

# CST8177 – Linux II

More on file systems, Booting  
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# Topics

- ▶ bind mounts
- ▶ quotas
- ▶ Booting process and SysVinit
- ▶ Installation Disk rescue mode

# Bind mounts

- ▶ A bind mount is used to mount a directory onto a mount point: `man mount`
- ▶ use the “bind” option for the mount command
  - # `mount -o bind /some/dir /anotherdir`
    - now `/some/dir` and `/anotherdir` are the same directory
- ▶ Be careful with bind mounts, because they make it possible to form cycles in the file system
- ▶ e.g. dangerous: `"mount -o bind /home /home/user/dir"`
  - serious repercussions for
    - `rm -rf /home/user` # will remove all of `/home`
    - `find /home/user` # will never stop
    - any program that recursively descends directories

# Bind mount examples

- ▶ make an inaccessible directory accessible:
  - `mount -o bind /home/user/private/public /public`
- ▶ make disk space in one file system available in another file system
  - suppose you have a large separate file system with lots of free space on `/var`, and root file system with `/home` is nearly full:
    - `mkdir /var/local/home/{user1,user2}`
    - move contents of `/home/{user1,user2,...}` to `/var/local/home`
    - `mount -o bind /var/local/home /home`
    - beware: new `/home` has same mount options as `/var`

# Bind mount examples (cont'd)

- ▶ share directories across chroot environments
  - `mount -o bind /dev /home/user/myroot/dev`
  - `chroot /home/user/myroot/dev`
  - in the chroot-ed environment, `/dev` will be the same as the un-chroot-ed `/dev`

# Quotas

- ▶ [https://access.redhat.com/knowledge/docs/en-US/Red\\_Hat\\_Enterprise\\_Linux/6/html/Storage\\_Administration\\_Guide/ch-disk-quotas.html](https://access.redhat.com/knowledge/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Storage_Administration_Guide/ch-disk-quotas.html)
- ▶ Quotas give us the ability to keep track of users' disk usage: both blocks (disk space) and inodes (number of files)
- ▶ `quota` rpm must be installed
- ▶ For both blocks and inodes, quotas allow hard limits and soft limits:
  - Soft limit: user is allowed to exceed a soft limit, but they will be warned, and after a grace period, they cannot increase usage
  - Hard limit: user is never allowed to exceed the hard limit
- ▶ We enable quotas for a file system
- ▶ Quotas can be applied to users and/or groups
- ▶ System administrator can report on all users' disk usage status
- ▶ Each user can see their own disk usage status (quota information)

# Turning quotas on (and off)

- ▶ Example: enabling quotas on /home (separate /home filesystem)

- In `/etc/fstab`, add the `usrquota`, `grpquota` mount options for the file system mounted on the `/home` mount point

- Initialize the quota database files for `/home` with the command

```
quotacheck -cug /home
```

- `c`: don't read quota files, create new quota database files
- `u`: do user quotas
- `g`: do group quotas

- Turn quotas on

- `quotaon -vaug # turn quotas on`

- `v`: display a message for each filesystem affected
- `a`: turn quotas on for all automatically mounted file systems according to `/etc/fstab`
- `u`: user quotas
- `g`: group quotas

- `repquota -a # report on quotas`

- Turn quotas off

- `quotaoff -vaug # turn quotas off`

- `quotaoff -vaug; quotacheck -vaug; quotaon -vaug #single user mode`

# Setting Quotas

- ▶ To set a quota for a user, as root

```
edquota username
```

- where

- you'll see (example) DO NOT edit blocks or inodes, just soft and hard limits!

Disk quotas for user tgk (uid 107):

Filesystem	blocks	soft	hard	inodes	soft	hard
/dev/sda8	108	1000	2000	1	0	0

or this command can be used in scripts

```
setquota -u username soft hard isoft ihard fs
```

- where

- username is the name of the user
- soft is the block soft limit
- hard is the block hard limit
- isoft is the inode soft limit
- ihard is the inode hard limit
- fs is the file system mount point (e.g. /home)

# Quota Grace Period

- ▶ To set the grace period for all users

```
edquota -t      # edit grace period
```

- where you'll see something like this (note units)

```
Grace period before enforcing soft limits for users:
```

```
Time units may be: days, hours, minutes, or seconds
```

Filesystem	Block grace period	Inode grace period
/dev/mapper/VolGroup00-LogVol100	8days	8days

- ▶ To set the grace period for an individual user

```
edquota -T tgk
```

- where you'll see something like this (note units)

```
Times to enforce softlimit for user tgk (uid 498):
```

```
Time units may be: days, hours, minutes, or seconds
```

Filesystem	block grace	inode grace
/dev/mapper/VolGroup00-LogVol100	unset	unset

# quota and repquota commands

- ▶ individual users can check their individual quota status with `quota` command:
  - shows
    - block usage and limits
    - inode usage and limits
    - remainder on grace period if over soft limit
- ▶ System administrator can print report of all users quota status (see also `warnquota`):
  - `repquota -a`
  - shows for each user what they've used, soft limits, hard limits, and remainder of grace periods if that user has entered one of their grace periods

