# Intro to Git

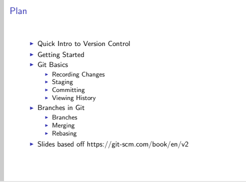
2017-02-23

Intro to Git

Intro to Git

## Plan

- Quick Intro to Version Control
- Getting Started
- Git Basics
  - Recording Changes
  - Staging
  - Committing
  - Viewing History
- Branches in Git
  - Branches
  - Merging
  - Rebasing
- Slides based off https://git-scm.com/book/en/v2

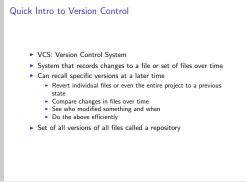

Plan

- Quick Intro to Version Control
- Getting Started
- Git Basics
  - Recording Changes
  - Staging
  - Committing
  - Viewing History
- Branches in Git
  - Branches
  - Merging
  - Rebasing
- Slides based off https://git-scm.com/book/en/v2

1. Test note here

## Quick Intro to Version Control

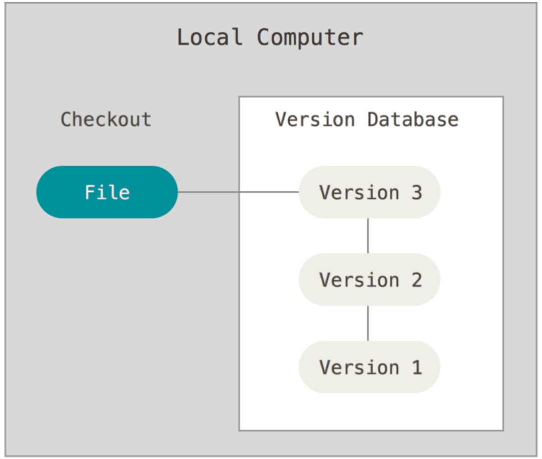
- VCS: Version Control System
- System that records changes to a file or set of files over time
- Can recall specific versions at a later time
  - Revert individual files or even the entire project to a previous state
  - Compare changes in files over time
  - See who modified something and when
  - Do the above efficiently
- Set of all versions of all files called a repository

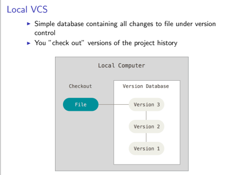

Quick Intro to Version Control

- VCS: Version Control System
- System that records changes to a file or set of files over time
- Can recall specific versions at a later time
  - Revert individual files or even the entire project to a previous state
  - Compare changes in files over time
  - See who modified something and when
  - Do the above efficiently
- Set of all versions of all files called a repository

## Local VCS

- Simple database containing all changes to file under version control
- You "check out" versions of the project history

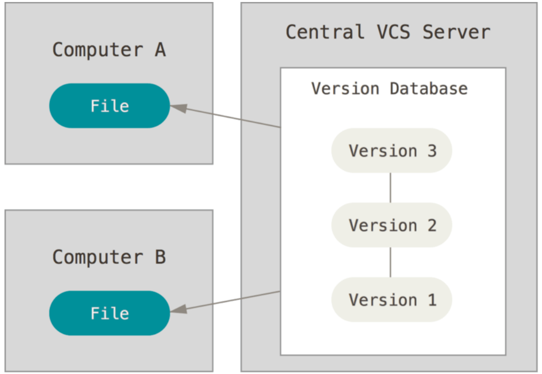


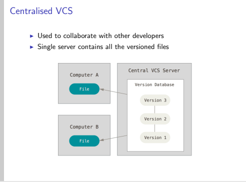

Local VCS

- Simple database containing all changes to file under version control
- You "check out" versions of the project history

## Centralised VCS

- Used to collaborate with other developers
- Single server contains all the versioned files

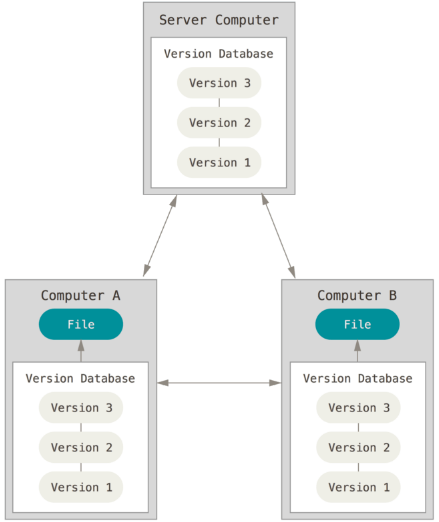


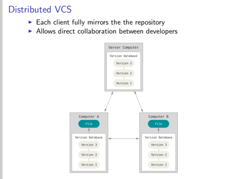


1. Only checked-out version copied to local machine

## Distributed VCS

- Each client fully mirrors the the repository
- Allows direct collaboration between developers

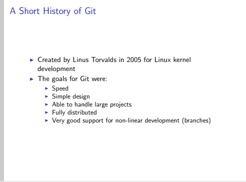




1. Whole history copied to each machine

## A Short History of Git

- Created by Linus Torvalds in 2005 for Linux kernel development
- The goals for Git were:
  - Speed
  - Simple design
  - Able to handle large projects
  - Fully distributed
  - Very good support for non-linear development (branches)


A Short History of Git

- Created by Linus Torvalds in 2005 for Linux kernel development
- The goals for Git were:
  - Speed
  - Simple design
  - Able to handle large projects
  - Fully distributed
  - Very good support for non-linear development (branches)

## Installing Git

- Available on Linux, Windows, Mac
- Package managers or from source at https://github.com/git/git/releases

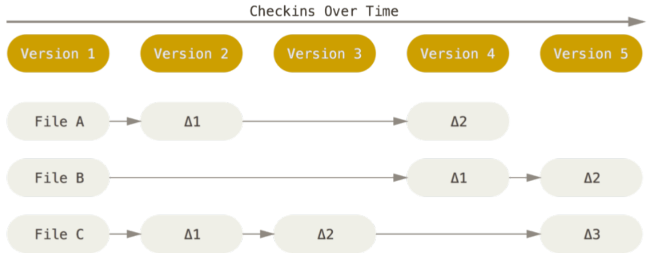
Installing Git

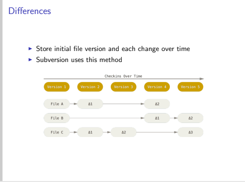
- Available on Linux, Windows, Mac
- Package managers or from source at https://github.com/git/git/releases

1. This is just a quick note for the few if any that don’t know

## Differences

- Store initial file version and each change over time
- Subversion uses this method

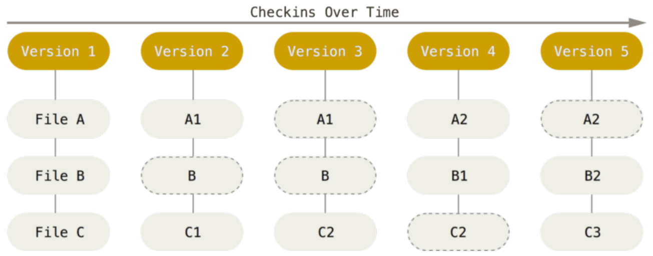


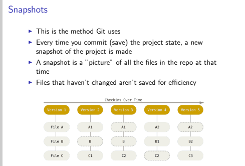


1. Mention how snapshots are rebuilt from deltas

## Snapshots

- This is the method Git uses
- Every time you commit (save) the project state, a new snapshot of the project is made
- A snapshot is a "picture" of all the files in the repo at that time
- Files that haven't changed aren't saved for efficiency

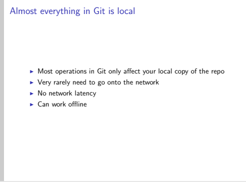




1. State speed advantage over deltas
2. Explain diagram, e.g. unchanged files not re-saved

## Almost everything in Git is local

- Most operations in Git only affect your local copy of the repo
- Very rarely need to go onto the network
- No network latency
- Can work offline


Almost everything in Git is local

- Most operations in Git only affect your local copy of the repo
- Very rarely need to go onto the network
- No network latency
- Can work offline

1. Nothing is shared automatically

## Git has built-in integrity checking

- Everything stored in Git is check-summed
- Changing something changes the checksum and the history
- Git is able to detect file corruption or modification
- SHA-1 hash (40-char hex string)
- 24b9da6552252987aa493b52f8696cd6d3b00373

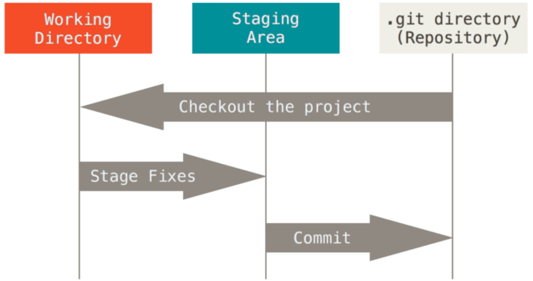
Git has built-in integrity checking

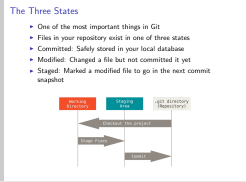
- Everything stored in Git is check-summed
- Changing something changes the checksum and the history
- Git is able to detect file corruption or modification
- SHA-1 hash (40-char hex string)
- 24b9da6552252987aa493b52f8696cd6d3b00373

1. You frequently refer to objects in Git directly by their hash

## The Three States

- One of the most important things in Git
- Files in your repository exist in one of three states
- Committed: Safely stored in your local database
- Modified: Changed a file but not committed it yet
- Staged: Marked a modified file to go in the next commit snapshot

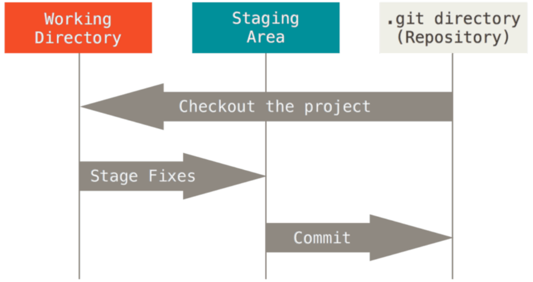


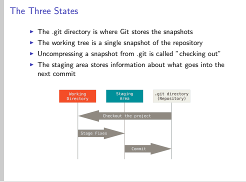


1. Each state (working dir etc.) is explained on next slide

## The Three States

- The .git directory is where Git stores the snapshots
- The working tree is a single snapshot of the repository
- Uncompressing a snapshot from .git is called "checking out"
- The staging area stores information about what goes into the next commit




The Three States

- The .git directory is where Git stores the snapshots
- The working tree is a single snapshot of the repository
- Uncompressing a snapshot from .git is called "checking out"
- The staging area stores information about what goes into the next commit

