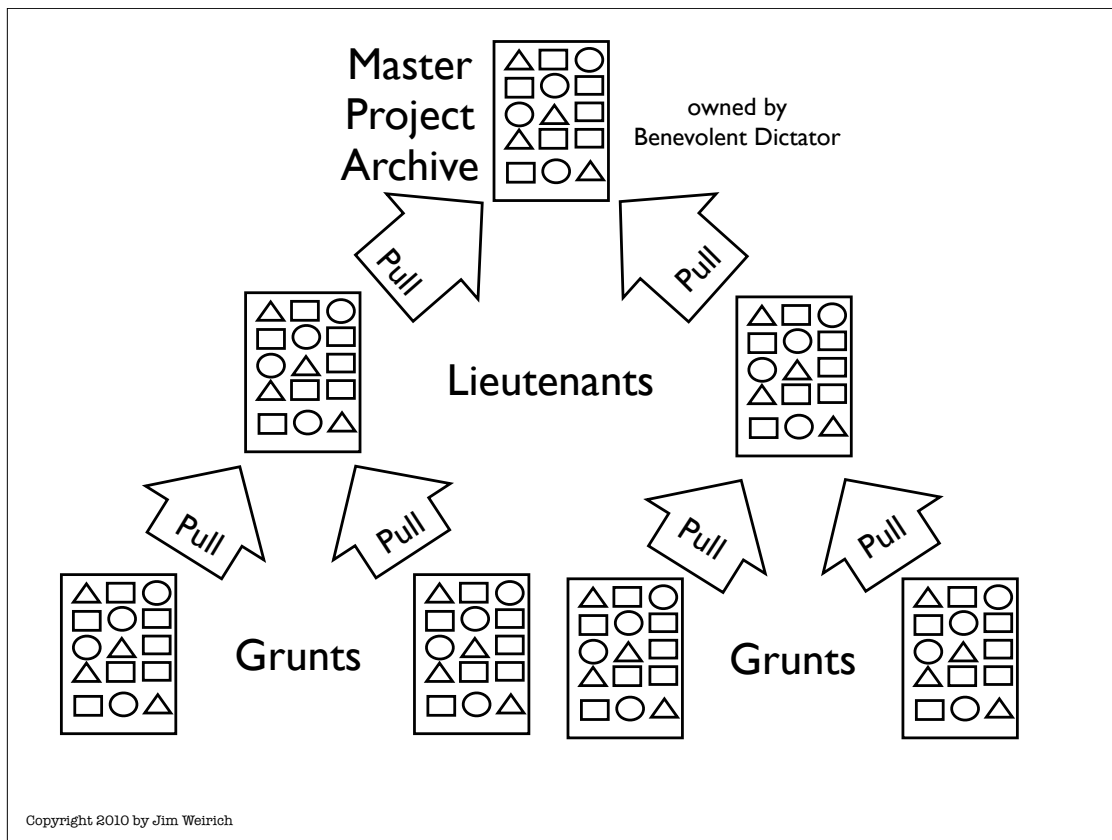
138



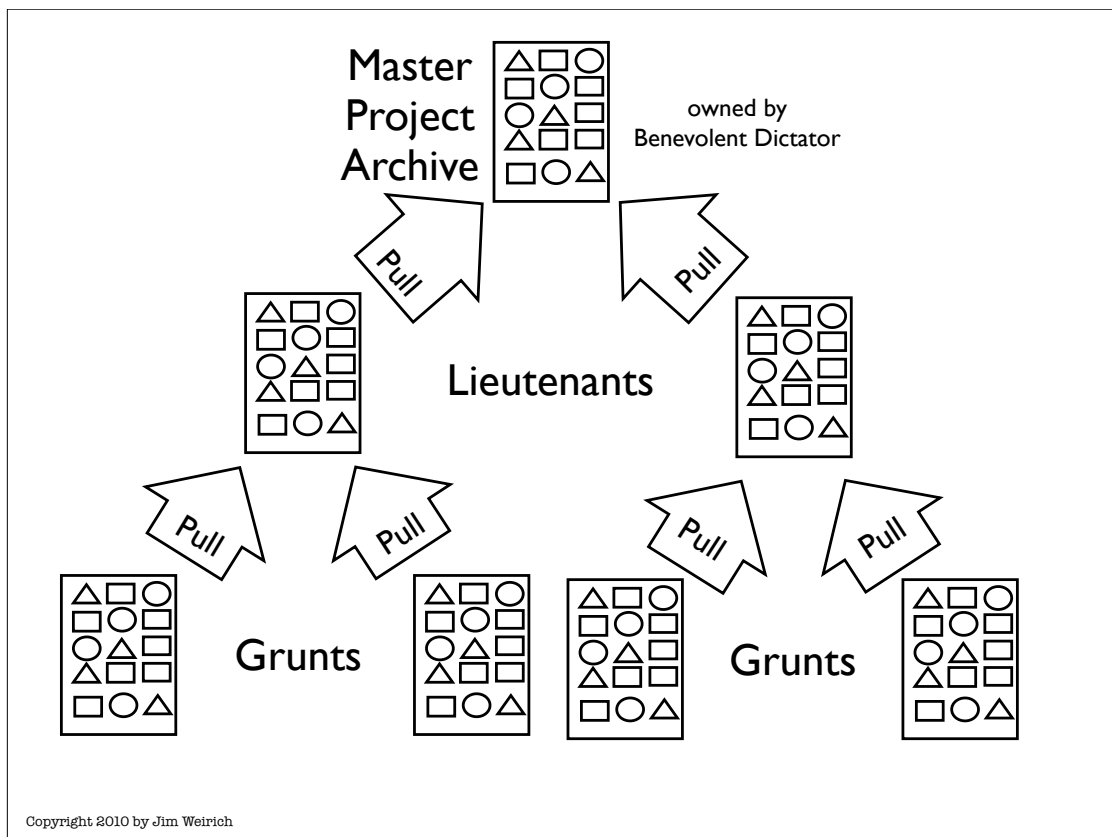
139



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# Wrap Up

## CSC Features

- Complete revision history
- Efficient Storage
  - very lightweight project archives
- Guaranteed integrity
- Flexible Sharing
- Cheap Branching
- Easy Tagging