# Booting

- ▶ [http://teaching.idallen.com/cst8207/14w/notes/750\\_booting\\_and\\_grub.html](http://teaching.idallen.com/cst8207/14w/notes/750_booting_and_grub.html)
- ▶ page numbers for Fifth Edition Sobell:
  - Chapter 11: 424–431
  - Chapter 15: 551–552

# Booting Sequence (CentOS)

- ▶ Power button pressed
- ▶ BIOS
- ▶ POST
- ▶ MBR : contains grub stage 1
- ▶ grub stage 1 : to find grub stage 2
- ▶ grub stage 2 : to launch kernel
- ▶ kernel running
- ▶ init process (PID 1) : consults inittab
- ▶ /etc/inittab
- ▶ /etc/rc.d/rc.sysinit
- ▶ /etc/rc.d/rc 3 : assuming default runlevel 3

# /etc/inittab

- ▶ /etc/inittab contains records of the form
  - id:runlevels:action:process
  - id: identifies an entry
  - runlevels: the runlevels in which the action should be taken
  - action: the action that should be taken
  - process: the process to be executed
- ▶ Because CentOS 6.5 is migrating to a successor of sysVinit (upstartd, which will be replaced with systemd), only the `initdefault` action is present in our `/etc/inittab`

# When booting

- ▶ Even in CentOS 6.5, with upstartd, when the system boots to runlevel 3, the following happens as it did with sysVinit

```
/etc/init.d/rc.sysinit
```

```
/etc/init.d/rc 3 #default runlevel 3
```

- ▶ The `sysinit` action now is invoked due to the `upstartd` `/etc/init/rcS.conf` file
- ▶ The `/etc/init.d/rc` script being called with argument 3 is due to the `upstartd` `/etc/init/rc.conf` file
- ▶ Under `sysVinit`, this was controlled by `/etc/inittab`

# SysVinit scripts

- ▶ Even with upstartd, sysVinit is supported
- ▶ `/etc/init.d/*`
  - these are scripts for starting, stopping, restarting services
- ▶ `/etc/rc.d/rc.N.d/*` #where N is a runlevel
  - these are symbolic links to service's script
  - begins with K means service should not be running in that runlevel: call it with "stop" argument
  - begins with S means service should be running in that runlevel: call it with "start" argument
- ▶ chkconfig maintains these scripts

# chkconfig

- ▶ all `/etc/init.d/*` scripts manageable by `chkconfig` have two or more commented lines
- ▶ first tells `chkconfig` what runlevels, and start and stop priority
- ▶ `runlevels` is "-" if by default should not be started in any runlevel
- ▶ second is a description
- ▶ For example: `/etc/init.d/ntpd`

```
# chkconfig: - 58 74
```

```
# description: ntpd is the NTPv4 daemon. \
```

```
# The Network .....
```

# /etc/rc.d/rcN.d/\*

- ▶ The /etc/rc.d/rcN.d/ (N=0,1,2,3,4,5,6) directories contain symbolic links to scripts in /etc/init.d
- ▶ These links are maintained by `chkconfig` (links created or removed by commands like `chkconfig <service> on`)
- ▶ When entering a new runlevel
  - during boot as controlled by /etc/inittab
  - or by root running a `telinit <newlevel>` command (example `telinit 2` to enter runlevel 2)The system will call scripts to stop services that should not run in that runlevel, and start services that should run in that runlevel

# Entering a runlevel

- ▶ When entering a new runlevel, the system needs to stop the services that should not be running in that runlevel, and start the services that should be running in that runlevel
- ▶ To do this, the system calls the scripts in that runlevel's directory,

`/etc/rc<lev>.d/`, where `<lev>` is a runlevel

- Scripts whose names begin with K are called with a stop argument (if that service is running)
- Scripts whose names begin with S are called with a start argument (if that service is not running)

# Example of entering a runlevel

- ▶ Upon entering runlevel 3 (for example):
  - each `/etc/rc3.d/K*` script is called with "stop" (if that service is running)
  - each `/etc/rc3.d/S*` script is called with "start" (if that service is not running)
  - The ordering of the scripts being called is given by the `chkconfig` priority, which is a number in the symlink-ed name of each script
  - These numbers in the link names put the scripts in a certain order
    - `chkconfig` created the link with this number in the link name because of those commented lines in the script itself (we talked about those a few slides ago)

# Example service: sshd

- ▶ **example** `/etc/rc3.d/S55sshd`
  - sshd is configured to run in runlevel 3
    - otherwise, there would be a `K25sshd` script there instead (why 25?)
  - 55 is the priority of starting the sshd service when entering that run level
- ▶ This `S55sshd` script is a symlink to `/etc/init.d/sshd`
- ▶ Again, the `chkconfig` command creates and removes these links when we use it to enable or disable a service for a runlevel

