

# 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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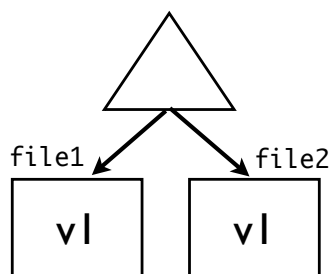
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# In the *Old Days* ...

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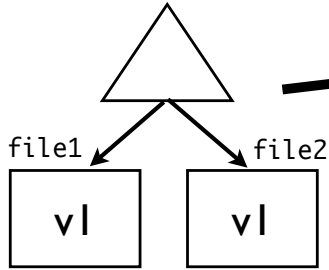
Working  
Directory



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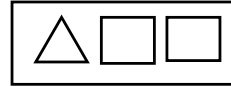
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Working Directory



Project Archive

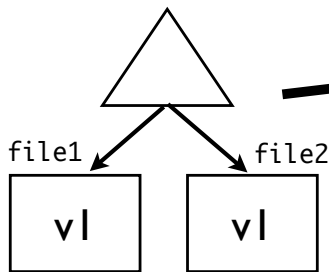
001.tar



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Working Directory



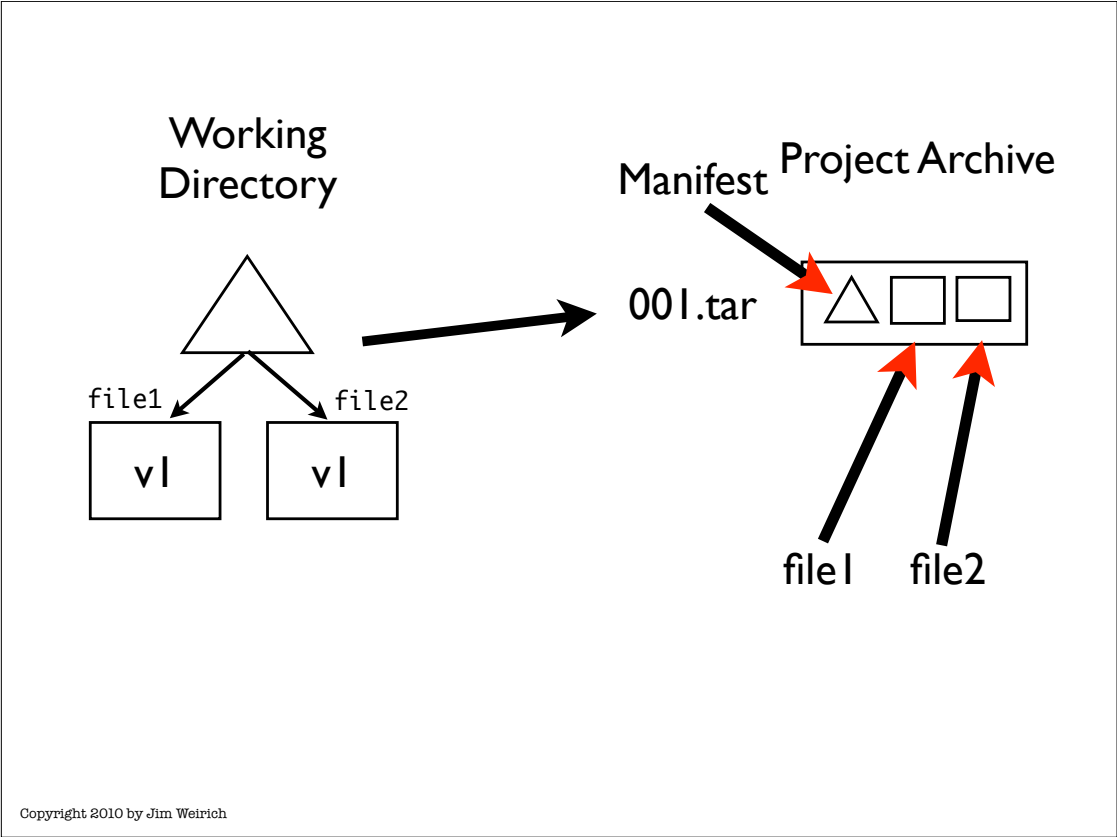
Manifest Project Archive

001.tar

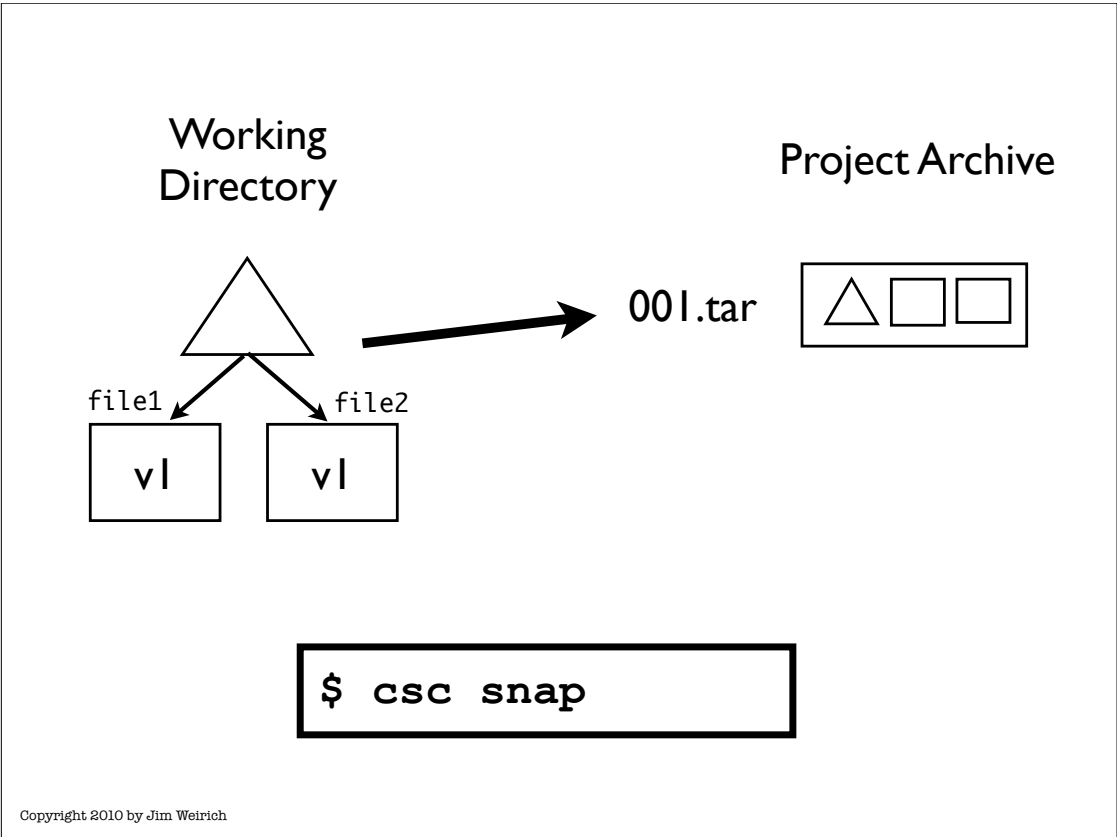


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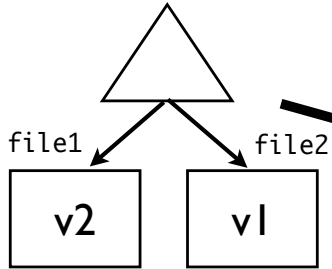


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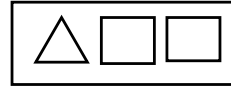
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## Working Directory



## Project Archive

001.tar

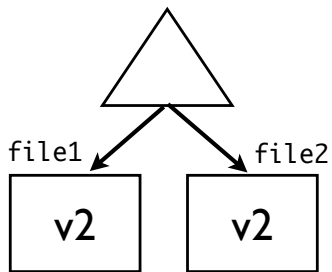


002.tar



```
$ csc snap
```

## Working Directory



## Project Archive

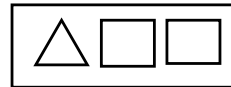
001.tar



002.tar

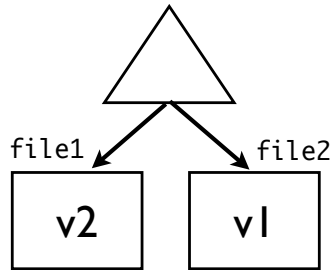


003.tar



```
$ csc snap
```

Working Directory



Project Archive

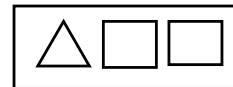
001.tar



002.tar



003.tar



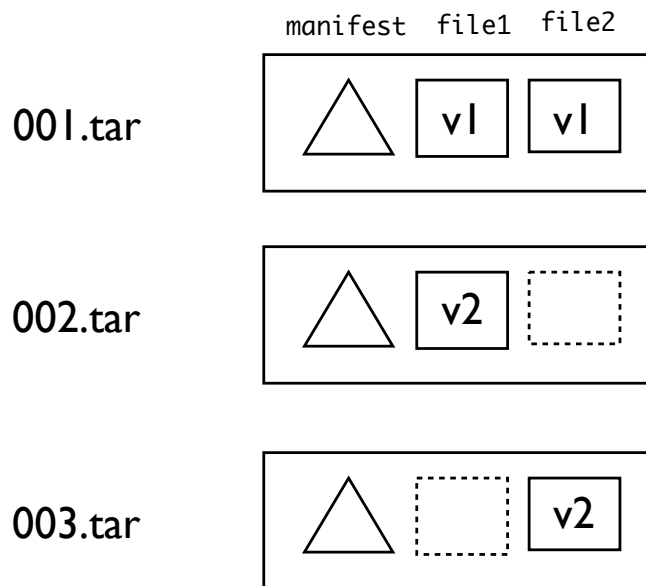
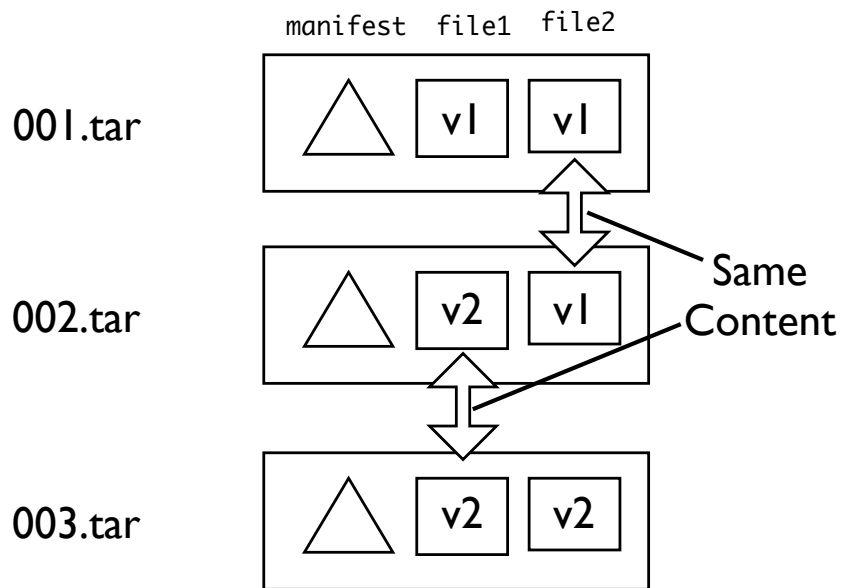
```
$ csc checkout 002
```

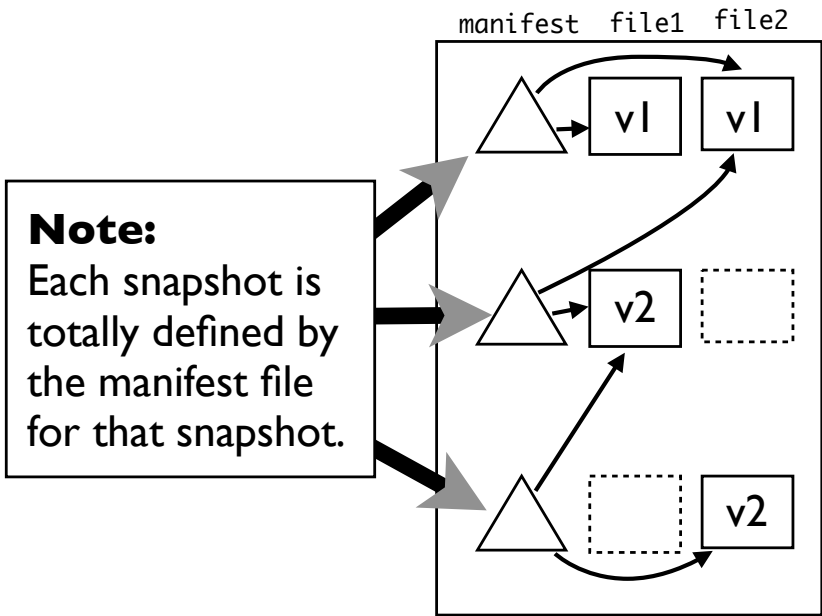
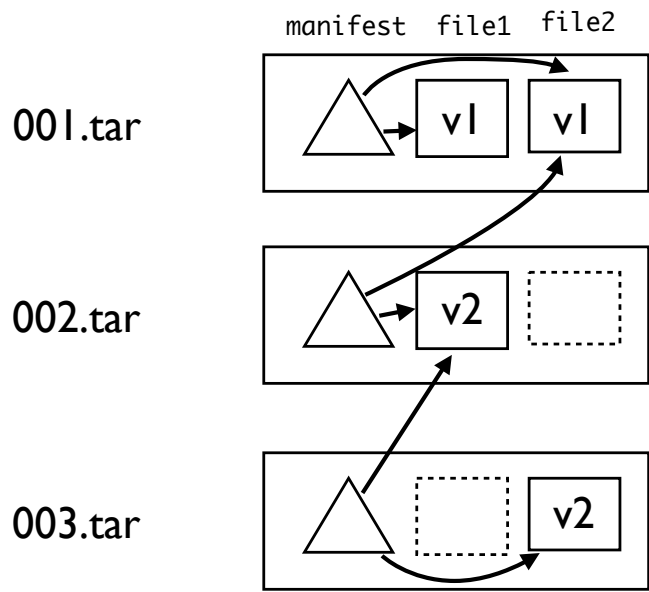
## Two Basic Commands

- Snap
- Checkout

Very Easy /  
Very Simple

Rather Wasteful





**File Name Contents**

manifest	△ / (001)
<b>file1</b>	<input type="checkbox"/> file1 (V1)
file2	<input type="checkbox"/> file2 (V1)
manifest	△ /
manifest	△ /
<b>file1</b>	<input type="checkbox"/> file1 (V2)
file2	<input type="checkbox"/> file2 (V2)

**CONFLICT!**

**File Name Contents**

?	△ / (001)
?	<input type="checkbox"/> file1 (V1)
?	<input type="checkbox"/> file2 (V1)
?	△ /
?	△ /
?	<input type="checkbox"/> file1 (V2)
?	<input type="checkbox"/> 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)

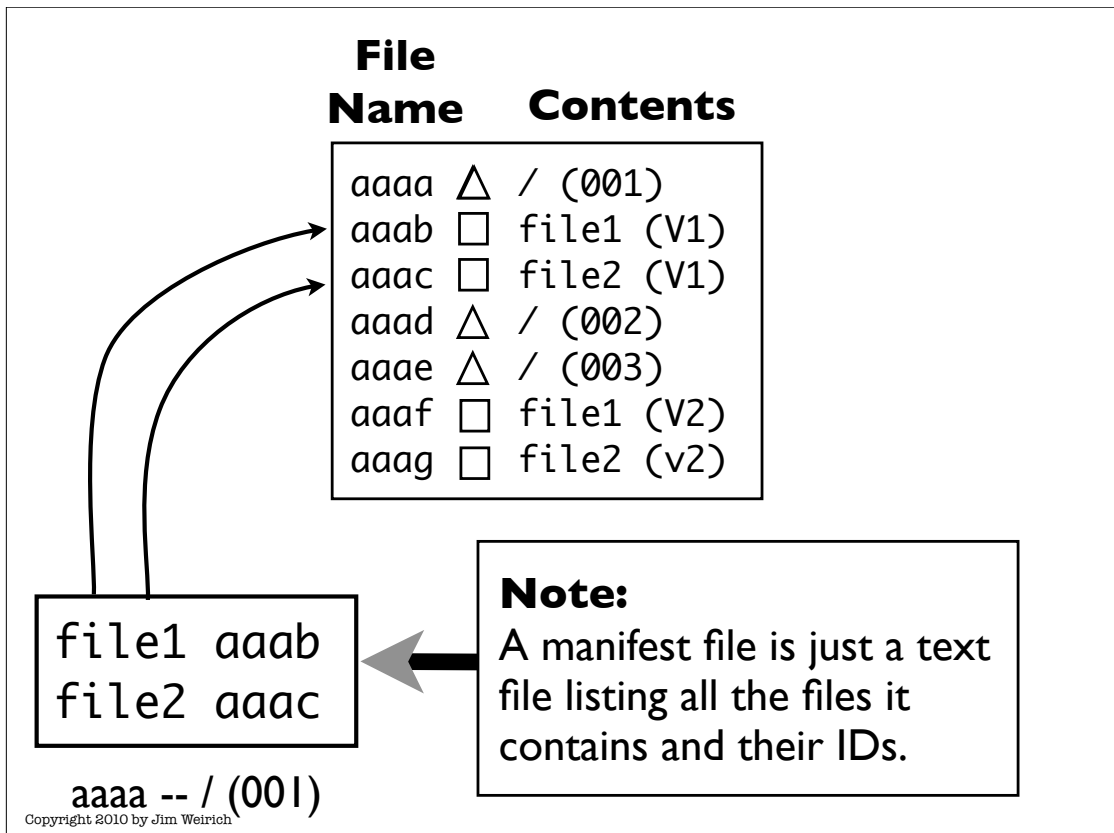
```
$ ls  
aaaa aaab aaac aaad aae aaaf aaag
```

# 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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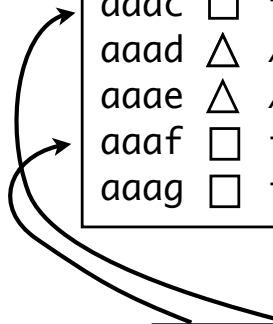


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**File  
Name      Contents**

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

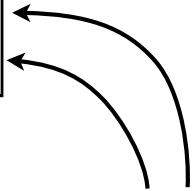


file1	aaaf
file2	aaac

aaad -- / (002)

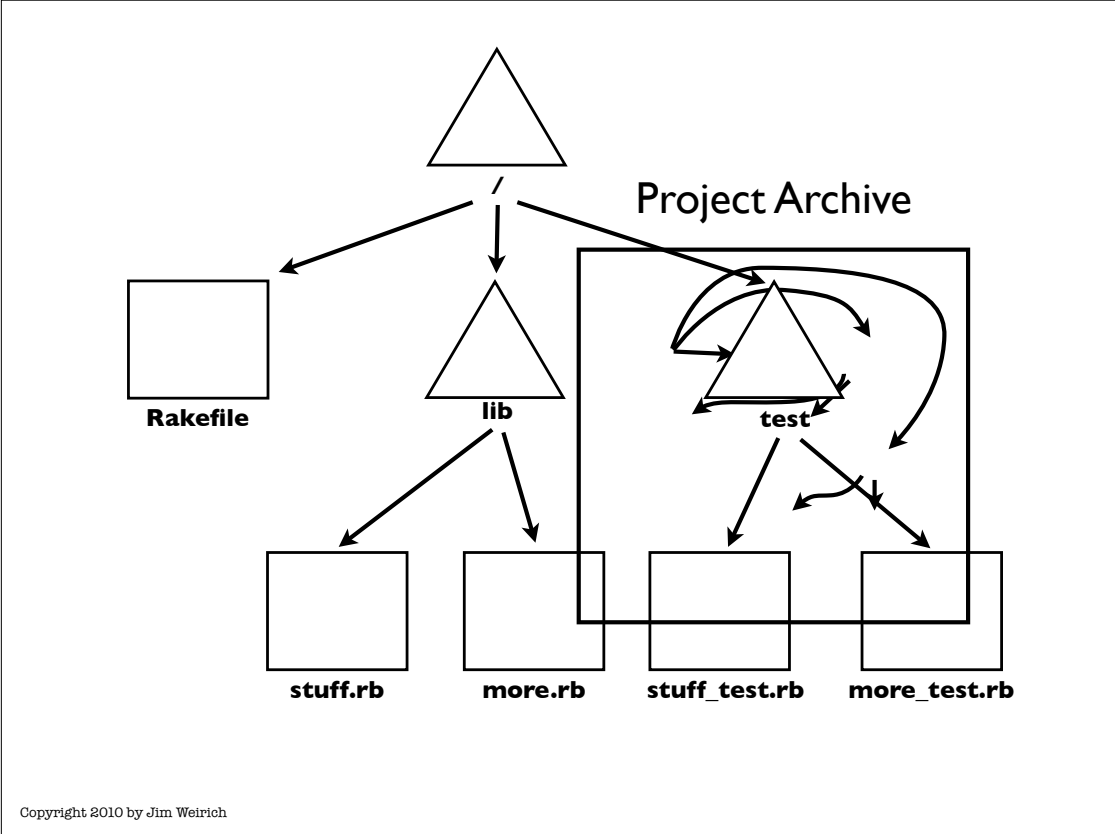
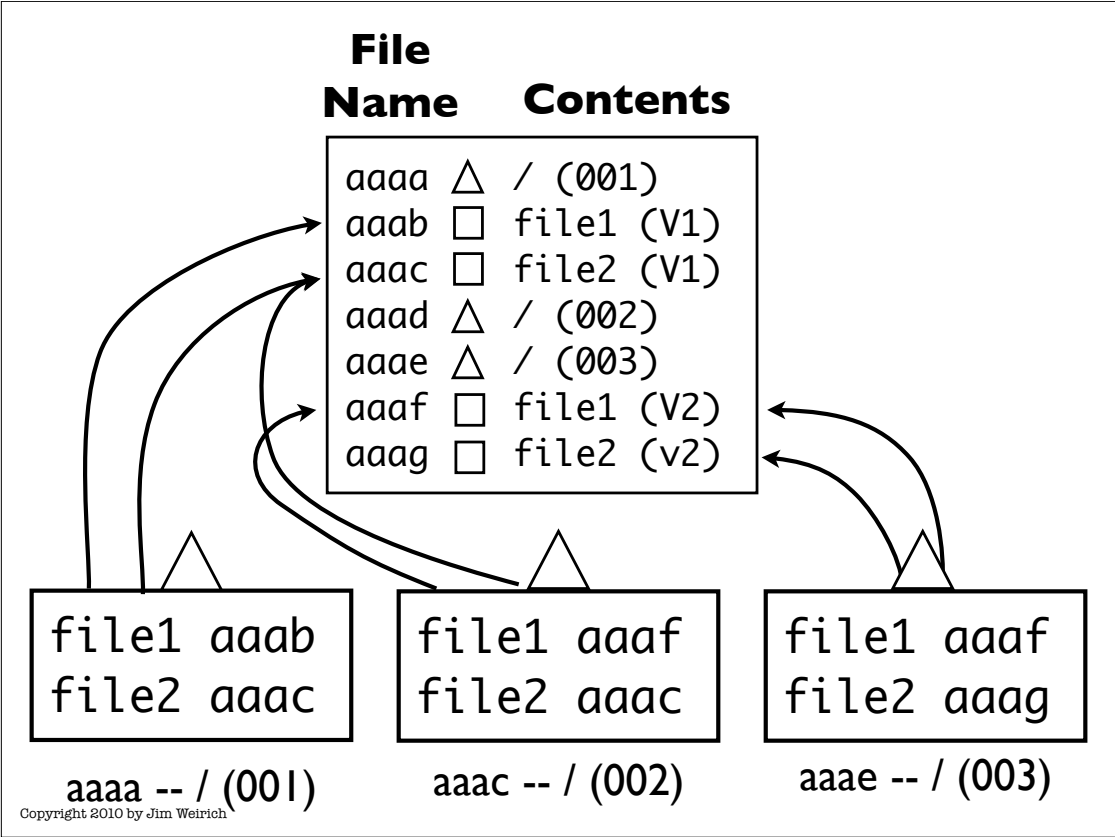
**File  
Name      Contents**

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



file1	aaaf
file2	aaag

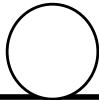
aaae -- / (003)



# Metadata would be nice

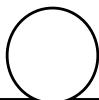
## What Metadata?