1. Development cycle explain in next slide

## Development Cycle

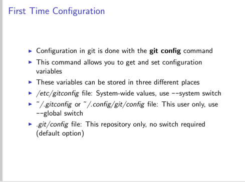
- 1. Modify files in working tree
- 2. Stage some of the modified files
- 3. Do a commit, saving the contents of the staging area into a new snapshot

Development Cycle

- 1. Modify files in working tree
- 2. Stage some of the modified files
- 3. Do a commit, saving the contents of the staging area into a new snapshot

## First Time Configuration

- Configuration in git is done with the **git config** command
- This command allows you to get and set configuration variables
- These variables can be stored in three different places
- */etc/gitconfig* file: System-wide values, use --system switch
- *~/.gitconfig* or *~/.config/git/config* file: This user only, use --global switch
- *.git/config* file: This repository only, no switch required (default option)

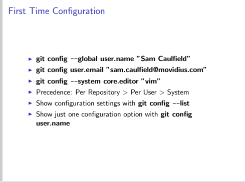


First Time Configuration

- Configuration in git is done with the **git config** command
- This command allows you to get and set configuration variables
- These variables can be stored in three different places
- */etc/gitconfig* file: System-wide values, use --system switch
- *~/.gitconfig* or *~/.config/git/config* file: This user only, use --global switch
- *.git/config* file: This repository only, no switch required (default option)

## First Time Configuration

- **git config --global user.name "Sam Caulfield"**
- **git config user.email "sam.caulfield@movidius.com"**
- **git config --system core.editor "vim"**
- Precedence: Per Repository > Per User > System
- Show configuration settings with **git config --list**
- Show just one configuration option with **git config user.name**



First Time Configuration

- **git config --global user.name "Sam Caulfield"**
- **git config user.email "sam.caulfield@movidius.com"**
- **git config --system core.editor "vim"**
- Precedence: Per Repository > Per User > System
- Show configuration settings with **git config --list**
- Show just one configuration option with **git config user.name**

## Getting help

- **git help** <**verb**>
- **git** <**verb**> **--help**
- **man git-**<**verb**>
- https://git-scm.com/book/en/v2/

Getting help

- **git help** <**verb**>
- **git** <**verb**> **--help**
- **man git-**<**verb**>
- https://git-scm.com/book/en/v2/

## Getting a Git Repository

- Two main ways: create one or copy one
- To create one: **git init** or **git init MyRepo**
- To copy one: **git clone https://github.com/libgit2/libgit2**

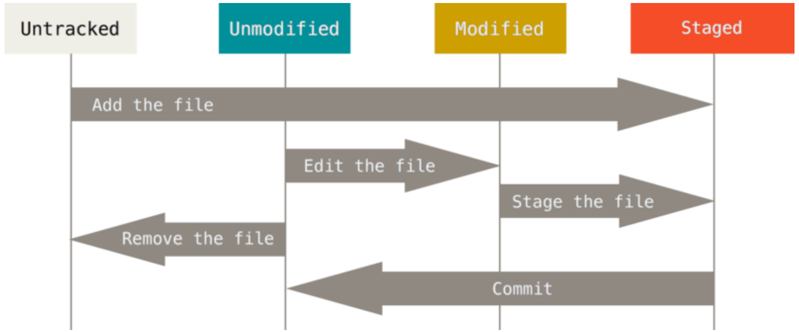
Getting a Git Repository

- Two main ways: create one or copy one
- To create one: **git init** or **git init MyRepo**
- To copy one: **git clone https://github.com/libgit2/libgit2**

1. This is just another quick note, most will know this

## Recording Changes to the Repository

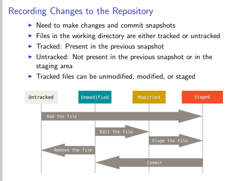
- Need to make changes and commit snapshots
- Files in the working directory are either tracked or untracked
- Tracked: Present in the previous snapshot
- Untracked: Not present in the previous snapshot or in the staging area
- Tracked files can be unmodified, modified, or staged



2017-02-23

Intro to Git

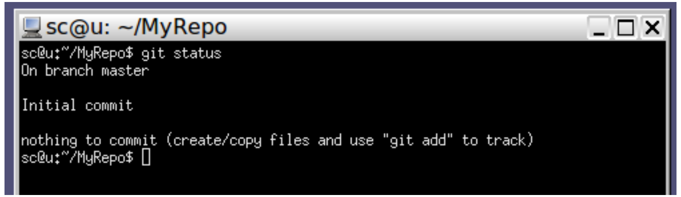
└Recording Changes to the Repository


Recording Changes to the Repository

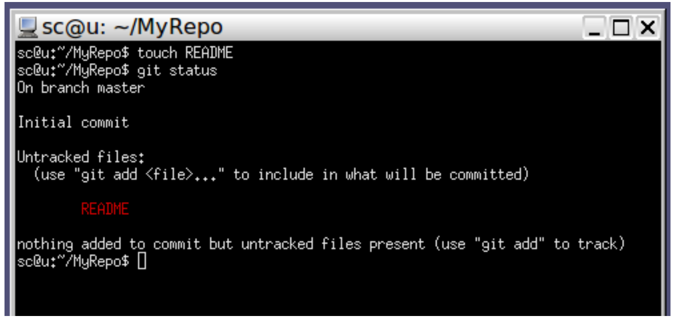
- Need to make changes and commit snapshots
- Files in the working directory are either tracked or untracked
- Tracked: Present in the previous snapshot
- Untracked: Not present in the previous snapshot or in the staging area
- Tracked files can be unmodified, modified, or staged

## Checking the Status of Files

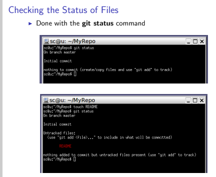
- Done with the **git status** command



```
sc@u: ~/MyRepo
sc@u:~/MyRepo$ git status
On branch master

Initial commit

nothing to commit (create/copy files and use "git add" to track)
sc@u:~/MyRepo$ 
```



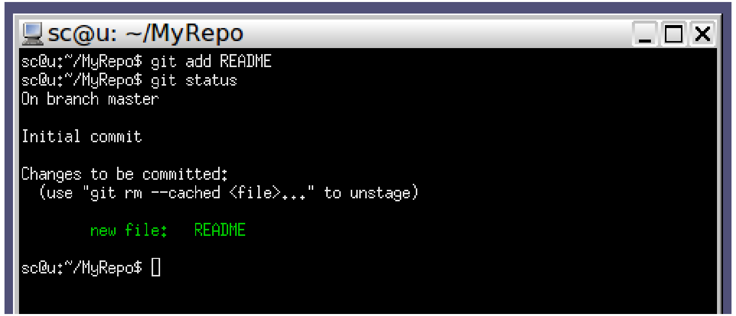
```
sc@u: ~/MyRepo
sc@u:~/MyRepo$ touch README
sc@u:~/MyRepo$ git status
On branch master

Initial commit

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        README

nothing added to commit but untracked files present (use "git add" to track)
sc@u:~/MyRepo$ 
```



Checking the Status of Files
- Done with the **git status** command

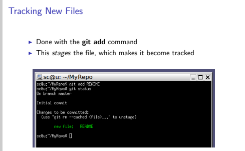
## Tracking New Files

- Done with the **git add** command
- This *stages* the file, which makes it become tracked



sc@u: ~/MyRepo

```
sc@u:~/MyRepo$ git add README
sc@u:~/MyRepo$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   README

sc@u:~/MyRepo$ []
```



Tracking New Files

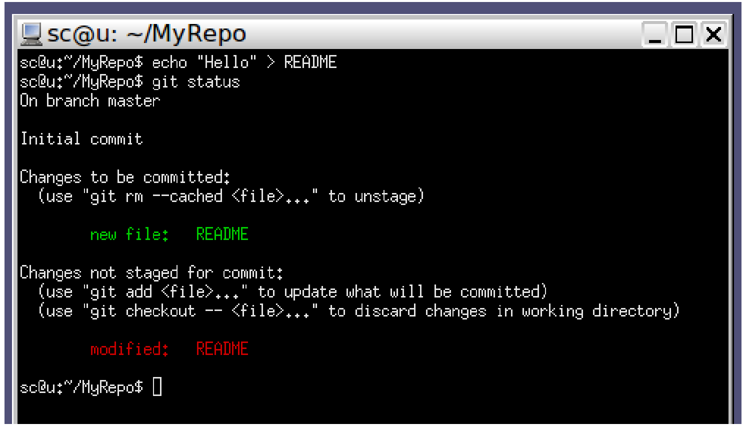
- Done with the **git add** command
- This *stages* the file, which makes it become tracked

sc@u: ~/MyRepo

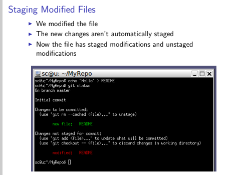
```
sc@u:~/MyRepo$ git add README
sc@u:~/MyRepo$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   README

sc@u:~/MyRepo$ []
```

## Staging Modified Files

- We modified the file
- The new changes aren't automatically staged
- Now the file has staged modifications and unstaged modifications


sc@u: ~/MyRepo

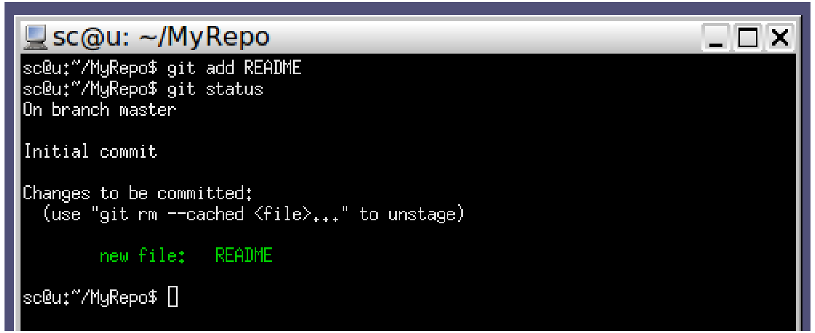
```
sc@u:~/MyRepo$ echo "Hello" > README
sc@u:~/MyRepo$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   README

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   README

sc@u:~/MyRepo$ 
```


Staging Modified Files

- We modified the file
- The new changes aren't automatically staged
- Now the file has staged modifications and unstaged modifications

## Staging Modified Files

- Done with the **git add** command
- **git add --patch** can be used to stage parts of files

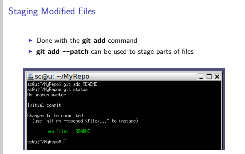

sc@u: ~/MyRepo

```
sc@u:~/MyRepo$ git add README
sc@u:~/MyRepo$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   README

sc@u:~/MyRepo$ 
```

