

CST8177 – Linux II

Processes

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Today's Topics

- ▶ From last time:
 - is stdin a terminal?
 - the command that does nothing
 - integer arithmetic
- ▶ processes
- ▶ nice
- ▶ ps, pstree, top
- ▶ job control, jobs, fg, bg
- ▶ signals, kill, killall
- ▶ crontab, anacron, at
- ▶ elinks, mail

Processes

- ▶ Any program we run executes as a process
- ▶ Processes have the following attributes
 - a process id: PID
 - a parent process id: PPID
 - a nice number (related to priority)
 - controlling terminal
 - Real (RUID) and effective (EUID) user id
 - Real (RGID) and effective (EGID) group id
- ▶ Also:
 - a current working directory
 - a umask value
 - an environment (values of environment variables)

ps command

- ▶ We have already been using the `ps` command to print out information about processes running on the system
- ▶ `ps -ef` or `ps aux` piped to `grep` is common
- ▶ there are many options for printing specific info in a specific way: `man ps` or `ps -h`
- ▶ `ps -l #` long format
- ▶ `ps -f` versus `ps -fw`

top command

- ▶ top displays some system information, and a list of processes, ordered on a column
- ▶ the most important keys are ?, h, and q (according to man page)
- ▶ load average: 5min, 10min, 15min
- ▶ load average is number of processes running or in uninterruptable state (disk IO, others)
- ▶ no exact rule, but if load average is more than 1–1.5 times the number of CPUs, the machine is overloaded in some way and you have a problem (your mileage may vary)

Other commands

- ▶ `ps`: connects parents and children in a pictorial display
- ▶ `free`: memory usage
- ▶ `vmstat`: processes, memory, and more

Process states

- ▶ Runnable: ready to go
- ▶ Sleeping: choosing not to go
- ▶ Stopped: suspended indefinitely, as in ^Z
- ▶ Uninterruptable Sleep: waiting on a disk I/O operation, or similar
- ▶ Zombie or Defunct: process has completed, but it's still in the process table waiting for parent to take action

Nice command

- ▶ Each process has a priority, which you can control with the nice command
- ▶ -20 highest priority, 19 lowest priority
- ▶ nice [-n increment] command
- ▶ nice -n 10 long_command # 10 is default
- ▶ only superuser can specify negative increments
- ▶ For processes already running:
 - renice priority -p PID or renice -n increment -p PID

Job Control

- ▶ your shell can run several processes for you at once
- ▶ we can run commands in the background
 - command &
- ▶ we can put a running command in the background
 - ^Z
- ▶ what jobs are there?
 - jobs
- ▶ resume a stopped job
 - bg %N # background, where N is a job number
 - fg %N # foreground

Sending signals: kill command

- ▶ When we type ^C when a process is running in the foreground, the process receives a SIGINT signal, which by default would cause a process to terminate.
- ▶ SIGINT: ^C (default), similar to SIGTERM
- ▶ SIGHUP: terminal has been closed
- ▶ SIGTERM: clean up if necessary, then die
- ▶ SIGKILL: die right now
- ▶ We can send these signals to a process with the kill command

Send a signal to kill a process

- ▶ `kill -SIGNAL PID` #send SIGNAL to process PID
- ▶ When system shuts down, it
 - sends all processes a SIGTERM
 - waits a few seconds (5 or 10)
 - sends all processes a SIGKILL
- ▶ Why not just wait for the SIGTERM to finish?
- ▶ Because SIGTERM can be handled, possibly ignored, it's optional
- ▶ SIGKILL cannot be handled – it works unless the process is in an uninterruptible state (maybe disk I/O, NFS)

When kill -9 PID doesn't work

- ▶ If kill -9 PID (kill -SIGKILL PID) as root doesn't kill the process, it is in an uninterruptible state
- ▶ if uninterruptible processes don't become interruptible, there may be a system problem (bad disk, misconfigured NFS filesystem, etc)
- ▶ Reboot may be the only way to get rid of them

What are the other signals?

- ▶ summary of all the POSIX signals:
http://en.wikipedia.org/wiki/Unix_signal

Scheduling tasks (cron)

- ▶ To run a command regularly and automatically, we use the cron facility
- ▶ The cron daemon process every minute checks to see if commands specified in crontab files need to be run
- ▶ for now, we're concerned only with our user crontab files, which are
 - `/var/spool/cron/*`
 - for example, `/var/spool/cron/user1` is user1's crontab file

Configuring your cron job

- ▶ full details from `man 5 crontab`
 - recall that is how we read section 5 of the manual (section 5 of the manual is file formats)
- ▶ `man crontab` will give info about the `crontab` command (in default section 1 of the manual)
- ▶ create a file containing your cron instructions (see next slide), naming that file, say, `myuser.crontab`
- ▶ run the `crontab` command to submit that file's contents to be your user's crontab file: `crontab < myuser.crontab`
- ▶ alternatively, you can edit your user's live crontab file: `crontab -e`

crontab format (man 5 crontab)

- All fields must contain a value of some valid kind
- Field are separated by one or more spaces
- Asterisk (*) indicates the entire range

.----- minute (0 - 59)

| .----- hour (0 - 23)

| | .----- day of month (1 - 31)

| | | .----- month (1 - 12)

| | | | .--- day of week (0 – 7, both 0 and 7 are Sunday)

| | | | |

0 6 1 * * /home/user/bin/mycommand

1 6 15 * * /home/user/bin/anothercommand > /dev/null 2>&1

crontab format (cont'd)

- ▶ ranges with dash are allowed: first-last
- ▶ * means every value first-last
- ▶ lists are allowed: first,second,third
- ▶ steps indicated with '/' are allowed after ranges or asterisk:
 - */2 means every second one
 - 1-7/2 means 1,3,5,7

common crontab options

- ▶ `crontab -l`
 - list the contents of your current live crontab file
- ▶ `crontab -e`
 - edit the contents of your current live crontab file
- ▶ `crontab`
 - read the new contents of for your crontab file from stdin
- ▶ `crontab -r`
 - remove your current crontab file

example crontab

- ▶ see man 5 crontab for example crontab
- ▶ really, see the example: man 5 crontab
- ▶ things to watch out for
 - input for your commands (they run without anyone to type input)
 - output of commands (if you don't (re)direct output, the output will be emailed – better if you handle it)
 - error output of commands (same as for output above)
 - summary: it's best if your commands in a crontab are arranged with input and output already handled, not relying on output to be emailed by cron
 - if you want to email, do it explicitly in your command somehow, and test that command before putting it into your crontab

at command

- ▶ at command runs a set of commands at a later time
- ▶ at command takes a TIME parameter and reads the set of commands from standard input
- ▶ example (run commands at 4pm 3 days from now)
 - at 4pm + 3 days
rm -f /home/usr/foo
touch /home/usr/newfoo
^D
- ▶ other at-related commands: atrm, atq
- ▶ for details: man at
- ▶ as with cron, you must be aware of how your commands will get their input (if any) and what will happen to their output (if any)