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

### Root Manifest for Snapshot



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

## Author & EMail

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

## Time Zone

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

Date/Time  
(seconds since 1970)

○

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

Comments describing this snapshot.

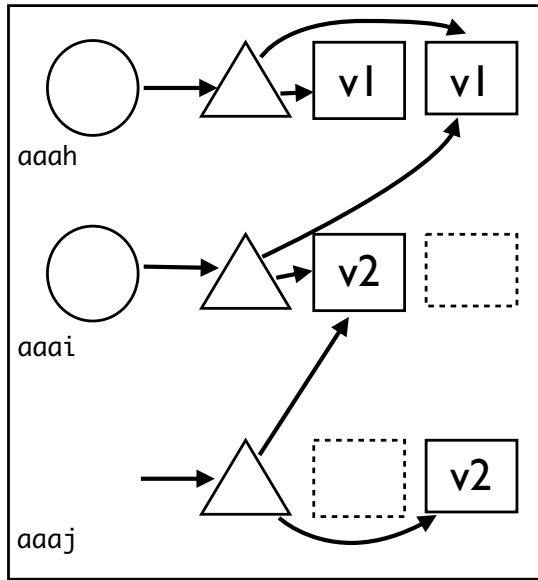
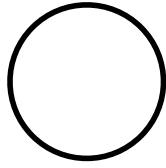
↗  
Comment

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○

```
tree aaaa
author Jim [redacted] 1246996320 -0400
[redacted]
Comments describing this snapshot.
```

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

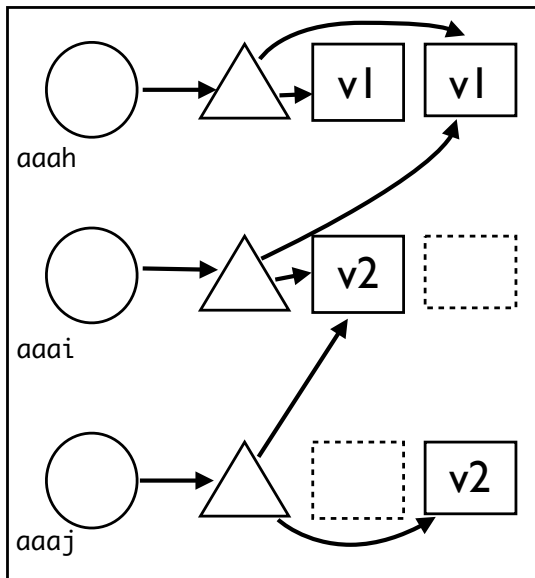
Comments describing this snapshot.

previous snapshot

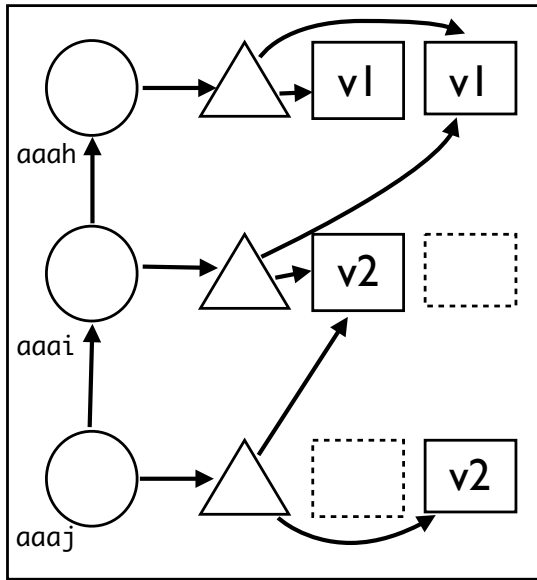
```
tree aaaa  
parent aaai  
author Jim <me@email.com> 1246996320 -0400
```

Comments describing this snapshot.

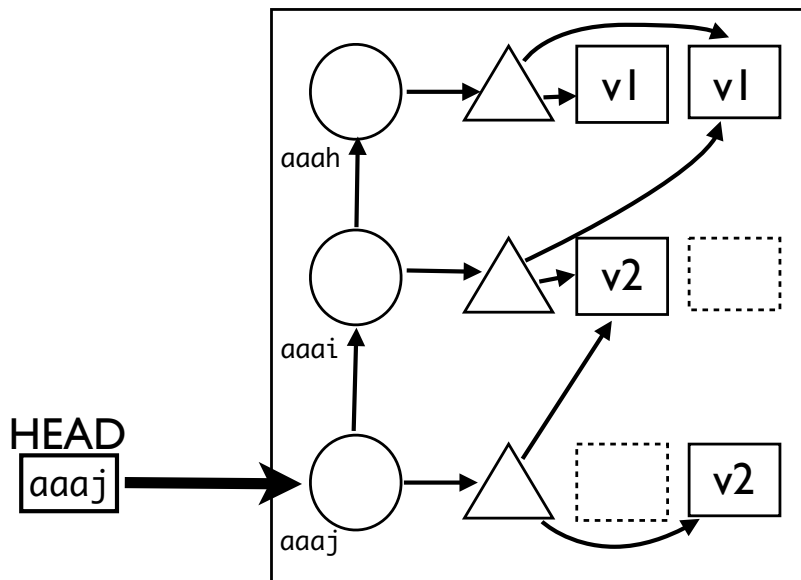
### Project Archive



# Project Archive

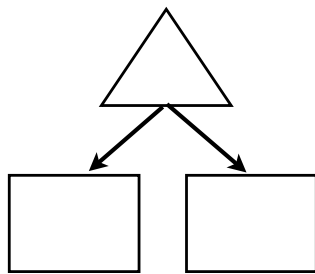


# Project Archive



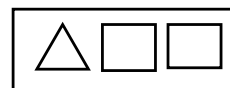
# Summary So Far ...

Working  
Directory

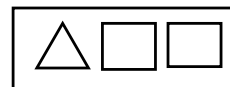


Project Archive

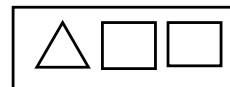
001.tar



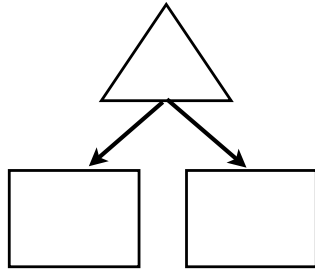
002.tar



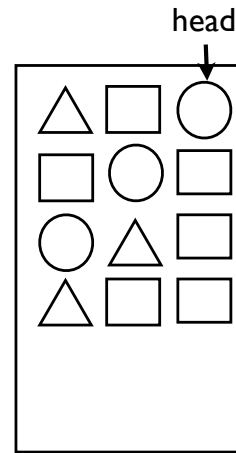
003.tar



## Working Directory



## Project Archive



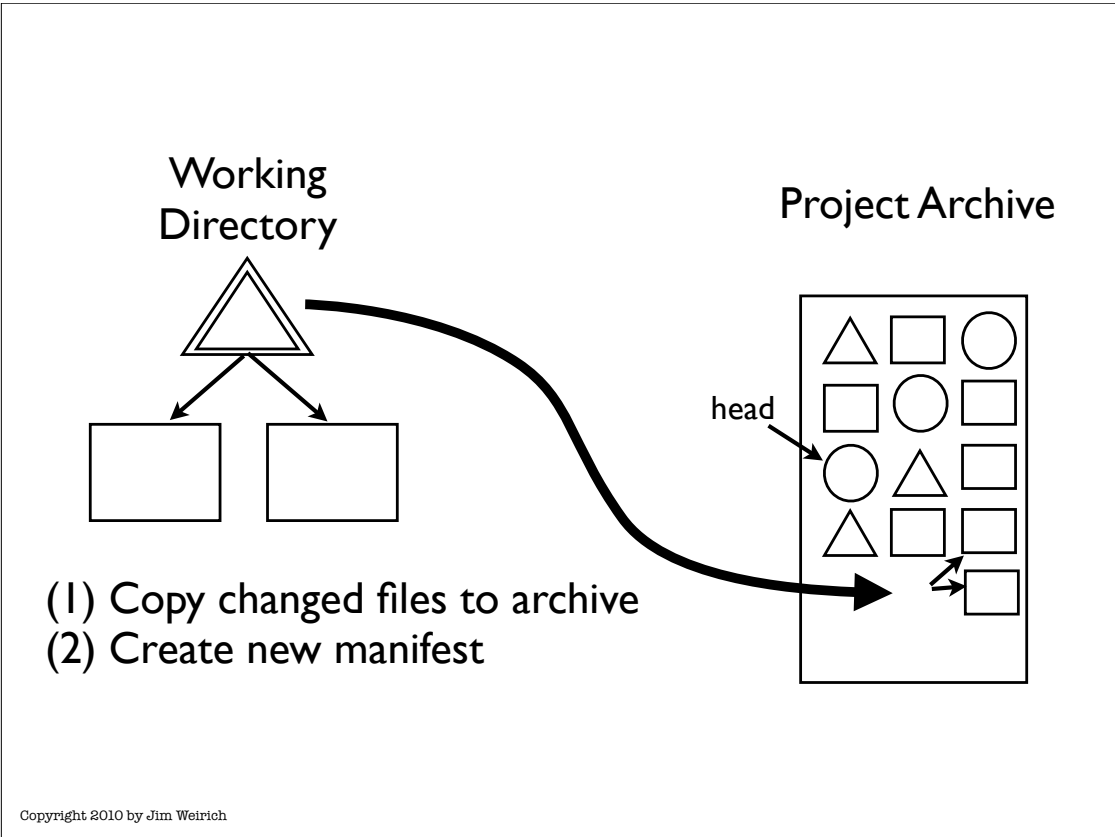
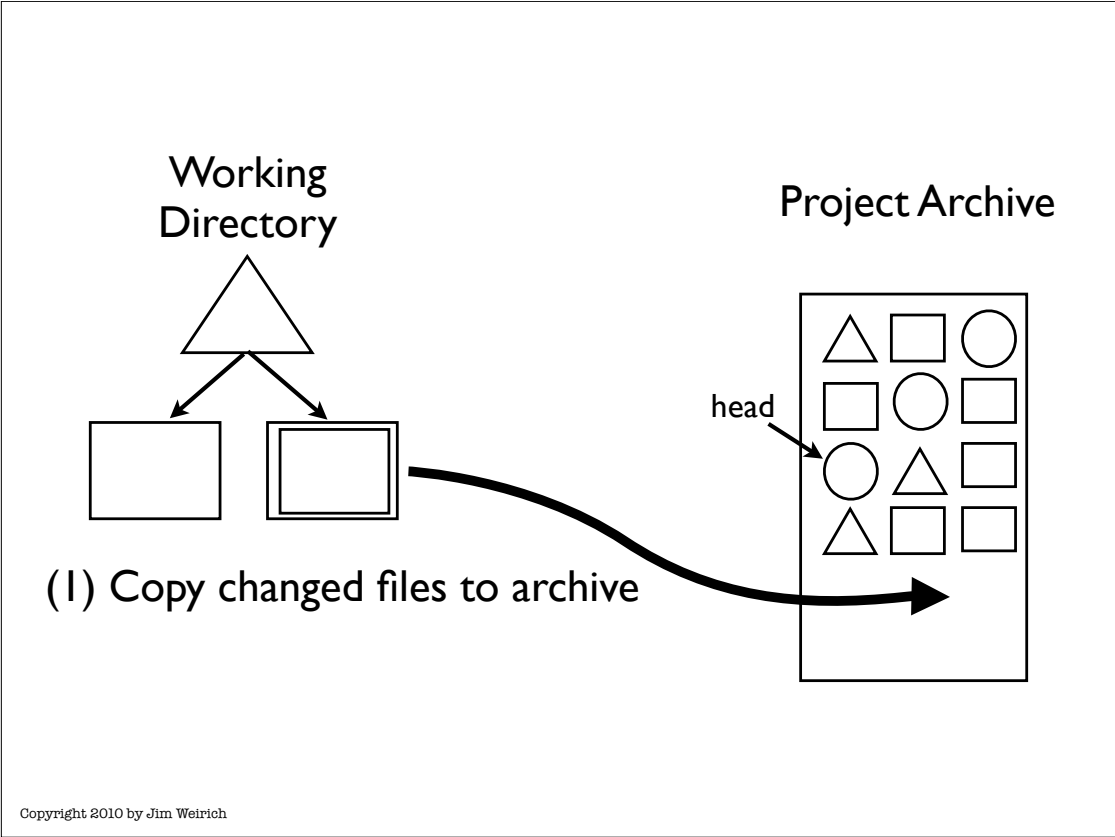
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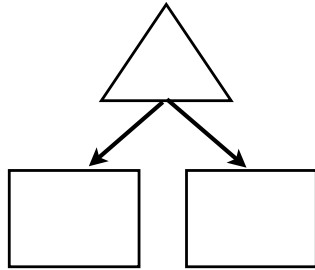
How do we create a  
snapshot now?

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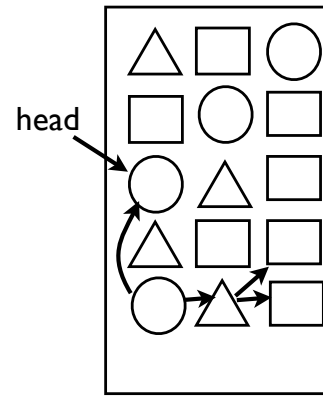


## Working Directory



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

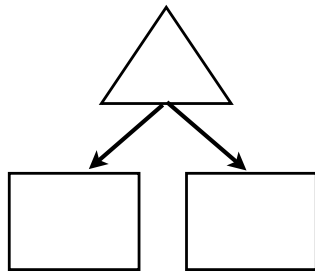
## Project Archive



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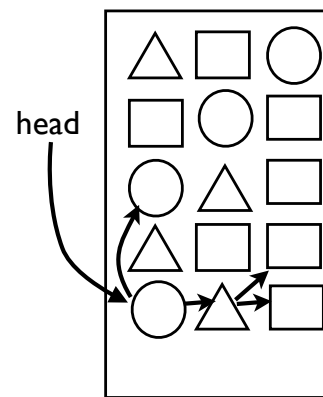
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## Working Directory



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

## Project Archive



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Work  
Direct

**Note:**  
The Project Archive  
is always *additive*.  
Information is never  
destroyed.

Project Archive

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

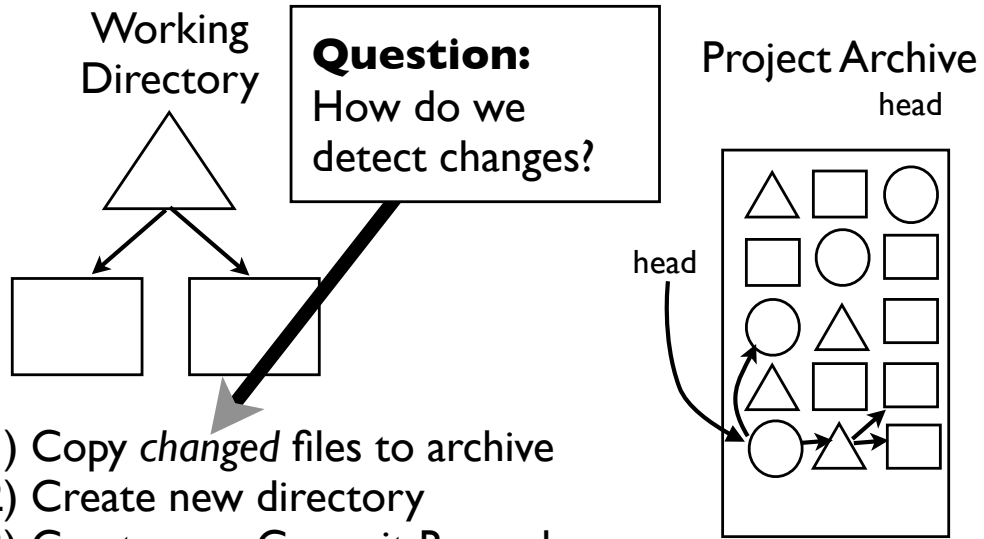
Copyright 2010 by Jim Weirich

Working  
Directory

Project Archive

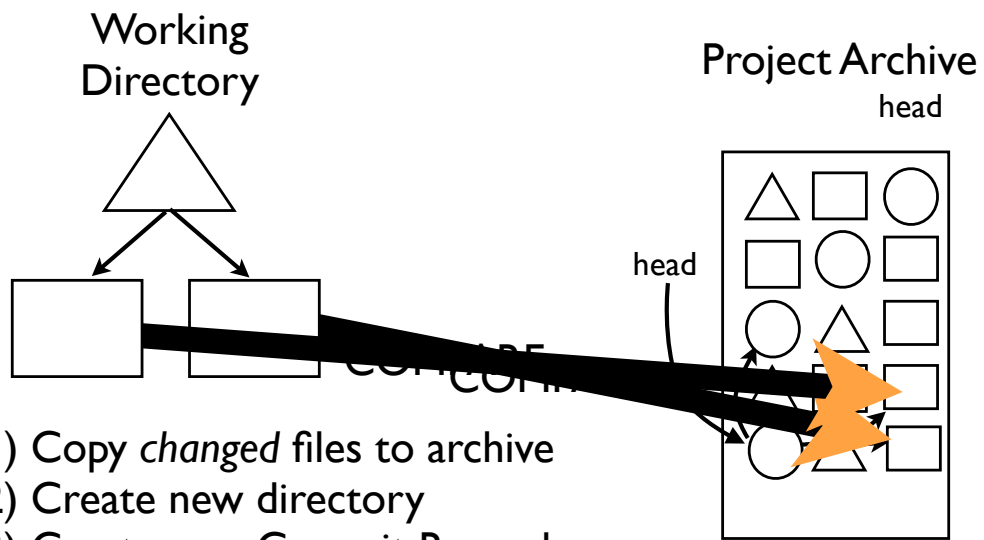
- (1) Copy changed files to archive
- (2) Create new manifest
- (3) Create new snapshot record
- (4) Readjust HEAD

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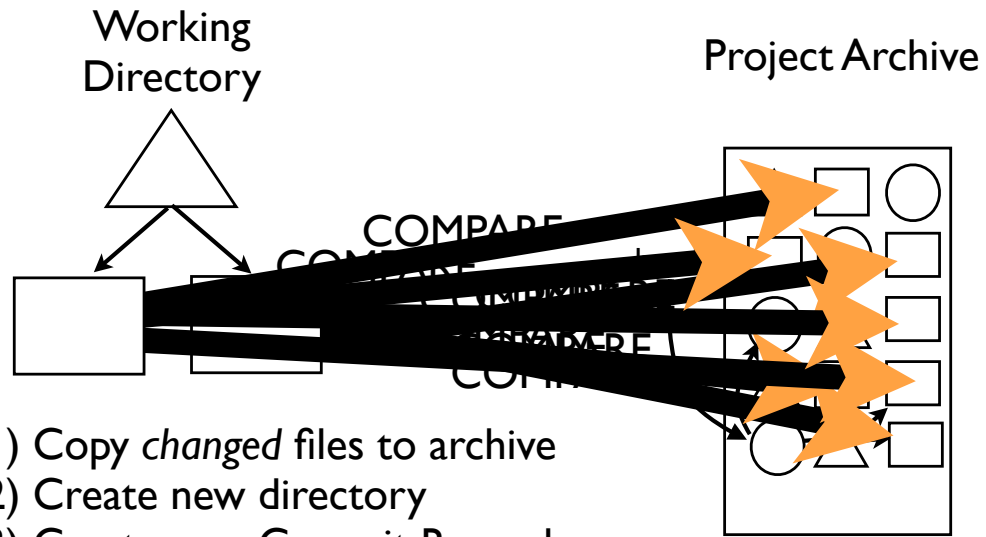
- (1) Copy *changed* files to archive
- (2) Create new directory
- (3) Create new Commit Record
- (4) Readjust HEAD

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- (1) Copy *changed* files to archive
- (2) Create new directory
- (3) Create new Commit Record
- (4) Readjust HEAD

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- (1) Copy *changed* files to archive
- (2) Create new directory
- (3) Create new Commit Record
- (4) Readjust HEAD

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# Detecting Duplication

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file.txt

Hi, my name is Bob.

SHA1

"55dc96ede241511e35f1973957bbd51f37f3762b"

file.txt

Hi, my name is Joe.

