CSE 391
Lecture 6

Persistent shell settings; users/groups; permissions

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Lecture summary

- Persistent settings for your bash shell
- User accounts and groups
- File permissions
- The Super User
- Useful Tidbit: tar files

Aliases

command	description
`alias`	assigns a pseudonym to a command

`alias` ***name*=*command***

- must wrap the command in quotes if it contains spaces
- **Do not put spaces on either side of the =**

- Example: When I type `q` , I want it to log me out of my shell.
- Example: When I type `ll` , I want it to list all files in long format.

```
alias q=exit
alias ll="ls -la"
```

- *Exercise* : Make it so that typing '`up3`' moves three directories up in the directory tree
- *Exercise* : Make it so that typing '`clean`' removes all files listed in '~/toRemove.txt'

.bash_profile and .bashrc

- Every time you log in to bash (e.g. ssh attu), 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 (e.g. bash), the commands in `~/.bashrc` are run
  - useful for setting up persistent commands for *local shell usage*, or when *launching multiple shells*
  - *Do not put things that would produce output in .bashrc (e.g. echo)*
  - 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

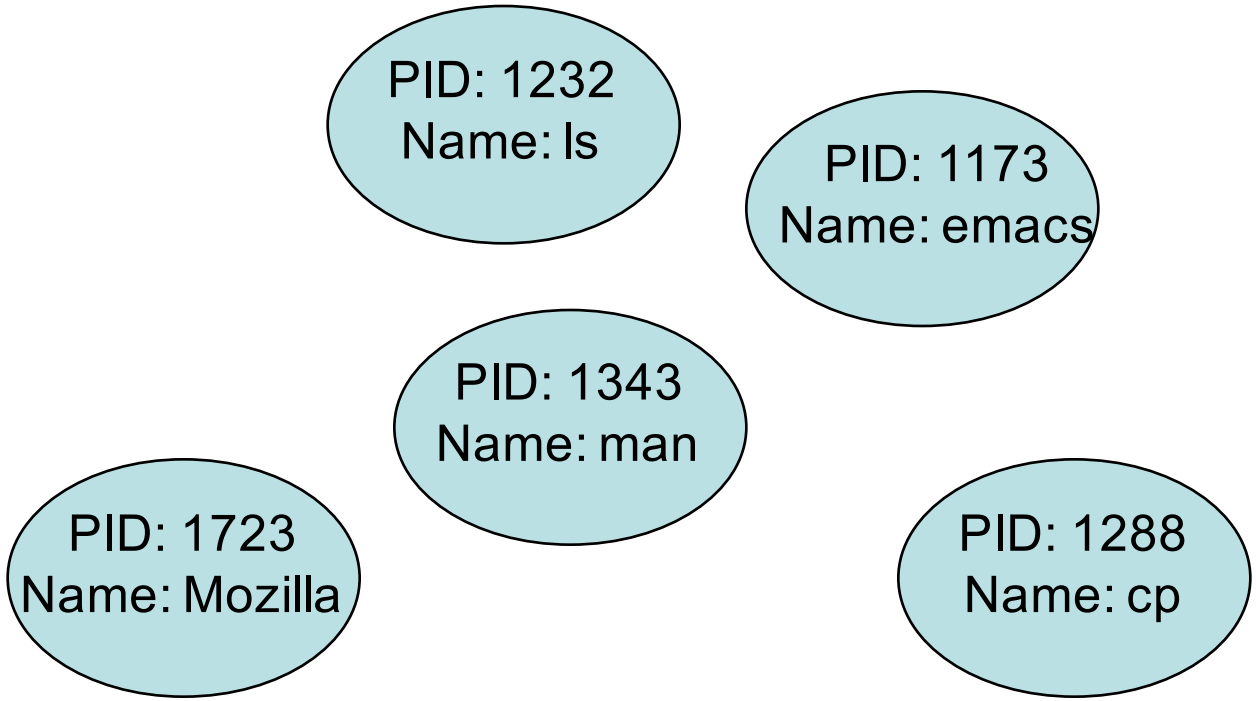
- *Exercise* : Make it so that our `attu` alias from earlier becomes persistent, so that it will work every time we run a shell.
- *Exercise* : Make it so that whenever you try to delete or overwrite a file during a move/copy, you will be prompted for confirmation first.

