CSE 390a
Lecture 4

Persistent shell settings; users/groups; permissions

slides created by Marty Stepp, modified by Jessica Miller and Ruth Anderson
http://www.cs.washington.edu/390a/

Lecture summary

- Persistent settings for your bash shell
- User accounts and groups
- File permissions
- The Super User

.bash_profile and .bashrc

- Every time you log in to `bash`, the commands in `~/.bash_profile` are run
  - you can put any common startup commands you want into this file
  - useful for setting up aliases and other settings for *remote login*
- Every time you launch a non-login bash terminal, the commands in `~/.bashrc` are run
  - useful for setting up persistent commands for *local shell usage*, or when *launching multiple shells*
  - often, `.bash_profile` is configured to also run `.bashrc`, but not always

Note: a dot (.) in front of a filename indicates a normally hidden file, use ls –a to see

.bash_profile and .bashrc

- *Exercise* : Make it so that our `attu` alias from earlier becomes persistent, so that it will work every time we run a shell.
- *Exercise* : Make it so that whenever you try to delete or overwrite a file during a move/copy, you will be prompted for confirmation first.

.plan

- Another fun settings file
- Stored in your home directory
- Contains information you'd like others to be able to see
  - is displayed when the finger protocol is run
- *Exercise*: create a quick .plan file, and make sure it works with `finger`

Users

Unix/Linux is a multi-user operating system.

- Every program/process is run by a user.
- Every file is owned by a user.
- Every user has a unique integer ID number (UID).
- Different users have different access permissions, allowing user to:
  - read or write a given file
  - browse the contents of a directory
  - execute a particular program
  - install new software on the system
  - change global system settings
  - ...

Groups

command	description
`groups`	list the groups to which a user belongs
`chgrp`	change the group associated with a file

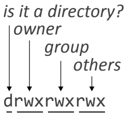
- **group**: A collection of users, used as a target of permissions.
  - a group can be given access to a file or resource
  - a user can belong to many groups
  - see who's in a group using grep <groupname> /etc/group
- Every file has an associated group.
  - the owner of a file can grant permissions to the group
- Every group has a unique integer ID number (GID).
- *Exercise*: create a file, see its default group, and change it

File permissions

command	description
`chmod`	change permissions for a file
`umask`	set default permissions for new files

types :	read (r),	write (w),	execute (x)
people :	owner (u),	group (g),	others (o)

- on Windows, .exe files are executable programs;
  on Linux, any file with `x` permission can be executed
- permissions are shown when you type `ls -l`



is it a directory?

owner

group

others

`drwxrwxrwx`

File permissions Examples

Permissions are shown when you type `ls -l`:

```
-rw-r--r-- 1 rea fac_cs     55 Oct 25 12:02 temp1.txt
-rw--w---- 1 rea orca      235 Oct 25 11:06 temp2.txt
```

`temp1.txt:`
- **owner** of the file (rea) has read & write permission
- **group** (fac_cs) members have read permission
- **others** have read permission

`temp2.txt:`
- **owner** of the file (rea) has read & write permission
- **group** (orca) members have write permission (but no read permission – can add things to the file but cannot cat it)
- **others** have no permissions (cannot read or write)

Changing permissions

- letter codes: `chmod` ***who***(+-)***what*** `filename`

`chmod u+rw myfile.txt`	(allow owner to read/write)
`chmod +x banner`	(allow everyone to execute)
`chmod ug+rw,o-rwx grades.xls`	(owner/group can read and write; others nothing)

  note: -R for recursive

- octal (base-8) codes: `chmod` ***NNN*** `filename`
  - three numbers between 0-7, for owner (u), group (g), and others (o)
  - each gets +4 to allow read, +2 for write, and +1 for execute

`chmod 600 myfile.txt`	(owner can read/write (rw))
`chmod 664 grades.dat`	(owner rw; group rw; other r)
`chmod 751 banner`	(owner rwx; group rx; other x)

chmod and umask

`chmod u+rw myfile.txt` (allow owner to read/write)

Note: leaves "group" and "other" permissions as they were.

`chmod 664 grades.dat` (owner rw; group rw; other r)

Note: sets permissions for "owner", "group" and "other" all at once.

`umask` – returns the "mask" in use, determines the default permissions set on files and directories I create. Can also be used to set that mask.

```
% umask
0022
% touch silly.txt
% ls -l silly.txt
-rw-r--r-- 1 rea fac_cs 0 Oct 25 12:04 silly.txt
```

0022 means that files I create will have group and other "write bits" turned off:
1) Take the bitwise complement of 022_8 -> 755_8
2) AND with 666_8 for files (777_8 for directories) : 755_8 = 111 101 101
666_8 = $\underline{110\ 110\ 110}$
110 100 100 = 644_8
(owner rw, group r, other r)

Exercises

- Change the permissions on `myfile.txt` so that:
  - Others cannot read it.
  - Group members can execute it.
  - Others cannot read or write it.
  - Group members & Others can read or write it.
  - Everyone has full access.
- Now try this:
  - Deny all access from everyone.
    - !!! is it dead?
    - I own this file. Can I change the Owner's (u) permissions?

Exercises (Solutions)

- Change the permissions on `myfile.txt` so that:

Others cannot read it.	chmod o-r myfile.txt
Group members can execute it.	chmod g+xmyfile.txt
Others cannot read or write it.	chmod o-rw myfile.txt
Group members & Others can read or write it.	chmod go+rw myfile.txt
Everyone has full access.	chmod ugo+rwx myfile.txt

- Now try this:
  - Deny all access from everyone. chmod ugo-rwx myfile.txt
    - !!! is it dead?
    - I own this file. Can I change the Owner's (u) permissions?