Intro to Git

2017-02-23

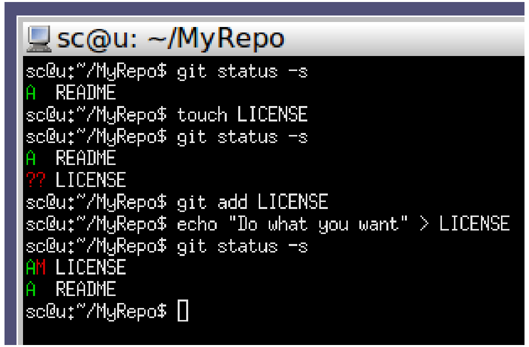
└Staging Modified Files


Staging Modified Files

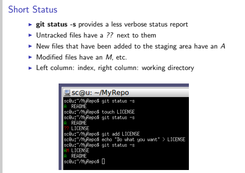
- Done with the **git add** command
- **git add --patch** can be used to stage parts of files

## Short Status

- **git status -s** provides a less verbose status report
- Untracked files have a *??* next to them
- New files that have been added to the staging area have an *A*
- Modified files have an *M*, etc.
- Left column: index, right column: working directory



```
sc@u: ~/MyRepo
sc@u:~/MyRepo$ git status -s
A  README
sc@u:~/MyRepo$ touch LICENSE
sc@u:~/MyRepo$ git status -s
A  README
?? LICENSE
sc@u:~/MyRepo$ git add LICENSE
sc@u:~/MyRepo$ echo "Do what you want" > LICENSE
sc@u:~/MyRepo$ git status -s
AM LICENSE
A  README
sc@u:~/MyRepo$ []
```

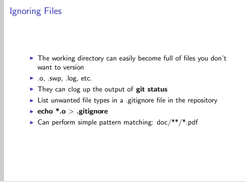


Short Status

- **git status** -s provides a less verbose status report
- Untracked files have a *??* next to them
- New files that have been added to the staging area have an *A*
- Modified files have an *M*, etc.
- Left column: index, right column: working directory

## Ignoring Files

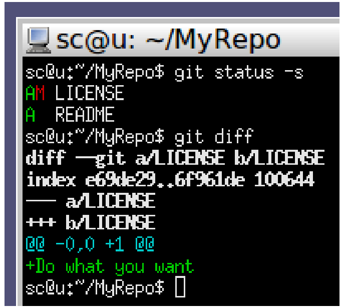
- The working directory can easily become full of files you don't want to version
- .o, .swp, .log, etc.
- They can clog up the output of **git status**
- List unwanted file types in a .gitignore file in the repository
- **echo *.o > .gitignore**
- Can perform simple pattern matching: doc/**/*.pdf


Ignoring Files

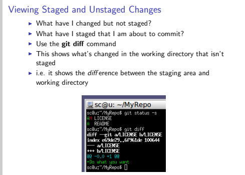
- The working directory can easily become full of files you don't want to version
- .o, .swp, .log, etc.
- They can clog up the output of **git status**
- List unwanted file types in a .gitignore file in the repository
- **echo *.o > .gitignore**
- Can perform simple pattern matching: doc/**/*.pdf

## Viewing Staged and Unstaged Changes

- What have I changed but not staged?
- What have I staged that I am about to commit?
- Use the **git diff** command
- This shows what's changed in the working directory that isn't staged
- i.e. it shows the *diff*erence between the staging area and working directory



```
sc@u: ~/MyRepo
sc@u:~/MyRepo$ git status -s
AM LICENSE
A  README
sc@u:~/MyRepo$ git diff
diff --git a/LICENSE b/LICENSE
index e69de29..6f961de 100644
--- a/LICENSE
+++ b/LICENSE
@@ -0,0 +1 @@
+Do what you want
sc@u:~/MyRepo$ 
```

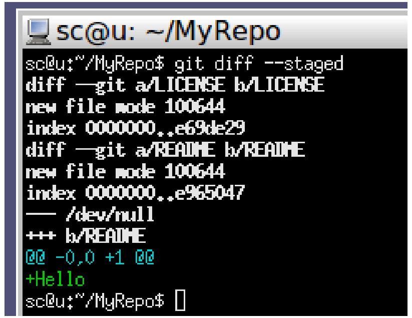


Viewing Staged and Unstaged Changes

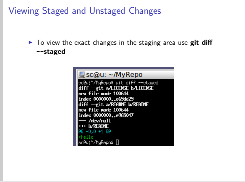
- What have I changed but not staged?
- What have I staged that I am about to commit?
- Use the **git diff** command
- This shows what's changed in the working directory that isn't staged
- i.e. it shows the *diff*erence between the staging area and working directory

## Viewing Staged and Unstaged Changes

- To view the exact changes in the staging area use **git diff --staged**

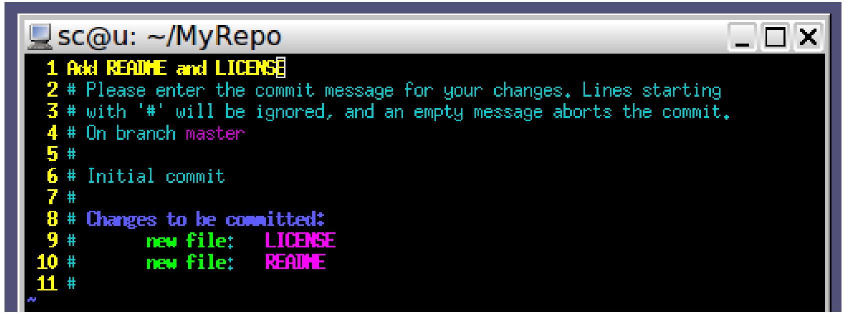


```
sc@u:~/MyRepo$ git diff --staged
diff --git a/LICENSE b/LICENSE
new file mode 100644
index 0000000..e69de29
diff --git a/README b/README
new file mode 100644
index 0000000..e965047
--- /dev/null
+++ b/README
@@ -0,0 +1 @@
+Hello
sc@u:~/MyRepo$
```



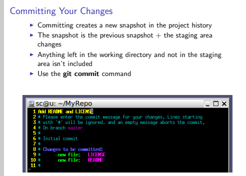
## Committing Your Changes

- Committing creates a new snapshot in the project history
- The snapshot is the previous snapshot + the staging area changes
- Anything left in the working directory and not in the staging area isn't included
- Use the **git commit** command



sc@u: ~/MyRepo

```
Add README and LICENSE
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
#
# Initial commit
#
# Changes to be committed:
#       new file:   LICENSE
#       new file:   README
#
~
```



Committing Your Changes

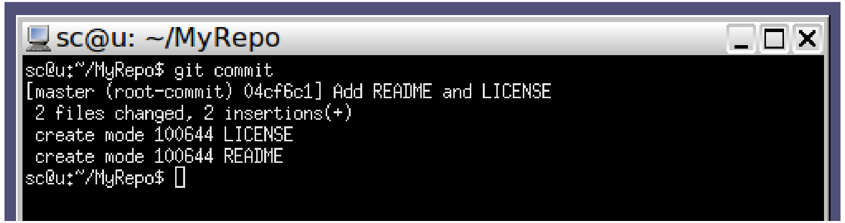
- Committing creates a new snapshot in the project history
- The snapshot is the previous snapshot + the staging area changes
- Anything left in the working directory and not in the staging area isn't included
- Use the **git commit** command

sc@u: ~/MyRepo

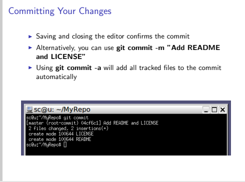
```
Add README and LICENSE
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
#
# Initial commit
#
# Changes to be committed:
#       new file:   LICENSE
#       new file:   README
#
```

## Committing Your Changes

- Saving and closing the editor confirms the commit
- Alternatively, you can use **git commit -m "Add README and LICENSE"**
- Using **git commit -a** will add all tracked files to the commit automatically

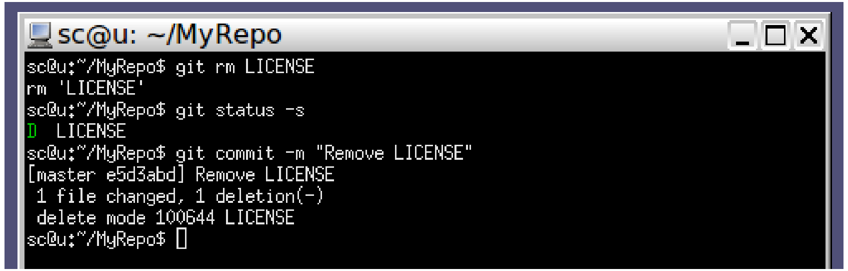


```
sc@u:~/MyRepo$ git commit
[master (root-commit) 04cf6c1] Add README and LICENSE
 2 files changed, 2 insertions(+)
 create mode 100644 LICENSE
 create mode 100644 README
sc@u:~/MyRepo$ 
```



## Removing Files from the Repository

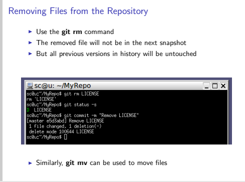
- Use the **git rm** command
- The removed file will not be in the next snapshot
- But all previous versions in history will be untouched



sc@u: ~/MyRepo

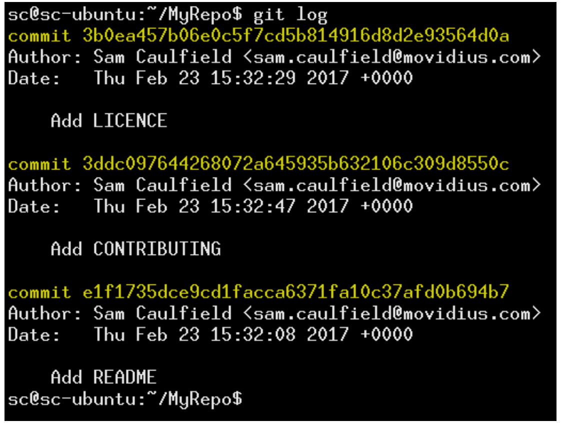
```
sc@u:~/MyRepo$ git rm LICENSE
rm 'LICENSE'
sc@u:~/MyRepo$ git status -s
D  LICENSE
sc@u:~/MyRepo$ git commit -m "Remove LICENSE"
[master e5d3abd] Remove LICENSE
 1 file changed, 1 deletion(-)
 delete mode 100644 LICENSE
sc@u:~/MyRepo$ []
```

