Version Control with Git

Linux Users Group

UT Arlington

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Need for Version Control

- Better than manually storing backups of older versions
- Easier to keep everyone updated on a large project
- Allows concurrent development by multiple developers and safely merges those chages
- Accountability for all changes
- Fine tuned access control

Version Control Systems

- CVS, SVN, Git, Mercurial, propreitary tools
- Git
  - Created by Linus Trovalds
  - Distributed vs centralized model of CVS and SVN
  - http://git-svn.com
  - Free and open source
  - Cross platform

Distributed VCS

- Each user has a copy of the whole repository, i.e. all the code and all the revisions.
- Advantages:
  - Safer due to redundancy
  - Fast access, can also work offline
  - No central server required
  - Less hesitation in making commits
- Disadvantages:
  - Commits are local/delayed
  - First time download is slow

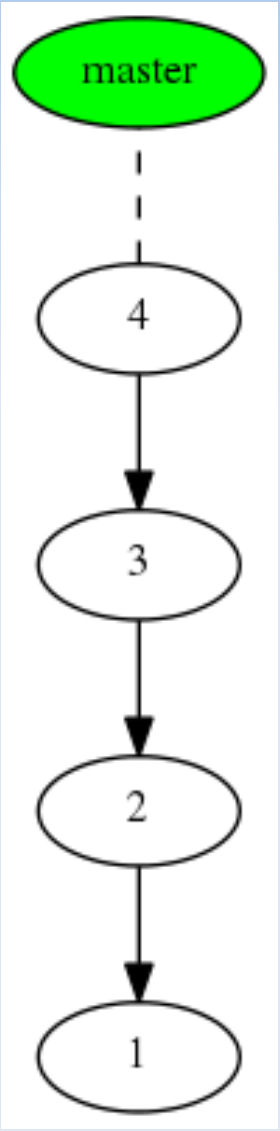
Is Git hard to set up?

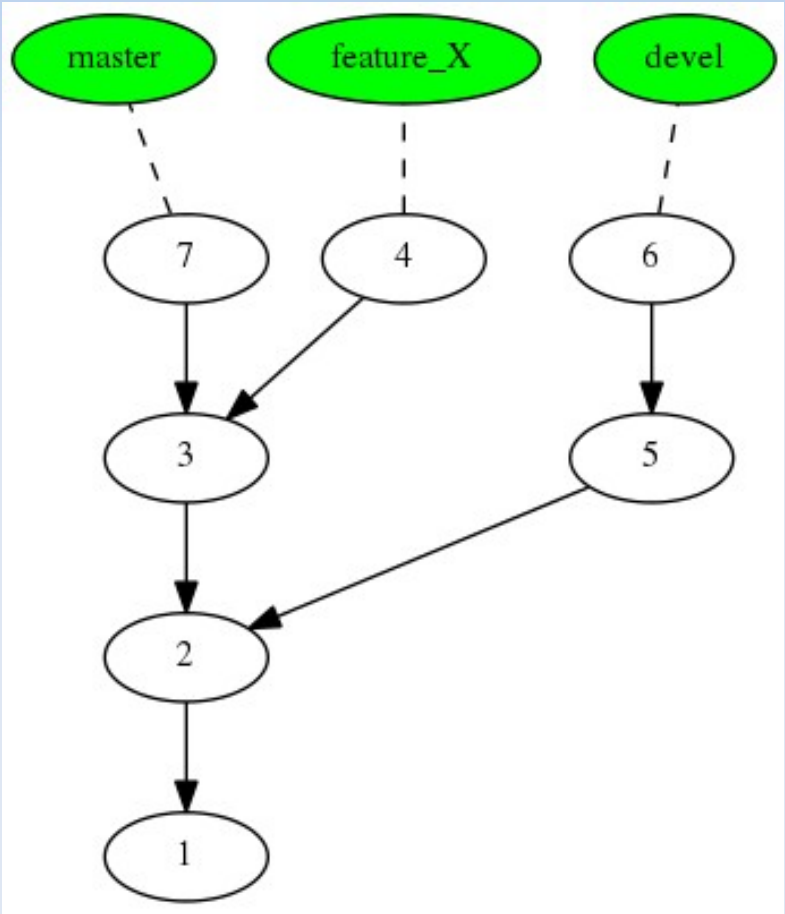
- Single user
  - Very simple to use on your local macine.
- Multiple developers
  - Easiest with an online service that sets it up for you:
    - SourceForge, Google Code, GitHub – best free hosting, but ONLY for open source project
    - Not many free options for closed source – Assembla, ProjectLocker
  - Not that hard to get your own server running
    - One of the developer machines can also act as the server.