Making Changes Visible

- After editing your `.bashrc` or `.bash_profile`, how do you make the aliases etc. in the file take effect?
  - `.bash_profile`
    - log on again (`e.g ssh attu`), or
    - `bash -l` (el not one) will start a login shell, or
    - `source .bash_profile`
  - `.bashrc`
    - start another bash shell (type: `bash`), or
    - `source .bashrc`

Processes

- **process**: a program that is running (essentially)
  - when you run commands in a shell, it launches a process for each command
  - Process management is one of the major purposes of an OS



Process commands

command	description
`ps` or `jobs`	list processes being run by a user; each process has a unique integer id (PID)
`top`	show which processes are using CPU/memory; also shows stats about the computer
`kill`	terminate a process by PID (sometimes –KILL is needed)
`killall`	terminate several processes by name

- use `kill` or `killall` to stop a runaway process (infinite loop)
  - similar to ^C hotkey, but doesn't require keyboard intervention

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
  - ...

Multi-user environments

command	description
`whoami`	outputs your username
`passwd`	changes your password
`hostname`	outputs this computer's name/address
`w or finger`	see info about people logged in to this server

Groups

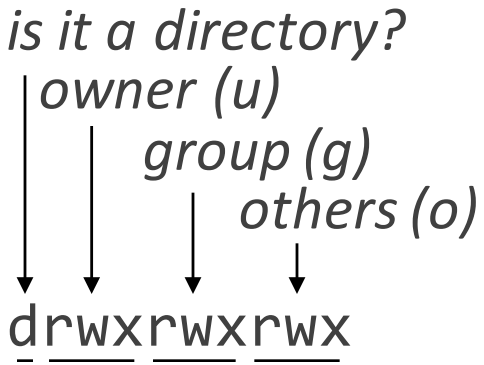
command	description
`groups`	list the groups to which a user belongs
`chgrp`	change the group associated with a file

- **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).

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`



People & Permissions

- **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 (using `chown`)
  - 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

You are in the most restrictive set that applies to you – e.g. if you are the owner, those permissions apply to you.

- **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.

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

Note, no space after the comma!

- 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)
```

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 and write it.
  - Everyone has full access.

- Now try this:
  - Deny all access from everyone.
    - !!! is it dead?

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 = 110 110 110
110 100 100 = 644_8
(owner rw, group r, other r)

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+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

- 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

- 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?

Careful with -R

- 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?

This command will:

- change permissions on all the files that end with .txt in the current directory, AND
- it will recursively change the permissions on any files that end with .txt in **directories whose name end in .txt**
  (you probably do not have any directories whose names end that way!)
- This is not really recursive in the way you meant it to be! (see next slide…)

Careful with –R (fix)

- 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`

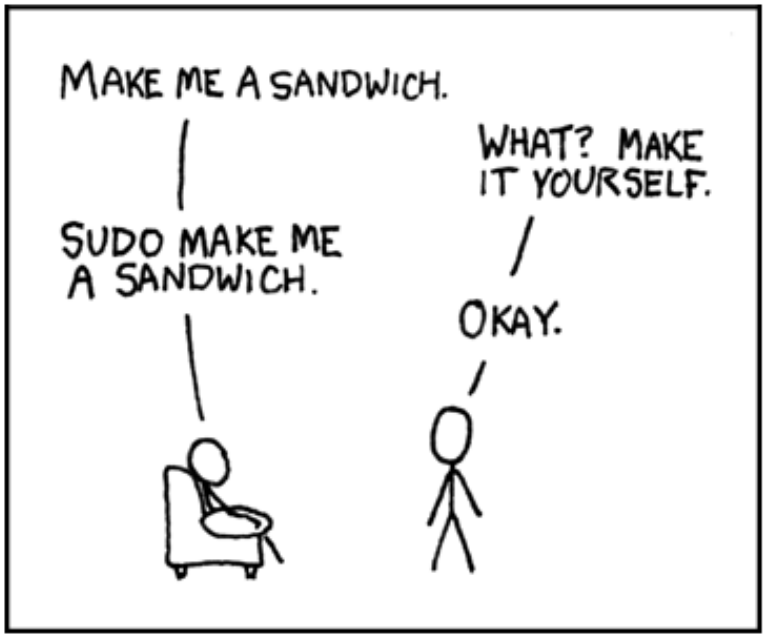
Super-user (root)

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 valgrind tool on the CSE VM.