# CSC Features

- Complete revision history
- Efficient Storage
  - very lightweight project archives
- Guaranteed integrity
- Flexible Sharing
- **Cheap Branching**
- Easy Tagging

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## Sounds Like ...

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# CSC

# GIT

csc == git  
snapshot == commit  
project archive == repository  
manifest == tree (or directory)

csc snap == git commit -a  
csc checkout *name* == git checkout *name*  
csc branch *name* == git checkout -b *name*  
csc tag *tagname* == git tag *tagname*

# Differences from Git

## Differences

### Csc

- We have only:
  - Working Directory
  - Repository (project archive)

### Git

- Git Uses
  - Working Directory
  - Staging Area
  - Repository

# Differences

## Csc

- We have only:
  - Working Directory
  - Repository (project archive)
- File Based

## Git

- Git Uses
  - Working Directory
  - Staging Area
  - Repository
- Content Based

# Differences

## Csc

- One level object file storage

## Git

- Files stored in .git/objects
  - Uses a 2-level directory
  - SHA1 hash is the directory/file name

# Differences

## Csc

- One level object file storage
- Plain Files

## Git

- Files stored in .git/objects
  - Uses a 2-level directory
  - SHA1 hash is the directory/file name
- Encoded/Compressed files

# Differences

## Csc

- Just the basic features

## Git

- init/log/status/diff
- reset/rebase
- cherry-pick
- bisect
- ... lots of others

# References

- Git from the Bottom Up (John Wiegley)
  - <http://ftp.newartisans.com/pub/git.from.bottom.up.pdf>
- Git Internals -- PeepCode PDF (Scott Chacon)
  - <http://peepcode.com/products/git-internals-pdf>
- Any presentation by Scott Chacon
  - <http://github.com/schacon/git-presentations>

# Pragmatic Bookshelf Screen Cast



Available at:

[http://pragprog.com/screencasts/  
v-jwsceasy/source-control-made-easy](http://pragprog.com/screencasts/v-jwsceasy/source-control-made-easy)

