Git Demo Notes

Requirements

- Unix like environment
- Have `git` installed
- Have `man` installed
- Have `gcc` installed
- Unix, Linux BSD, etc
  - Use your package manager to install
  - Ex. Debian/Ubuntu derivatives: `sudo apt install <x>`
- MacOSX terminal
  - homebrew: https://brew.sh
  - Ex. `brew install <x>`
- Windows
  - Windows Subsystem for Linux (WSL) *Preferred*
    - Activate Windows features:
      - Windows Subsystem for Linux
      - Virtual Machine Platform
    - Distributions available in the Windows Store
    - Ubuntu (easiest, reqs pre-installed)
  - Cygwin
  - SCM-Git

Environment Sidebar

- `~` is shorthand for your home folder.
- `..` is shorthand for the parent folder
- `.` is shorthand for the current folder

Start A Project

Create a demo structure

- `mkdir remote-host`
- `mkdir workstation1`
- `mkdir workstation2`

Create a Hello World project in Workstation1

- `cd workstation1`
- `mkdir hello`
- `cd hello`

- `vim hello.c`
  - Add version 1 (or your something of your own choosing)
- `touch branch1`

`vim` Sidebar

- Movement: h - Left, j - Down, k - Up, l - Right
- i - insert mode
- ESC - go back to movement mode
- To save and quit: Press ESC and then Shift-Colon and type `wq` (write and quit)
  - `:wq`

Version 1

```
#include "stdio.h"

int main(int argc, char** argv){

   printf("hello world\n");
}
```

Setup Project with `git`

`git init .`

Add .gitignore for *.out

`git status`

`git add/remove`

- Concept of staging
- `git add -A`

`git commit`

- `git commit -a -m`
- `git commit -m`

Create a Remote Repository

`git init --bare ../../remote-host/hello.git`

`git remote add <remote name> <url>`

- `git remote add origin ../../remote-host/hello.git`

`git push --set-upstream <remote name> <branch>`

- First push: `git push --set-upstream origin master`
- Subsequent pushes: `git push`

`git clone`

- `cd ../../workstation2`
- `git clone ../remote-host/hello.git`
- `ls`
  - You should see a a copy of your project in a new folder named: `hello`

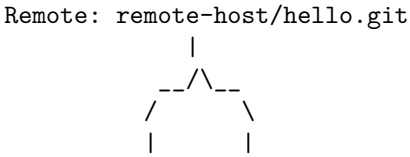
Version 2

```
#include "stdio.h"

int main(int argc, char** argv){

   if(argc > 1){
      printf("%s\n", argv[1]);
   } else {
      printf("No input\n");
   }
}
```

`git pull`

- Make changes in `workstation1/hello` and then follow the add-commit-push flow.
- Come back to `workstation2/hello` and run
  - `git pull`
- You should see the changes applied to your *local* copy!
- You may have to tell `git` how to handle merge conflicts. Generally speaking, NEVER use `rebase` if you are integrating work from other branches into the production (`master`/`main`) branch use `merge` instead. Conversely, if you are updating your working copy to be in sync with the `master`/`main` branch, you probably want to use `rebase`. Fast-forward is generally only useful, when new work has been commited in only one of the two branches being merged.
  - `git --config pull.rebase false`

So, now we have 3 copies of the project:



`workstation1/hello  workstation2/hello`

Either one can push changes to the up-stream remote, if they have it set up as a remote and have the proper credentials.

SSH Integration

Git understands the SSH protocol. If you have your remote on a remote machine, you can set it up to use an off-site repository, just as easily.

Here is an example using a Raspberry Pi on a home network, with `Host pi` configured in `~/.ssh/config`. On the Pi, create a new `--bare` repository just like before. Navigate back to `workstation1` and add it as a remote:

- `git remote add pi-server user@pi:~/repos/hello.git`
- `git push --set-upstream pi-server master`

It really is that easy.

`.git/config`

When you ran `git init .`, `git` added a hidden folder to your project: `.git`. This is where it stores the project configuration, and the compressed archive of previous versions. You can edit the configuration manually, which may actually be easier for some than using the "porcelain" commands.

If we did everything correctly, then our `.git/config` should look something like this:

```
[core]
        repositoryformatversion = 0
        filemode = true
        bare = false
        logallrefupdates = true
[remote "origin"]
        url = ../../remote-host/hello-repo.git
        fetch = +refs/heads/*:refs/remotes/origin/*
[branch "master"]
        remote = origin
        merge = refs/heads/master
[remote "pi-server"]
        url = user@pi:~/repos/hello.git
        fetch = +refs/heads/*:refs/remotes/pi-server/*
```

Some hosting services (GitHub/Bit Bucket) require the following format:

```
[remote "origin"]
    url = https://<username>:<access token>@<host domain>/PATH/TO/hello.git
    fetch = +refs/heads/*:refs/remotes/origin/*
```

Branching

One of the purposes of branching, is to provide a mechanism where active development will not interfere with a known stable release. Another, could be to work on an experimental feature that may not make it's way into the final product, or for individual work before merging into the larger project.

Creating a branch is easy:

`git branch <name>`

`git switch <branch name>`

To push the new branch, remember to set your upstream with: `--set-upstream <remote> <branch>`. After that you can push normally, and the new branch is mirrored on the remote host. It's just that easy.

Once you are ready to integrate your changes, to the main branch, you can just:

`git switch master`

`git merge <branch>` or `git rebase <branch>`

`git push`

In many projects, especially open-source, there is an extra step. You would be doing all this with a "fork", which is essentially a clone of the project repository on the remote host for your personal use. Once you have a change that you think the project should incorporate, you can open a "Pull Request", often abbreviated as "PR". If the Project Owner likes your change, they will run a `pull` against your fork to bring the changes into the official repository.

Hooks

One of the features that makes `git` really nice, is that you can trigger system actions in response to events that happen to your repository. Say for example, you are hosting a local Test webserver for your website on your home network. You make changes to your local working copy, and then push to your Test repository: `user@pi:~/repos/homestead.git`

On the Pi, navigate to `~/repos/homestead.git/hooks`. Any thing that is not a ".sample" file, is a live system script file that will be run when that event occurs.

So, for instance, when your repository receives a push, it could have a `post-receive` hook so that some action will occur whenever it receives a push:

```
#!/bin/sh
git --work-tree=/var/www/html --git-dir=/home/user/repos/homestead.git checkout -f master
```

This script checks out a copy of the repository into the webserver's directory.

Updating your website is now just as easy as typing: `git push test-server`, which is nice! But, security can be another advantage.

For instance, what if you wanted to update your website, but manually copying your changes to the web-server's root directory everytime is just not fun anymore? What if you simply maintained a down-stream `git` project in the web-server's html root directory? This might be tempting too do, because all you would have to do to update your site, would be to login to the server, navigate to the web-server's root directory, and do a `git pull`.

Can you see how how this could potentially allow an epic-level security breach? Remember, that `.git/config` contains urls and often login credentials for project and development servers! And now that information is in a publicly accessible area. If you manage any public facing server, look at the access logs sometime. Automated attack bots regularly make requests for `.git`, for this very reason.

Conclusion

Git in a nutshell. You should now know how to create a create a repository, initiate a local project, commit, push and pull. Branching and hooks are both very nice features, too, and hopefully you can make use of them.

As you can hopefully see, `git` is a simple and powerful tool with great potential for easing project management, and even benefits beyond simply that. I hope this has been helpful and that you will be able to use it to be more productive. However, as always, with knowledge and power comes responsibility. Please use what you have learned responsibly, and thank you for joining me in this exploration.