Vanier College

Faculty of Careers and Technical Programs

Department of Computer Science Technology

Advanced UNIX

Lab #5

Title: Linux Filesystem Administration

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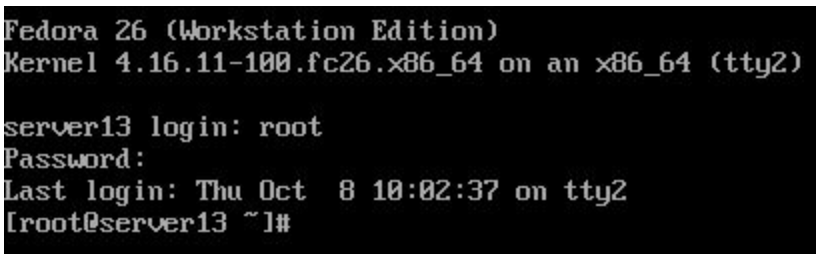
Review Questions *(p.241-244)*:

1. D. `parted`
2. False
3. C. `cat /etc/mtab`
4. C. Create one or more partitions on each of the hard disk drives.
   E. Mount any partitions created on the two hard drives such that they are accessible by the operating system.
   F. Format any partitions created with a valid filesystem recognized by Linux.
5. C. /, /proc, and swap
6. C. Unmount the device from the directory.
7. D. `df`
8. C. Unmount the filesystem.
9. False
10. B. shows the size of all directories within the /var directory
11. B. displays the number of inodes used and available in an ext2 filesystem
12. C. The device file has become corrupt.
13. C. Quotas can limit both userspace and the number of files a user can own.
    D. Hard limits can never be exceeded.
    G. Soft limits allow a user to exceed them for a certain period of time.
14. B. has no data section
    D. displays a major and minor number in place of a file size
15. C. VGs are comprised of one or more PVs.
16. True
17. D. /dev/sdc1
18. B. `mount -a`
19. C. Mount the filesystem and check the lost+found directory underneath the mount point.
20. C. `e2mkfs –t ext4 device`

Project 5-1 *(p.245)*:

1.



2. Basically, the file is represented by the sixth local terminal on the system and it is a character device file since there is the character “c” identifying the device, instead of “b” for mentioning a block device file. Also, according to the file result, the major number is 4, while the minor number is 6.

```
[root@server13 ~]# ls -l /dev/tty6
crw--w----. 1 root tty 4, 6 Oct 22 07:47 /dev/tty6
```

3. Yes, the file has been successfully removed.

```
[root@server13 ~]# rm -f /dev/tty6
[root@server13 ~]# ls -l /dev/tty6
ls: cannot access '/dev/tty6': No such file or directory
```

4. We weren’t able to access the sixth local terminal, since the file doesn’t currently exist

5. Once the first command is executed, a new character device file with major number 4 and minor number 6 is created. Due to the displayed file result from the second command, the file was re-created successfully, yes.

```
[root@server13 ~]# mknod /dev/tty6 c 4 6
[root@server13 ~]# ls -l /dev/tty6
crw--w----. 1 root tty 4, 6 Oct 22 10:09 /dev/tty6
```

6. Yes, logging into the sixth local terminal was successful since rebooting the system allowed the device file to run, thus having access to the sixth local terminal to log in.

```
[root@server13 ~]# reboot
```

```
Fedora 26 (Workstation Edition)
Kernel 4.16.11-100.fc26.x86_64 on an x86_64 (tty6)

server13 login: root
Password:
Last login: Thu Oct 22 10:06:18 on tty5
[root@server13 ~]#
```

7. Essentially, all the listed files are local terminals on the system, character device files, and have the same major numbers, as well as similar user permissions. While each file's major number is identical, the minor number is different since each terminal file corresponds to a distinct device.

```
[root@server13 ~]# ls -l /dev/tty?
crw--w----. 1 root tty 4, 0 Oct 22 10:18 /dev/tty0
crw--w----. 1 gdm  tty 4, 1 Oct 22 10:18 /dev/tty1
crw--w----. 1 root tty 4, 2 Oct 22 10:18 /dev/tty2
crw--w----. 1 root tty 4, 3 Oct 22 10:18 /dev/tty3
crw--w----. 1 root tty 4, 4 Oct 22 10:18 /dev/tty4
crw--w----. 1 root tty 4, 5 Oct 22 10:18 /dev/tty5
crw--w----. 1 root tty 4, 6 Oct 22 10:54 /dev/tty6
crw--w----. 1 root tty 4, 7 Oct 22 10:18 /dev/tty7
crw--w----. 1 root tty 4, 8 Oct 22 10:18 /dev/tty8
crw--w----. 1 root tty 4, 9 Oct 22 10:18 /dev/tty9
```