# Questions?

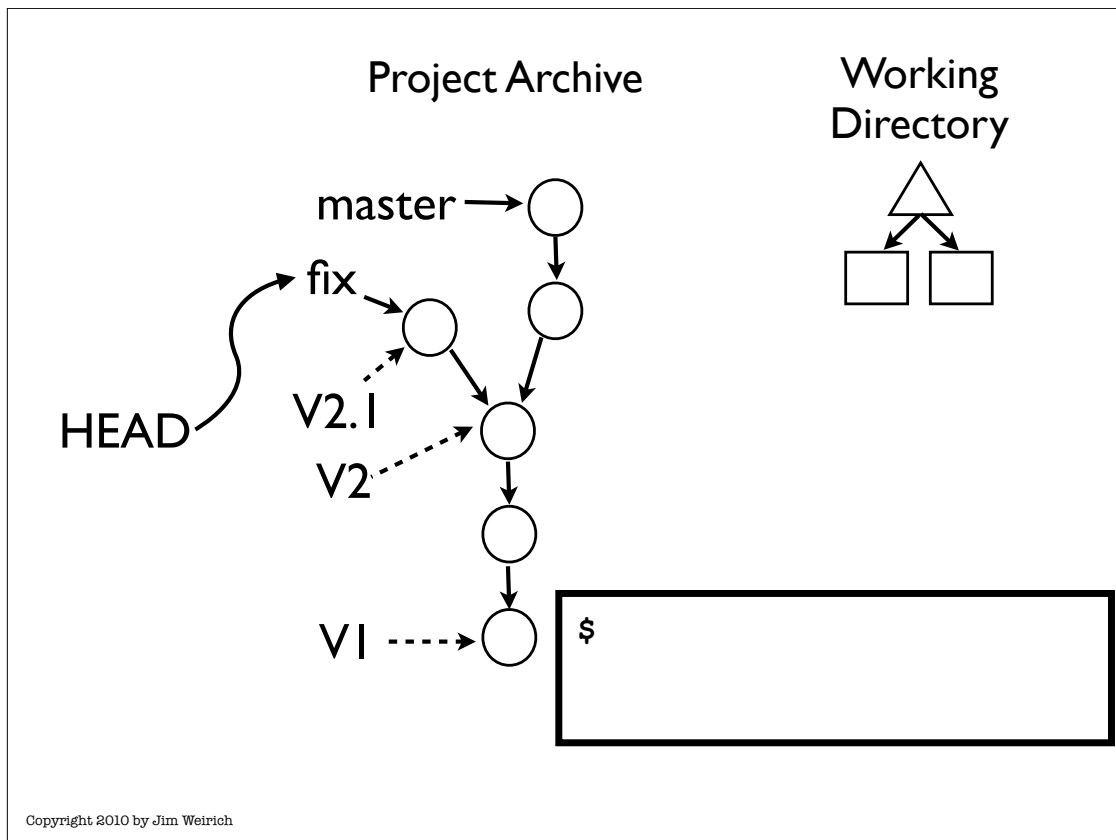
# Labs



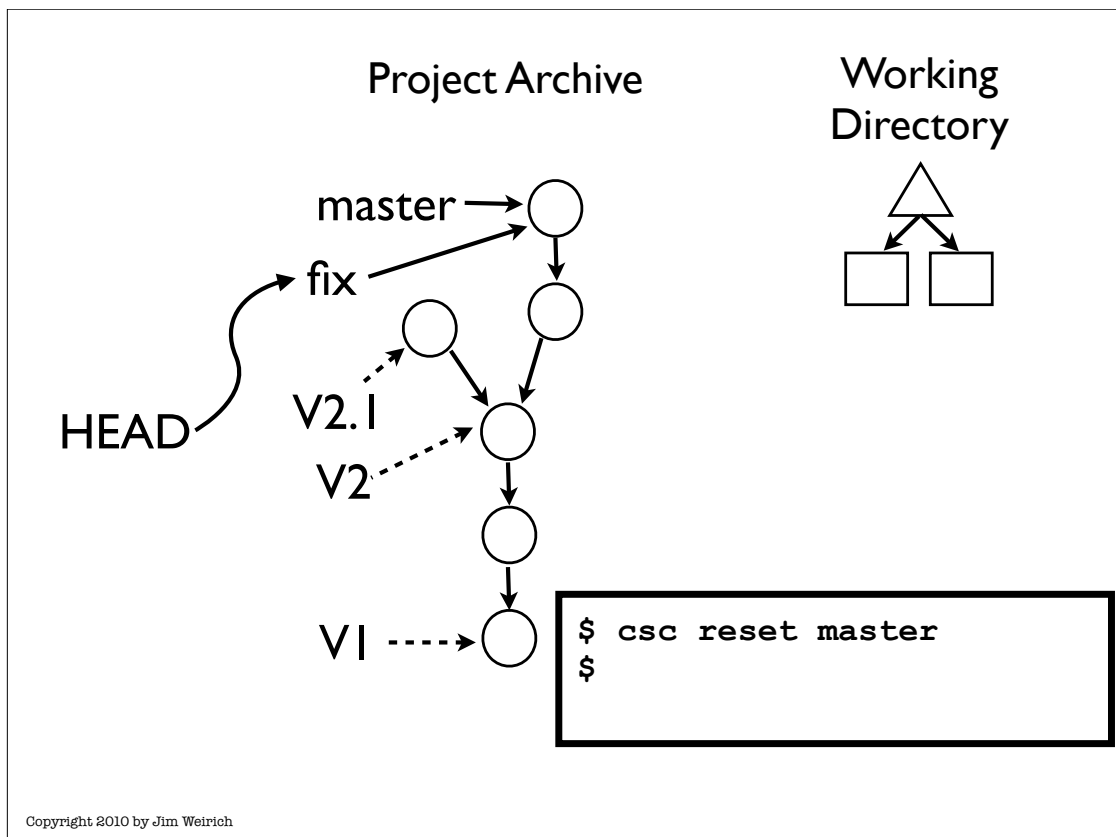
# Labs Can be found at ...

[http://onestepback.org/download/git\\_tutorial.zip](http://onestepback.org/download/git_tutorial.zip)

