Lab 7: File Systems

The purpose of this lab is to explore the structure of the EXT filesystem used throughout most Linux Distributions. We will run commands that allow you to create file systems configure the superblock, modify inode information, perform file system checks, and implement disk quotas.

The objective of this lab is to move the home directories of users from the root file system to a separate file system where we can implement disk quotas.

Supplies

- VMWare Server 1.05 or higher
- Benji VM or CentOS 5 ISO

Preconfiguration

- Benji should have the users configured in Lab 6.
- Initial partitions on Benji

Location	Type	Boot Code	Type	Mount	Size
MBR					
/dev/sda1	Primary	GRUB	ext3	/	3000 MB
/dev/sda2	Primary		swap		512 MB
/dev/sda3	Primary		ext3	/var	500 MB
/dev/sda4	Extended				
/dev/sda5	Logical		ext3	/opt	300 MB
/dev/sda6	Logical		ext3		50 MB

Forum

If you get stuck on one of the steps below don't beat your head against the wall. Use the forum to ask for assistance or post any valuable tips and hints once you have finished. Forum is at: http://simms-teach.com/forum/viewforum.php?f=13

Background

File systems are storage structures that allow the computer system to maintain the integrity and whereabouts of large numbers of different files in a quick and secure manner.

Regardless of the type of file system, UNIX/Linux file systems treat files as having three distinct components:

1. **filenames** - which are kept in special files called directories
2. **inode** - a block of data that keeps information about the file e.g. permissions, ownership, size and location of the contents of the file.
3. **data** - the actual contents of the file are stored in blocks of data that are allocated in clusters ranging from 1K to 32K or more in size. These clusters do not necessarily have to be contiguous on the hard disk.

Part I: Creating a File system

Typically, file systems are used to format partitions of a hard disk, floppy or CD-ROM. In this section, we are going to add and format a logical partition on the hard disk.

1. Log on as root and use the **fdisk** command to add a new 200 MB logical partition (/dev/sda7) to your hard drive.
2. Use the **fdisk –l** command to verify that the new /dev/sda7 partition has been created. If you made a partition that is larger than 200MB, delete it and make it again.
3. Format this partition with an ext3 file system that contains 800 inodes:
   mkfs -t ext3 -N 800 /dev/sda7
4. Before we mount the file system, lets look at the superblock structure:
   dumpe2fs /dev/sda7 | more
   Note the following fields:
   - Filesystem volume name
   - Filesystem state
   - Inode count
   - Block count
   - Block size
   - Maximum mount count

   Do you understand the kind of information that's kept in the Superblock?

5. Let's configure some of these fields with some file system commands:
   e2label /dev/sda7 /home # adds a volume name
   tune2fs -c 24 /dev/sda7 # changes maximum mount count
6. Check your modifications using the **dumpe2fs** command.

Part II: Mounting and Populating a File System

File systems are controlled by device drivers, and therefore are treated as devices.
To make the files within a file system available to users, the file system device must be mounted to a directory of an already-mounted file system (usually root).

1. Now mount your new filesystem:
   mount /dev/sda7 /mnt

2. List the current contents of your filesystem by listing the contents of the */mnt* directory. What is there? Anything?
3. Note that the mkfs command made a fairly large, but empty, directory called *lost+found* in your file system. This directory is used by **fsck** to store recovered files when fixing file system corruption. What is the inode of the *lost+found* directory? What is the inode of the mntpoint, (*/mnt*)? directory?
   ls -ai /mnt
   Note: mount point directories are always given inode number 2. (0 and 1 are reserved and never used as regular inodes.)
4. Now populate your new fileystem with all the home directories of your users. Here is a cool command for doing that, but it requires that you are in the /mnt directory:
   cd /mnt
   (cd /home; tar cvf - .) | tar xvf -
   We have just copied all the subdirectories from the root filesystem to your file system. Enclosing one or more commands in () runs them in a sub-shell. In this case we only want the cd to /home to be temporary. The – is used to pipe stdout to other commands. In this case the – is used to pipe the tar file created by the first tar command to be used for extraction by the second tar command. See the – section in http://tldp.org/LDP/abs/html/special-chars.html for more details.
5. List the contents of your filesystem with inode numbers:
   ls -i
6. Change directory to / and unmount your file system.
7. Check the integrity of your new file system using the following command:
   fsck -f /dev/sda7
   The -f option forces the check even though the filesystem was unmounted cleanly.

Part III: Setting up disk quotas

In this procedure we will setup disk quotas for our users.
Disk quotas are setup on a per file system basis. Quotas may be set for individual user accounts and/or groups. We are going to setup quotas for user accounts in the file system that we just created.

1. As root, mount your new file system to the /home mount point with the following command:
   mount -o usrquota /dev/sda7 /home
   What would you do if you wanted this file system mounted like this every time you booted the system?
2. Change directory to /home and verify that all your user directories are there.
3. Analyze this file system for current disk usage:
   quotacheck -cuv /dev/sda7
   Notice the datafile that gets created for holding this quota information. What is its name?
4. Now turn on user quotas on with the command:
   quotaon -uv /dev/sda7
5. On another screen, log in as gimli and issue the quota command.
   What does it say?
6. Go back to your root login and setup a quota for this user using the following command:
   edquota gimli

Notice the beautiful user interface! You are in vi, and you can edit the *soft* and *hard* fields in this file. Note they are currently 0. Notice that you can set quotas on disk space (blocks) or on number of files (inodes). Set Gimli's soft quota to be 2MB and his hard quota to be 2.5 MB:

```
Disk quotas for user gimli (uid 800):
  Filesystem                  blocks       soft       hard     inodes     soft     hard
  /dev/sda7                       25       2000       2500          5        0        0
```

7. Once you've setup the quota for gimli, test it out by logging in as gimli on another terminal or Putty session and start using up his diskspace. Either copying files into gimli's home directory or use a script like the following. You should reach the limits.

   ```
   > bigfile; while du; do man quota >> bigfile; done
   ```
   (use several ctrl-c's to end)

8. To make this quota persistent across reboots, you will have to add the *usrquota* keyword to the options column of the appropriate entry in */etc/fstab*. Do that now.

```
[root@benji ~]# cat /etc/fstab
LABEL=/1                /                       ext3    defaults        1 1
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
LABEL=/opt              /opt                    ext3    defaults        1 2
proc                    /proc                   proc    defaults        0 0
sysfs                   /sys                    sysfs   defaults        0 0
LABEL=/var              /var                    ext3    defaults        1 2
LABEL=SWAP-sda2         swap                    swap    defaults        0 0
LABEL=/home             /home                   ext3    usrquota,defaults 1 2
[root@benji ~]#
```

To Turn in

fdisk –l > lab07
mount >> lab07
cat /etc/fstab >> lab07
repquota –a >> lab07
du /home/gimli >> lab07

Review you work in lab07 before submitting to make sure you have covered each area of the grading rubric. Then submit your work using:

scp lab07 cis191@opus.cabrillo.edu:lab07.*lastname*

Grading rubric (30 points)

5 points for correctly sized /dev/sda7
5 points for correctly formatting /dev/sda7
5 points for /dev/sda7 mounted as /home
5 points for /dev/sda7 mounted with usrquota option
5 points for correct /etc/fstab
5 points for correct quotas set on gimli