SHA1

~~"55dc96ede241511e35f1973957bbd51f37f3762b"~~

"53f2509e877de3cad85c547a0c2a22b43c5d81eb"

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	□

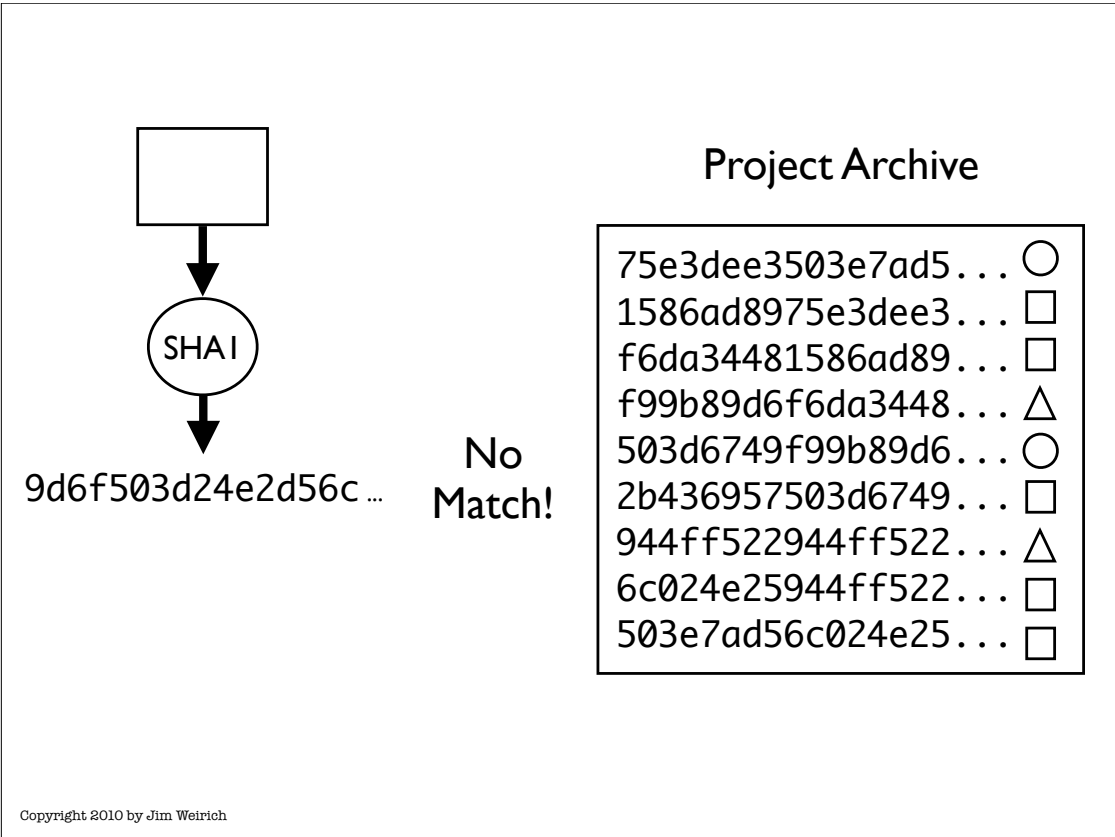
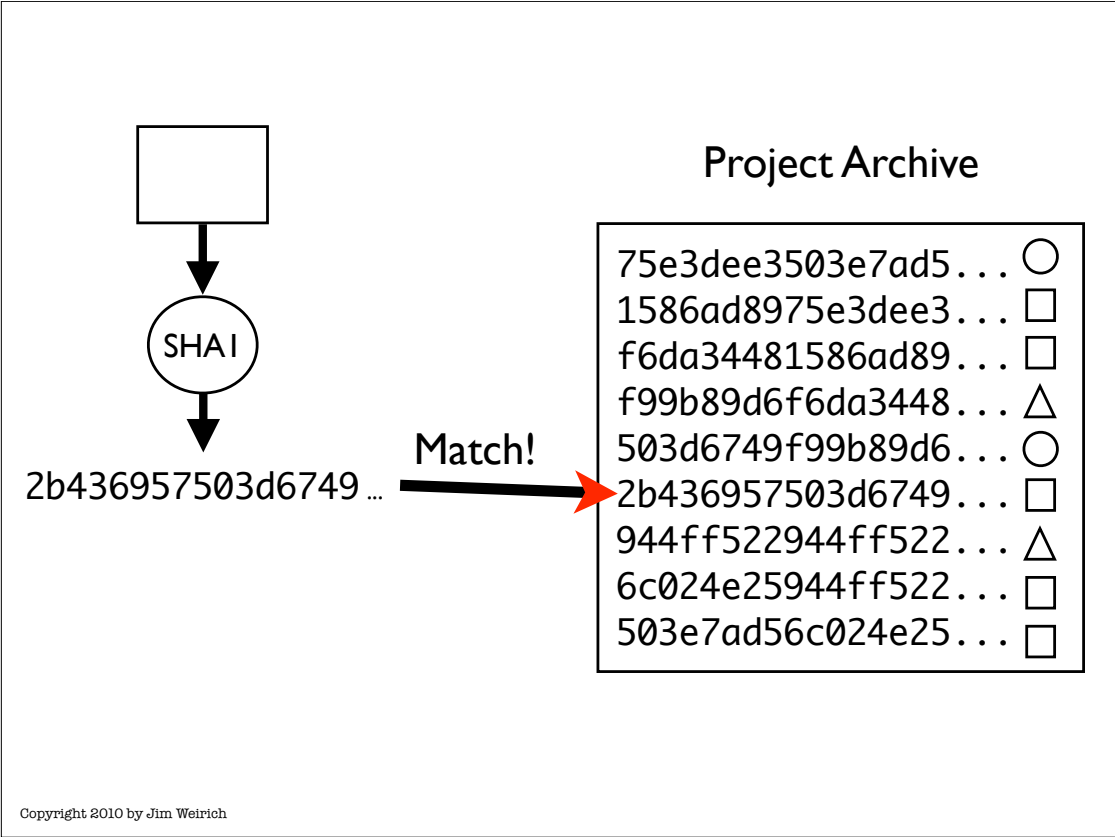
# Project Archive

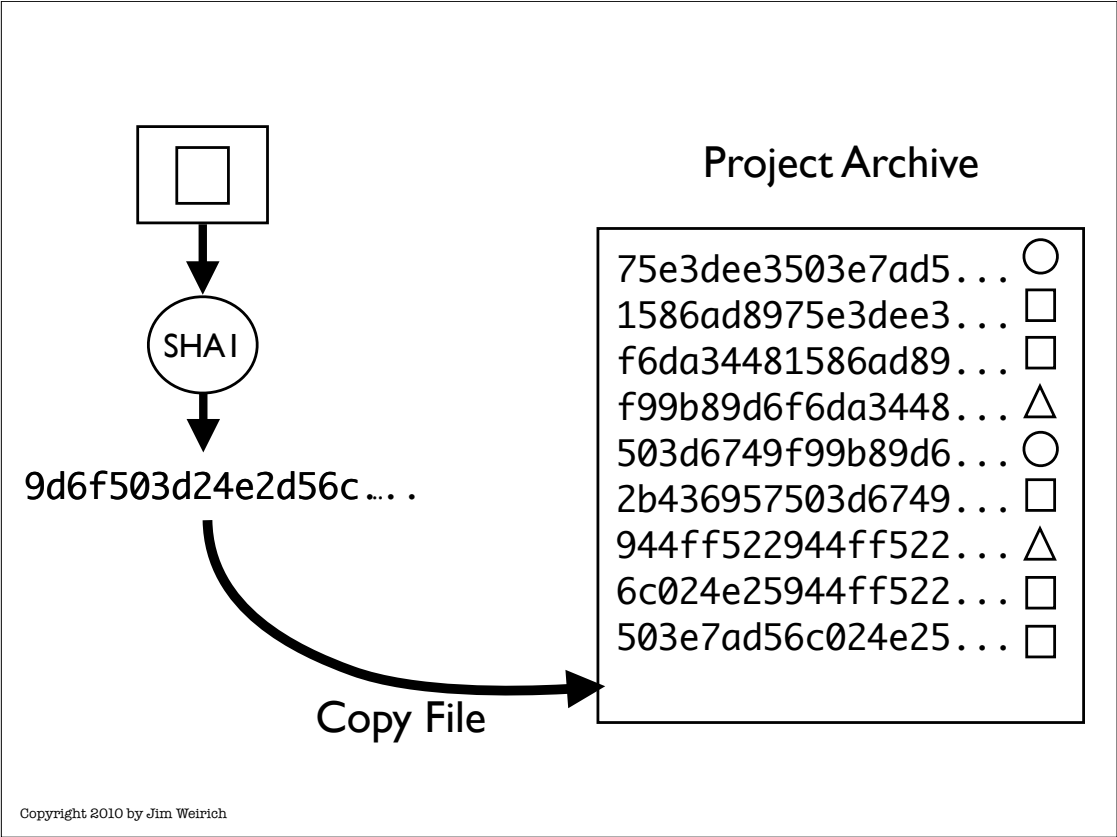
- 75e3dee3503e7ad5... ○
- 1586ad8975e3dee3... □
- f6da34481586ad89... □
- f99b89d6f6da3448... △
- 503d6749f99b89d6... ○
- 2b436957503d6749... □
- 944ff522944ff522... △
- 6c024e25944ff522... □
- 503e7ad56c024e25... □

# Project Archive

HEAD

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

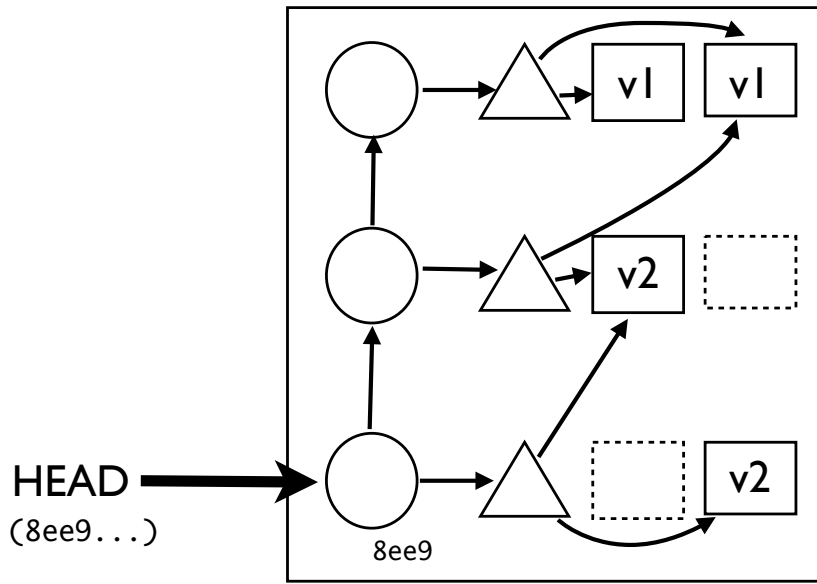




# Project Archive Integrity

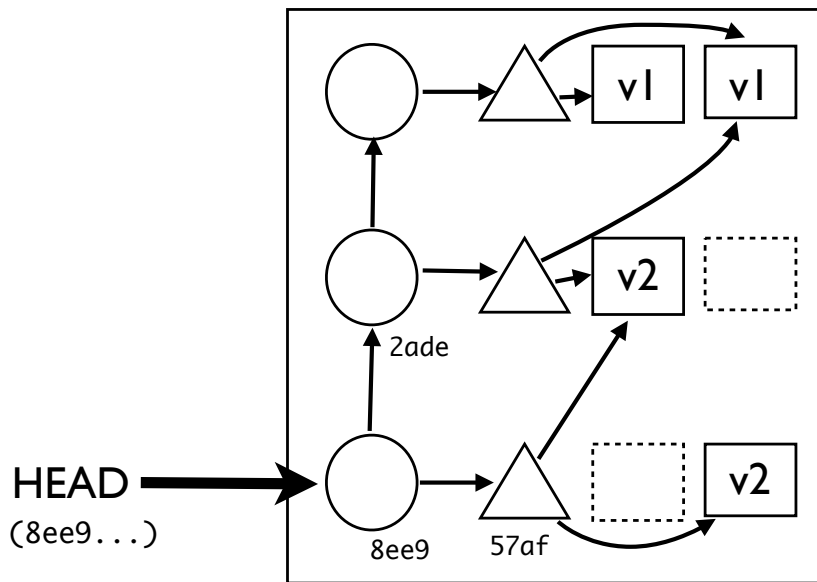
Copyright 2010 by Jim Weirich

# Project Archive



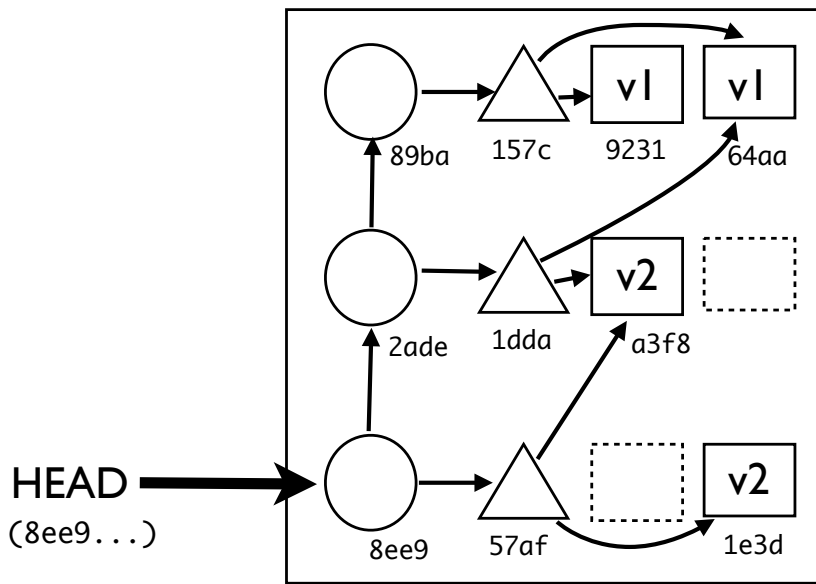
Copyright 2010 by Jim Weirich

# Project Archive



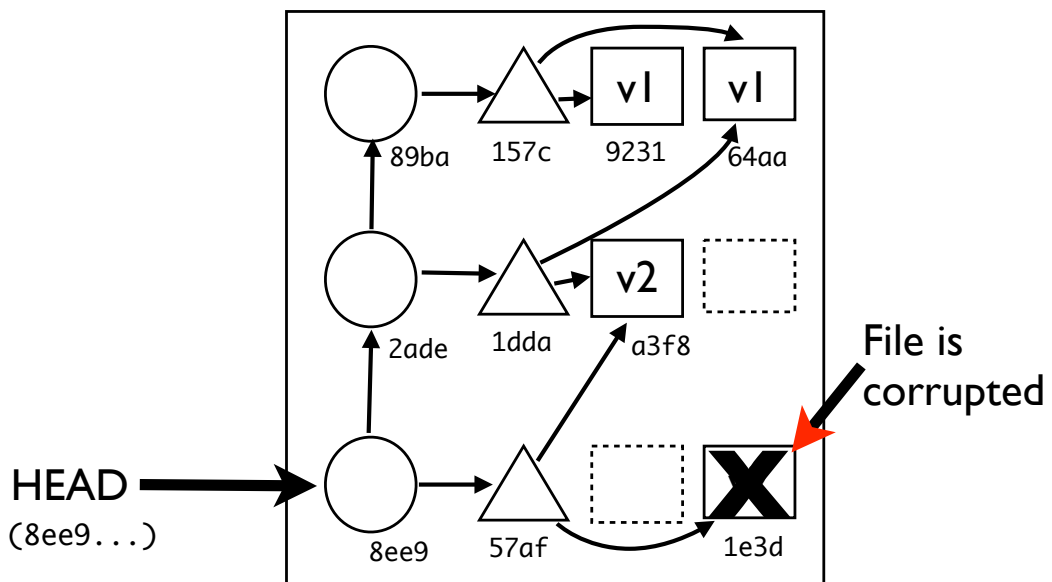
Copyright 2010 by Jim Weirich

# Project Archive



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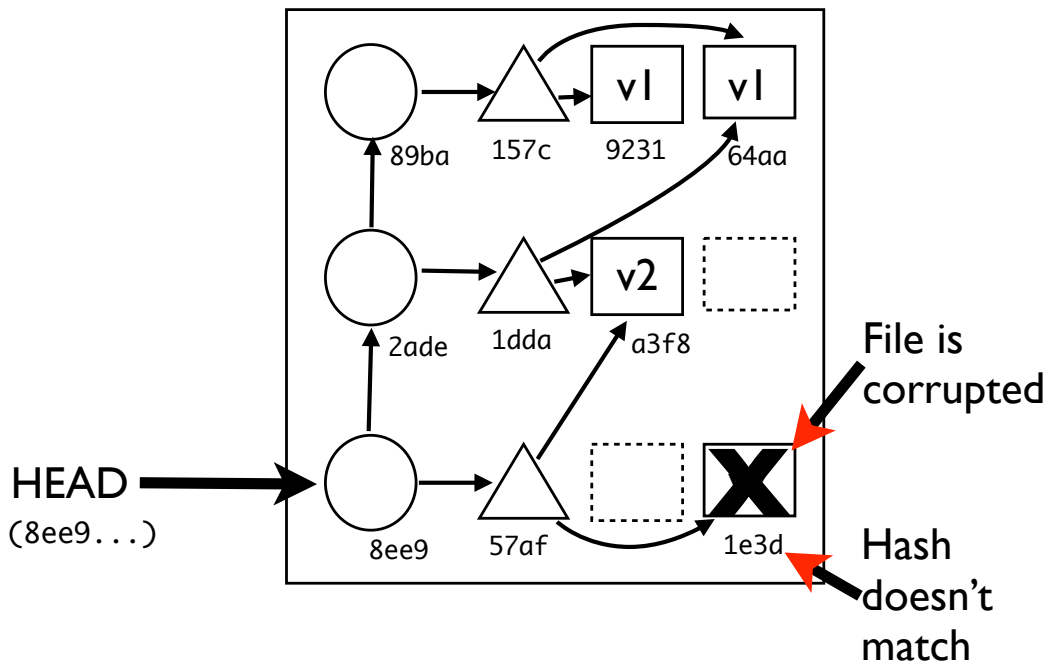
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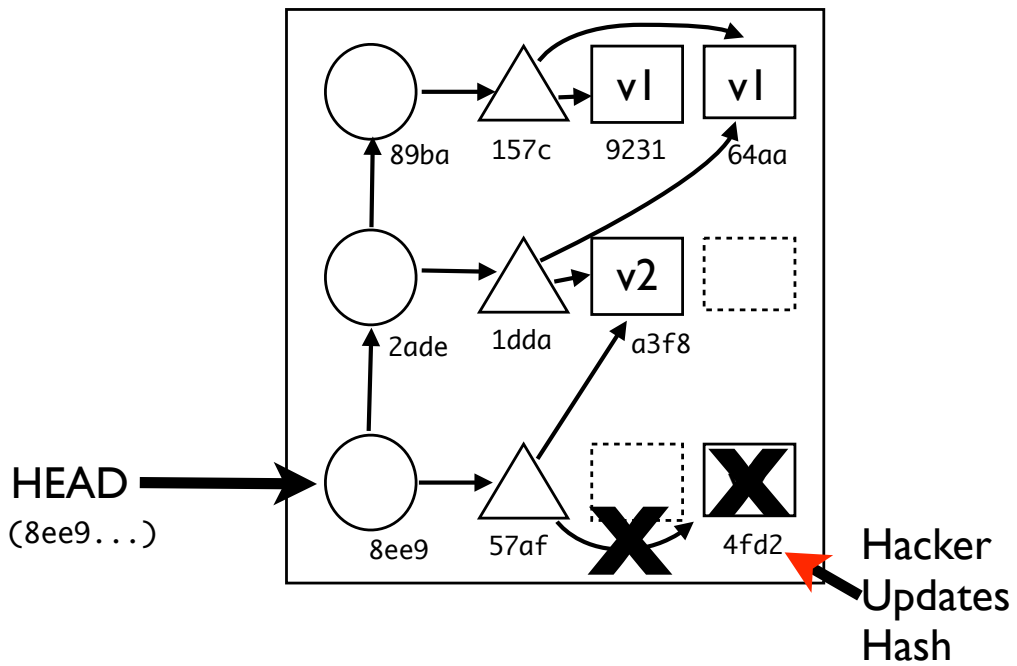
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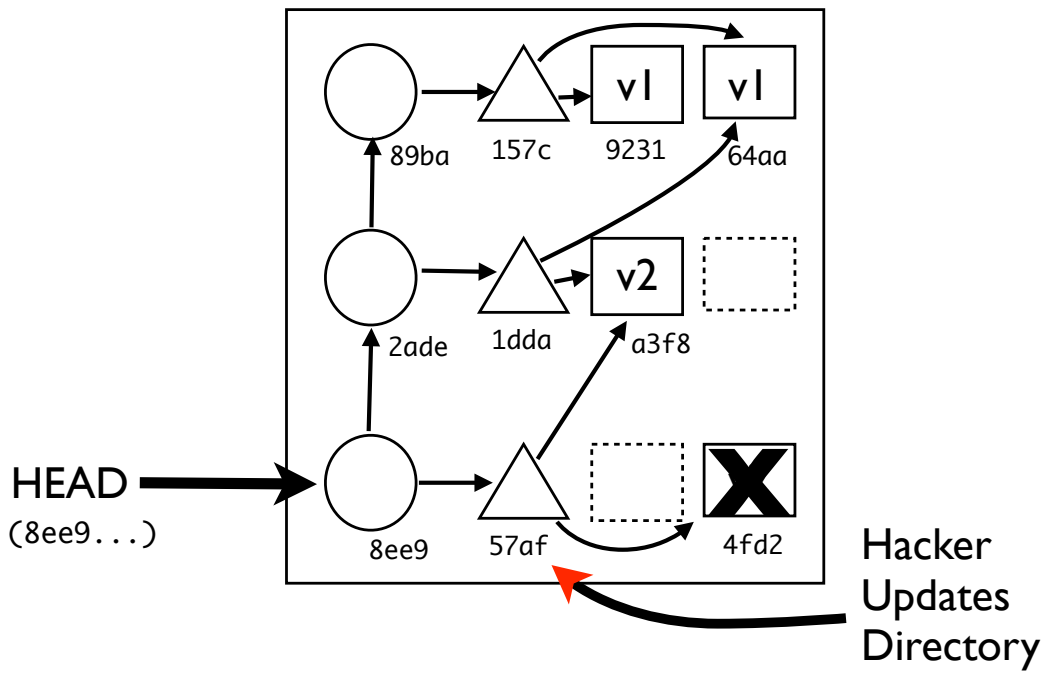
# Project Archive



# Project Archive



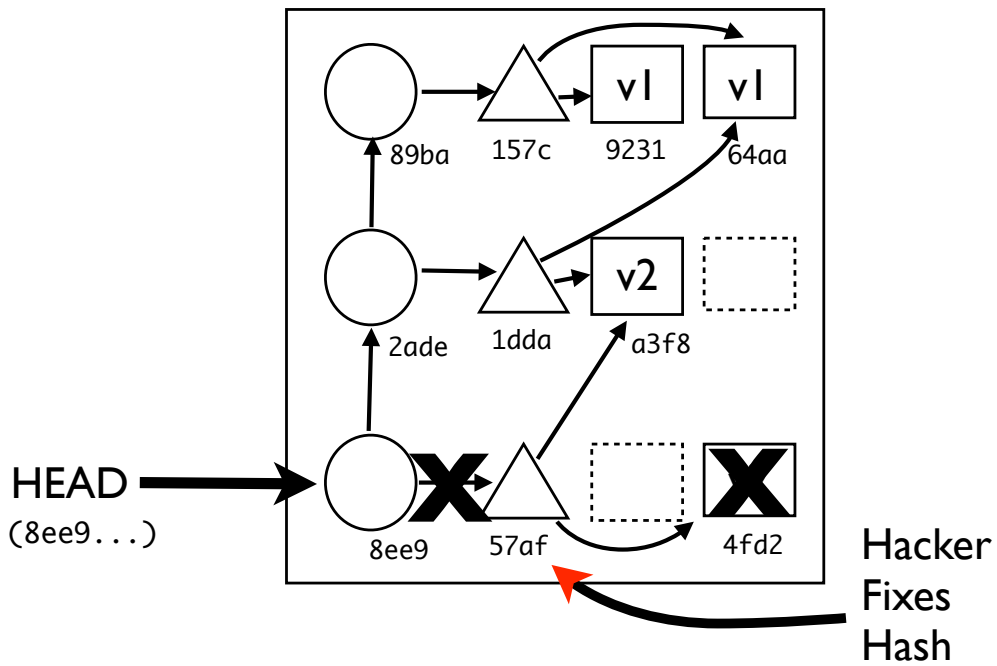
# Project Archive



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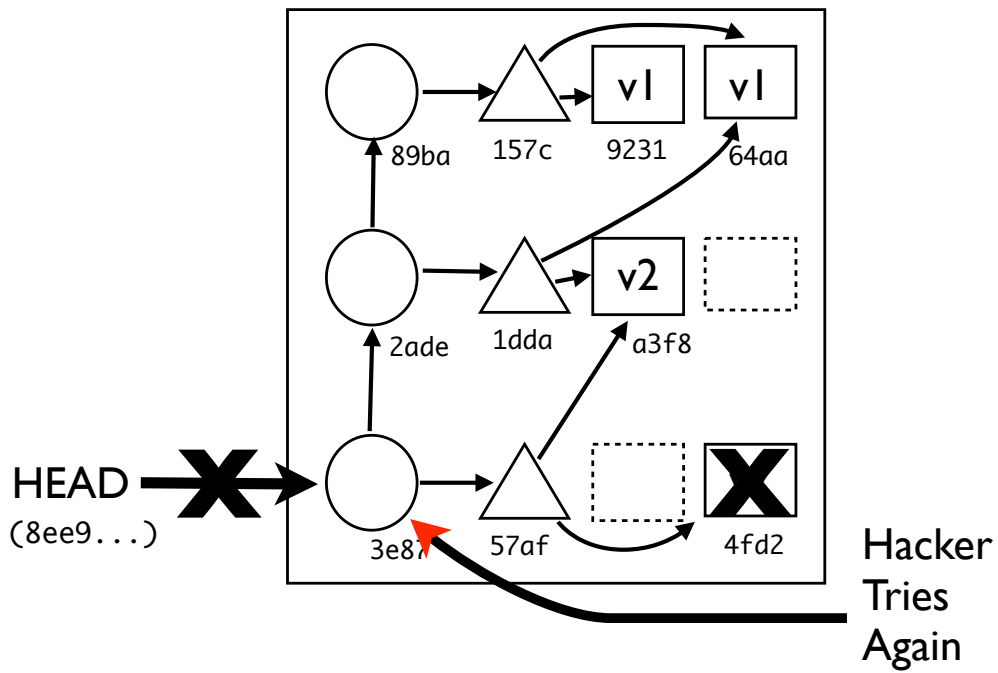
# Project Archive



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## Project Archive



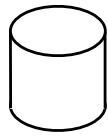
Copyright 2010 by Jim Weirich

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## Tracking Snapshots

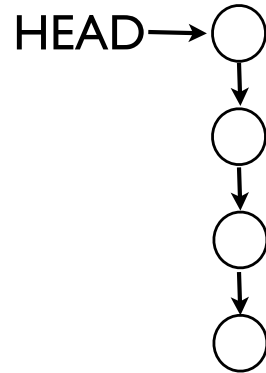
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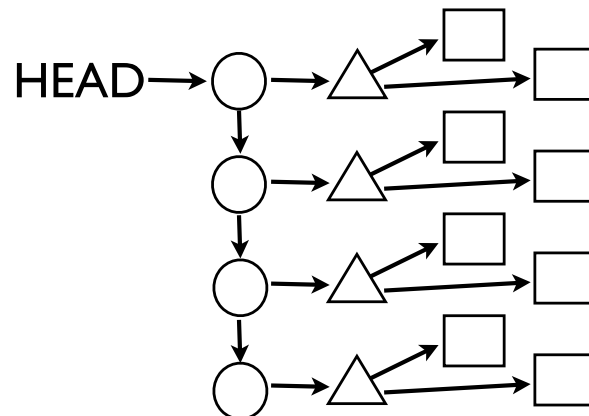


Need to keep track of  
versions by name.