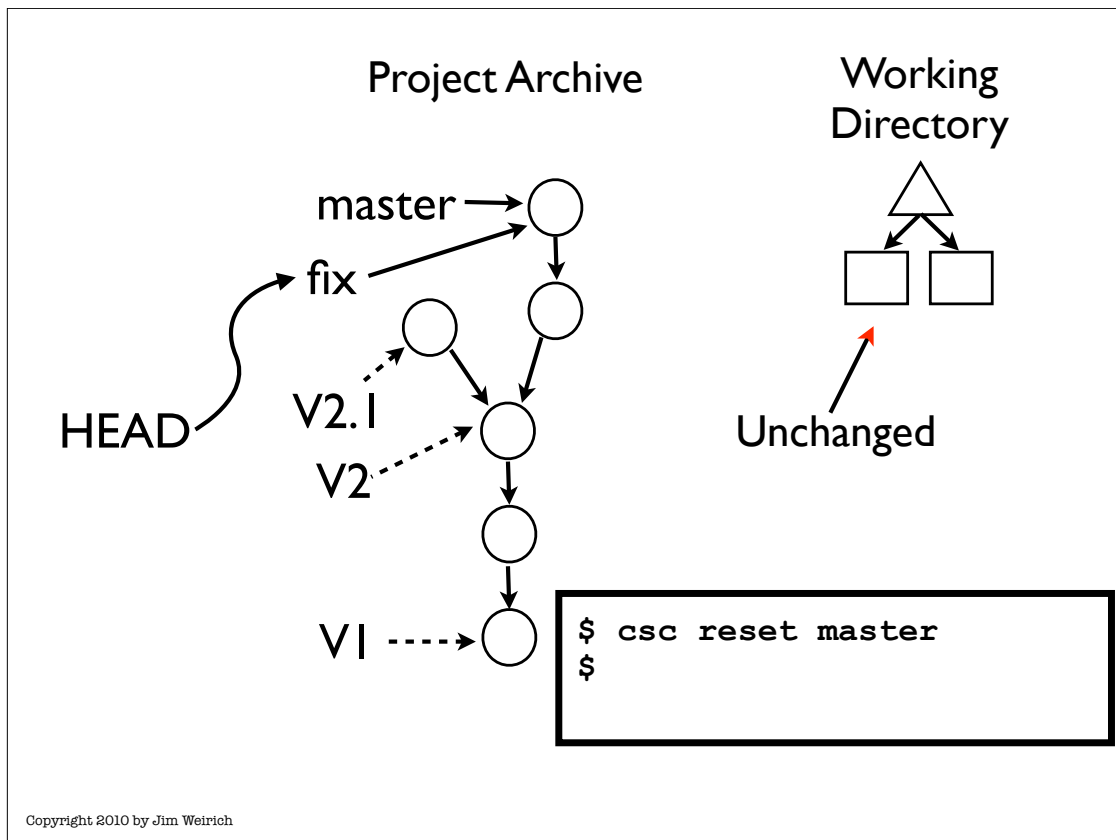
## Appendix A -- Reset



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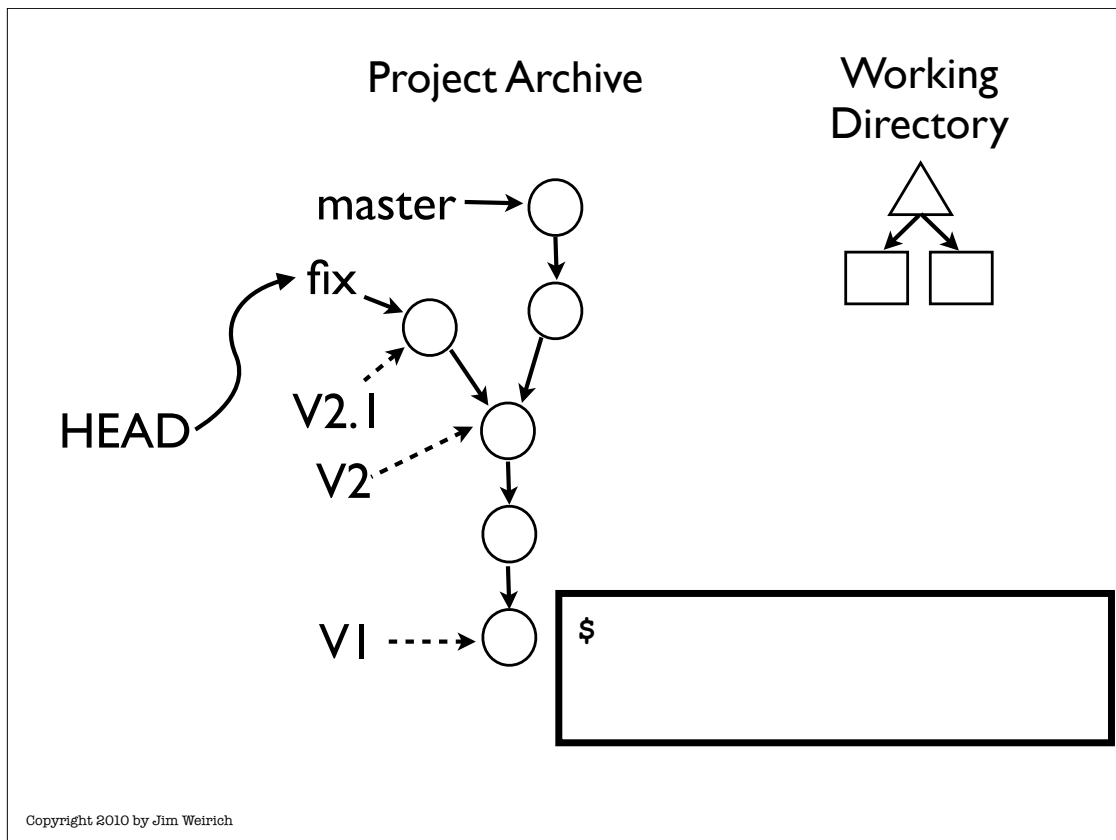
164