VCS Terminology

- Repository – a location where all your code revisions and hsitory is stored
- Commit – 1. v. The act of recording your changes into the repository. 2. n. A snapshot of your code created during a commit
- Branch – A sequence of commits leading to a particular code state.
  - Multiple branches lead to different versions of code
  - Convention is to have a ”master” branch for your stable code, separate branches for development work

Repositories and branches





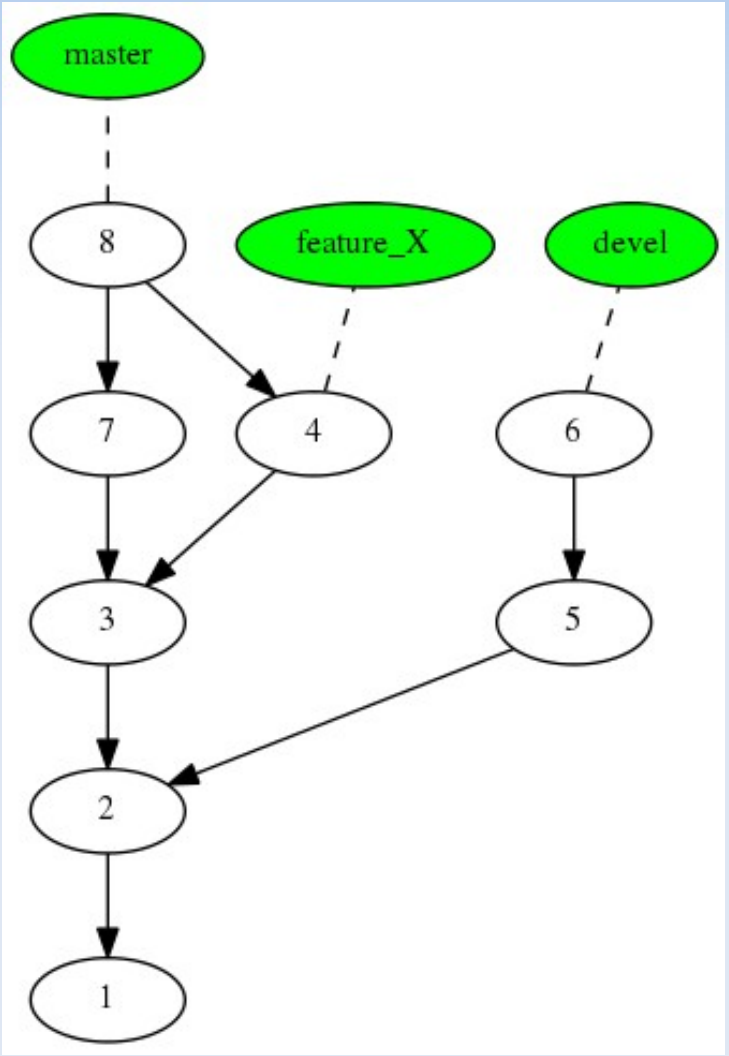


Image source: [1] http://sitaramc.github.com/gcs/

More terminology

- Working copy – the code present on your machine, with changes that may or may not have been committed
- Unversioned files – Files which are not put under version control, like temporary files, binaries.

Using Git

- Linux – install **git** package
- Windows – install **msysgit**
- Graphical tools are also available – GitGUI, TortoiseGit

- Configure git for first time use:

```
git config --global user.name "Rohit"
git config --global user.email "rohit.rawat@mavs.uta.edu"
git config --global core.editor vi
```

- Your username and email are logged with each commit.