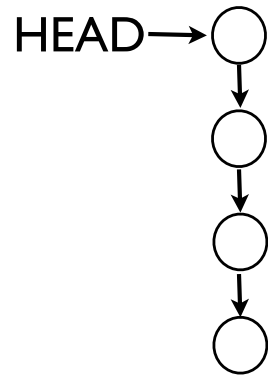
# Project Archive (snapshots only)



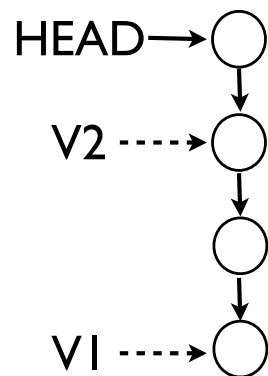
# Project Archive



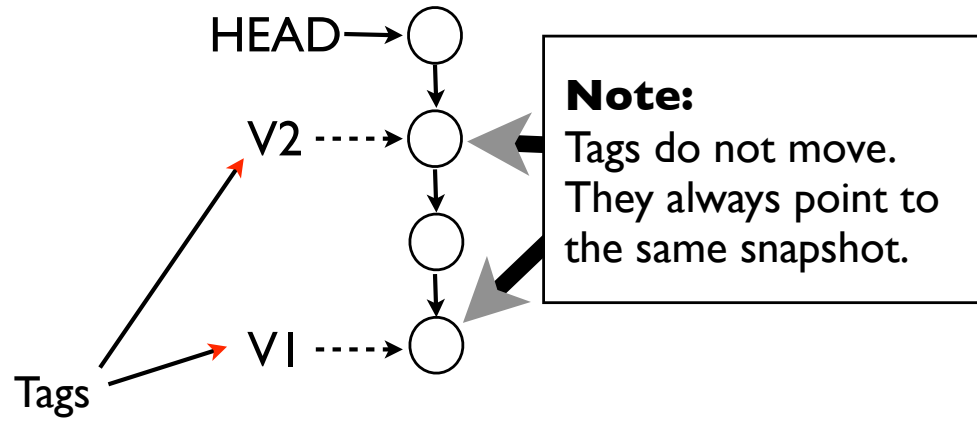
## Project Archive (snapshots only)



## Project Archive (snapshots only)



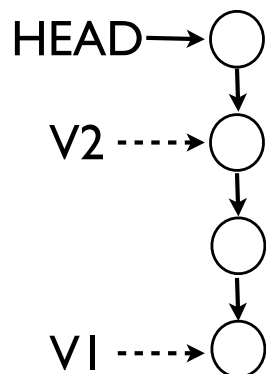
## Project Archive (snapshots only)



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## Project Archive (snapshots only)

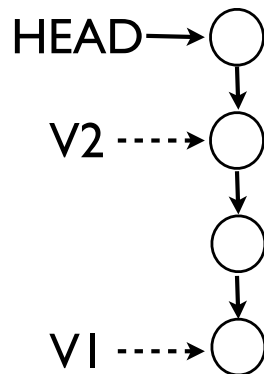


Copyright 2010 by Jim Weirich

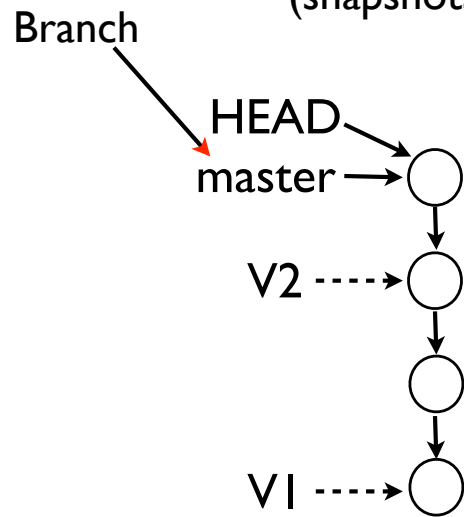
96

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

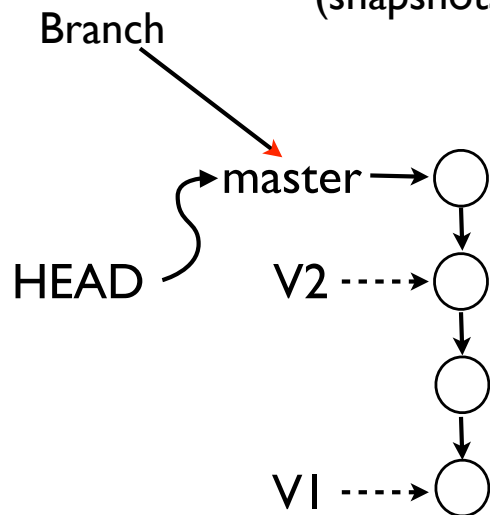
Project Archive  
(snapshots only)



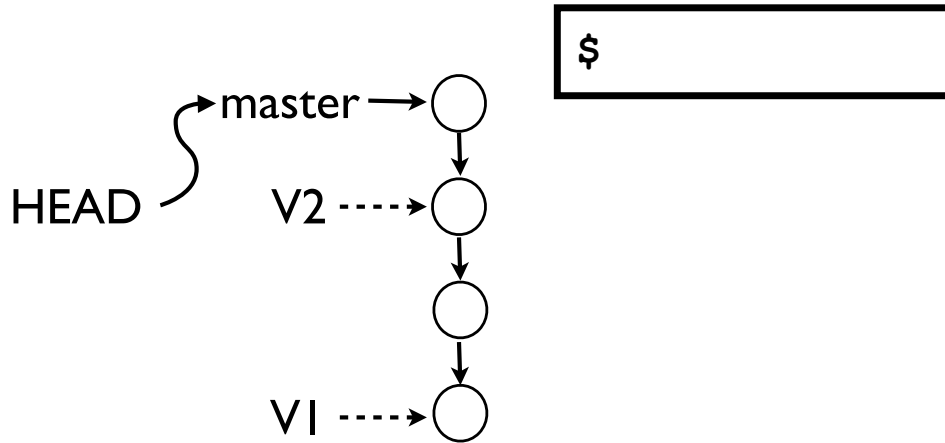
Project Archive  
(snapshots only)



Project Archive  
(snapshots only)



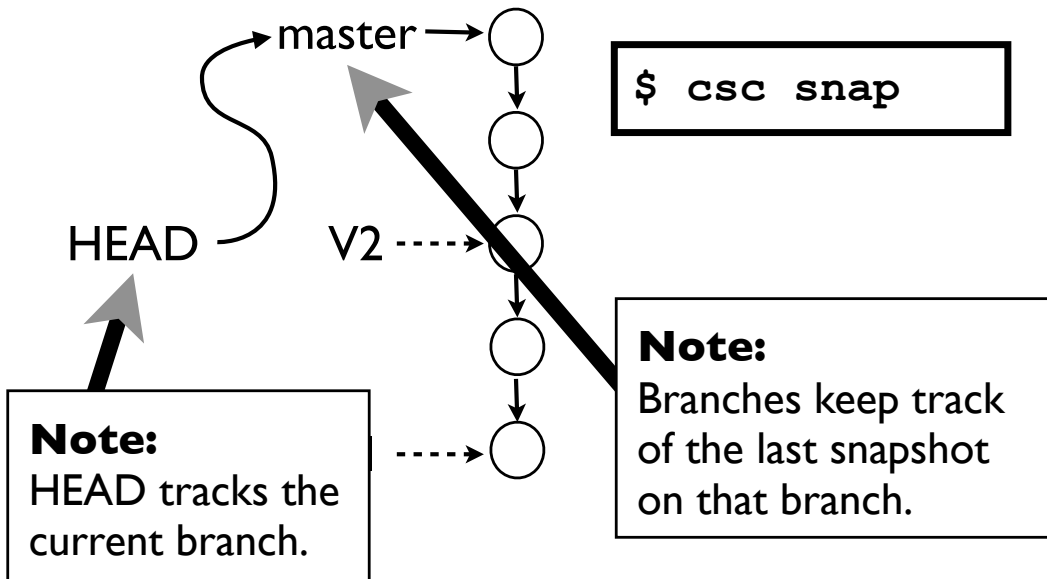
# Project Archive (snapshots only)



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# Project Archive (snapshots only)

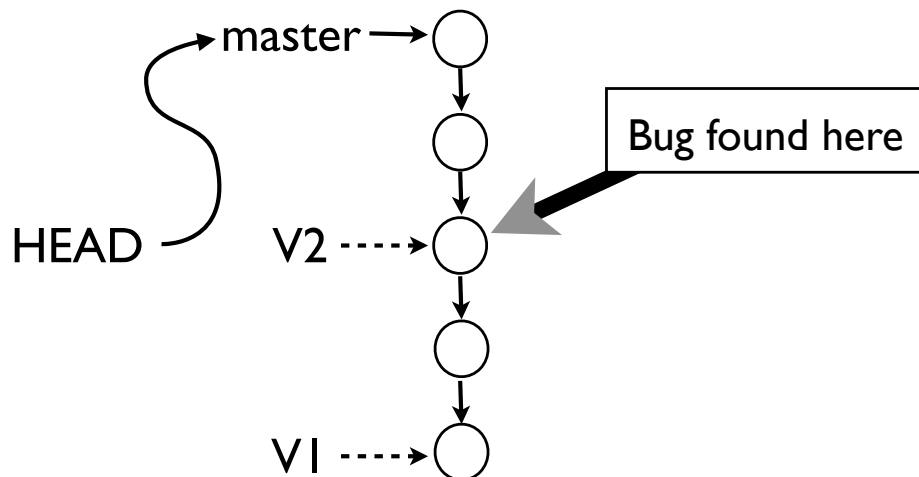


Copyright 2010 by Jim Weirich

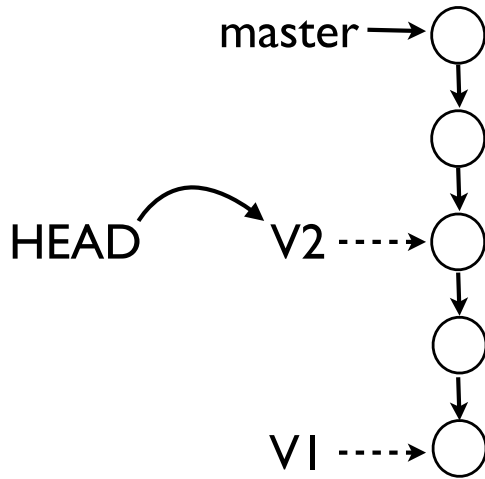
102

# Oops! We found a bug

## Project Archive

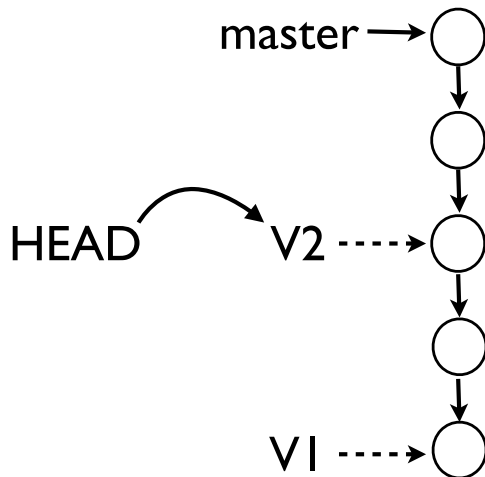


# Project Archive



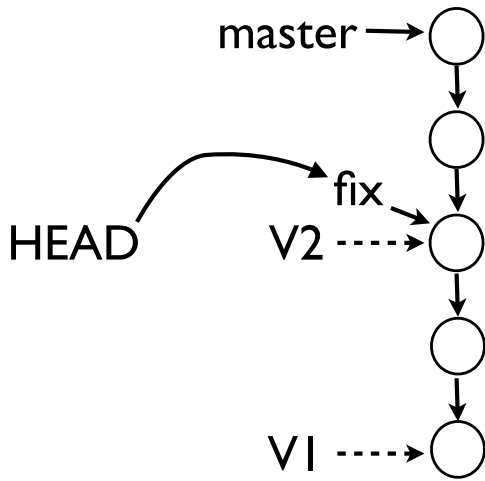
```
$ csc checkout V2
```

# Project Archive



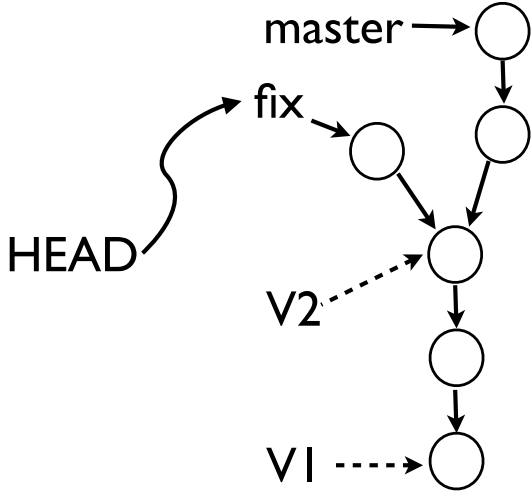
```
$ csc checkout V2  
$ edit files
```

# Project Archive



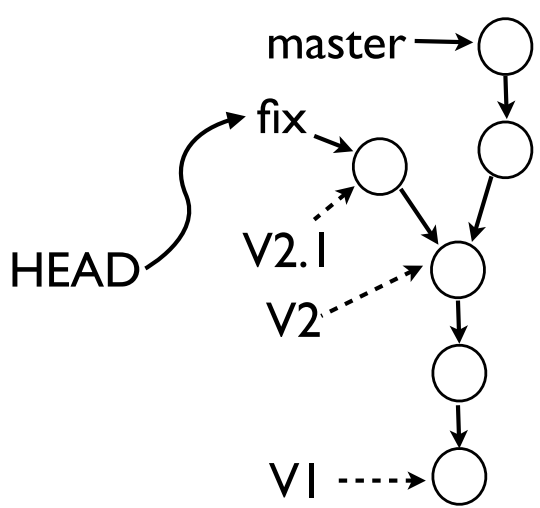
```
$ csc checkout V2  
$ edit files  
$ csc branch fix
```

# Project Archive



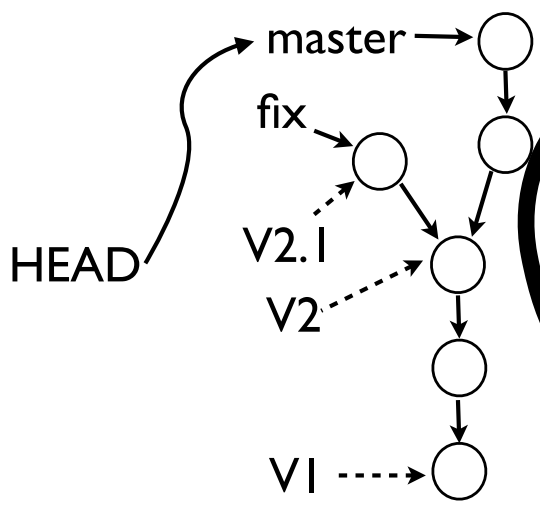
```
$ csc checkout V2  
$ edit files  
$ csc branch fix  
$ csc snap
```

# Project Archive



```
$ csc checkout V2
$ edit files
$ csc branch fix
$ csc snap
$ csc tag V2.1
```

# Project Archive



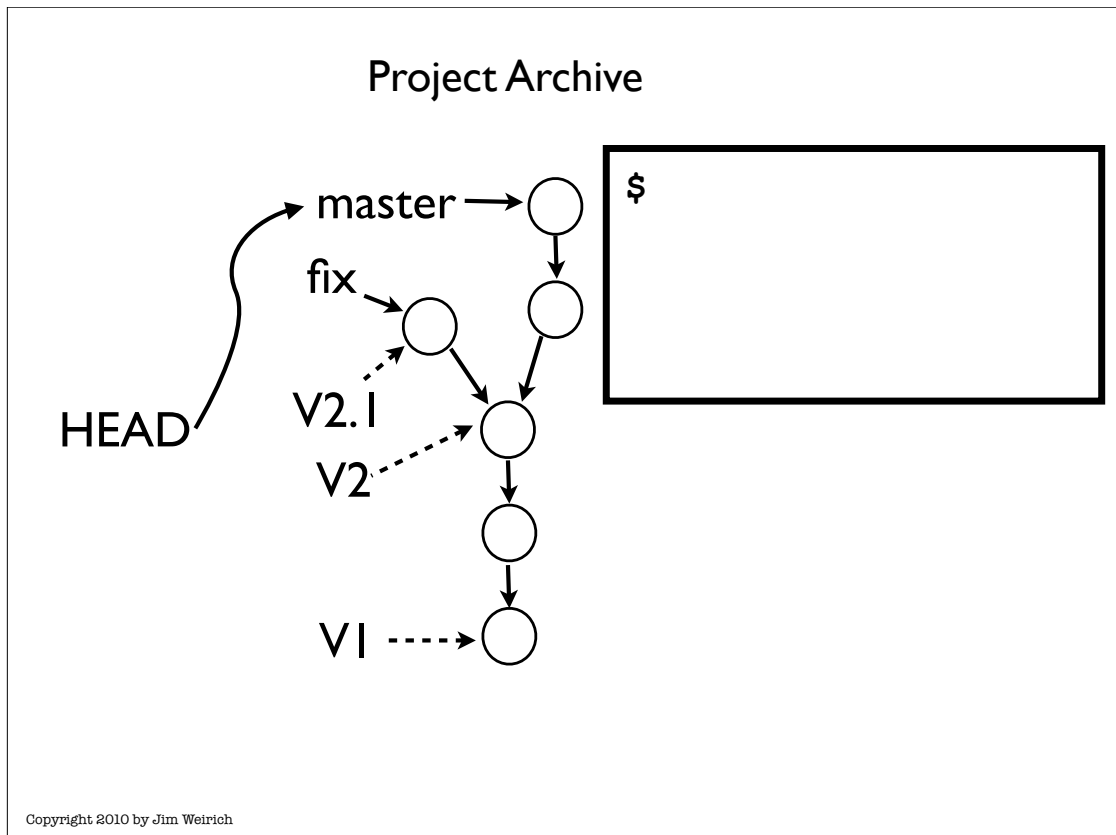
```
$ csc checkout V2
$ edit files
$ csc branch fix
$ csc snap
$ csc tag V2.fix
$ csc checkout master
```

**Note:**  
We didn't create a branch until after we edited files.

# Merge Bug Fixes to Master

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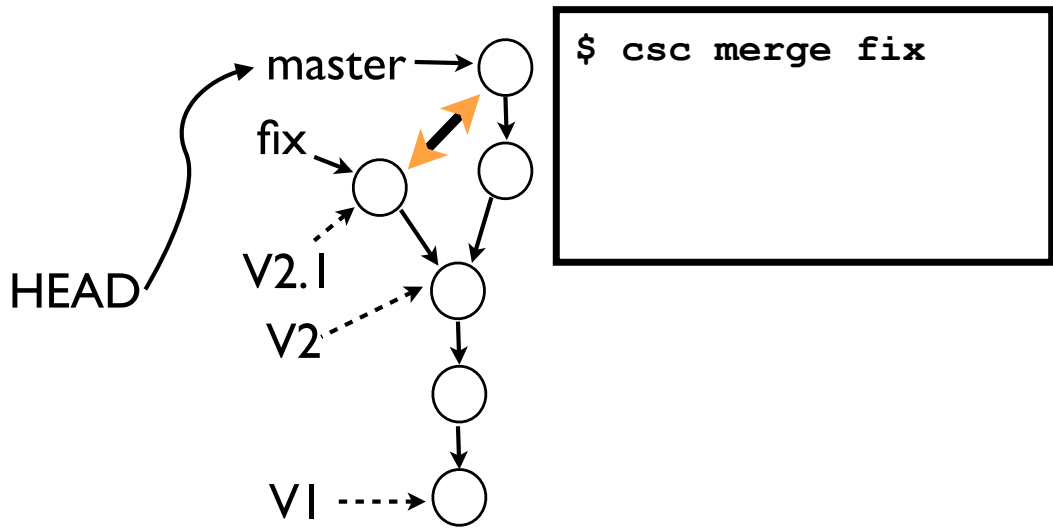
111