- Similarly, **git mv** can be used to move files



## Viewing the Commit History

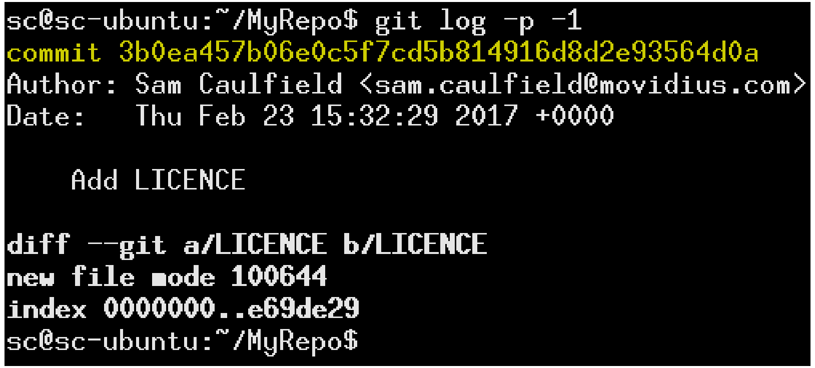
- Use the **git log** command



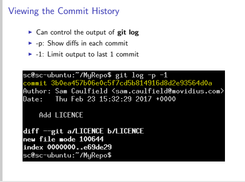
```
sc@sc-ubuntu:~/MyRepo$ git log
commit 3b0ea457b06e0c5f7cd5b814916d8d2e93564d0a
Author: Sam Caulfield <sam.caulfield@movidius.com>
Date:   Thu Feb 23 15:32:29 2017 +0000

    Add LICENCE

commit 3ddc097644268072a645935b632106c309d8550c
Author: Sam Caulfield <sam.caulfield@movidius.com>
Date:   Thu Feb 23 15:32:47 2017 +0000

    Add CONTRIBUTING

commit e1f1735dce9cd1facca6371fa10c37afd0b694b7
Author: Sam Caulfield <sam.caulfield@movidius.com>
Date:   Thu Feb 23 15:32:08 2017 +0000

    Add README
sc@sc-ubuntu:~/MyRepo$
```

## Viewing the Commit History

- Can control the output of **git log**
- -p: Show diffs in each commit
- -1: Limit output to last 1 commit

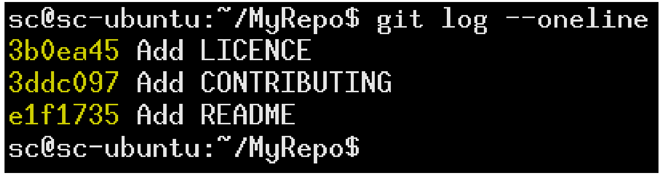


```
sc@sc-ubuntu:~/MyRepo$ git log -p -1
commit 3b0ea457b06e0c5f7cd5b814916d8d2e93564d0a
Author: Sam Caulfield <sam.caulfield@movidius.com>
Date:   Thu Feb 23 15:32:29 2017 +0000

    Add LICENCE

diff --git a/LICENCE b/LICENCE
new file mode 100644
index 0000000..e69de29
sc@sc-ubuntu:~/MyRepo$
```

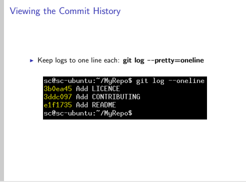


## Viewing the Commit History

- Keep logs to one line each: **git log --pretty=oneline**



```
sc@sc-ubuntu:~/MyRepo$ git log --oneline
3b0ea45 Add LICENCE
3ddc097 Add CONTRIBUTING
e1f1735 Add README
sc@sc-ubuntu:~/MyRepo$
```



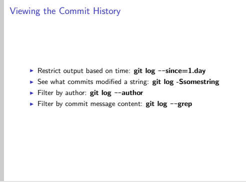
Viewing the Commit History

- Keep logs to one line each: **git log --pretty=oneline**

```
sc@sc-ubuntu:~/MyRepo$ git log --oneline
3b0ea45 Add LICENCE
3ddc097 Add CONTRIBUTING
e1f1735 Add README
sc@sc-ubuntu:~/MyRepo$
```

## Viewing the Commit History

- Restrict output based on time: **git log --since=1.day**
- See what commits modified a string: **git log -Ssomestring**
- Filter by author: **git log --author**
- Filter by commit message content: **git log --grep**

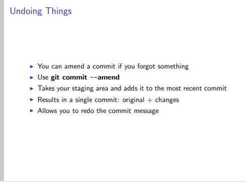


Viewing the Commit History

- Restrict output based on time: **git log --since=1.day**
- See what commits modified a string: **git log -Ssomestring**
- Filter by author: **git log --author**
- Filter by commit message content: **git log --grep**

## Undoing Things

- You can amend a commit if you forgot something
- Use **git commit --amend**
- Takes your staging area and adds it to the most recent commit
- Results in a single commit: original + changes
- Allows you to redo the commit message


Undoing Things

- You can amend a commit if you forgot something
- Use **git commit --amend**
- Takes your staging area and adds it to the most recent commit
- Results in a single commit: original + changes
- Allows you to redo the commit message

## Unstaging Staged Files

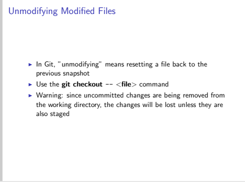
- Use the **git reset HEAD** <**file**> command
- This removes the file from the staging area
- This is safe because the changes are also in the working directory
- Warning: **git reset --hard** isn't necessarily safe

Unstaging Staged Files

- Use the **git reset HEAD** <**file**> command
- This removes the file from the staging area
- This is safe because the changes are also in the working directory
- Warning: **git reset --hard** isn't necessarily safe

## Unmodifying Modified Files

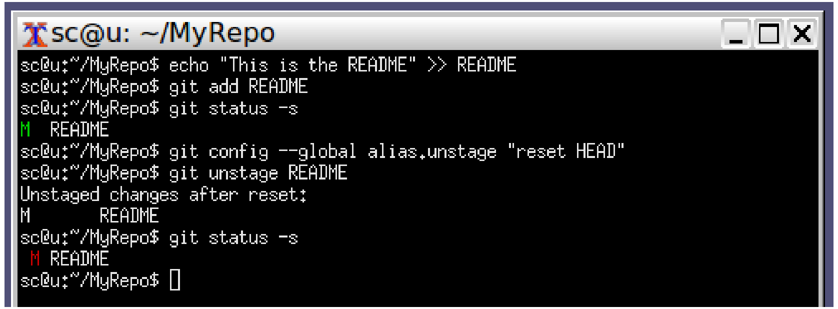
- In Git, "unmodifying" means resetting a file back to the previous snapshot
- Use the **git checkout --** <**file**> command
- Warning: since uncommitted changes are being removed from the working directory, the changes will be lost unless they are also staged


Unmodifying Modified Files

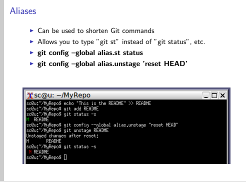
- In Git, "unmodifying" means resetting a file back to the previous snapshot
- Use the **git checkout --** <**file**> command
- Warning: since uncommitted changes are being removed from the working directory, the changes will be lost unless they are also staged

## Aliases

- Can be used to shorten Git commands
- Allows you to type "git st" instead of "git status", etc.
- **git config –global alias.st status**
- **git config –global alias.unstage 'reset HEAD'**



```
sc@u:~/MyRepo$ echo "This is the README" >> README
sc@u:~/MyRepo$ git add README
sc@u:~/MyRepo$ git status -s
M  README
sc@u:~/MyRepo$ git config --global alias.unstage "reset HEAD"
sc@u:~/MyRepo$ git unstage README
Unstaged changes after reset:
M       README
sc@u:~/MyRepo$ git status -s
 M README
sc@u:~/MyRepo$ 
```


Aliases

- Can be used to shorten Git commands
- Allows you to type "git st" instead of "git status", etc.
- **git config –global alias.st status**
- **git config –global alias.unstage 'reset HEAD'**

## Branches in Git

- Branching: Diverge from the main line of development
- Continue working on a different "line" of development
- Can merge back into the main line when complete
- One of Git's best features

Branches in Git

- Branching: Diverge from the main line of development
- Continue working on a different "line" of development
- Can merge back into the main line when complete
- One of Git's best features

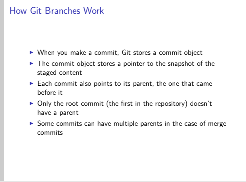
## How Git Branches Work

- When you make a commit, Git stores a commit object
- The commit object stores a pointer to the snapshot of the staged content
- Each commit also points to its parent, the one that came before it
- Only the root commit (the first in the repository) doesn't have a parent
- Some commits can have multiple parents in the case of merge commits

2017-02-23

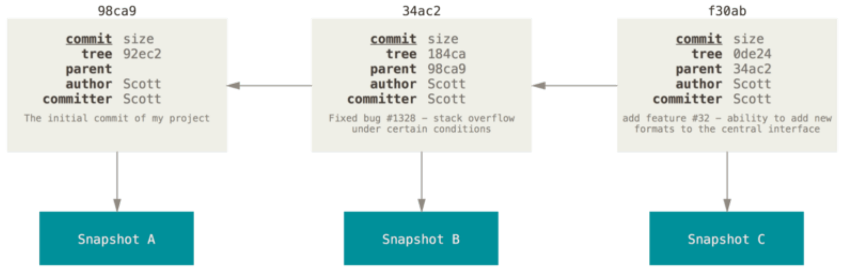
Intro to Git

└How Git Branches Work


How Git Branches Work

- When you make a commit, Git stores a commit object
- The commit object stores a pointer to the snapshot of the staged content
- Each commit also points to its parent, the one that came before it
- Only the root commit (the first in the repository) doesn't have a parent
- Some commits can have multiple parents in the case of merge commits

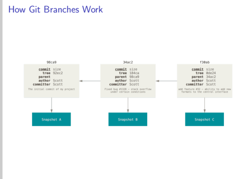
## How Git Branches Work



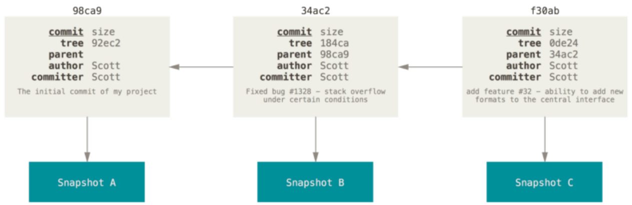
Intro to Git

2017-02-23

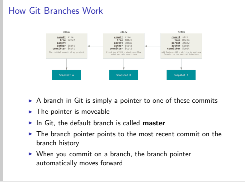
└─How Git Branches Work



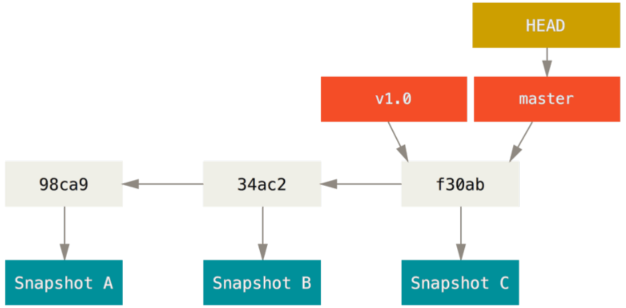
## How Git Branches Work



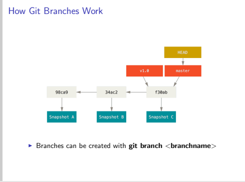
- A branch in Git is simply a pointer to one of these commits
- The pointer is moveable
- In Git, the default branch is called **master**
- The branch pointer points to the most recent commit on the branch history
- When you commit on a branch, the branch pointer automatically moves forward