Initialize Git repository

- Git repositories reside with the code

  Project_folder/
  code1.cpp, code2.cpp, subfolders, '.git' folder

- Initialize git repository, creates '.git' folder:

  git init

- Check status of the repository:

  git status

Add files to version control

- You need to select which files are to be kept under git

```
git add *.cpp
git status
```

- Files are added to a staging area. They have not been comitted yet and no permanent changes have been made to the repository.
- Make the first commit

```
git commit -m ”First import of code into Git!”
git status
```

Making changes

- Modify a file, then check git status. It should tell you the file has been modified, but not staged.
- If you change multiple files, git does not assume you want to record all those changes in the next commit.
- You have to manually add the changed files to the staging area with git add.
- Or you can commit with the -a option:

```
git commit -a -m ”Second commit!”
```

Comparing versions

- Git lets you compare commits with other commits or your working copy (w.c.).
- Compares the last commmit with w.c.:

```
git diff
```

- HEAD is a label pointing to the the commit responsible for the w.c. To compare w.c. with the version 1 commit behind HEAD:

```
git diff HEAD~1
```

- If you manually staged files for commit with git add, they don't show up in the diff without the --cached switch.

Creating a branch

- Do you need a branch if you are the sole developer?
  - If you are working on more than one feature at the same time, you should do that on separate branches.
  - If you are experimenting with stuff that you are not sure you want to keep, do it on a branch – the master branch will stay clean.
  - Since there are no conflicts with other developers, merging witll be fast and easy.

Creating a branch

- Create a branch:

  git branch branch_name

- List the active branch:

  git branch

  - The active branch will have an *.

- Switch to the new branch:

  git checkout branch_name

- Shortcut: git checkout -b branch_name
- All further commits go on the active branch. Make changes and commit them to the branch

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Merge a branch back into master

- Switch to the master branch

  git checkout master

- Merge the branch branch_name

  git merge branch_name

- If there are any conflicts during the merge, git highlights them in the file using markers ”>>>”. You can manually open the files and fix the conflicts.

- You can delete the branch to keep things clean

  git branch -d branch_name

Remote repositories

- Create a free account on Github
- Follow instructions to create a new repository
- Follow instructions to push an existing repository from the command line:

```
git remote add origin https://github.com/rohitrawat/Demo22.git
git push -u origin master
```

Remote repositories

- A remote is like an alias for a remote copy of the repository.
- Multiple remotes may be added.
- In this case, we added a remote at Github, which was empty.
- When we pushed out changes, the remote repo got updated with our code.

Add a second developer

- The new developer also creates a Github account, and configures his git installation with the correct email address.
- The original developer logs into Github and adds him under Admin->Collaborators
- The new developer clones the repository:

  git clone https://url/of/the/repository

  - Clone automatically initializes a new local repo, adds the url as the 'origin', and pulls the code.
  - You may save your public key to your github account to avoid autheticating every time.

Back and forth

- Users may now commit changes to their local repositories.

```
vi code.cpp
git commit -a
```

- To sync, they would first 'push' their commits to the remote.

```
git push origin master
```