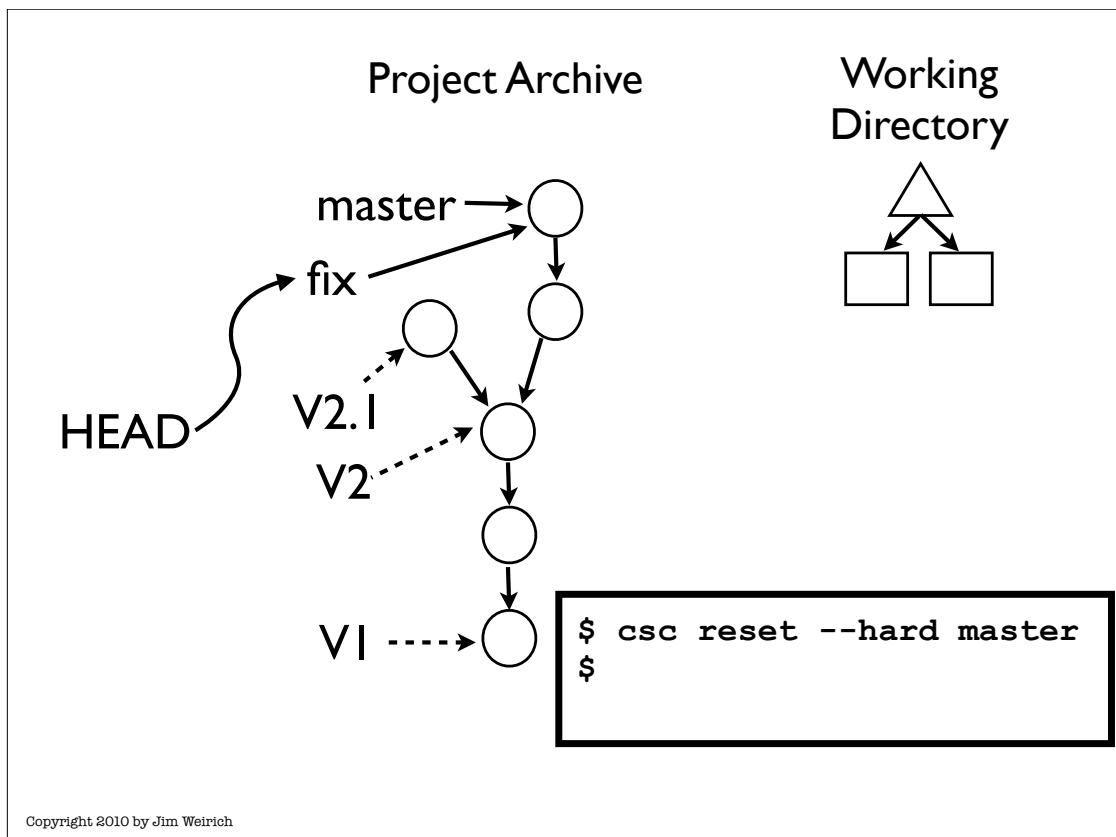
165

Now the --hard way

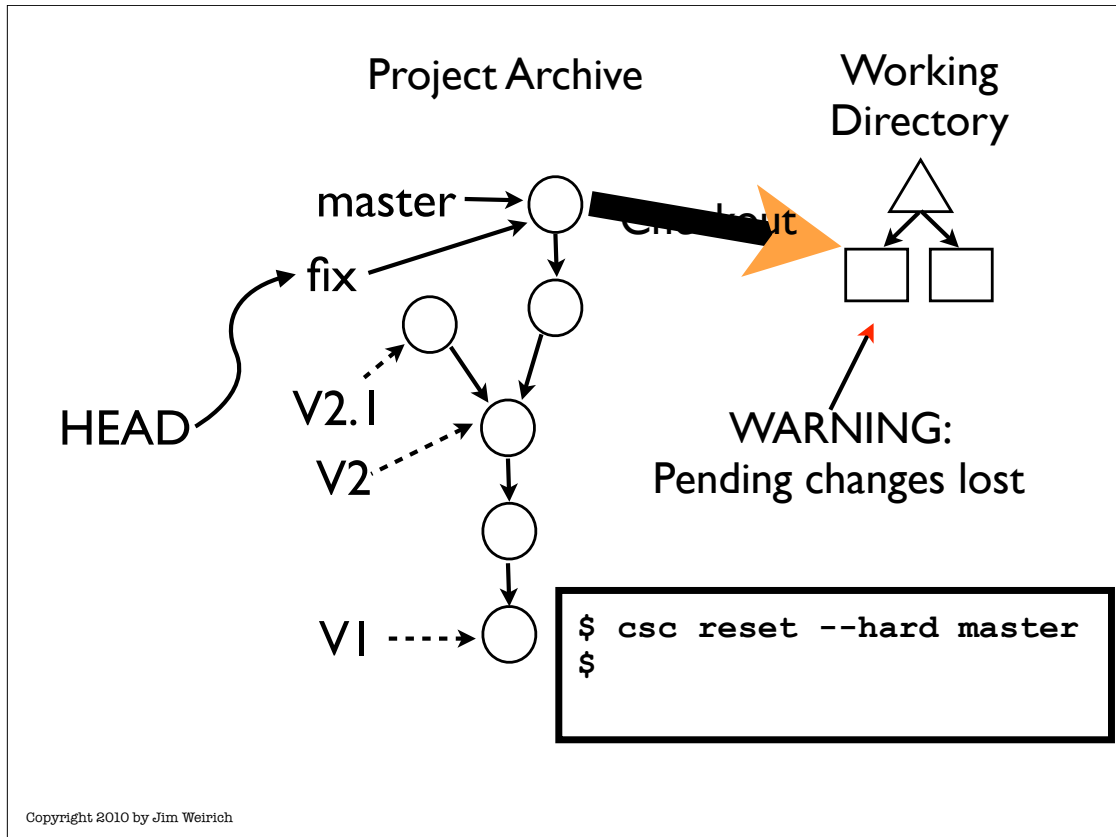
166



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168

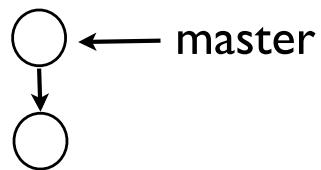


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## Appendix B -- Rebase

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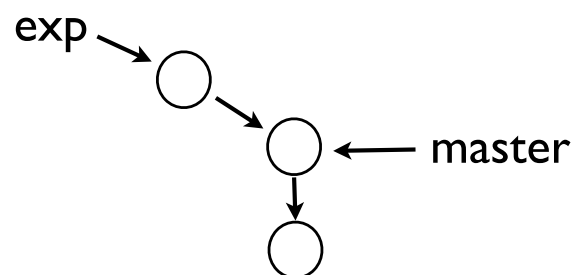
## Rebase (setup)



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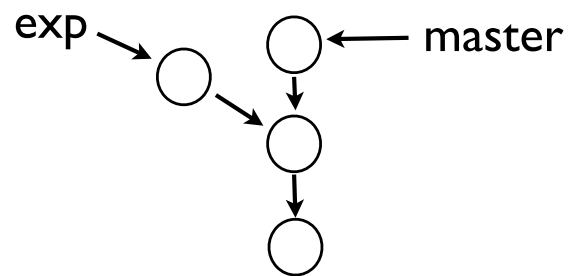
## Rebase (setup)