How Git Branches Work
- A branch in Git is simply a pointer to one of these commits
- The pointer is moveable
- In Git, the default branch is called **master**
- The branch pointer points to the most recent commit on the branch history
- When you commit on a branch, the branch pointer automatically moves forward

## How Git Branches Work



- Branches can be created with **git branch** <**branchname**>

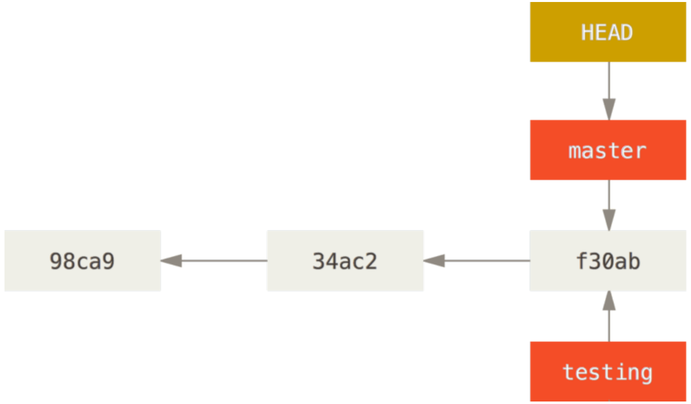


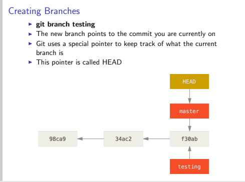
How Git Branches Work

- Branches can be created with **git branch** <**branchname**>

## Creating Branches

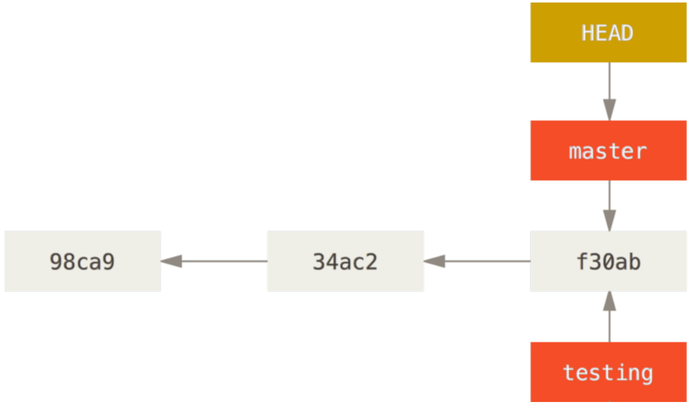
- **git branch testing**
- The new branch points to the commit you are currently on
- Git uses a special pointer to keep track of what the current branch is
- This pointer is called HEAD





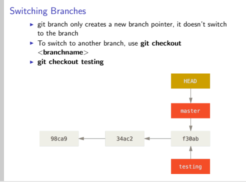
## Switching Branches

- git branch only creates a new branch pointer, it doesn't switch to the branch
- To switch to another branch, use **git checkout <branchname>**
- **git checkout testing**



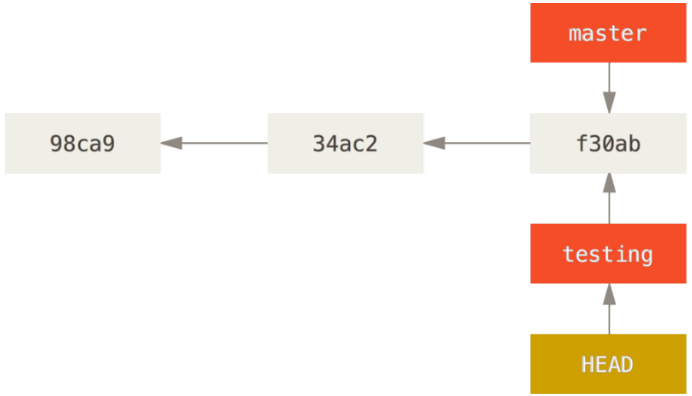
Intro to Git

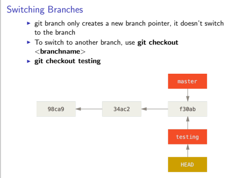
└─Switching Branches



## Switching Branches

- git branch only creates a new branch pointer, it doesn't switch to the branch
- To switch to another branch, use **git checkout <branchname>**
- **git checkout testing**

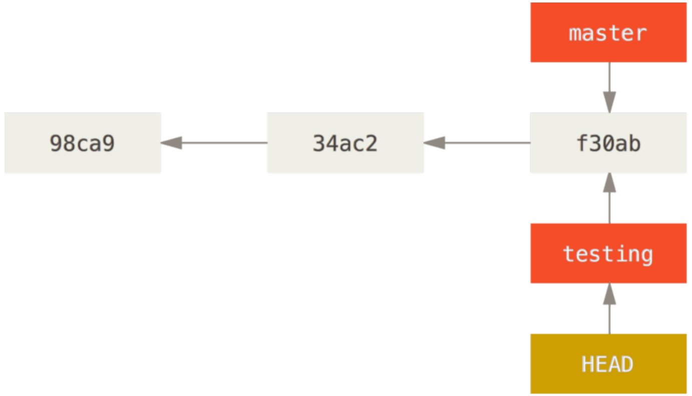


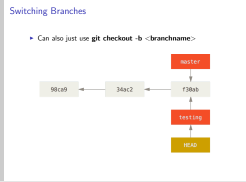

Switching Branches

- git branch only creates a new branch pointer, it doesn't switch to the branch
- To switch to another branch, use **git checkout <branchname>**
- **git checkout testing**

## Switching Branches

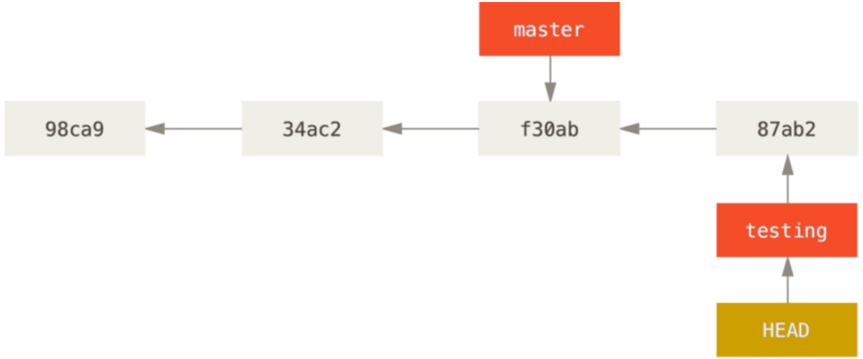
- Can also just use **git checkout -b** <**branchname**>

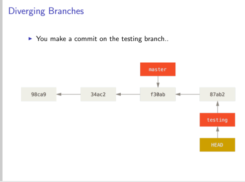




## Diverging Branches

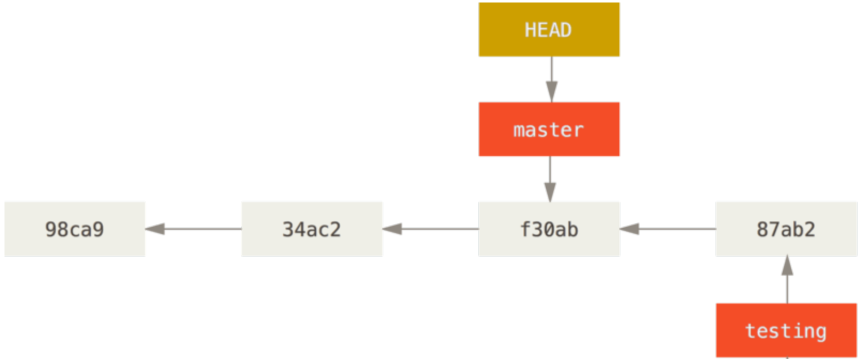
- You make a commit on the testing branch..

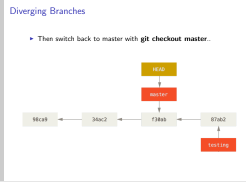



Diverging Branches
- You make a commit on the testing branch..

## Diverging Branches

- Then switch back to master with **git checkout master**..



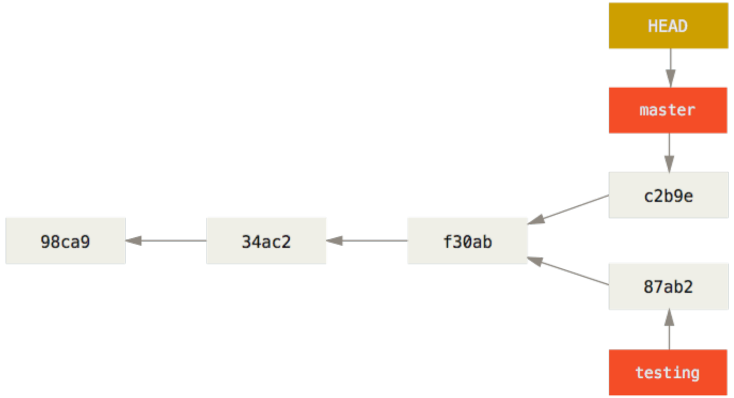


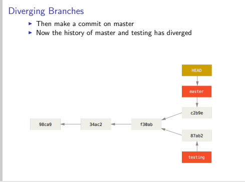
Diverging Branches

- Then switch back to master with **git checkout master**..