Directory Permissions

- Read, write, execute a directory?
  - **Read** - permitted to read the contents of directory (view files and sub-directories in that directory, run `ls` on the directory)
  - **Write** - permitted to write in to the directory (add, delete, or rename create files and sub-directories in that directory)
  - **Execute** - permitted to enter into that directory (`cd` into that directory)
- It is possible to have any combination of these permissions:
  - Have **read** permission for a directory, but NOT **execute** permission
    - Can do an `ls` from outside of the directory but cannot `cd` into it, cannot access files in the directory
  - Have **execute** permission for a directory, but NOT **read** permission
    - Can `cd` into the directory, can access files in that directory if you already know their name, but cannot do an `ls` of the directory

***Note:** permissions assigned to a directory **are not inherited** by the files within that directory

Permissions don't travel

- Note in the previous examples that permissions are separate from the file
  - If I disable read access to a file, I can still look at its permissions
  - If I upload a file to a directory, its permissions will be the same as if I created a new file locally
- Takeaway: permissions, users, and groups reside on the particular machine you're working on. If you email a file or throw it on a thumbdrive, no permissions information is attached.
  - Why? Is this a gaping security hole?

Lets combine things

- Say I have a directory structure, with lots of .txt files scattered
  - I want to remove all permissions for Others on all of the text files
  - First attempt:
    - `chmod –R o-rwx *.txt`
    - What happened?
  - Try and fix this using `find` and `xargs`!
    - `find –name "*.txt"`
    - `find –name "*.txt" | xargs chmod o-rwx`

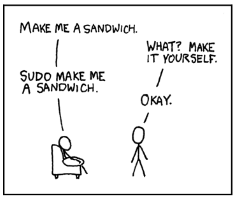
Super-user (root)

command	description
sudo	run a single command with root privileges (prompts for password)
su	start a shell with root privileges (so multiple commands can be run)

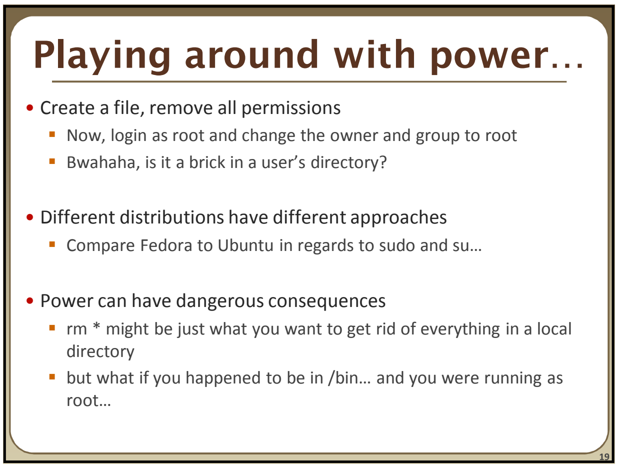
- **super-user**: An account used for system administration.
  - has full privileges on the system
  - usually represented as a user named `root`
- Most users have more limited permissions than `root`
  - protects system from viruses, rogue users, etc.
  - if on your own box, why ever run as a non-root user?
- Example: Install the `sun-java6-jdk` package on Ubuntu.

```
sudo apt-get install sun-java6-jdk
```

Playing around with power…

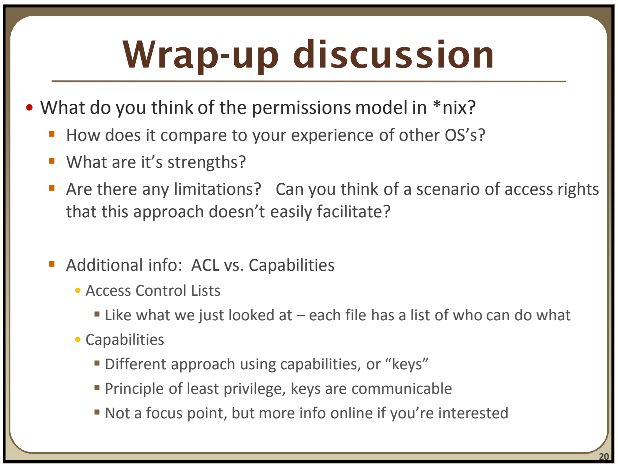


Courtesy XKCD.com



Playing around with power…

- Create a file, remove all permissions
  - Now, login as root and change the owner and group to root
  - Bwahaha, is it a brick in a user's directory?
- Different distributions have different approaches
  - Compare Fedora to Ubuntu in regards to sudo and su…
- Power can have dangerous consequences
  - rm * might be just what you want to get rid of everything in a local directory
  - but what if you happened to be in /bin… and you were running as root…



Wrap-up discussion

- What do you think of the permissions model in *nix?
  - How does it compare to your experience of other OS's?
  - What are it's strengths?
  - Are there any limitations?   Can you think of a scenario of access rights that this approach doesn't easily facilitate?
  - Additional info: ACL vs. Capabilities
    - Access Control Lists
      - Like what we just looked at – each file has a list of who can do what
    - Capabilities
      - Different approach using capabilities, or "keys"
      - Principle of least privilege, keys are communicable
      - Not a focus point, but more info online if you're interested