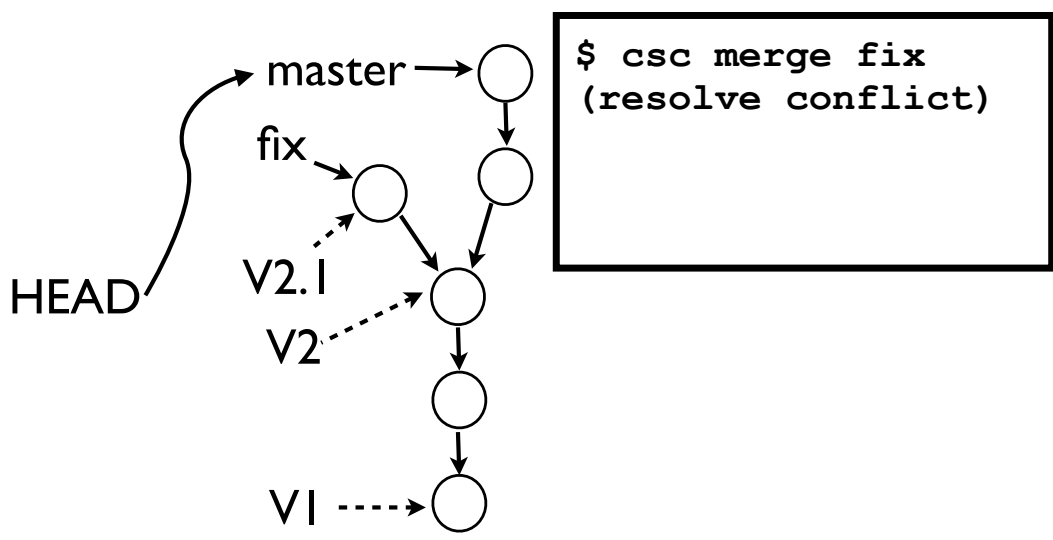
Copyright 2010 by Jim Weirich

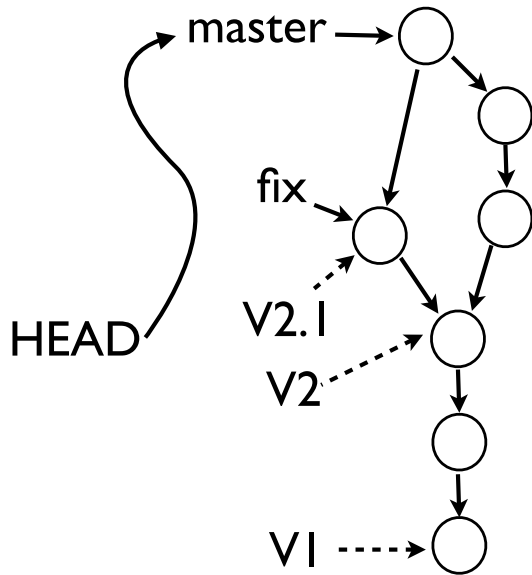
112

# Project Archive



# Project Archive

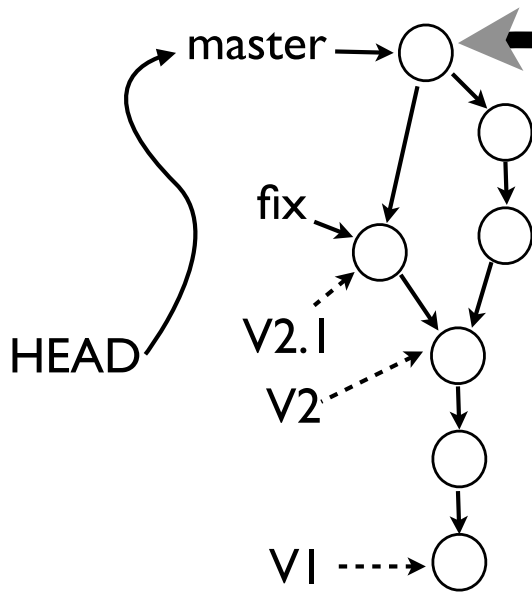




```

$ csc merge fix
(resolve conflict)
$ csc snap

```



```

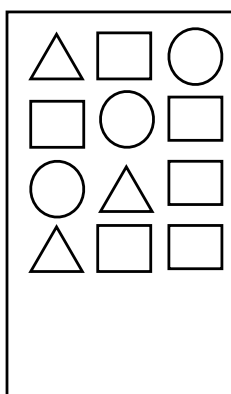
$ csc merge fix
(resolve conflict)
$ csc snap

```

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

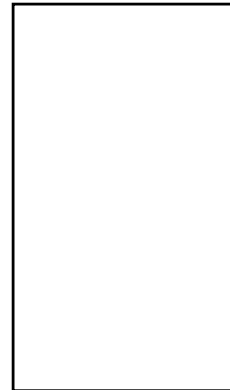
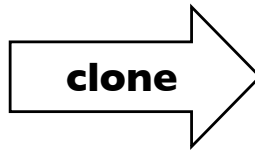
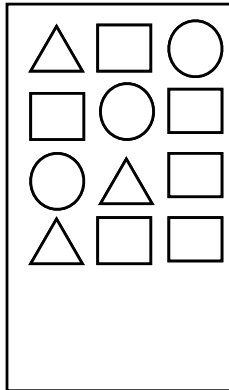
# Sharing Code

## My Archive



My Archive

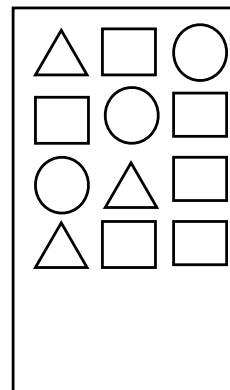
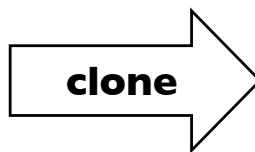
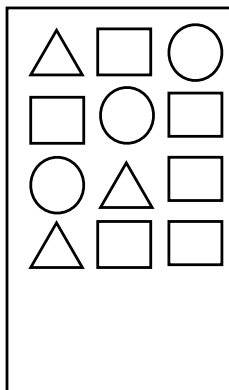
Your Archive



```
you$ csc clone url_for_my_repo
```

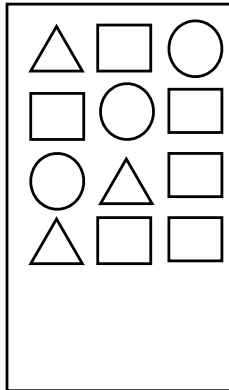
My Archive

Your Archive

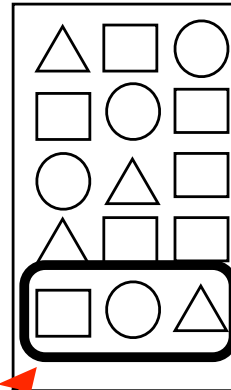


```
you$ csc clone url_for_my_repo
```

My Archive



Your Archive

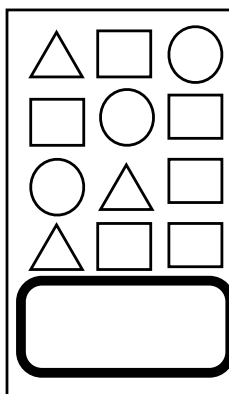


You make changes

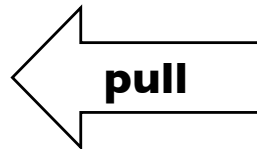
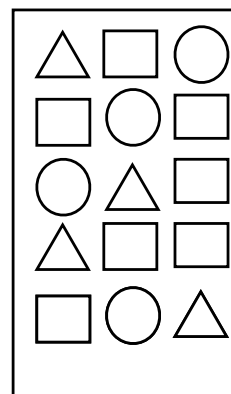
Copyright 2010 by Jim Weirich

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My Archive



Your Archive

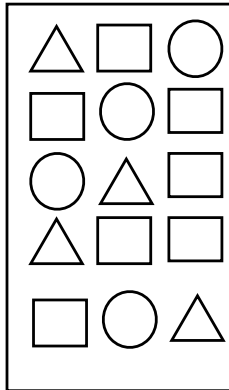


```
me$ csc pull url_for_my_repo
```

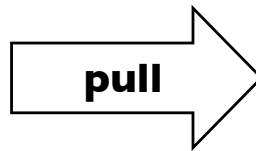
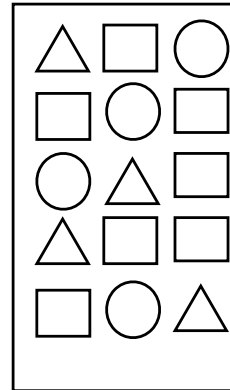
Copyright 2010 by Jim Weirich

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My Archive



Your Archive



```
you$ csc pull url_for_my_repo
```

Copyright 2010 by Jim Weirich

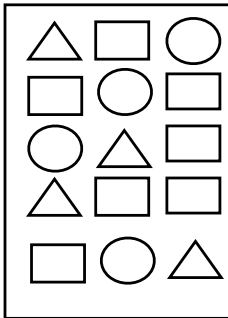
123

## Common Remote Uses

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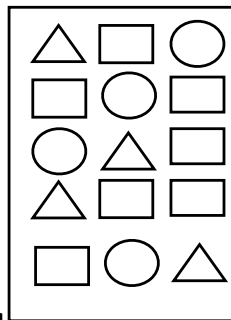
## My Archive



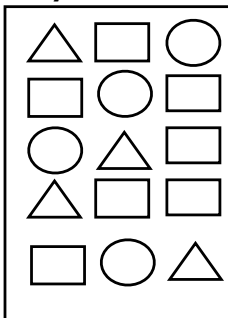
Copyright 2010 by Jim Weirich

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## Remote Archive



## My Archive

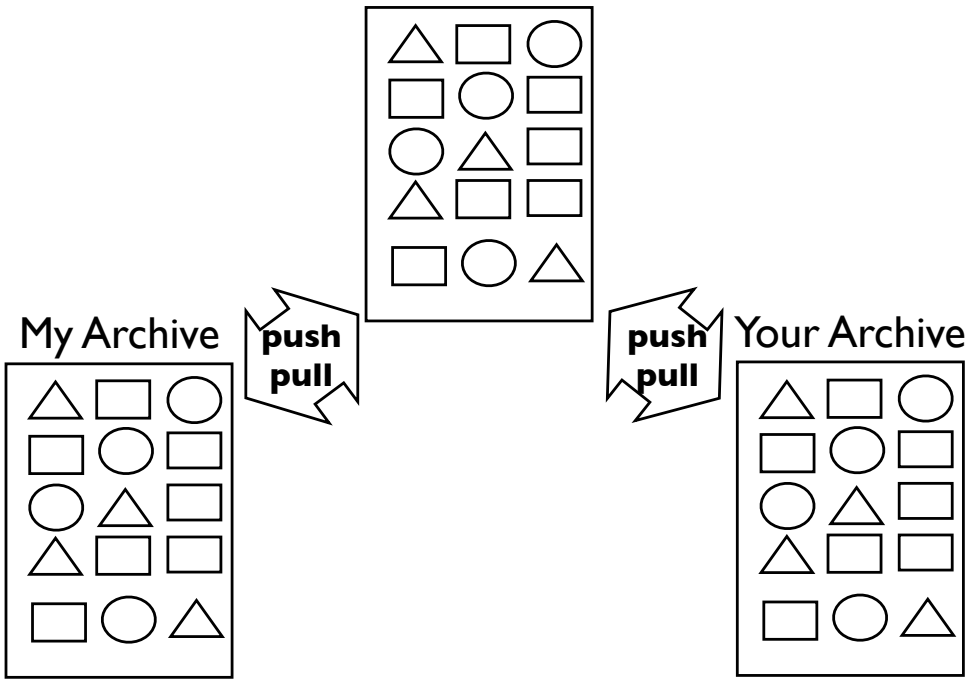


**push**  
**pull**

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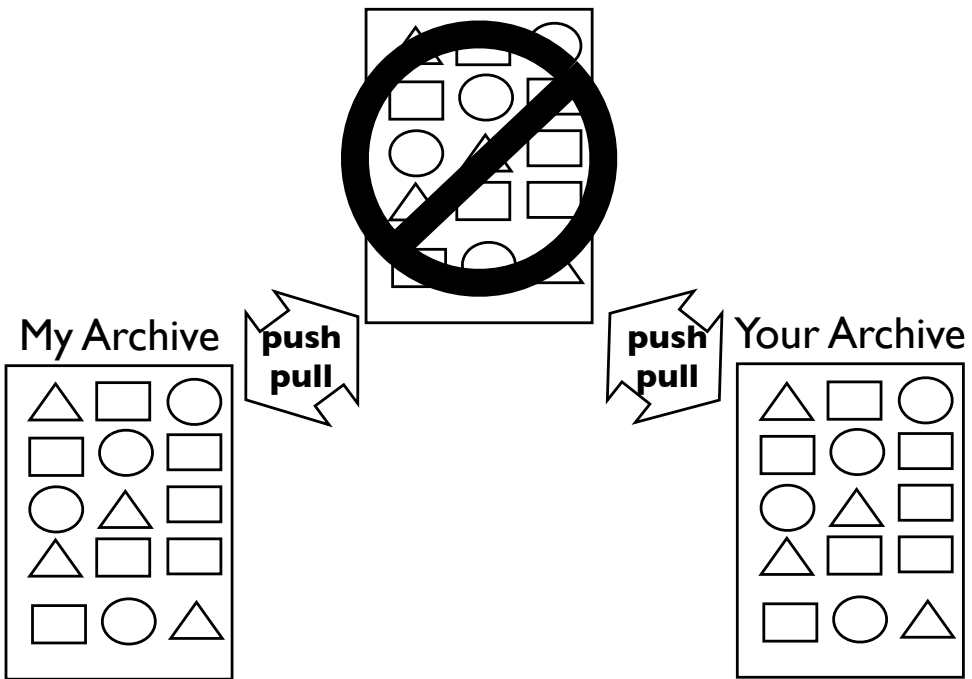
126

### Shared Remote Archive



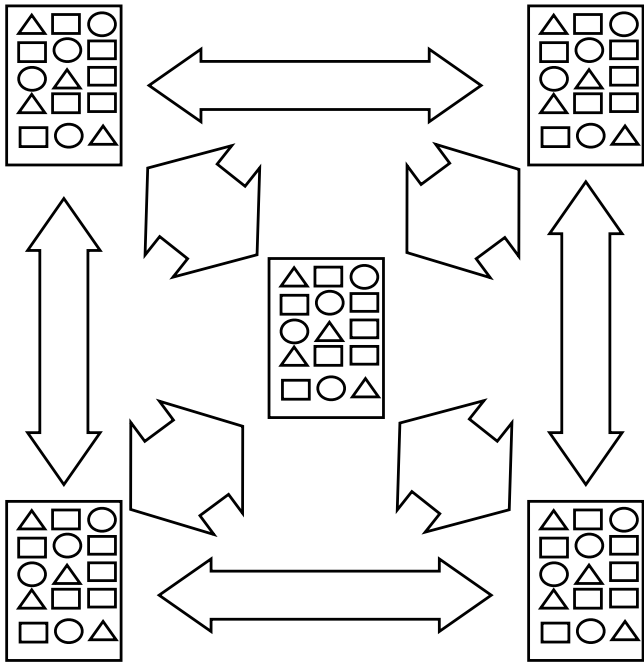
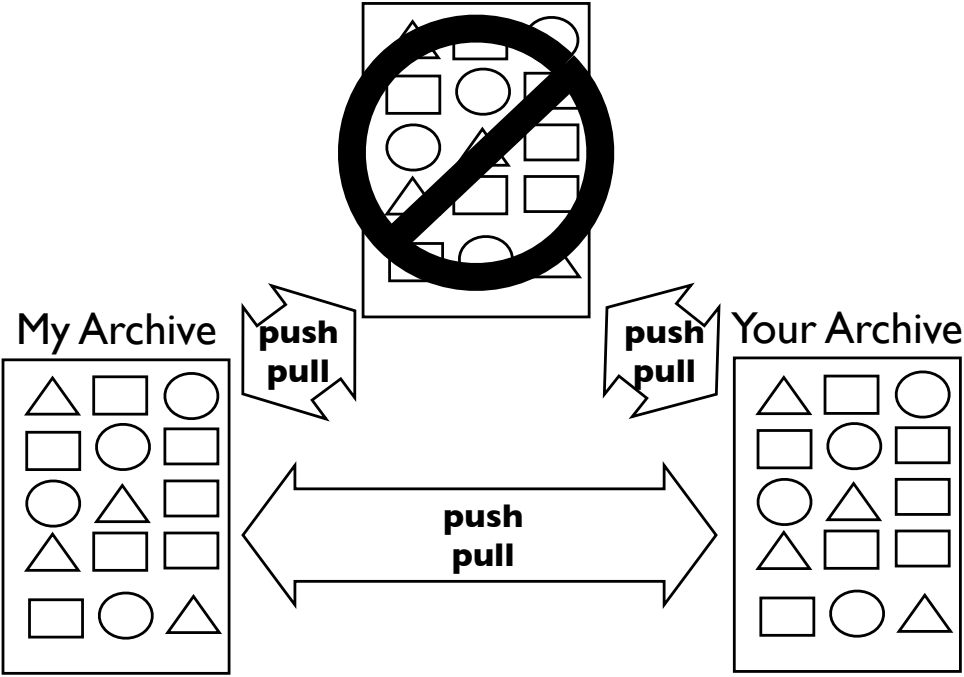
Copyright 2010 by Jim Weirich