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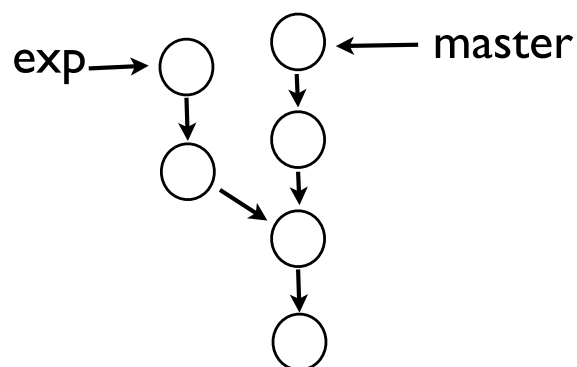
## Rebase (setup)



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## Rebase (setup)

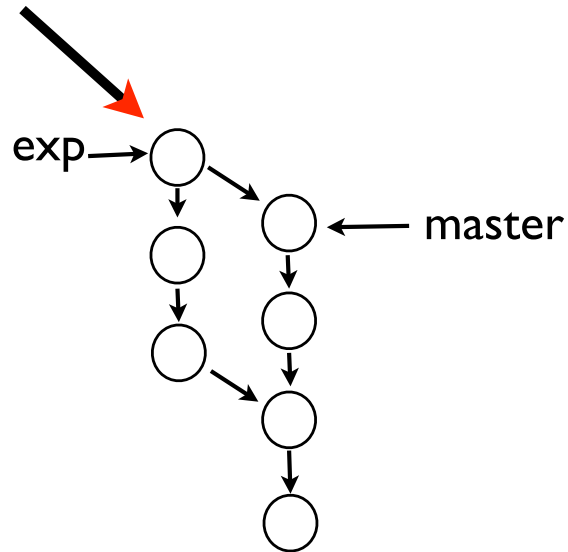


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## Rebase (merging option)

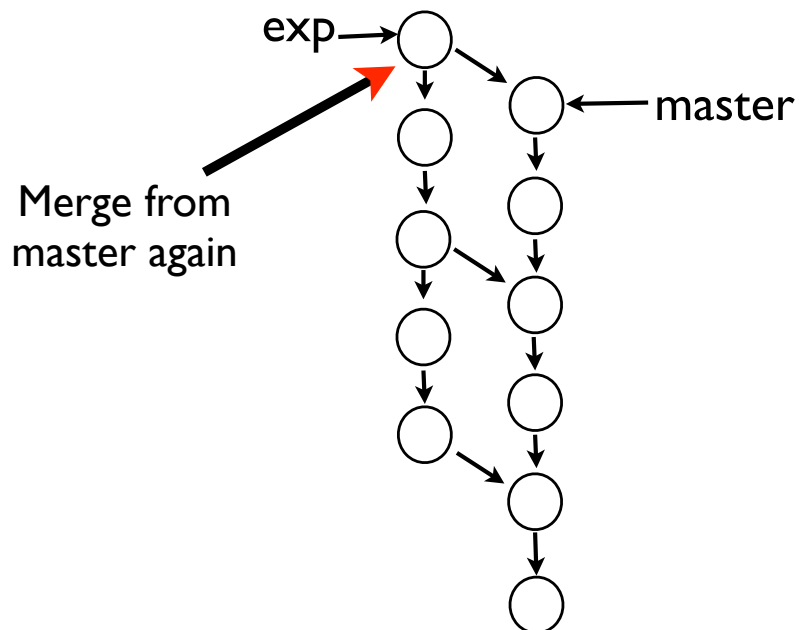
Merge changes on  
master to exp



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## Rebase (merging option)



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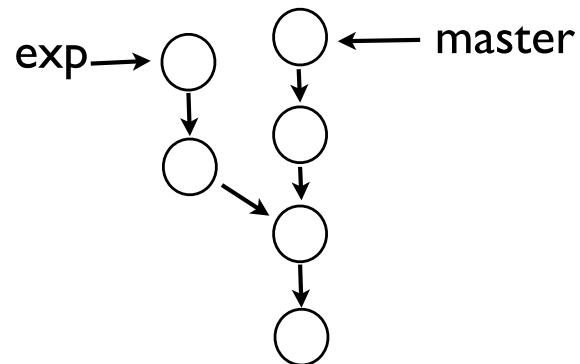
Diagram illustrating a merge operation in a version control system:

- A vertical sequence of nodes represents the **master** branch.
- A side branch **exp** branches off from the second node of the master branch.
- The **exp** branch contains four nodes, representing changes made while working on the feature.
- A red arrow points from the tip of the **exp** branch to the fourth node of the **master** branch, indicating the merge operation: **Merge exp changes onto master**.