## Diverging Branches

- Then make a commit on master
- Now the history of master and testing has diverged

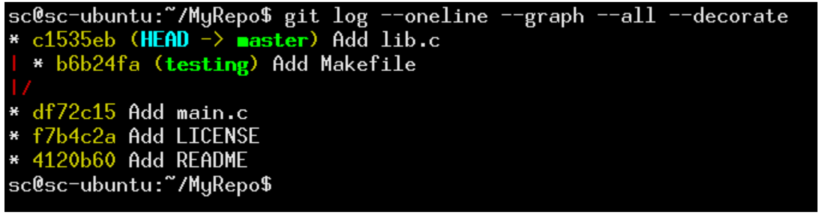




Diverging Branches
- Then make a commit on master
- Now the history of master and testing has diverged

## Viewing the History with Branches

- **git log –all –oneline –graph**
- all: show all branches
- graph: visually indicate divergent history
- decorate: show where branch pointers are

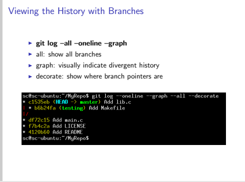


```
sc@sc-ubuntu:~/MyRepo$ git log --oneline --graph --all --decorate
* c1535eb (HEAD -> master) Add lib.c
| * b6b24fa (testing) Add Makefile
|/
* df72c15 Add main.c
* f7b4c2a Add LICENSE
* 4120b60 Add README
sc@sc-ubuntu:~/MyRepo$
```

Intro to Git

2017-02-23

└Viewing the History with Branches



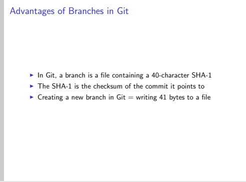
Viewing the History with Branches

- **git log –all –oneline –graph**
- all: show all branches
- graph: visually indicate divergent history
- decorate: show where branch pointers are

```
sc@sc-ubuntu:~/MyRepo$ git log --oneline --graph --all --decorate
* c1535eb (HEAD -> master) Add lib.c
| * b6b24fa (testing) Add Makefile
|/
* df72c15 Add main.c
* f7b4c2a Add LICENSE
* 4120b60 Add README
sc@sc-ubuntu:~/MyRepo$
```

## Advantages of Branches in Git

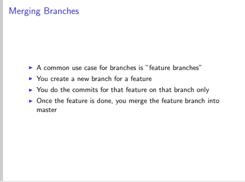
- In Git, a branch is a file containing a 40-character SHA-1
- The SHA-1 is the checksum of the commit it points to
- Creating a new branch in Git = writing 41 bytes to a file


Advantages of Branches in Git

- In Git, a branch is a file containing a 40-character SHA-1
- The SHA-1 is the checksum of the commit it points to
- Creating a new branch in Git = writing 41 bytes to a file

## Merging Branches

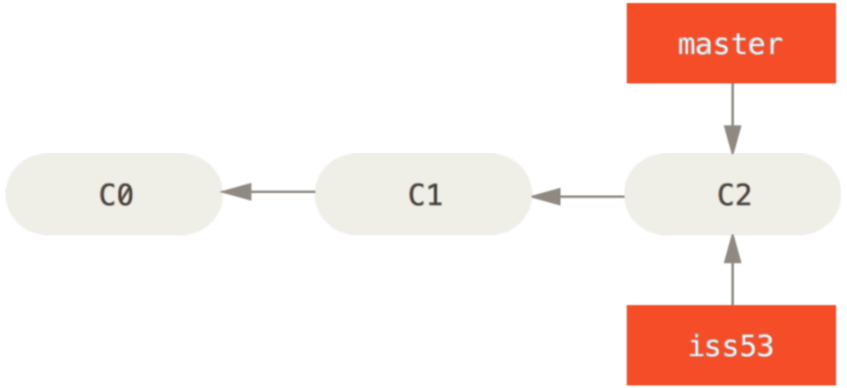
- A common use case for branches is "feature branches"
- You create a new branch for a feature
- You do the commits for that feature on that branch only
- Once the feature is done, you merge the feature branch into master

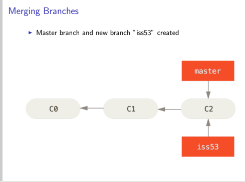

Merging Branches

- A common use case for branches is "feature branches"
- You create a new branch for a feature
- You do the commits for that feature on that branch only
- Once the feature is done, you merge the feature branch into master

## Merging Branches

- Master branch and new branch "iss53" created

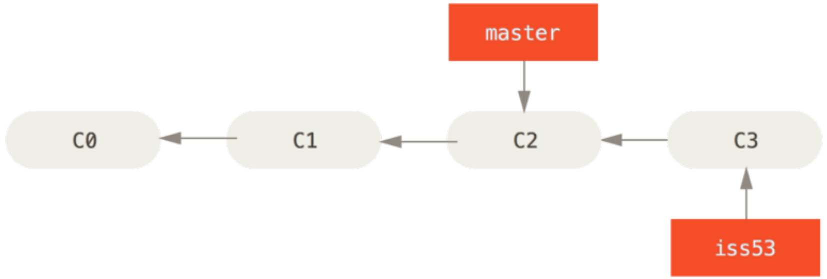


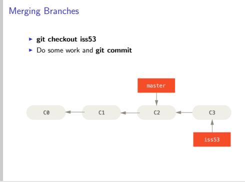

Merging Branches

- Master branch and new branch "iss53" created

## Merging Branches

- **git checkout iss53**
- Do some work and **git commit**

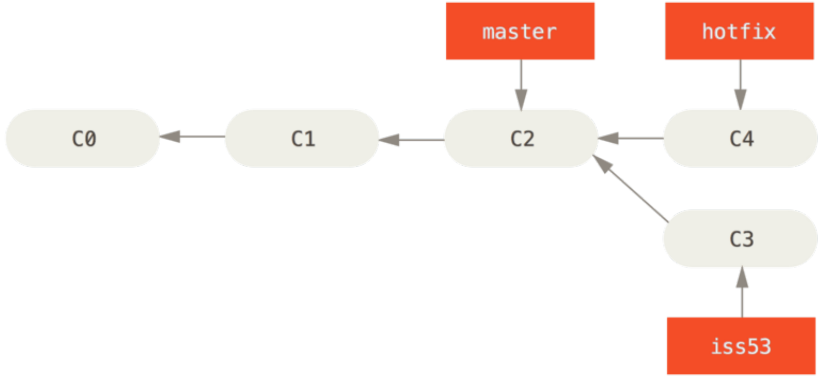


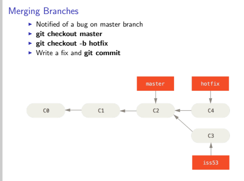

Merging Branches

- **git checkout iss53**
- Do some work and **git commit**

## Merging Branches

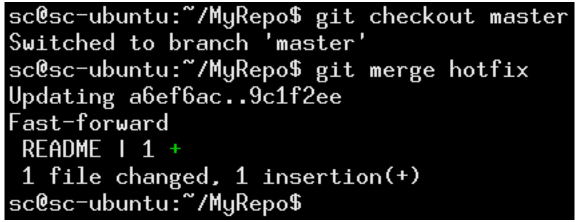
- Notified of a bug on master branch
- **git checkout master**
- **git checkout -b hotfix**
- Write a fix and **git commit**



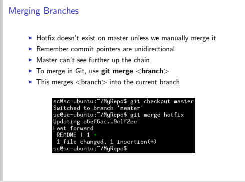

Merging Branches
- Notified of a bug on master branch
- **git checkout master**
- **git checkout -b hotfix**
- Write a fix and **git commit**

## Merging Branches

- Hotfix doesn't exist on master unless we manually merge it
- Remember commit pointers are unidirectional
- Master can't see further up the chain
- To merge in Git, use **git merge** <**branch**>
- This merges <branch> into the current branch



```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge hotfix
Updating a6ef6ac..9c1f2ee
Fast-forward
 README | 1 +
 1 file changed, 1 insertion(+)
sc@sc-ubuntu:~/MyRepo$
```



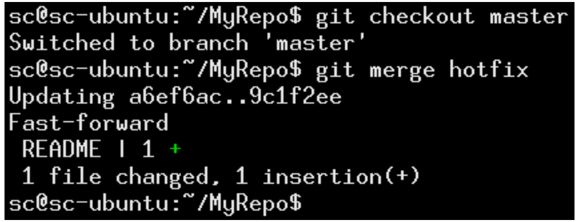
Merging Branches

- Hotfix doesn't exist on master unless we manually merge it
- Remember commit pointers are unidirectional
- Master can't see further up the chain
- To merge in Git, use **git merge** <**branch**>
- This merges <branch> into the current branch

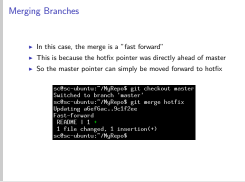
```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge hotfix
Updating a6ef6ac..9c1f2ee
Fast-forward
 README | 1 +
 1 file changed, 1 insertion(+)
sc@sc-ubuntu:~/MyRepo$
```

## Merging Branches

- In this case, the merge is a "fast forward"
- This is because the hotfix pointer was directly ahead of master
- So the master pointer can simply be moved forward to hotfix



```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge hotfix
Updating a6ef6ac..9c1f2ee
Fast-forward
 README | 1 +
 1 file changed, 1 insertion(+)
sc@sc-ubuntu:~/MyRepo$
```



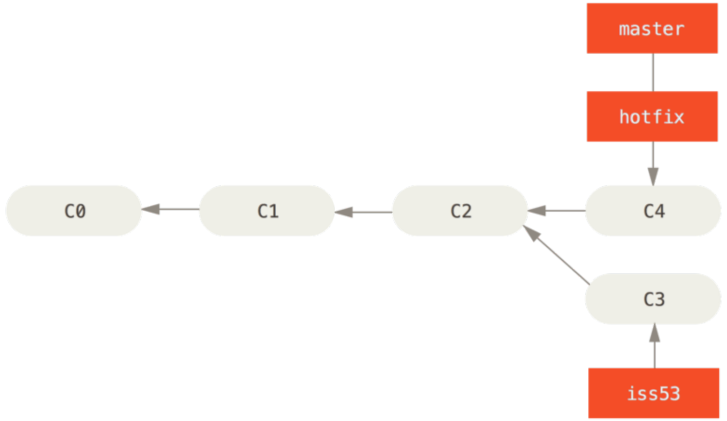
Merging Branches

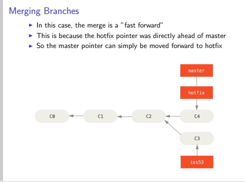
- In this case, the merge is a "fast forward"
- This is because the hotfix pointer was directly ahead of master
- So the master pointer can simply be moved forward to hotfix

```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge hotfix
Updating a6ef6ac..9c1f2ee
Fast-forward
 README | 1 +
 1 file changed, 1 insertion(+)
sc@sc-ubuntu:~/MyRepo$
```