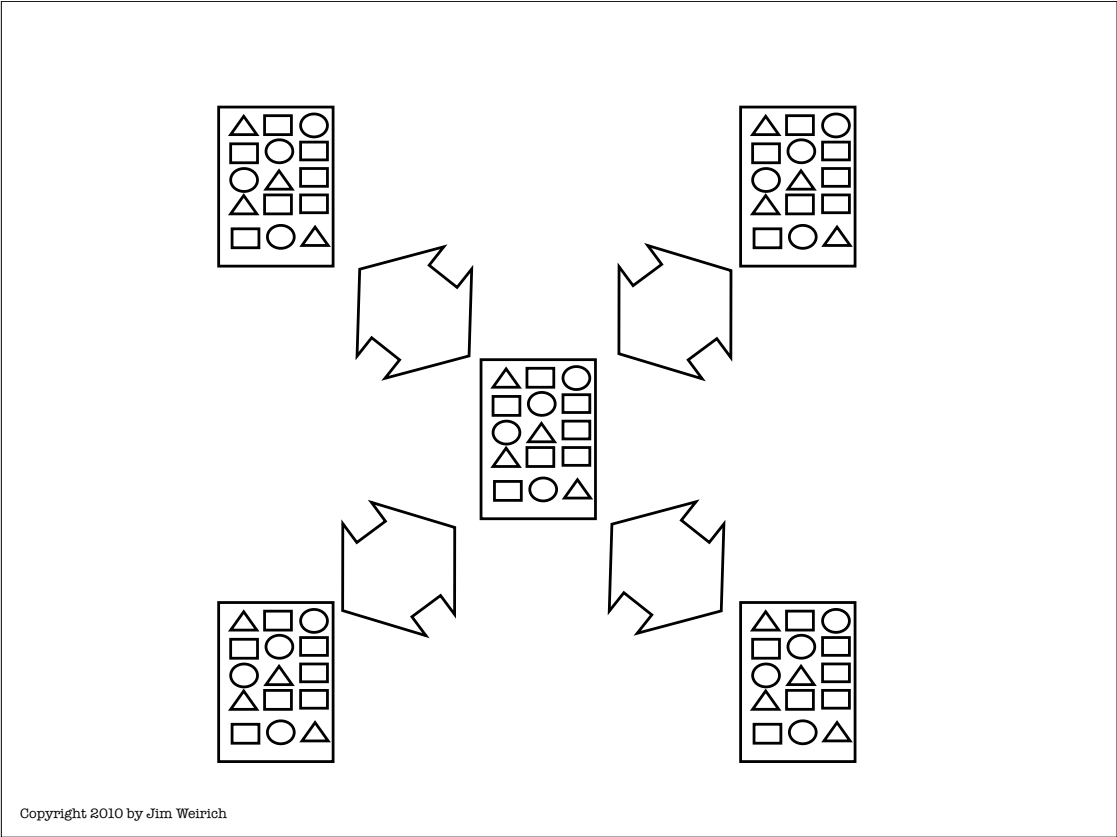
### Shared Remote Archive



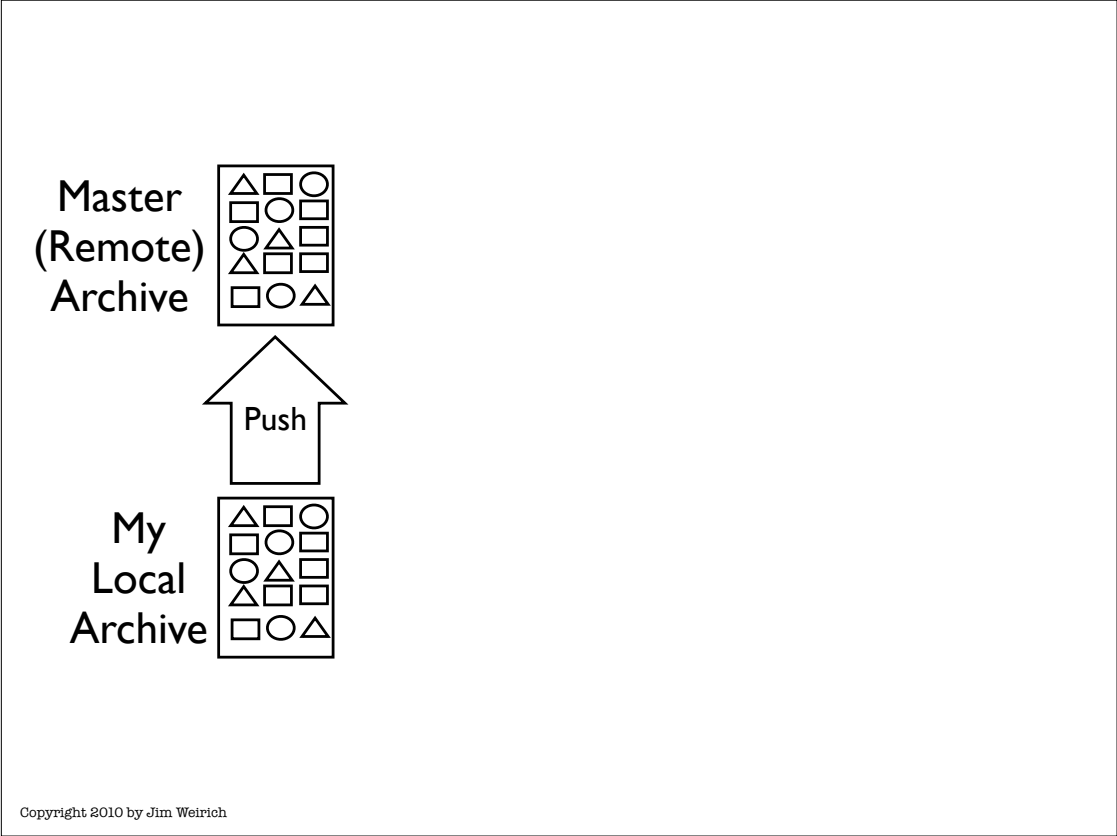
Copyright 2010 by Jim Weirich

# Shared Remote Archive

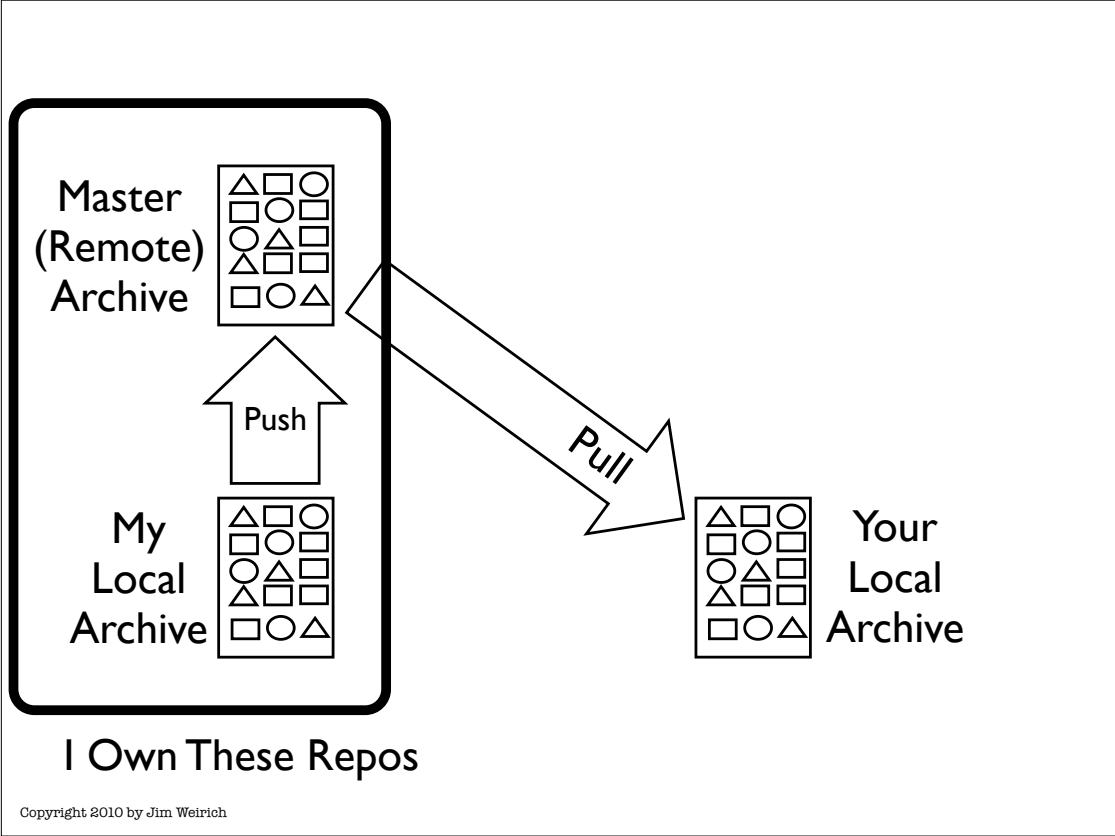
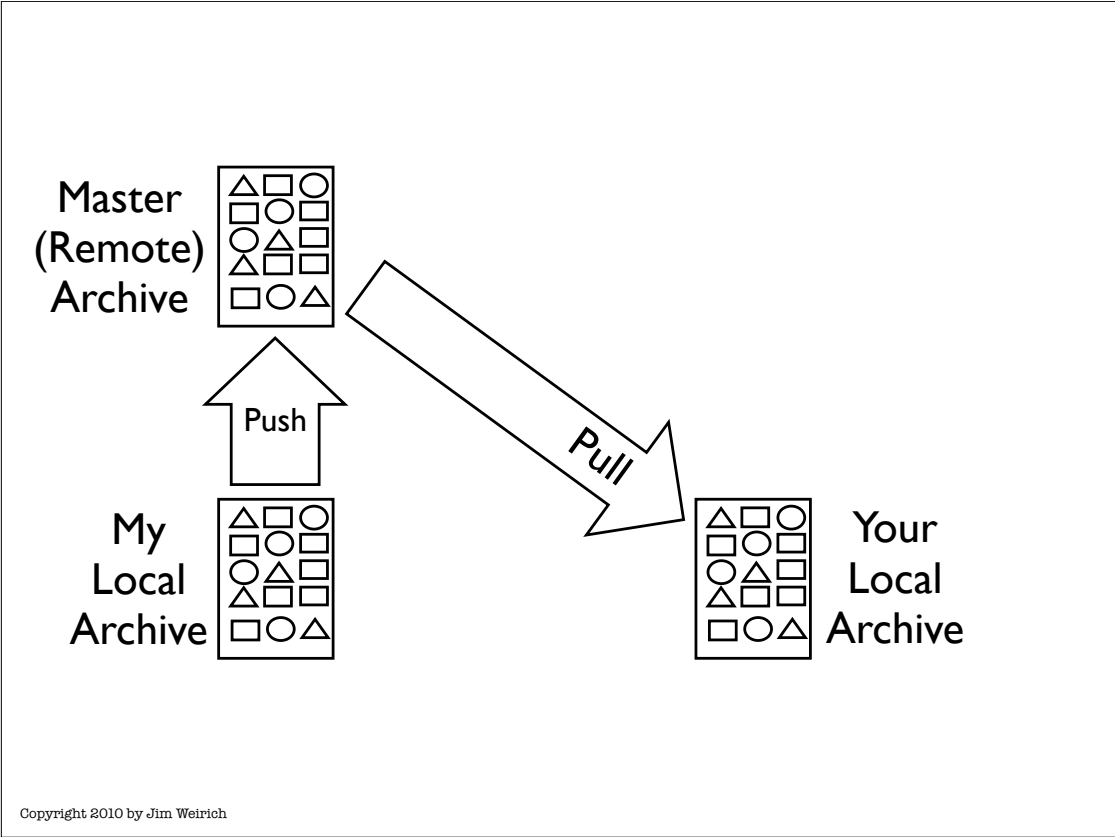


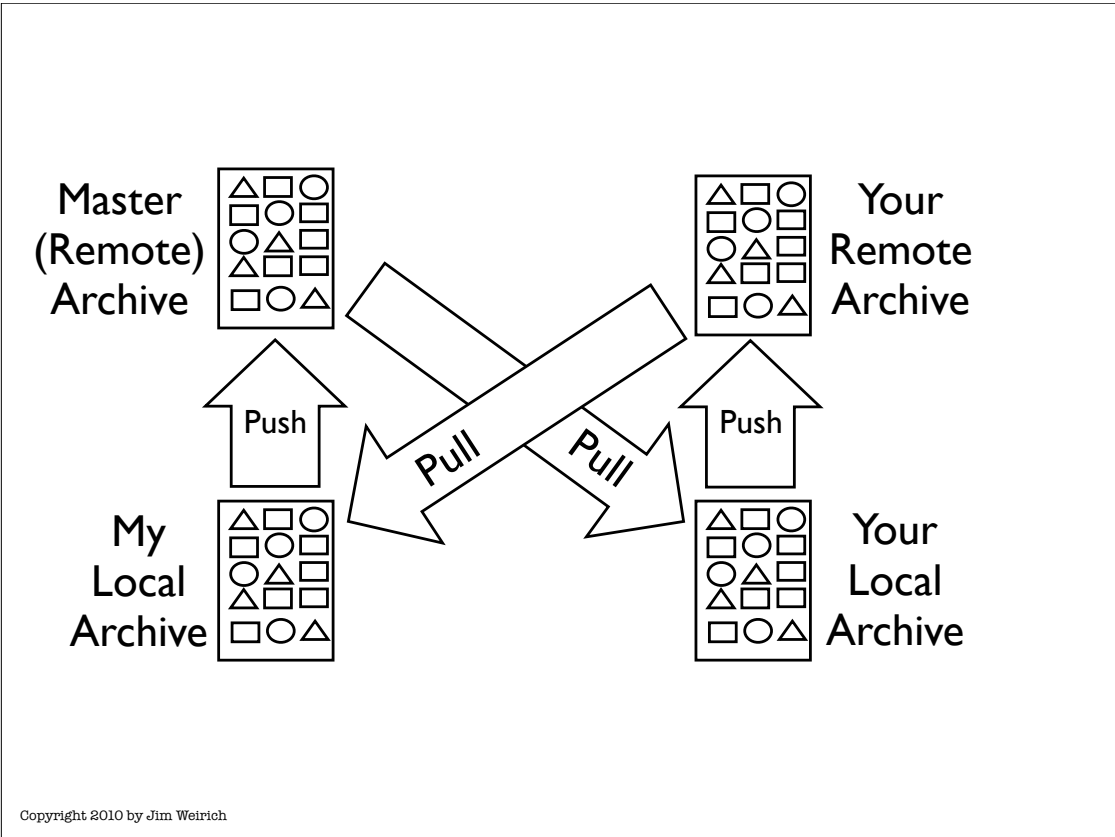
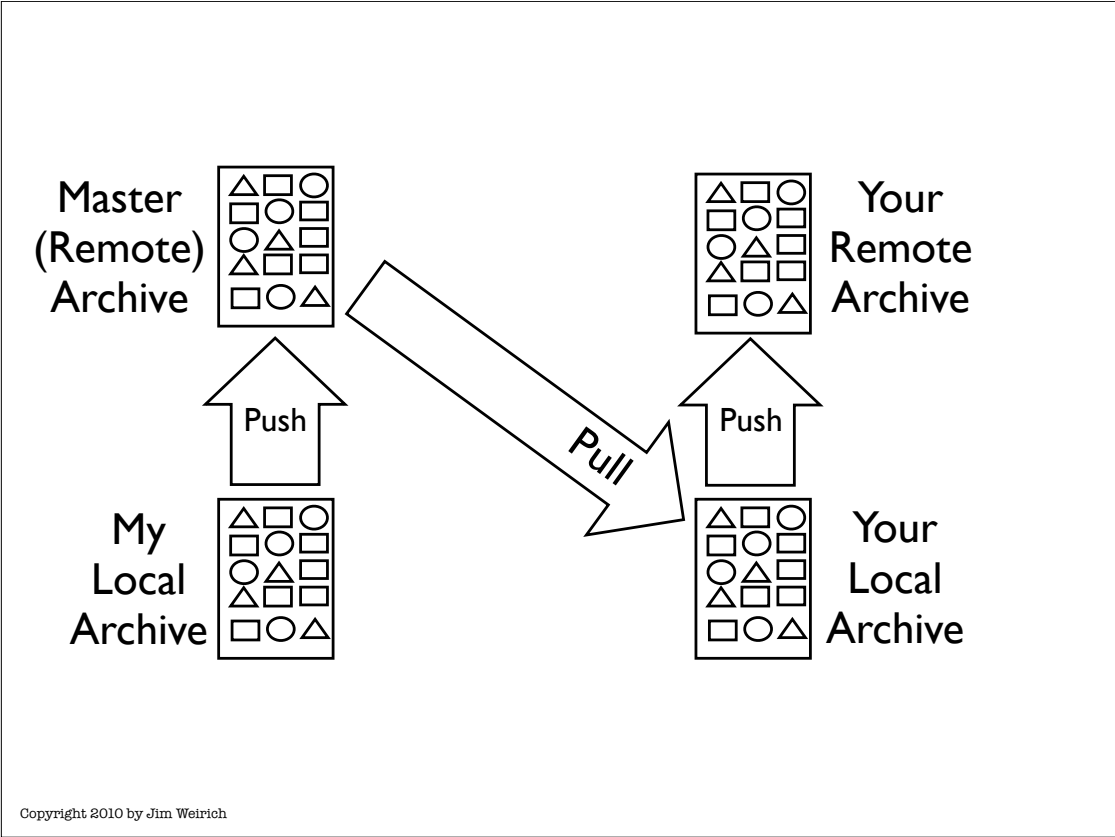


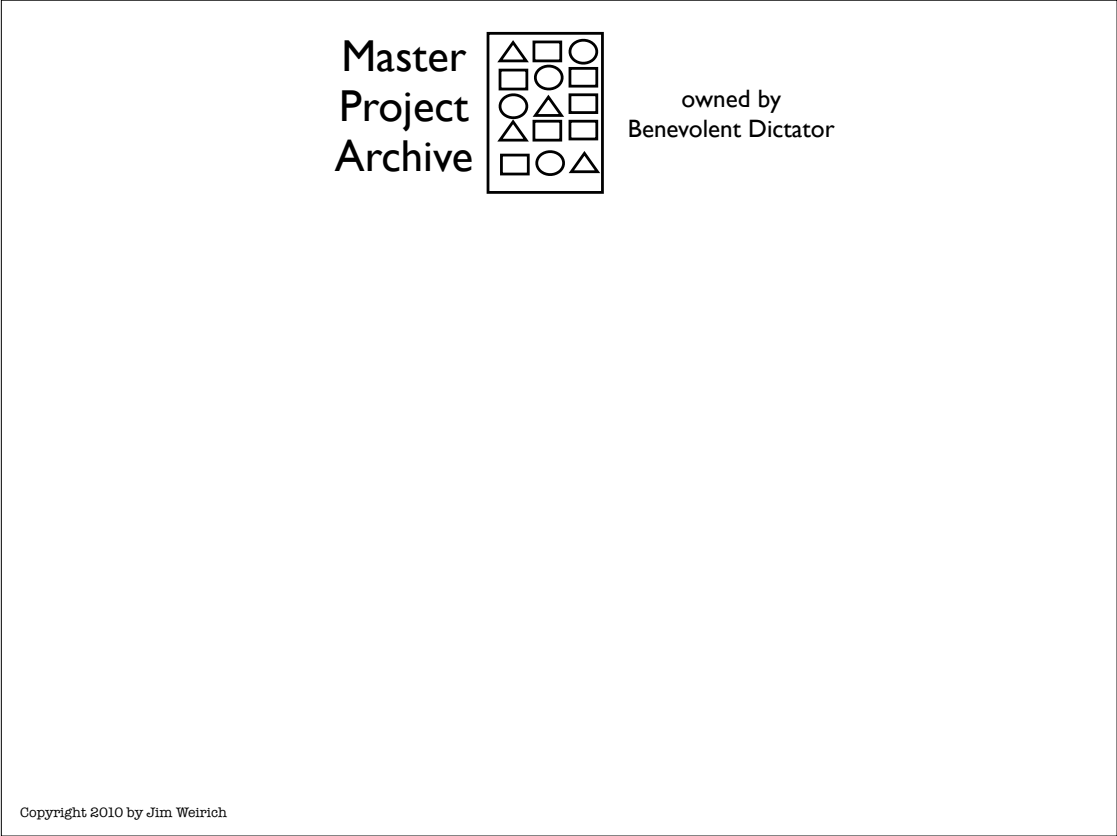
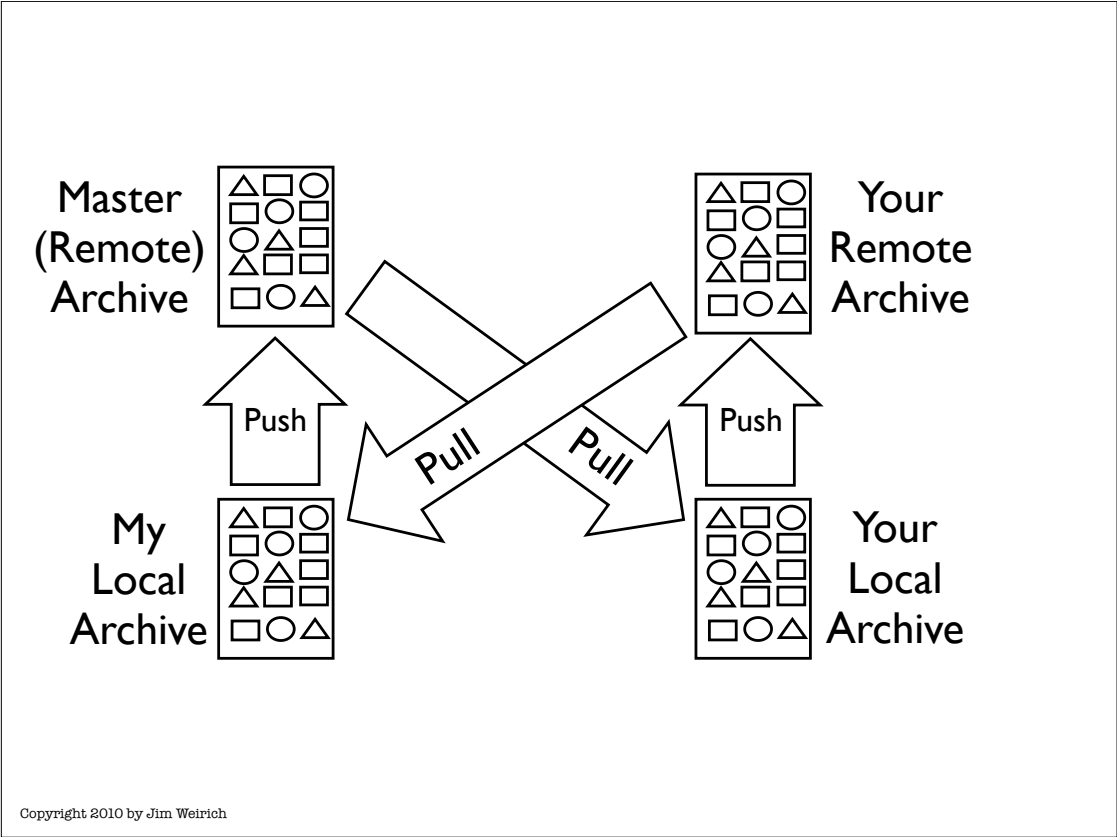
Copyright 2010 by Jim Weirich

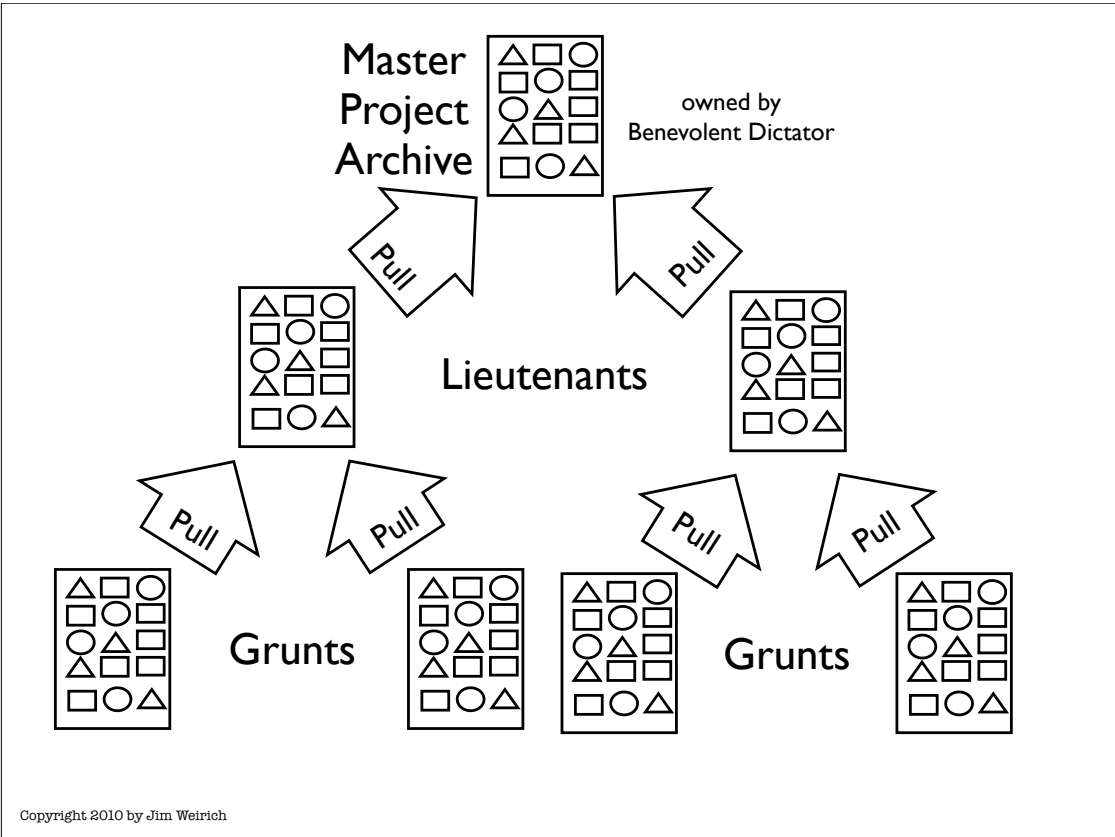
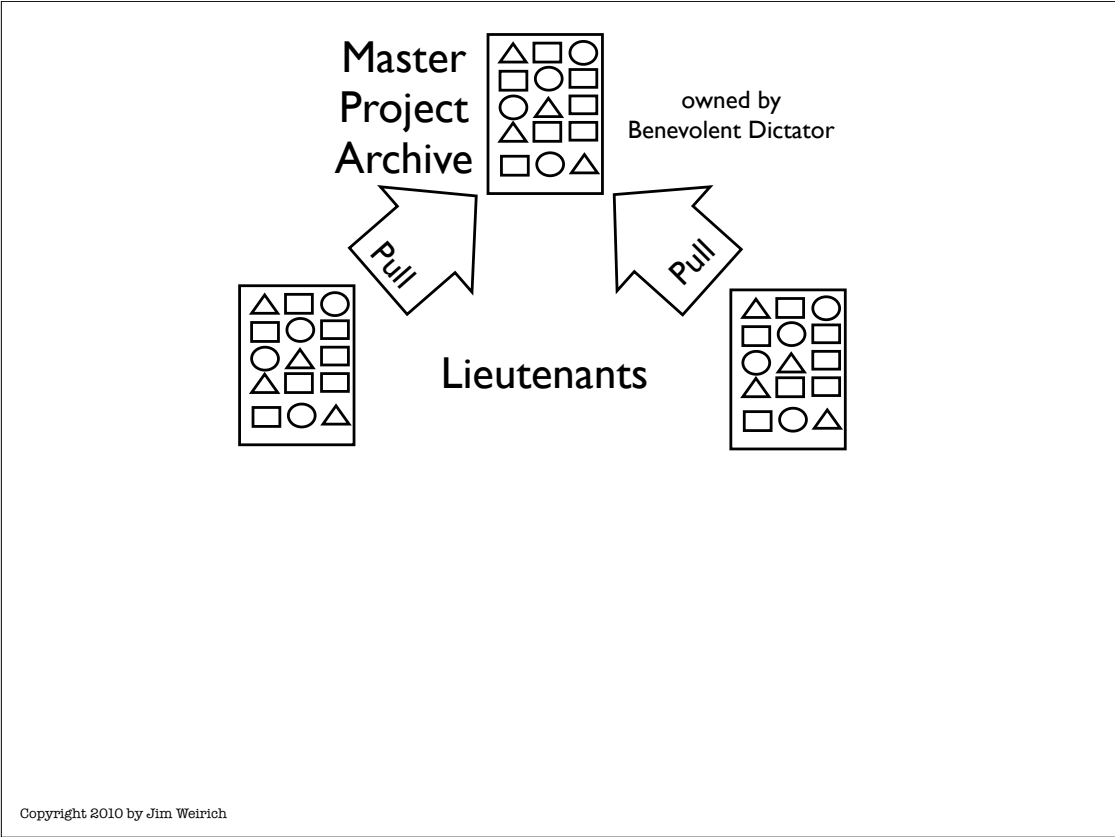