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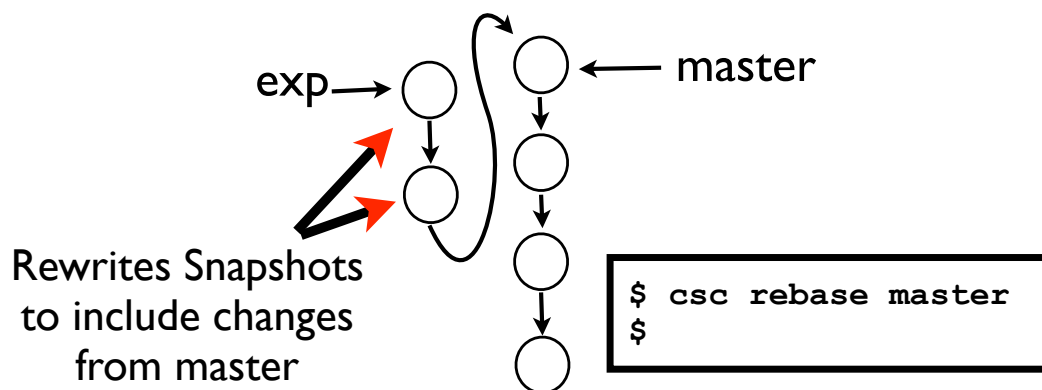
## Rebase



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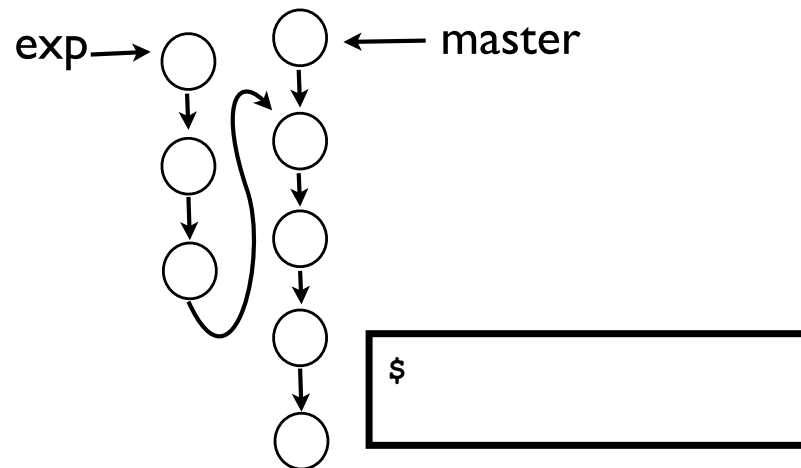
## Rebase



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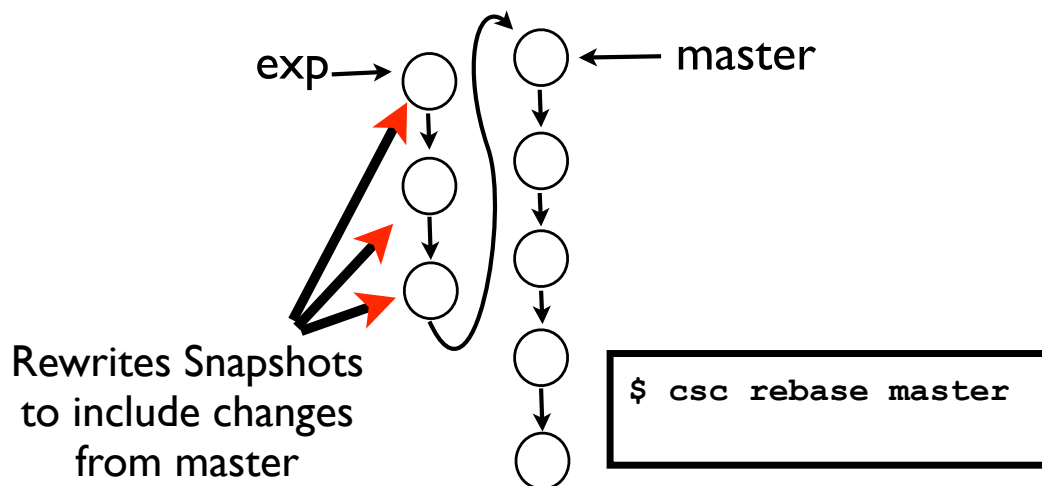
## Rebase



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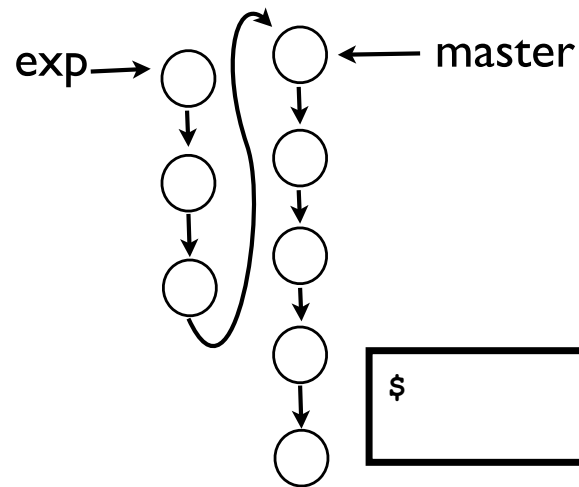
## Rebase



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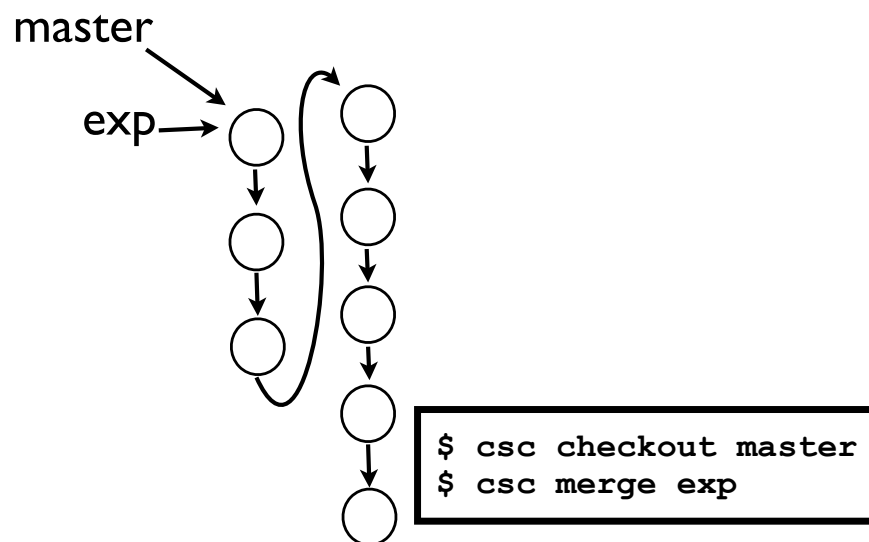
## Rebase