8. Yes, there are many character device files listed once the first command is executed. However, when executing the second command, all files within /dev directory add up to a total of 0 kilobytes because they are direct interfaces with the Linux kernel.

```
[root@server13 ~]# find /dev_
```

```
/dev/tty20
/dev/tty19
/dev/tty18
/dev/tty17
/dev/tty16
/dev/tty15
/dev/tty14
/dev/tty13
/dev/tty12
/dev/tty11
/dev/tty10
/dev/tty9
/dev/tty8
/dev/tty7
/dev/tty6
/dev/tty5
/dev/tty4
/dev/tty3
/dev/tty2
/dev/tty1
/dev/vcsa1
/dev/vcs1
/dev/vcsa
```

```
/dev/vcs
/dev/tty0
/dev/console
/dev/tty
/dev/kmsg
/dev/urandom
/dev/random
/dev/full
/dev/zero
/dev/port
/dev/null
/dev/mem
/dev/vga_arbiter
```

```
[root@server13 ~]# du -s /dev
0       /dev
```

9. Once this command is executed, character and block devices, as well as 51 unique major numbers. The character devices having major number 4, include /dev/vc/0, tty and ttyS. Compared to Step 2 in this Project Exercise, the device file listed has a character device called tty with a major number of 4.

```
[root@server13 ~]# cat /proc/devices | more_
```

```
Character devices:
  1 mem
  4 /dev/vc/0
  4 tty
  4 ttyS
  5 /dev/tty
  5 /dev/console
  5 /dev/ptmx
  7 vcs
 10 misc
 13 input
 14 sound
 21 sg
 29 fb
116 alsa
128 ptm
136 pts
162 raw
180 usb
188 ttyUSB
189 usb_device
202 cpu/msr
203 cpu/cpuid
226 drm
```

```
244 aux
245 hidraw
246 usbmon
247 bsg
248 hmm_device
249 watchdog
250 rtc
251 dax
252 dimmctl
253 ndctl
254 gpiochip

--More--
```

```
Block devices:
  8 sd
  9 md
 11 sr
 65 sd
 66 sd
 67 sd
 68 sd
 69 sd
 70 sd
 71 sd
128 sd
129 sd
130 sd
131 sd
132 sd
133 sd
134 sd
135 sd
253 device-mapper
254 mdp
259 blkext
```

10.

```
[root@server13 ~]# exit
```

```
Fedora 26 (Workstation Edition)
Kernel 4.16.11-100.fc26.x86_64 on an x86_64 (tty6)

server13 login:
```

Discovery Exercises *(p.253)*:

1. a) The command for displaying the total number (65536), available for use (65178) and currently utilized (65536 - 65178 = 358) nodes in the root system:

   ➔ `dumpe2fs -h /dev/sda1`

```
[root@server13 ~]# dumpe2fs -h /dev/sda1
dumpe2fs 1.43.4 (31-Jan-2017)
Filesystem volume name:   <none>
Last mounted on:          /boot
Filesystem UUID:          9d4614f7-83ca-450d-91db-233139c09903
Filesystem magic number:  0xEF53
Filesystem revision #:    1 (dynamic)
Filesystem features:      has_journal ext_attr resize_inode dir_index filetype needs_recovery extent 64bit f
lex_bg sparse_super large_file huge_file uninit_bg dir_nlink extra_isize
Filesystem flags:         signed_directory_hash
Default mount options:    user_xattr acl
Filesystem state:         clean
Errors behavior:          Continue
Filesystem OS type:       Linux
Inode count:              65536
Block count:              262144
Reserved block count:     13107
Free blocks:              217842
Free inodes:              65178
```

```
First block:              0
Block size:               4096
Fragment size:            4096
Group descriptor size:    64
Reserved GDT blocks:      127
Blocks per group:         32768
Fragments per group:      32768
Inodes per group:         8192
Inode blocks per group:   512
Flex block group size:    16
Filesystem created:       Thu Sep 17 19:08:05 2020
Last mount time:          Thu Oct 22 16:21:37 2020
Last write time:          Thu Oct 22 16:21:37 2020
Mount count:              16
Maximum mount count:      -1
Last checked:             Thu Sep 17 19:08:05 2020
Check interval:           0 (<none>)
Lifetime writes:          33 MB
Reserved blocks uid:      0 (user root)
Reserved blocks gid:      0 (group root)
First inode:              11
Inode size:               256
```

```
Required extra isize:     32
Desired extra isize:      32
Journal inode:            8
Default directory hash:   half_md4
Directory Hash Seed:      c3929438-d284-437d-b1b0-93e615b60b16
Journal backup:           inode blocks
Journal features:         journal_64bit
Journal size:             32M
Journal length:           8192
Journal sequence:         0x00000184
Journal start:            1
```

b) The command to know currently mounted filesystems on our system:

➔ `mount`

```
[root@server13 ~]# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime,seclabel)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
devtmpfs on /dev type devtmpfs (rw,nosuid,seclabel,size=2524872k,nr_inodes=631218,mode=755)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,seclabel)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,seclabel,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,seclabel,mode=755)
tmpfs on /sys/fs/cgroup type tmpfs (ro,nosuid,nodev,noexec,seclabel,mode=755)
cgroup on /sys/fs/cgroup/unified type cgroup2 (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/systemd type cgroup (rw,nosuid,nodev,noexec,relatime,xattr,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime,seclabel)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,cpu,cpuacct)
cgroup on /sys/fs/cgroup/net_cls,net_prio type cgroup (rw,nosuid,nodev,noexec,relatime,net_cls,net_prio)
cgroup on /sys/fs/cgroup/memory type cgroup (rw,nosuid,nodev,noexec,relatime,memory)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,perf_event)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio)
cgroup on /sys/fs/cgroup/hugetlb type cgroup (rw,nosuid,nodev,noexec,relatime,hugetlb)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,cpuset)
cgroup on /sys/fs/cgroup/pids type cgroup (rw,nosuid,nodev,noexec,relatime,pids)
```

```
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,devices)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,freezer)
configfs on /sys/kernel/config type configfs (rw,relatime)
/dev/mapper/fedora-root on / type ext4 (rw,relatime,seclabel,data=ordered)
selinuxfs on /sys/fs/selinux type selinuxfs (rw,relatime)
debugfs on /sys/kernel/debug type debugfs (rw,relatime,seclabel)
mqueue on /dev/mqueue type mqueue (rw,relatime,seclabel)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs (rw,relatime,fd=36,pgrp=1,timeout=0,minproto=5,maxproto=5,direct,pipe_ino=14826)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime,seclabel,pagesize=2M)
/dev/sda1 on /boot type ext4 (rw,relatime,seclabel,data=ordered)
tmpfs on /tmp type tmpfs (rw,nosuid,nodev,seclabel)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw,relatime)
tmpfs on /run/user/42 type tmpfs (rw,nosuid,nodev,relatime,seclabel,size=507428k,mode=700,uid=42,gid=42)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,seclabel,size=507428k,mode=700,uid=1000,gid=1000)
gvfsd-fuse on /run/user/1000/gvfs type fuse.gvfsd-fuse (rw,nosuid,nodev,relatime,user_id=1000,group_id=1000)
fusectl on /sys/fs/fuse/connections type fusectl (rw,relatime)
```

c) The command to know the available filesystems to be mounted on our system:

➔ `cat /etc/fstab`

```
[root@server13 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Thu Sep 17 19:08:18 2020
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/fedora-root /                       ext4    defaults        1 1
UUID=9d4614f7-83ca-450d-91db-233139c09903 /boot                   ext4    defaults        1 2
/dev/mapper/fedora-swap swap                    swap    defaults        0 0
```

d) The command to know the filesystems automatically mounted at boot time:

➔ `cat /etc/fstab`

```
[root@server13 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Thu Sep 17 19:08:18 2020
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/fedora-root /                       ext4    defaults        1 1
UUID=9d4614f7-83ca-450d-91db-233139c09903 /boot                   ext4    defaults        1 2
/dev/mapper/fedora-swap swap                    swap    defaults        0 0
```

2.

```
[root@server13 ~]# cat /proc/devices
Character devices:
  1 mem
  4 /dev/vc/0
  4 tty
  4 ttyS
  5 /dev/tty
  5 /dev/console
  5 /dev/ptmx
  7 vcs
 10 misc
 13 input
 14 sound
 21 sg
 29 fb
```

```
116 alsa
128 ptm
136 pts
162 raw
180 usb
188 ttyUSB
189 usb_device
202 cpu/msr
203 cpu/cpuid
226 drm
244 aux
245 hidraw
246 usbmon
247 bsg
248 hmm_device
249 watchdog
250 rtc
251 dax
252 dimmctl
253 ndctl
254 gpiochip
```

```
Block devices:
  8 sd
  9 md
 11 sr
 65 sd
 66 sd
 67 sd
 68 sd
 69 sd
 70 sd
 71 sd
128 sd
129 sd
130 sd
131 sd
132 sd
133 sd
134 sd
135 sd
253 device-mapper
254 mdp
259 blkext
```

```
[root@server13 ~]# ls -ld /dev/fd*
lrwxrwxrwx. 1 root root 13 Oct 22 10:18 /dev/fd -> /proc/self/fd
```

a) fd0: 2, due to searching for the major number online.

b) fd1: 2, due to searching for the major number online.

c) fd3: 2, due to searching for the major number online.

```
[root@server13 ~]# ls -ld /dev/hda*
ls: cannot access '/dev/hda*': No such file or directory
```

d) hda1: 3, due to searching for the major number online.

e) hda2: 3, due to searching for the major number online.

f) hda3: 3, due to searching for the major number online.

```
[root@server13 ~]# ls -ld /dev/sda*
brw-rw----. 1 root disk 8, 0 Oct 22 10:18 /dev/sda
brw-rw----. 1 root disk 8, 1 Oct 22 10:18 /dev/sda1
brw-rw----. 1 root disk 8, 2 Oct 22 10:18 /dev/sda2
```

g) sda1: 8

h) sda2: 8

i) sda3: 8

There is a pattern indeed since the same first two or three characters (like “fd”, “hda” and “sda” in this situation) from the device files have an equivalent major number.