## Merging Branches

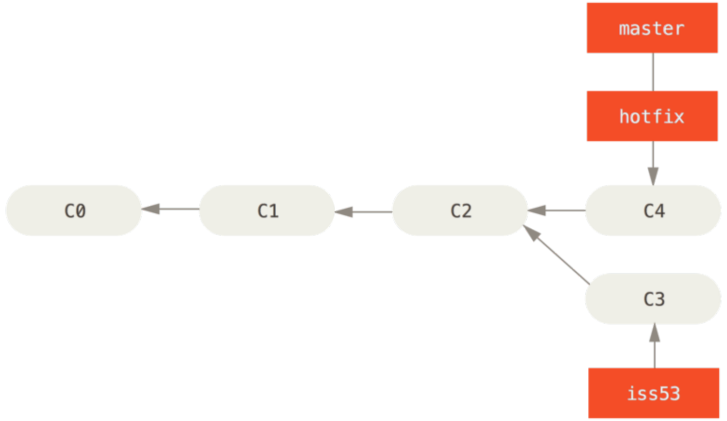
- In this case, the merge is a "fast forward"
- This is because the hotfix pointer was directly ahead of master
- So the master pointer can simply be moved forward to hotfix

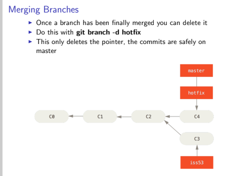




## Merging Branches

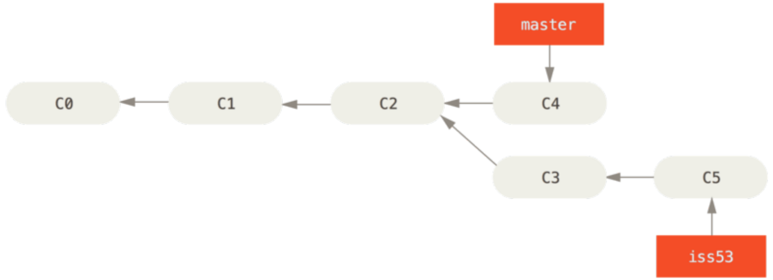
- Once a branch has been finally merged you can delete it
- Do this with **git branch -d hotfix**
- This only deletes the pointer, the commits are safely on master

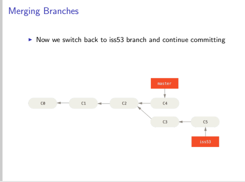



Merging Branches
- Once a branch has been finally merged you can delete it
- Do this with **git branch -d hotfix**
- This only deletes the pointer, the commits are safely on master

## Merging Branches

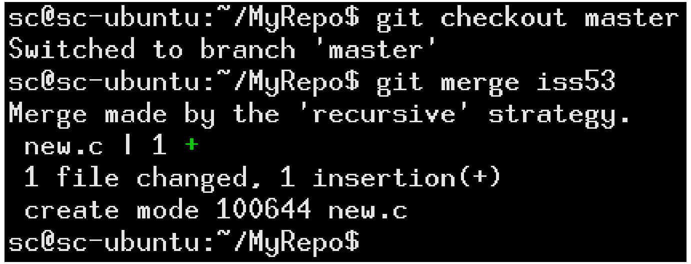
- Now we switch back to iss53 branch and continue committing



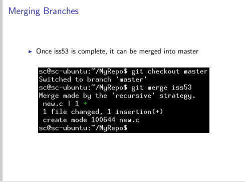


## Merging Branches

- Once iss53 is complete, it can be merged into master



```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge iss53
Merge made by the 'recursive' strategy.
 new.c | 1 +
 1 file changed, 1 insertion(+)
 create mode 100644 new.c
sc@sc-ubuntu:~/MyRepo$
```



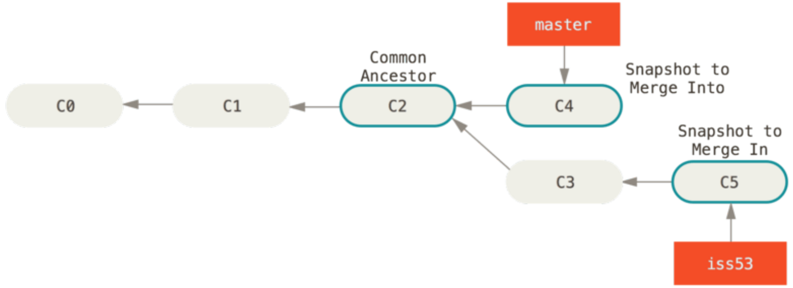
Merging Branches

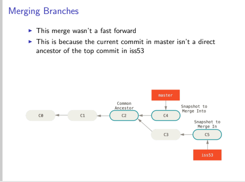
- Once iss53 is complete, it can be merged into master

```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge iss53
Merge made by the 'recursive' strategy.
 new.c | 1 +
 1 file changed, 1 insertion(+)
 create mode 100644 new.c
sc@sc-ubuntu:~/MyRepo$
```

## Merging Branches

- This merge wasn't a fast forward
- This is because the current commit in master isn't a direct ancestor of the top commit in iss53

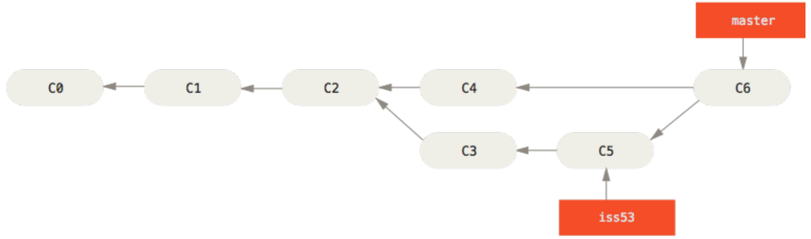


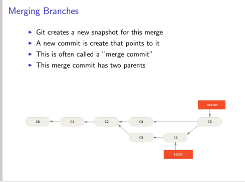

Merging Branches

- This merge wasn't a fast forward
- This is because the current commit in master isn't a direct ancestor of the top commit in iss53

## Merging Branches

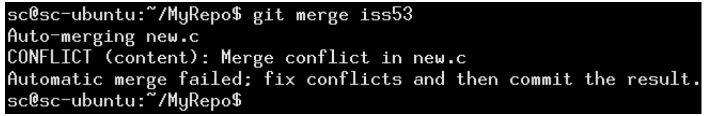
- Git creates a new snapshot for this merge
- A new commit is create that points to it
- This is often called a "merge commit"
- This merge commit has two parents



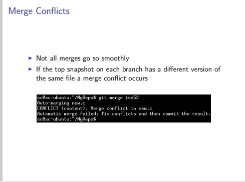


## Merge Conflicts

- Not all merges go so smoothly
- If the top snapshot on each branch has a different version of the same file a merge conflict occurs



```
sc@sc-ubuntu:~/MyRepo$ git merge iss53
Auto-merging new.c
CONFLICT (content): Merge conflict in new.c
Automatic merge failed; fix conflicts and then commit the result.
sc@sc-ubuntu:~/MyRepo$
```



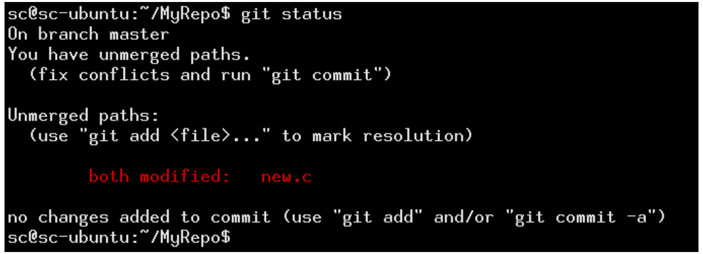
Merge Conflicts

- Not all merges go so smoothly
- If the top snapshot on each branch has a different version of the same file a merge conflict occurs

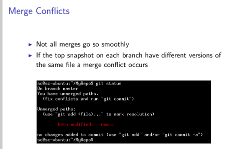
```
sc@sc-ubuntu:~/MyRepo$ git merge iss53
Auto-merging new.c
CONFLICT (content): Merge conflict in new.c
Automatic merge failed; fix conflicts and then commit the result.
sc@sc-ubuntu:~/MyRepo$
```

## Merge Conflicts

- Not all merges go so smoothly
- If the top snapshot on each branch have different versions of the same file a merge conflict occurs



```
sc@sc-ubuntu:~/MyRepo$ git status
On branch master
You have unmerged paths.
  (fix conflicts and run "git commit")

Unmerged paths:
  (use "git add <file>..." to mark resolution)

        both modified:   new.c

no changes added to commit (use "git add" and/or "git commit -a")
sc@sc-ubuntu:~/MyRepo$
```



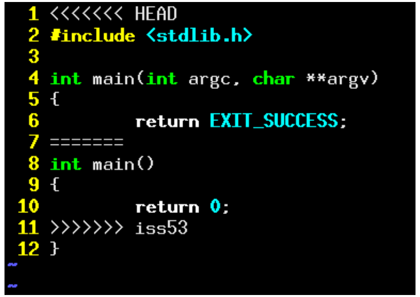
Merge Conflicts

- Not all merges go so smoothly
- If the top snapshot on each branch have different versions of the same file a merge conflict occurs

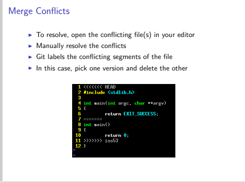
```
sc@sc-ubuntu:~/MyRepo$ git status
On branch master
You have unmerged paths.
  (fix conflicts and run "git commit")

Unmerged paths:
  (use "git add <file>..." to mark resolution)

        both modified:   new.c

no changes added to commit (use "git add" and/or "git commit -a")
sc@sc-ubuntu:~/MyRepo$
```

## Merge Conflicts

- To resolve, open the conflicting file(s) in your editor
- Manually resolve the conflicts
- Git labels the conflicting segments of the file
- In this case, pick one version and delete the other



```
<<<<<<< HEAD
#include <stdlib.h>

int main(int argc, char **argv)
{
        return EXIT_SUCCESS;
=======
int main()
{
        return 0;
>>>>>>> iss53
}
~
~
```

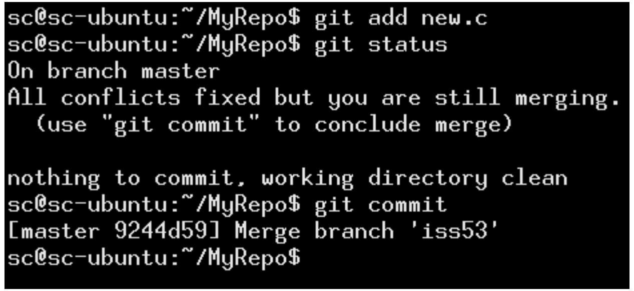


Merge Conflicts

- To resolve, open the conflicting file(s) in your editor
- Manually resolve the conflicts
- Git labels the conflicting segments of the file
- In this case, pick one version and delete the other