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## Rebase



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# WARNING:

Conflicts may occur during rebase

# WAIT!

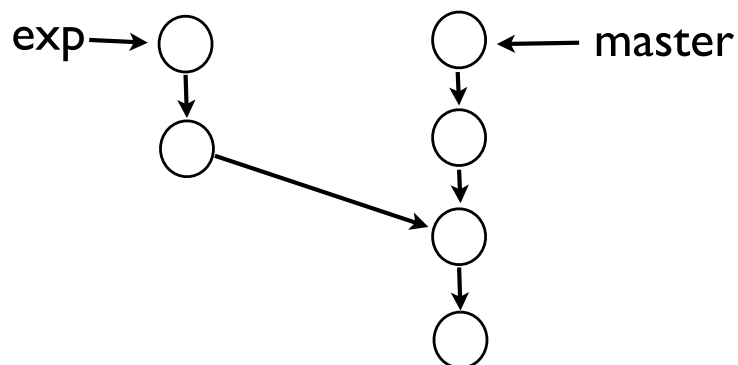
Rebase rewrites history?  
Isn't that dangerous?

# Yes and No

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## Rebase

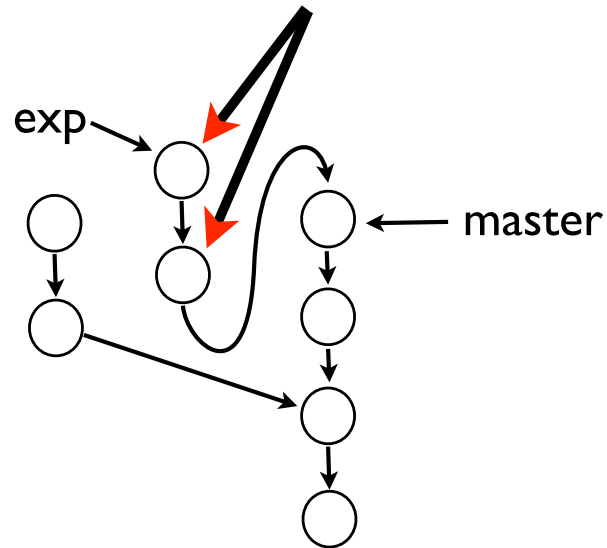


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## Rebase

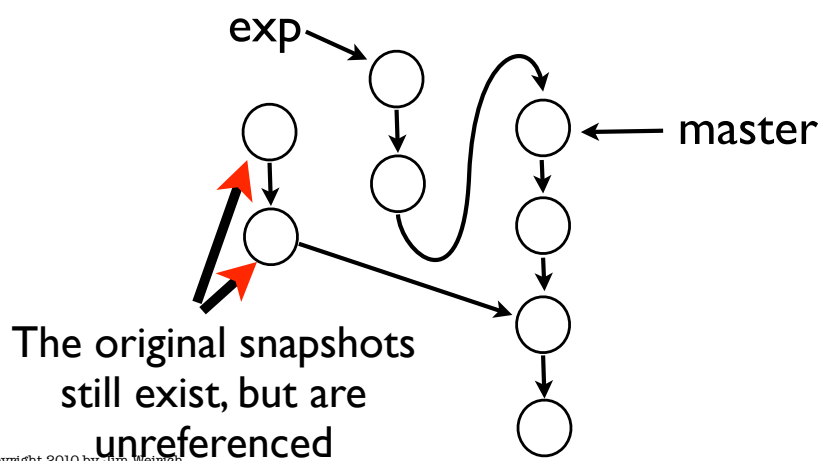
These snapshots are  
rewritten from scratch



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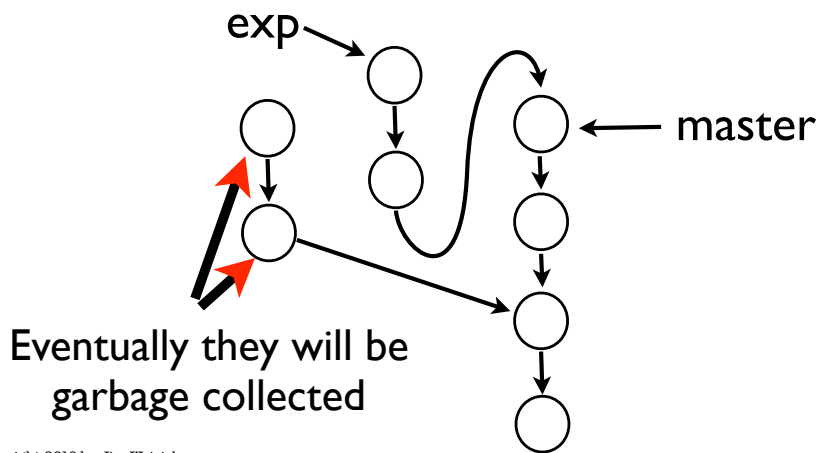
## Rebase



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## Rebase



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## WARNING:

Do **not** rebase shared branches!

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