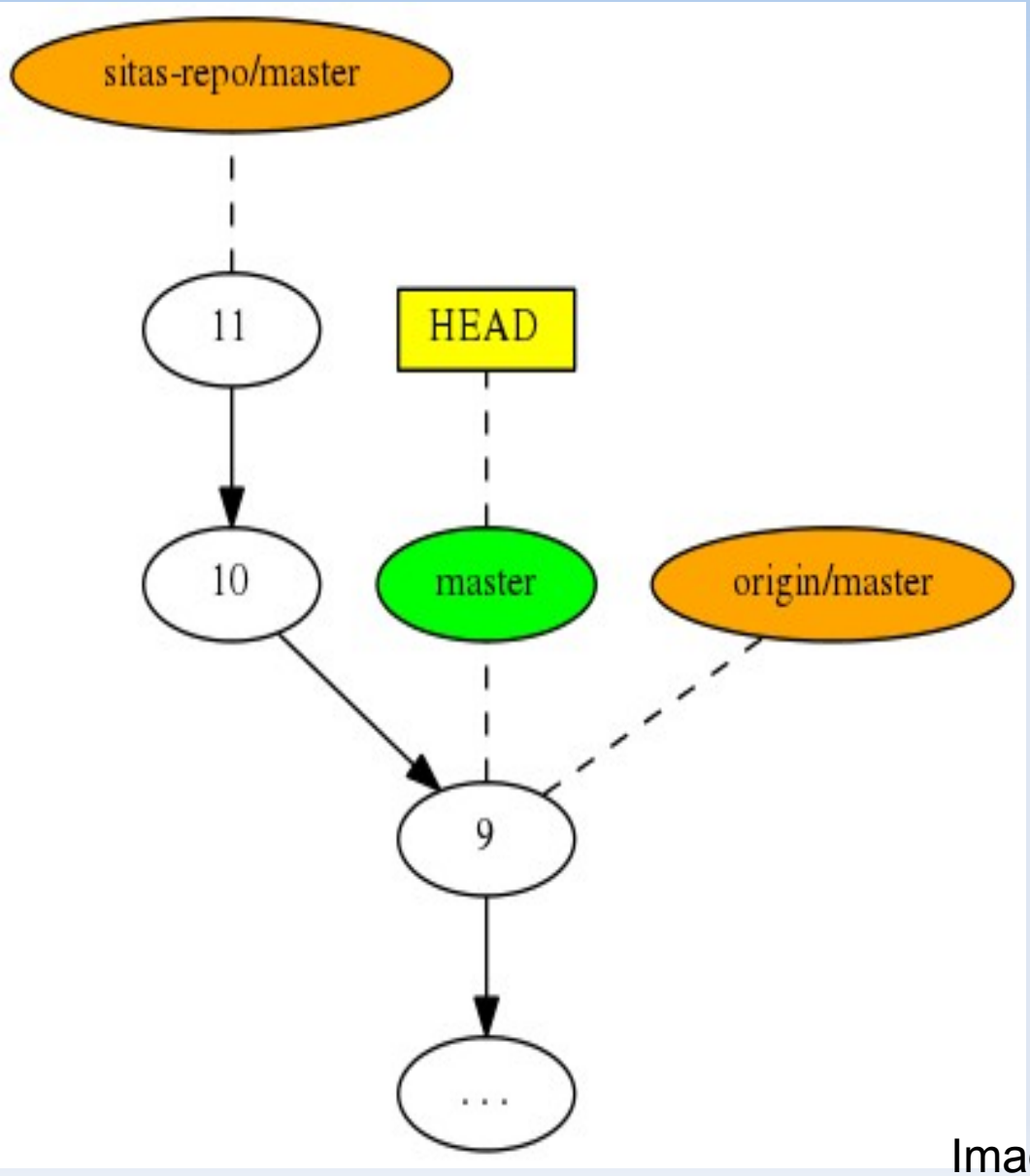
- The other user would then 'pull' from the remote.

```
git pull origin master
```

Git fetch and pull

- Git fetch downloads the latest copy of the remote repository to your machine, but does not affect any code sitting on it.
- Remote branches are different from local branches even if they have the same name!
- You may now diff it with your working copy to see how they differ, and then merge them if you like.
- Git pull does the fetch and merge together.

Different remotes and branches



Here there are two remotes:
origin and sitas-repo

The local repo and origin are in sync, i.e. their master branch is the same. sitas-repo/master is at a different commit.

You would want to pull sitas-repo.

Image source: [1] http://sitaramc.github.com/gcs/

Your own remote repository

- ”remote” can refer to any storage location where a repository can be created. It could be a folder on a backup drive.
- You can create an empty shared repo on a shared folder on a Linux server:

  git init --bare --shared

  - This is what Github gives when creating a new repo
- You can give certain users read/write permissions to the folder.
- They may set up a remote or clone that location using the format user@server:/path/to/shared/repo

With tools

- You may set up a git server with very fine tuned access controls using a tool like Gitolite or Gitosis

References

- [1] http://sitaramc.github.com/gcs/

Disclaimer:

Some assertions made in this presentation are based on my own experience. So look up definitions etc. from a more definitive place.

-Rohit

The End