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.

- Merging TLDR: `git --config pull.rebase false`

Merge Strategy Sidebar

- `merge` merges the lastest work from both the source and the current branch.
- `rebase` is a very powerful command that by default replays *all* new commits from the source to the end of the current branch.

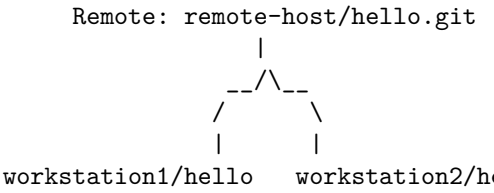
You can even rewrite history by doing:

`git rebase -i <branch> HEAD~<# of commits to change>`

Generally speaking, best practice is to *NEVER* use `rebase` when integrating new work into the main project repository, but when pulling from `master` into your own working copy, or for other tasks, the power of `rebase` may be helpful.

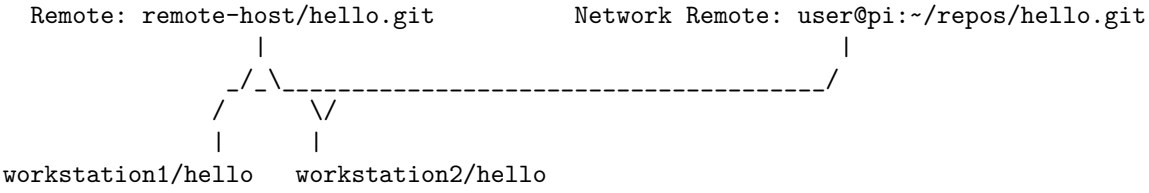
Collaboration

So, now we have 3 copies of the project:



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

It is also common to have multiple remotes. Later we have an example of adding an additional remote on a networked server, for a structure something like this:



This can be useful if you want to maintain a project DEV repository, and say for instance only push to a TEST, or PROD repository occasionally.

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 as a local one.

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/*
```

Hosting services may require some variation on the following formats for the `[remote <name>]` section:

Bitbucket

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

Github

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

Branching

Branching makes it easy to containerize work, and helps collaborating developers avoid interfering with each other. It can also help protect stable code while you mock-up a new feature, or try out an experiment. `git` makes no assumptions, so branching can be used for all sorts of things.

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 repository to bring the changes into the official repository.

Hooks

Another feature 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!

Security Sidebar 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?

How about this idea? 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`. You might be tempted, but *DO NOT* do this! It could potentially result in an epic-level security breach.

Do you see how? Remember, that the `.git` directory contains project history and configuration! And `.git/config` likely even contains urls and login credentials for project and development servers! Now that information is potentially accessible to anyone who contacts your server.

If you manage any public facing servers, look at the access logs sometime. Automated attack bots regularly make requests for `.git`, and this is why.

Conclusion

Git in a nutshell. You should now know how to 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.