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# CSE 390a

## Lecture 4

Persistent shell settings; users/groups; permissions

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<http://www.cs.washington.edu/390a/>

# Lecture summary

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

# .bash\_profile and .bashrc

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- 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

# Exercise: Edit your `.bashrc`

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- *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

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- 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

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*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
  - ...

# People & Permissions

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- **People:** each user fits into only one of three permission sets:
  - owner (u) – if you create the file you are the owner, the owner can also be changed
  - group (g) – by default a group (e.g. ugrad\_cs, fac\_cs) is associated with each file
  - others (o) – everyone other than the owner and people who are in the particular group associated with the file
- **Permissions:** For regular files, permissions work as follows:
  - read (r) – allows file to be open and read
  - write (w) – allows contents of file to be modified or truncated
  - execute (x) – allows the file to be executed (use for executables or scripts)

\* Directories also have permissions (covered later). Permission to delete or rename a file is controlled by the permission of its parent directory.

# Groups

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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 (u)*  
↓  
*group (g)*  
↓  
*others (o)*  
↓

drwxrwxrwx

# File permissions Examples

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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

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- 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

note: `-R` for recursive write; others nothing)

- 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  $022_8 \rightarrow 755_8$
- 2) AND with  $666_8$  for files ( $777_8$  for directories) :  $755_8 = 111\ 101\ 101$   
 $666_8 = \underline{110\ 110\ 110}$   
 $\quad\quad 110\ 100\ 100 = 644_8$   
(owner rw, group r, other r)

# Exercises

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- 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 and write it.
  - Everyone has full access.
  
- Now try this:
  - Deny all access from everyone.
    - !!! is it dead?

# Exercises (Solutions)

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- Change the permissions on `myfile.txt` so that:
  - Others cannot read it. `chmod o-r myfile.txt`
  - Group members can execute it. `chmod g+x myfile.txt`
  - Others cannot read or write it. `chmod o-rw myfile.txt`
  - Group members & Others can read and 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

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- 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:

Try these:

- Have **read** permission for a directory, but NOT **execute** permission
  - ????
- Have **execute** permission for a directory, but NOT **read** permission
  - ???

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

# Directory Permissions

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- 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

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- 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

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- 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)

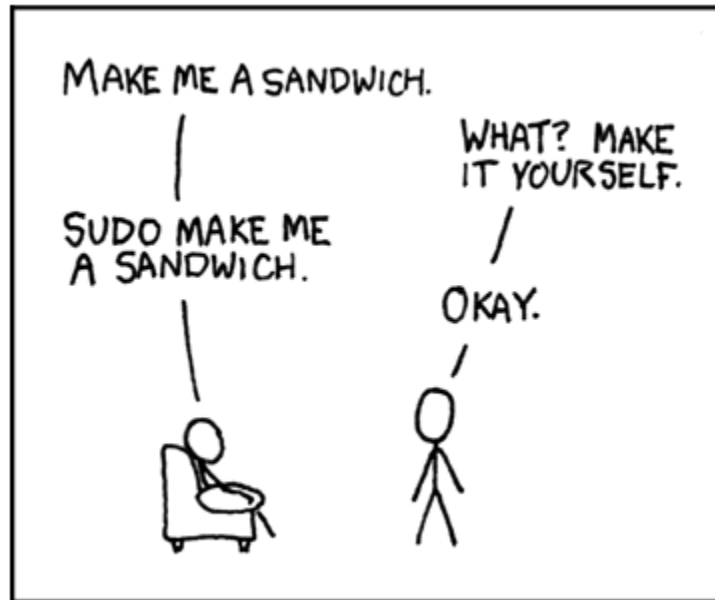
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command	description
sudo	run a single command with root privileges (prompts for password)
su	start a shell with root privileges (so multiple commands can be run)

- **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 valgrind tool on the CSE VM.  
`sudo yum install valgrind`

# Playing around with power...

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Courtesy XKCD.com

# Playing around with power...

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- 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

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- 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