```
sudo yum install valgrind
```

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…

tar files

	description
`tar`	create or extract .tar archives (combines multiple files into one .tar file)

- Originally used to create "tape archive" files
- Combines multiple files into a single .tar file
- You probably always want to use –f option and IT SHOULD COME LAST

- To **create** a single file from multiple files:

```
$ tar -cf filename.tar stuff_to_archive
```

  - -c **creates** an archive
  - -f read to/from a file
  - stuff_to_archive - can be a list of filenames or a directory

- To **extract** files from an archive:

```
$ tar -xf filename.tar
```

  - -x **extracts** files from an archive

Compressed files

command	description
`zip, unzip`	create or extract .zip compressed archives
`gzip, gunzip`	GNU free compression programs (single-file)
`bzip2, bunzip2`	slower, optimized compression program (single-file)

- To **compress** a `file`:

  `$ gzip` ***`filename`*** produces: ***`filename.gz`***

- To **uncompress** a `file`:

  `$ gunzip` ***`filename.gz`*** produces: ***`filename`***

Similar for zip, bzip2. See man pages for more details.

.tar.gz archives

- Many Linux programs are distributed as .tar.gz archives (sometimes called .tgz)
- You could unpack this in two steps:
  1. `gzip foo.tar.gz` produces: foo.tar
  2. `tar -xf foo.tar` extracts individual files
- You can also use the tar command to create/extract compressed archive files all in one step:

```
$ tar -xzf filename.tar.gz
```

  - -x **extracts** files from an archive
  - -z filter the archive through gzip (compress/uncompress it)
  - -f read to/from a file

Handy tip: You can use the "`file`" command to see what type a file is, just changing the file extension on a file does **not** change its type.

`tar` examples

You can combine options (-v, -z, etc.) various ways:

Create a single .tar archive file from multiple files (without compression):

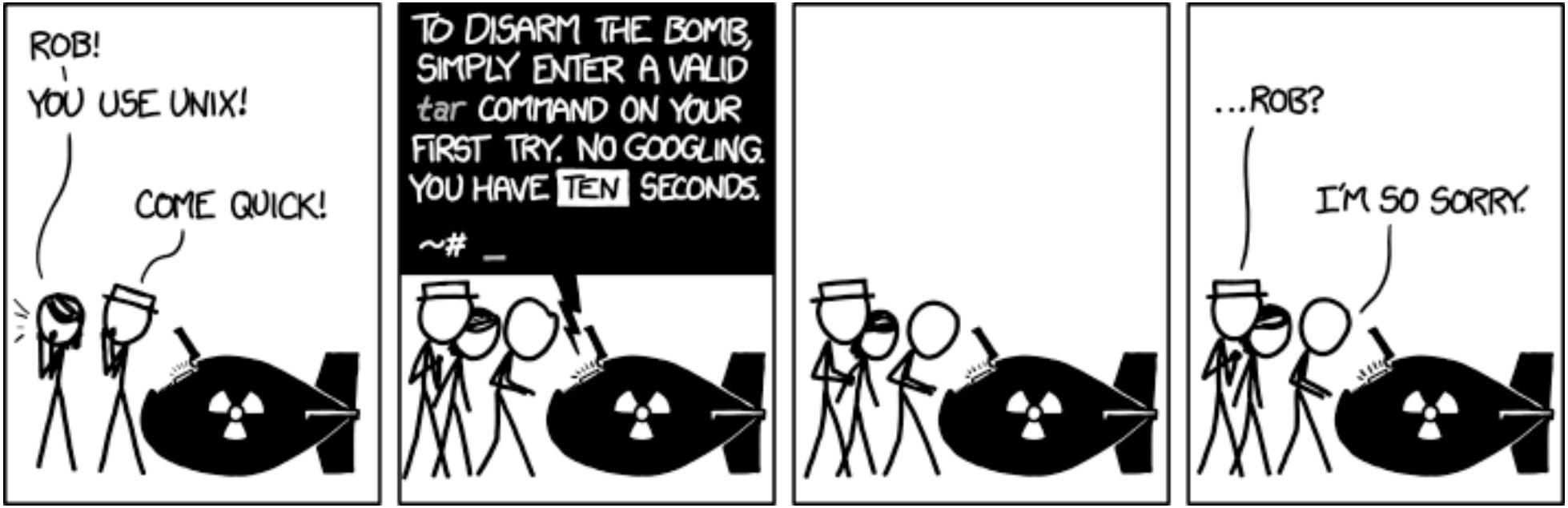
```
$ tar -cvf filename.tar stuff_to_archive
```

- -c **creates** an archive file called ***`filename`*`.tar`**
- -v verbosely list the files processed
- -f read to/from a file (as opposed to a tape archive)
- stuff_to_archive - can be filenames or a directory

Add –z option and use ***`filename`*`.tar.gz`** to use compression:

```
$ tar -cvzf filename.tar.gz stuff_to_archive
```

tar


ROB!
YOU USE UNIX!
COME QUICK!
TO DISARM THE BOMB, SIMPLY ENTER A VALID tar COMMAND ON YOUR FIRST TRY. NO GOOGLING. YOU HAVE TEN SECONDS.
~# _
...ROB?
I'M SO SORRY.