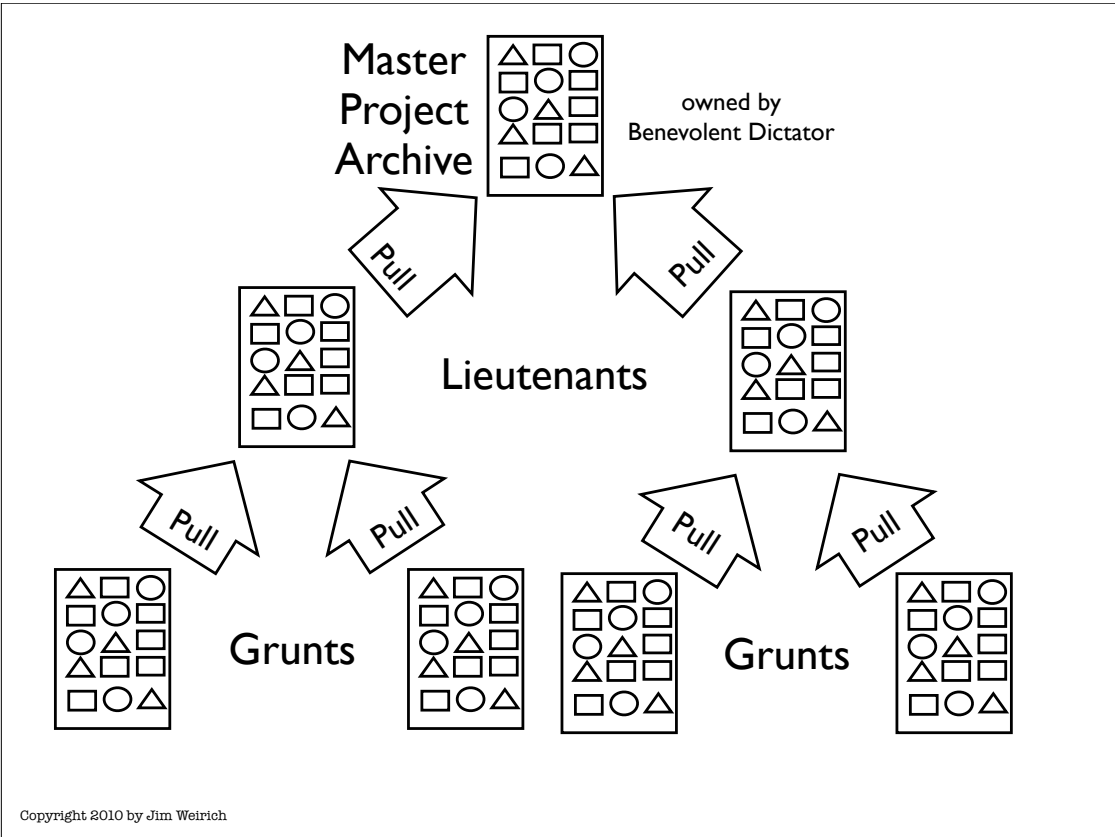
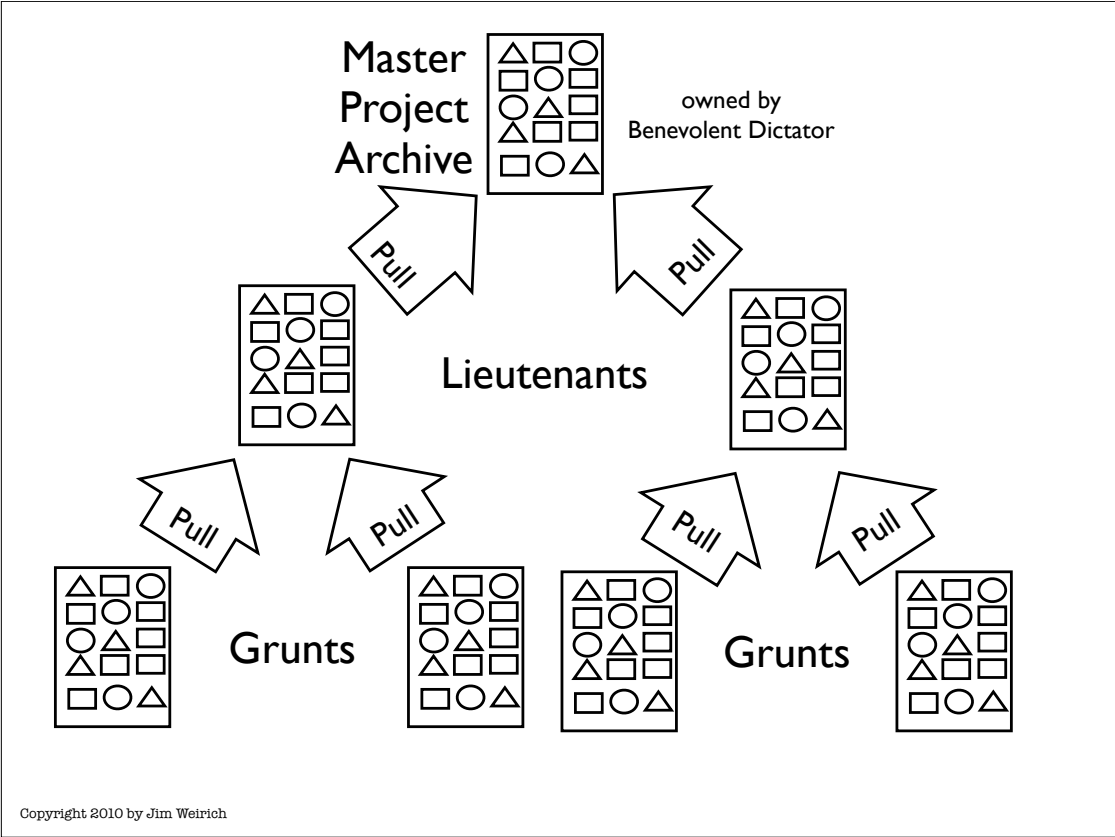
Copyright 2010 by Jim Weirich











# 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

# Sounds Like ...

# 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)

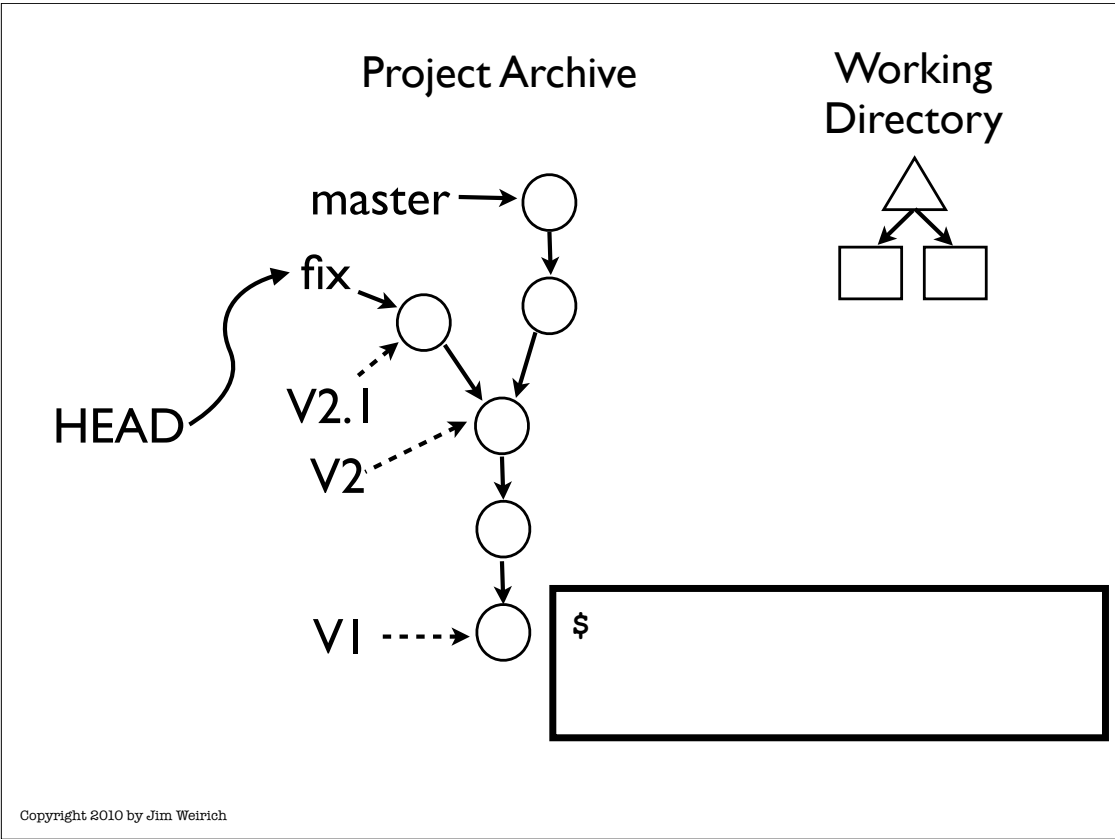
# Questions?

# Labs

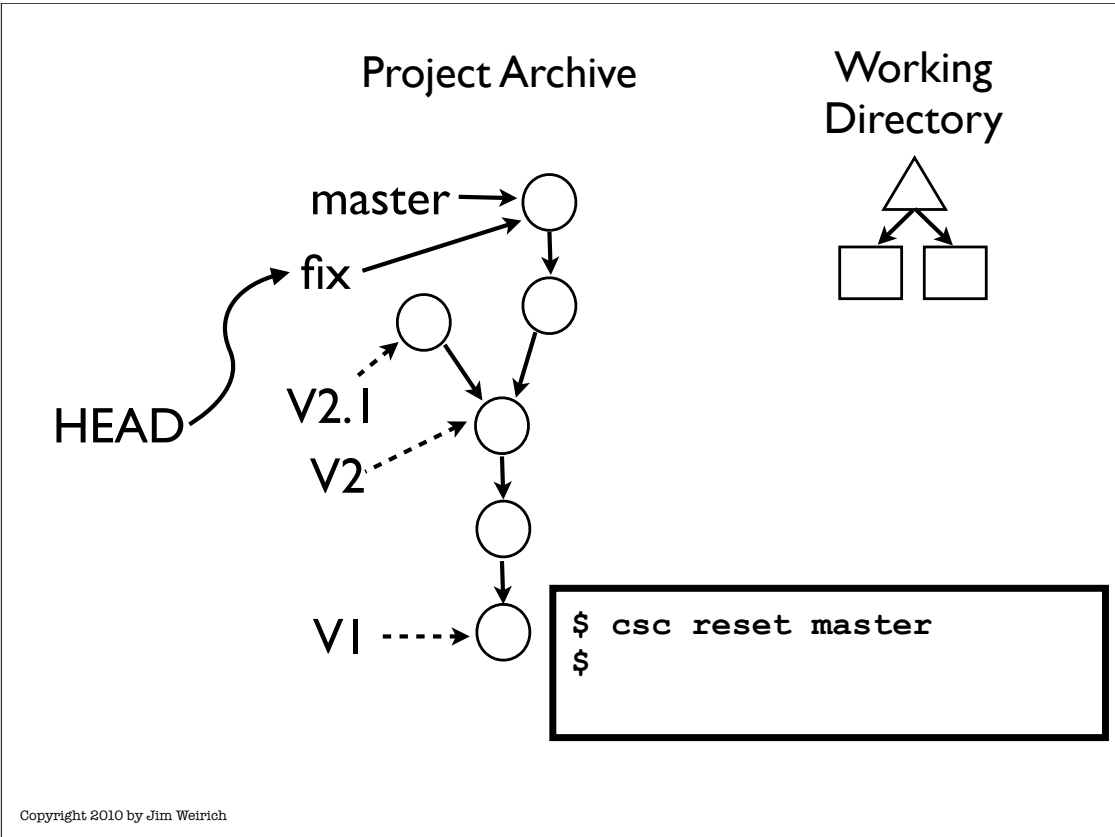
# Labs Can be found at ...