## Merge Conflicts

- Once the files have been edited to resolve the conflicts:
- Stage the files
- **git commit**



```
sc@sc-ubuntu:~/MyRepo$ git add new.c
sc@sc-ubuntu:~/MyRepo$ git status
On branch master
All conflicts fixed but you are still merging.
  (use "git commit" to conclude merge)

nothing to commit, working directory clean
sc@sc-ubuntu:~/MyRepo$ git commit
[master 9244d59] Merge branch 'iss53'
sc@sc-ubuntu:~/MyRepo$
```

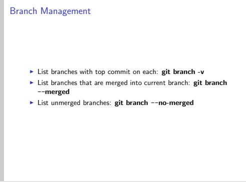
Merge Conflicts

- Once the files have been edited to resolve the conflicts:
- Stage the files
- **git commit**

```
sc@sc-ubuntu:~/MyRepo$ git add new.c
sc@sc-ubuntu:~/MyRepo$ git status
On branch master
All conflicts fixed but you are still merging.
  (use "git commit" to conclude merge)

nothing to commit, working directory clean
sc@sc-ubuntu:~/MyRepo$ git commit
[master 9244d59] Merge branch 'iss53'
sc@sc-ubuntu:~/MyRepo$
```

## Branch Management

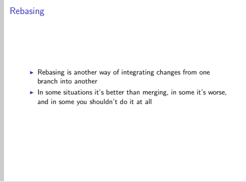
- List branches with top commit on each: **git branch -v**
- List branches that are merged into current branch: **git branch --merged**
- List unmerged branches: **git branch --no-merged**


Branch Management

- List branches with top commit on each: **git branch -v**
- List branches that are merged into current branch: **git branch --merged**
- List unmerged branches: **git branch --no-merged**

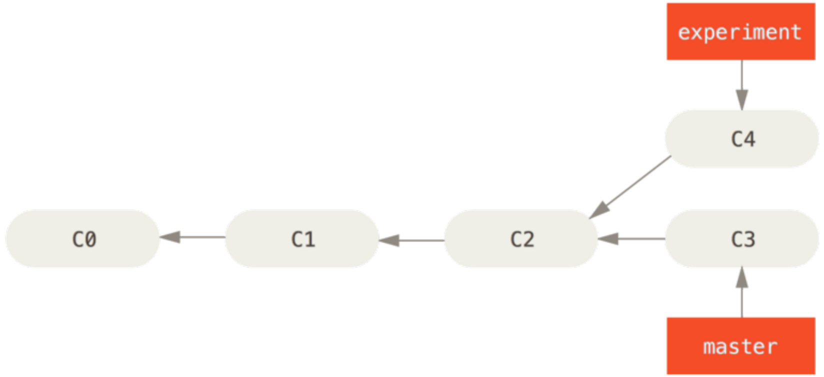
## Rebasing

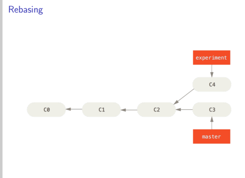
- Rebasing is another way of integrating changes from one branch into another
- In some situations it's better than merging, in some it's worse, and in some you shouldn't do it at all


Rebasing

- Rebasing is another way of integrating changes from one branch into another
- In some situations it's better than merging, in some it's worse, and in some you shouldn't do it at all

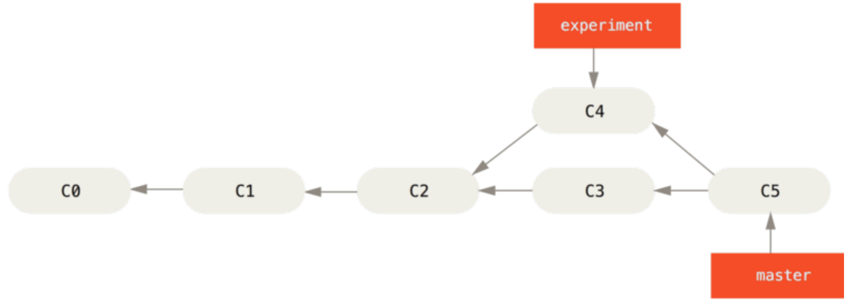
## Rebasing

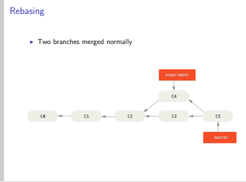

experiment
C4
C0
C1
C2
C3
master


Rebasing
experiment
C4
C0
C1
C2
C3
master

## Rebasing

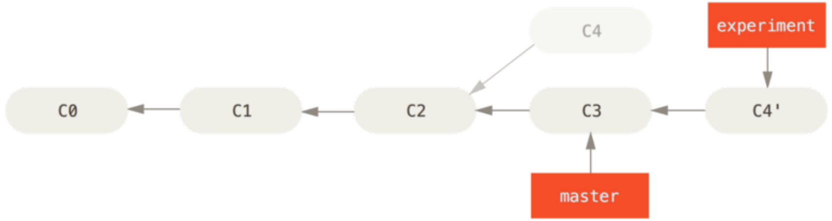
- Two branches merged normally

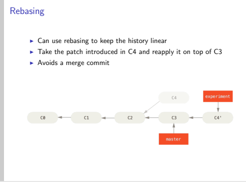




## Rebasing

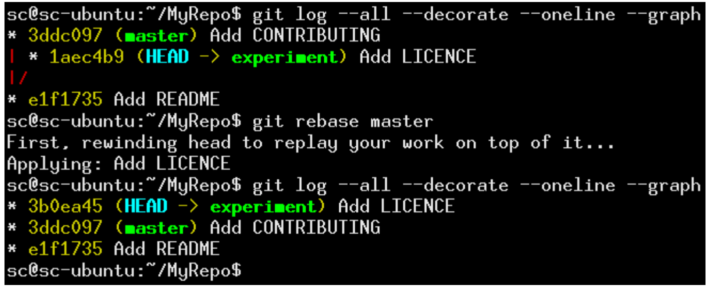
- Can use rebasing to keep the history linear
- Take the patch introduced in C4 and reapply it on top of C3
- Avoids a merge commit



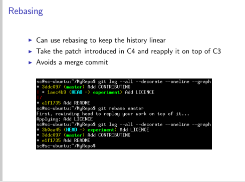


## Rebasing

- Can use rebasing to keep the history linear
- Take the patch introduced in C4 and reapply it on top of C3
- Avoids a merge commit

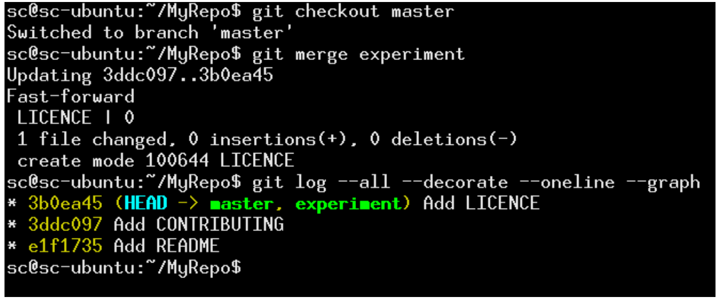


```
sc@sc-ubuntu:~/MyRepo$ git log --all --decorate --oneline --graph
* 3ddc097 (master) Add CONTRIBUTING
| * 1aec4b9 (HEAD -> experiment) Add LICENCE
|/
* e1f1735 Add README
sc@sc-ubuntu:~/MyRepo$ git rebase master
First, rewinding head to replay your work on top of it...
Applying: Add LICENCE
sc@sc-ubuntu:~/MyRepo$ git log --all --decorate --oneline --graph
* 3b0ea45 (HEAD -> experiment) Add LICENCE
* 3ddc097 (master) Add CONTRIBUTING
* e1f1735 Add README
sc@sc-ubuntu:~/MyRepo$
```

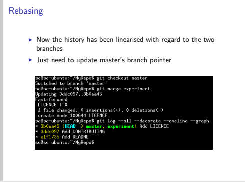


## Rebasing

- Now the history has been linearised with regard to the two branches
- Just need to update master's branch pointer



```
sc@sc-ubuntu:~/MyRepo$ git checkout master
Switched to branch 'master'
sc@sc-ubuntu:~/MyRepo$ git merge experiment
Updating 3ddc097..3b0ea45
Fast-forward
 LICENCE | 0
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 LICENCE
sc@sc-ubuntu:~/MyRepo$ git log --all --decorate --oneline --graph
* 3b0ea45 (HEAD -> master, experiment) Add LICENCE
* 3ddc097 Add CONTRIBUTING
* e1f1735 Add README
sc@sc-ubuntu:~/MyRepo$
```

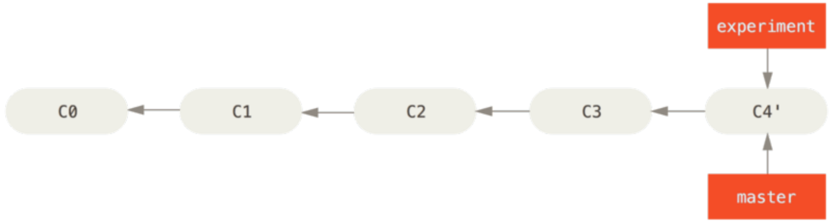


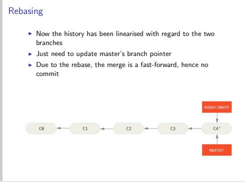
Rebasing

- Now the history has been linearised with regard to the two branches
- Just need to update master's branch pointer

## Rebasing

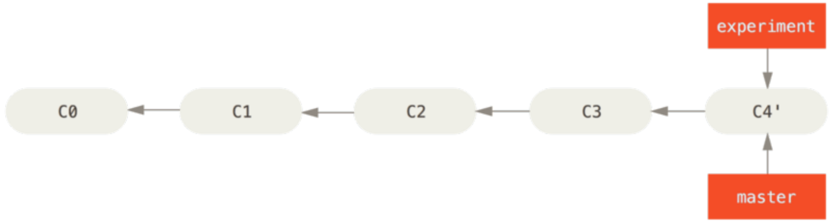
- Now the history has been linearised with regard to the two branches
- Just need to update master's branch pointer
- Due to the rebase, the merge is a fast-forward, hence no commit

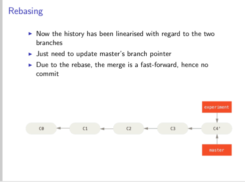




## Rebasing

- Now the history has been linearised with regard to the two branches
- Just need to update master's branch pointer
- Due to the rebase, the merge is a fast-forward, hence no commit




Rebasing

- Now the history has been linearised with regard to the two branches
- Just need to update master's branch pointer
- Due to the rebase, the merge is a fast-forward, hence no commit