# service – run a System V init script

- ▶ `service SCRIPT COMMAND [OPTIONS]`
- ▶ `SCRIPT` is `/etc/init.d/SCRIPT`
- ▶ `COMMAND` is an argument to the script
  - `start`
  - `stop`
  - `restart`
  - *etc*
  - `start` and `stop` must be recognized by `SCRIPT`
- ▶ **Example:** `service ntpd start`
  - same effect as `/etc/init.d/ntpd start`
- ▶ **Example:** `service ntpd stop`
  - same effect as `/etc/init.d/ntpd stop`

# Installation DVD for rescue mode / Live CD

- ▶ There are dangers associated with doing file system operations on "system directories" that might be used in system operation.
- ▶ For example, many programs will use the shared libraries in `/usr/lib`, which disappear if we move `/usr` as we did earlier when we had to run `/usr1/bin/rsync`
- ▶ Also, there may come a time when the system won't boot properly: MBR corrupted, bad entry in `/etc/fstab`, inconsistent / file system

# Rescue Mode

- ▶ When you boot with a CD/DVD into rescue mode, you are running a different Linux system installation (from the CD)
- ▶ However, because the rescue Linux system is running on your hardware, it can access the hard disks you have attached (where your "real" Linux system installation resides)
- ▶ Your "real" Linux installation is not running in rescue mode – it might even be broken
- ▶ The rescue system can let you make changes/repairs to that "real" Linux system which isn't even running

# linux rescue

- ▶ To boot into rescue mode
  - ensure BIOS boot order is set for booting from CD/DVD before Hard Drive (even in VMware – F2 to enter setup)
  - insert the installation DVD into drive (or the iso image into the virtual DVD drive)
  - boot the system
  - type "linux rescue" at the prompt, or select the "Rescue" menu item
  - Linux will run "from" the DVD (Live CD), not from your file systems (your system is not running)
  - It will offer to search for and mount your Linux file systems on `/mnt/sysimage`

# linux rescue (cont'd)

- ▶ The Live CD Linux system can see your hard drives, and this is how you can repair or alter what is on those hard drives
- ▶ You need to remember that a Live CD Linux system is running from its own root filesystem (like dual boot?), so this means
  - the users are different `/etc/passwd` `/etc/shadow`, etc (or should we say all of `/etc`) are different
  - the services running, firewalling, and so on, are different

# Rescue mode / Live CD

ramdisk (the root file system of the rescue system)

	/		
etc/		bin/	dev/
passwd		ls	sda
shadow		bash	sda1
			sda2

/dev/sda1 (your "real" root file system)

	/		
etc/		home/	dev/
fstab		idallen/	
passwd		donnelr	

# linux rescue example 1

- ▶ Fix /etc/fstab
  - mount /dev/sda1 /mnt/sysimage (if it isn't already mounted – the rescue boot process probably offered to mount this for you)
  - vi /mnt/sysimage/etc/fstab
    - fix the problem
    - save and quit
  - exit (to reboot)

# linux rescue example 2

## ▶ fix MBR

- # our root file system is mounted on /mnt/sysimage
- chroot /mnt/sysimage
- # now / is our root file system!
- # our boot filesystem is mounted on /boot
- grub-install /dev/sda

## ▶ Whoa! That chroot thing was neat

- chroot runs a program or interactive shell using the named directory as the root directory
- Default program is `${SHELL} -i`
- This simulates running off our system's root file system without going through its boot process

# chroot

- ▶ That `chroot` command did something very special, so let's be sure we understand what it did
- ▶ `chroot /some/dir` gives us a shell process where the `/some/dir` is `/` for that shell process
- ▶ In that shell process, any commands you run from its prompt and those resulting processes will work with that changed "root"
- ▶ They will use the `/bin`, `/lib/`, `/etc...` in the changed root

# rescue chroot /mnt/sysimage

- ▶ When we are running in rescue mode, and our "real" root file system is mounted on

`/mnt/sysimage`

then the shell prompt we get from

```
chroot /mnt/sysimage
```

will "use" (because that's what it sees) our "real" `/bin`, `/lib/`, `/etc...` (our "real" root file system that resides on our disk)

- ▶ We can even start services from that chroot-ed prompt – they will run with our "real" root file system binaries (`/bin`) libraries (`/lib`) and configuration (`/etc`), but on the rescue kernel

# rescue /dev

- ▶ The `/dev` directory on modern Linux systems contains the device nodes, and these are managed by `udev` at boot time
- ▶ When booting in rescue mode, `udev` puts device nodes for *your* hardware (disks, partitions, etc) into `/dev`
- ▶ Your "real" (non-rescue) root file system contains an empty `/dev` directory (it looks full to you because `udev` populates it when you boot your real system!

# /mnt/sysimage and /dev

- ▶ When the rescue system mounts your "real" root file system on `/mnt/sysimage`, it first creates a bind mount from

`/dev` to `/mnt/sysimage/dev`

so that when you do

```
chroot /mnt/sysimage
```

the shell you get will see a populated `/dev` instead of the empty directory

- ▶ This is a good reason to know about bind mounts!