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

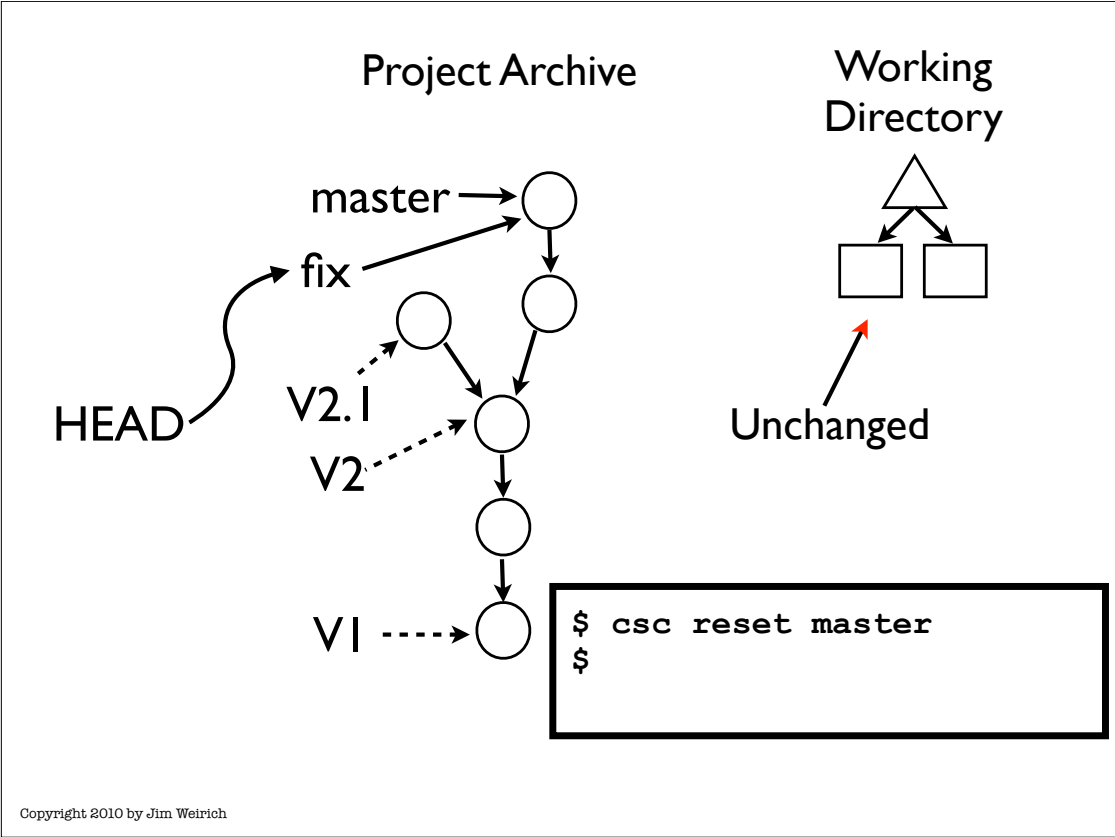
# Appendix A -- Reset



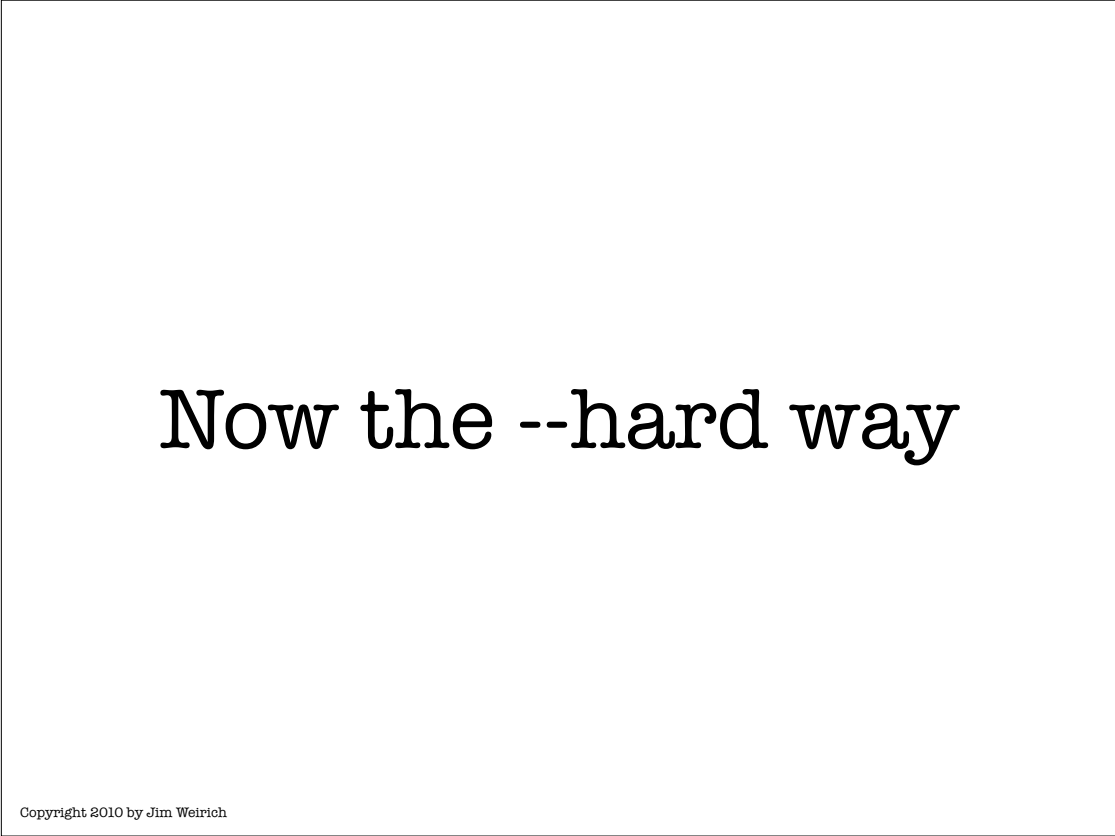
163

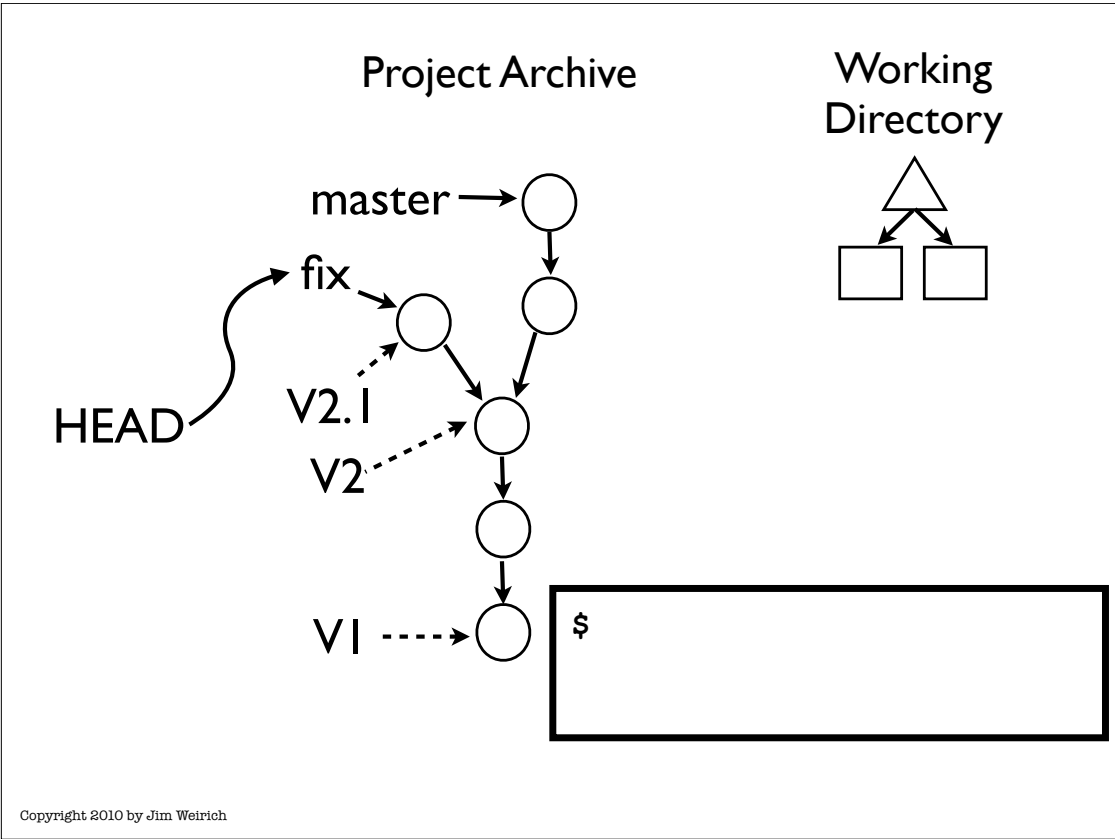


164

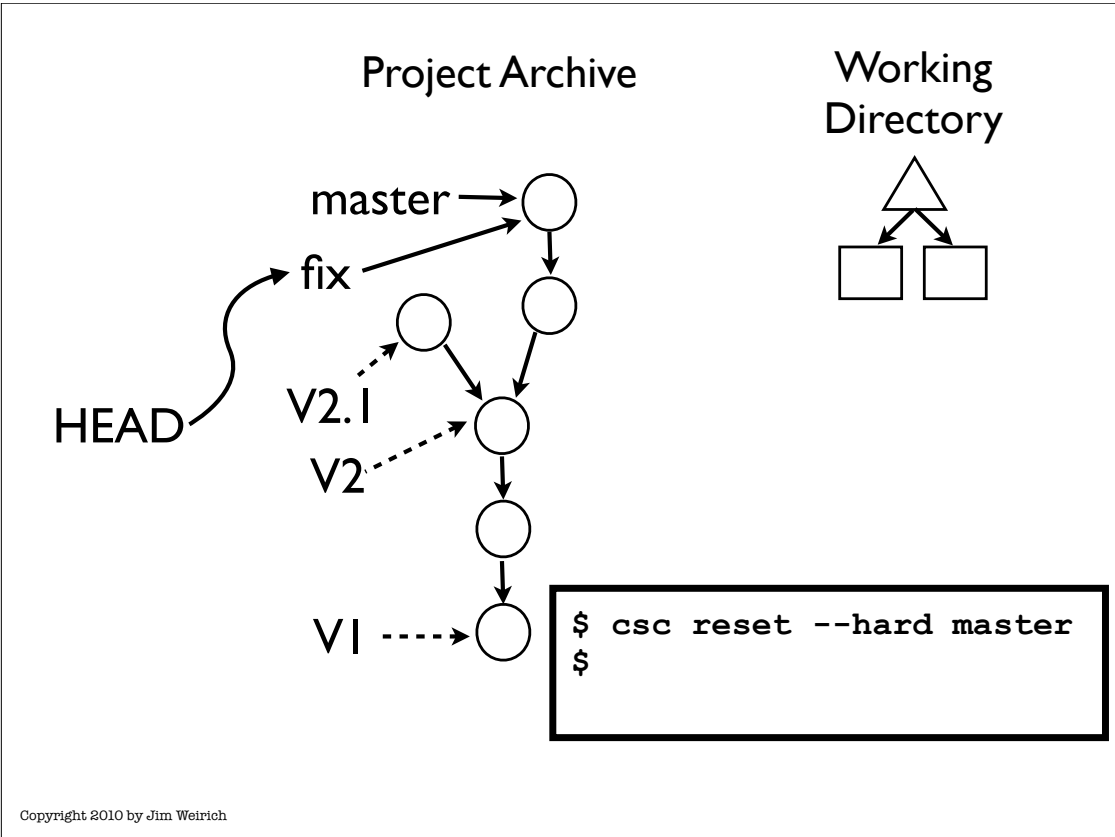


Now the --hard way

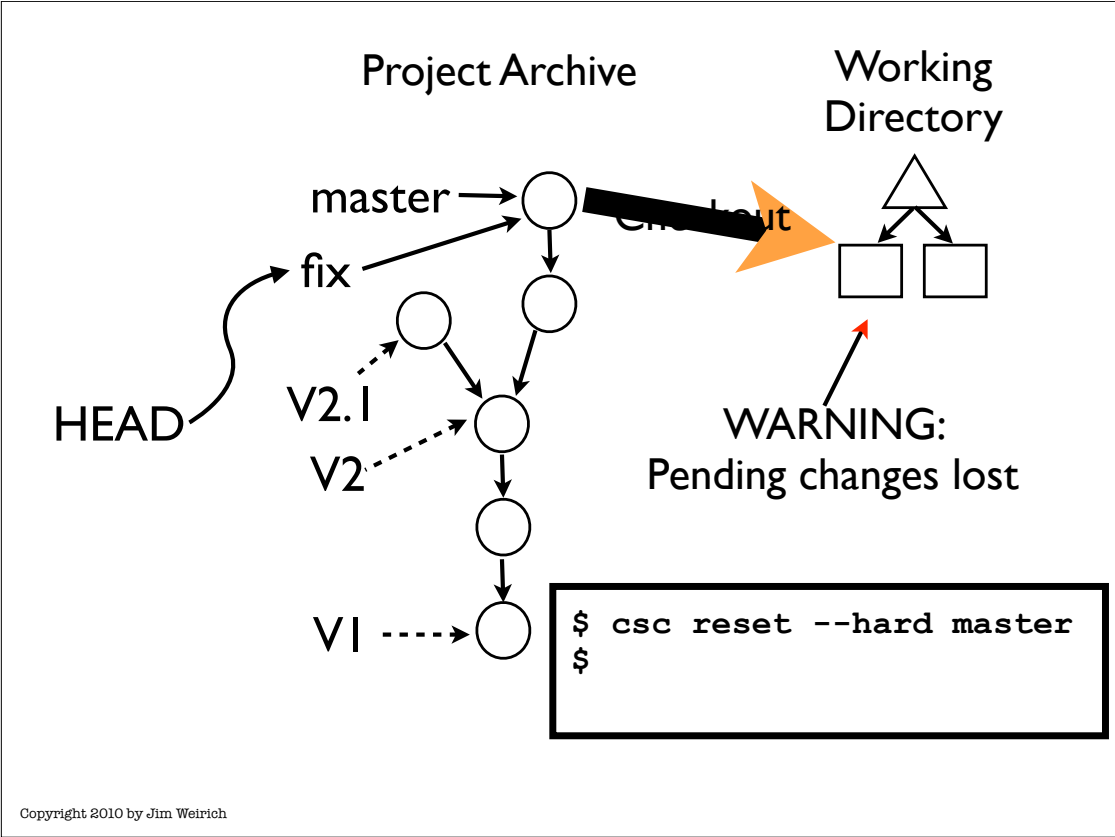




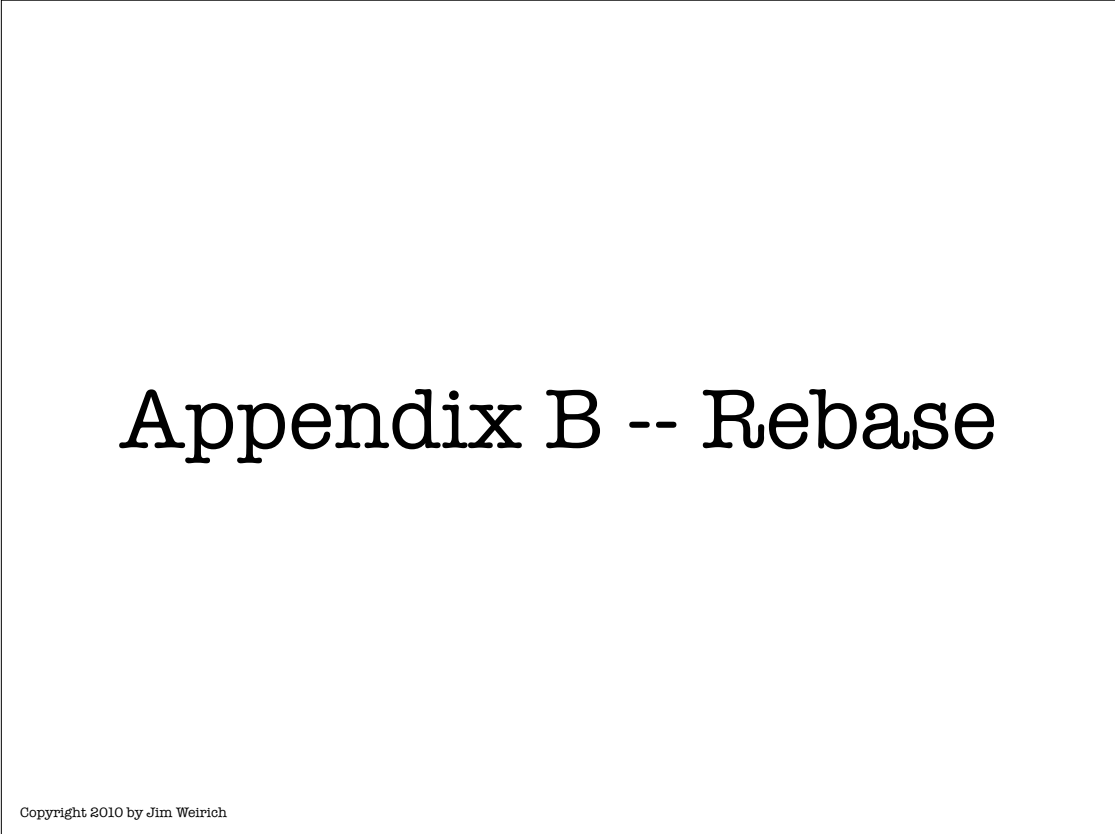
Copyright 2010 by Jim Weirich



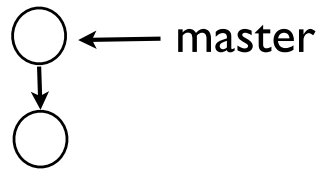
Copyright 2010 by Jim Weirich



# Appendix B -- Rebase



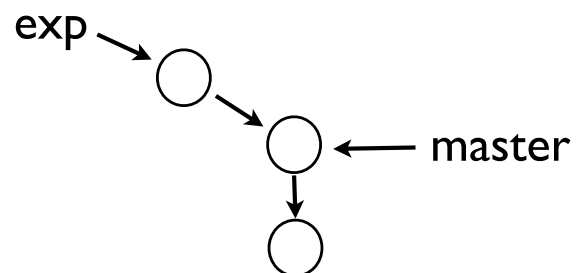
## Rebase (setup)



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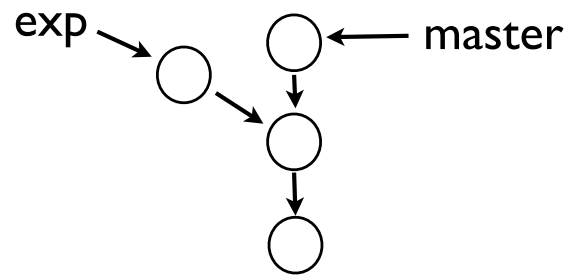
## Rebase (setup)



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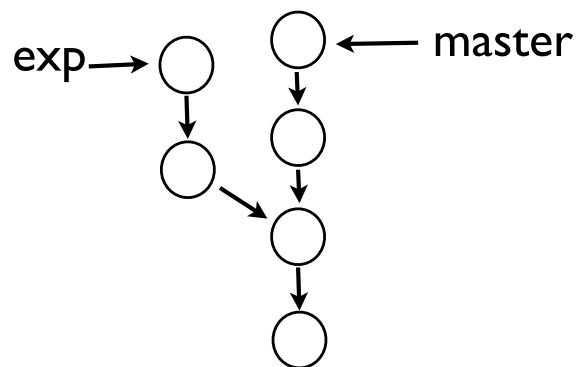
## Rebase (setup)



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## Rebase (setup)

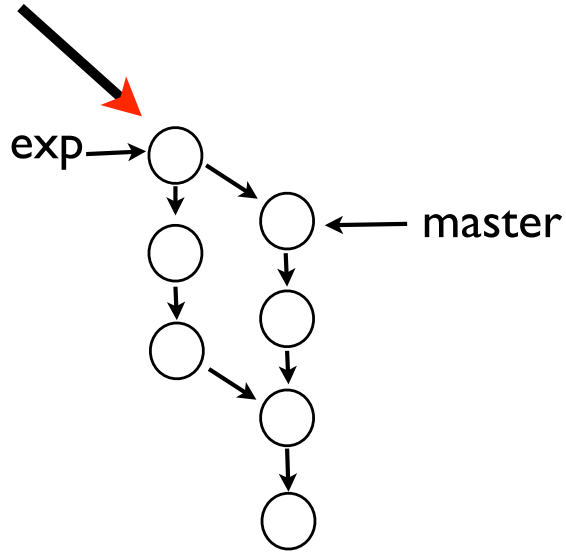


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## Rebase (merging option)

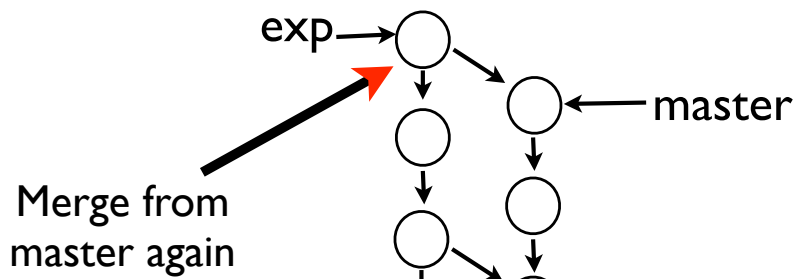
Merge changes on  
master to exp



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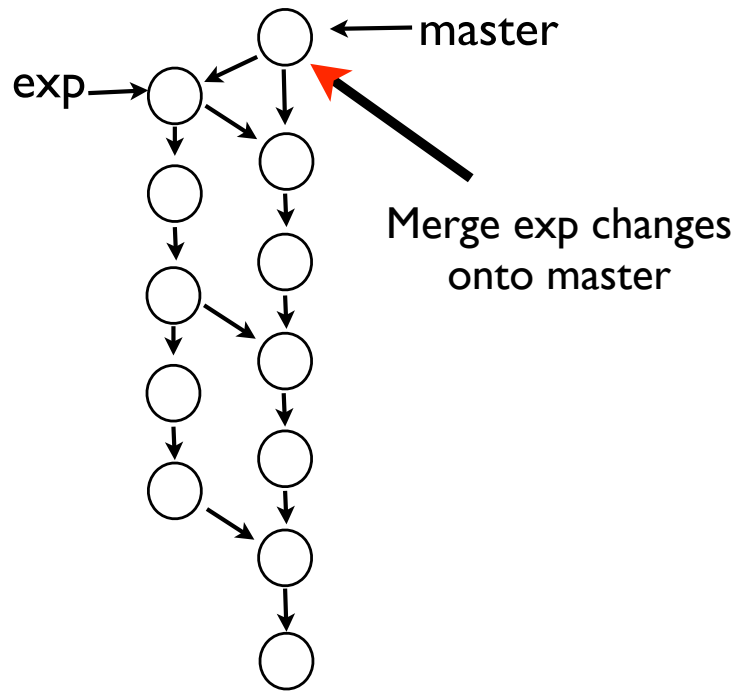
## Rebase (merging option)



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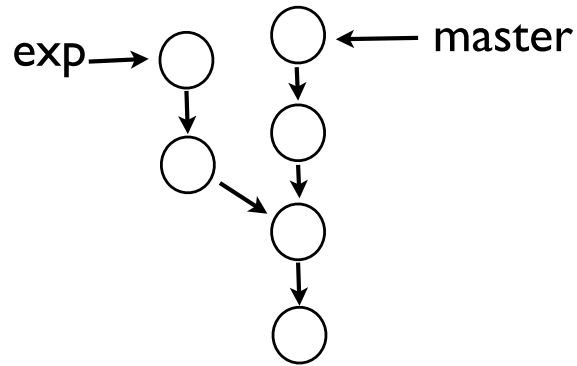
176

## Rebase (merging option)



# Rewind !

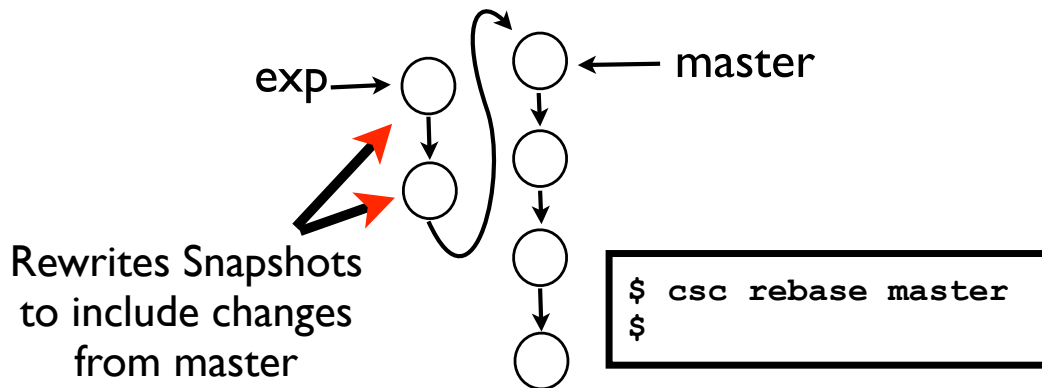
# Rebase



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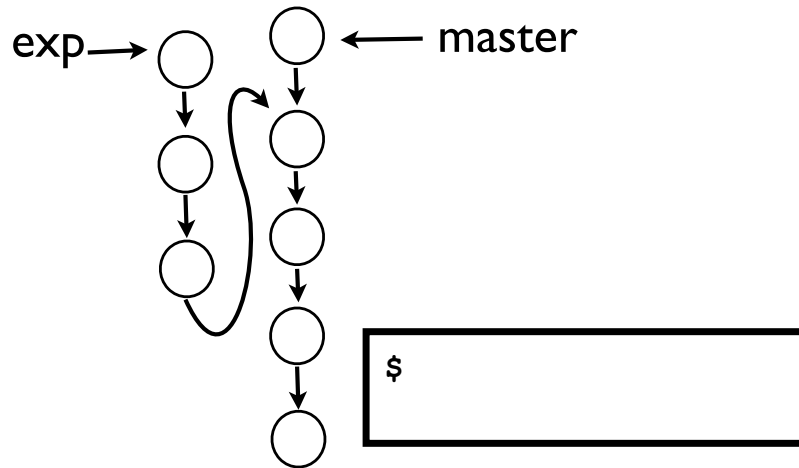
# Rebase



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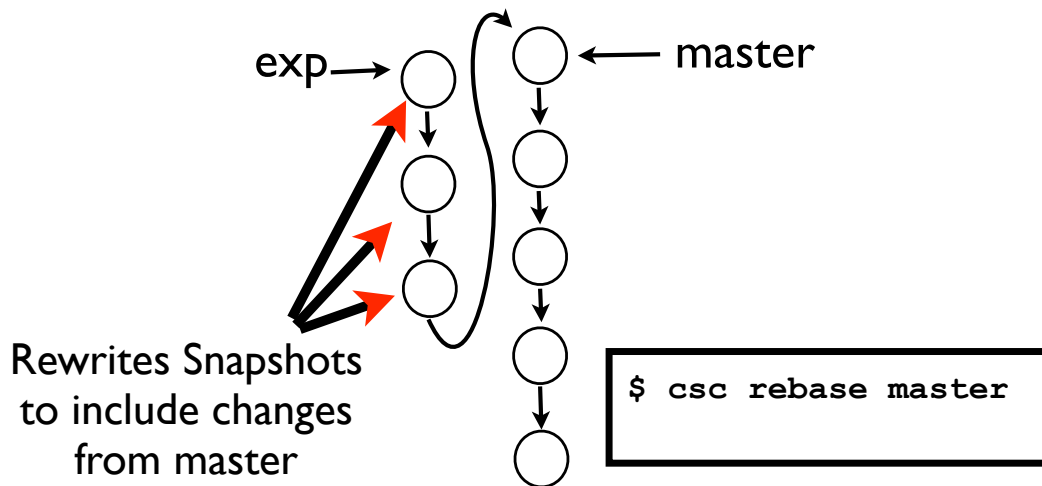
# Rebase



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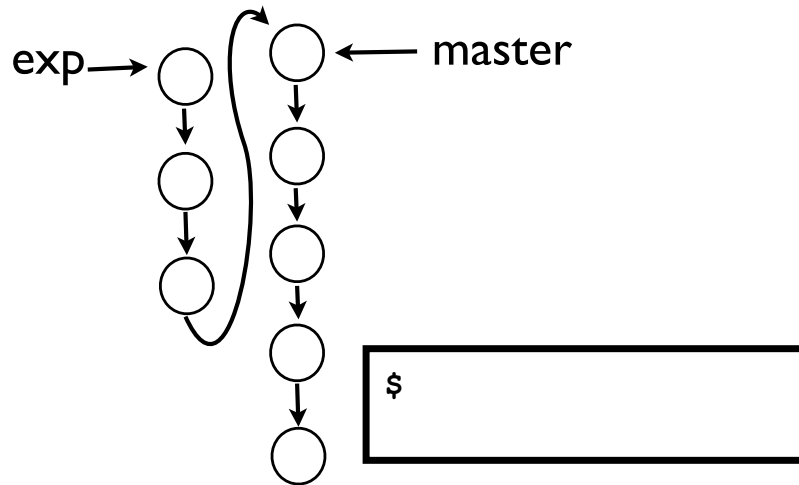
# Rebase



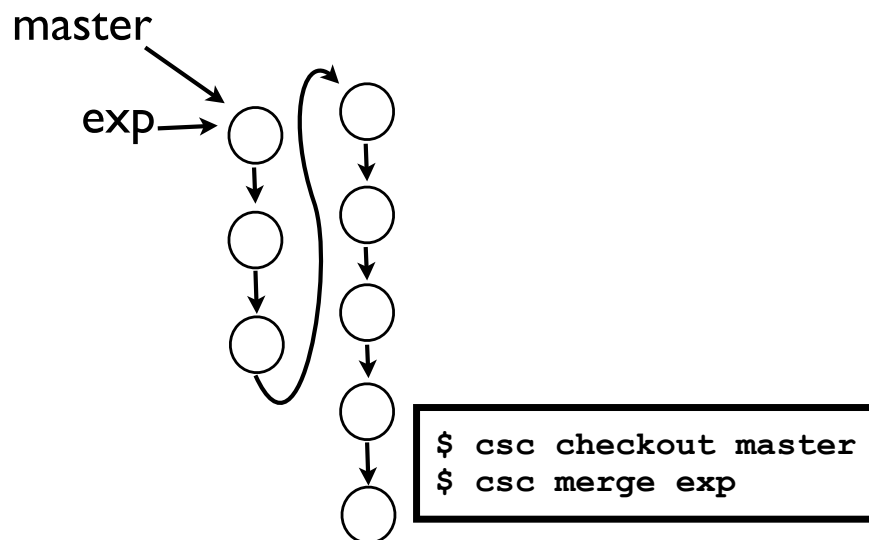
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# Rebase



# Rebase



# WARNING:

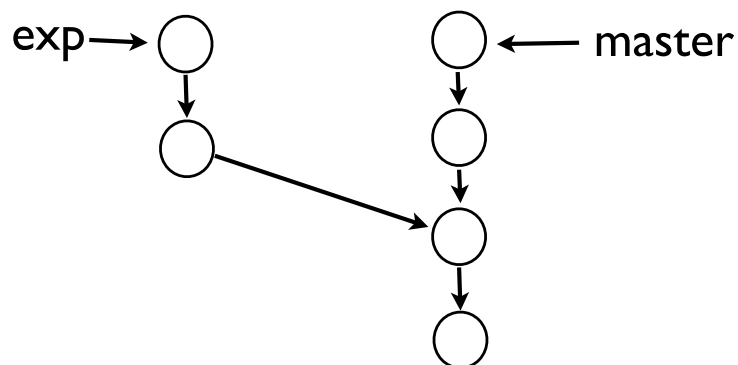
Conflicts may occur during rebase

# WAIT!

Rebase rewrites history?  
Isn't that dangerous?

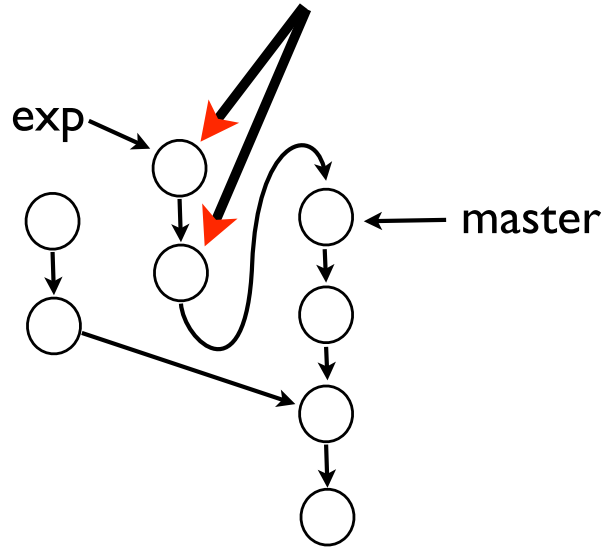
# Yes and No

## Rebase



# Rebase

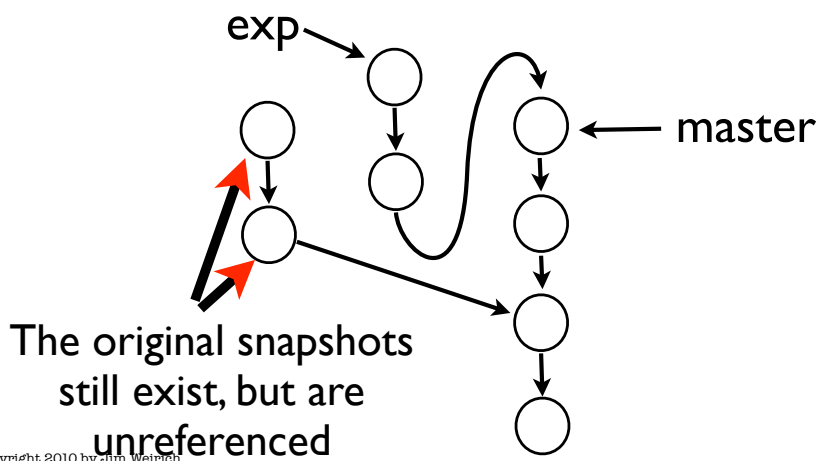
These snapshots are rewritten from scratch



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# Rebase

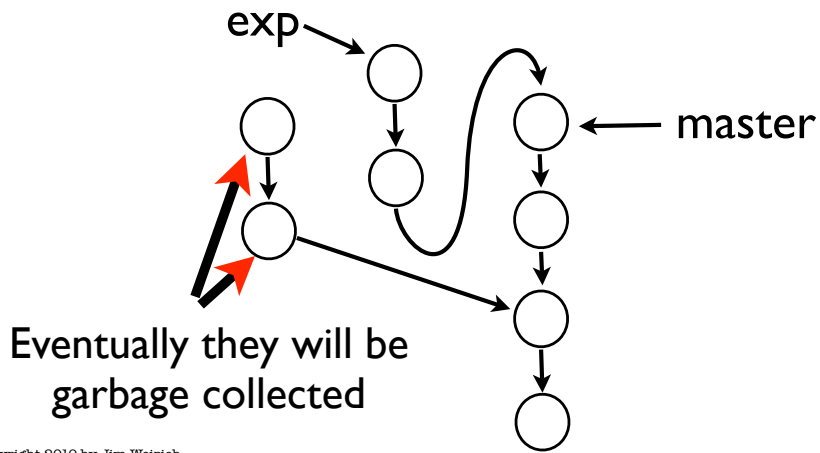


The original snapshots still exist, but are unreferenced

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## Rebase



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## WARNING:

Do **not** rebase shared branches!

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