

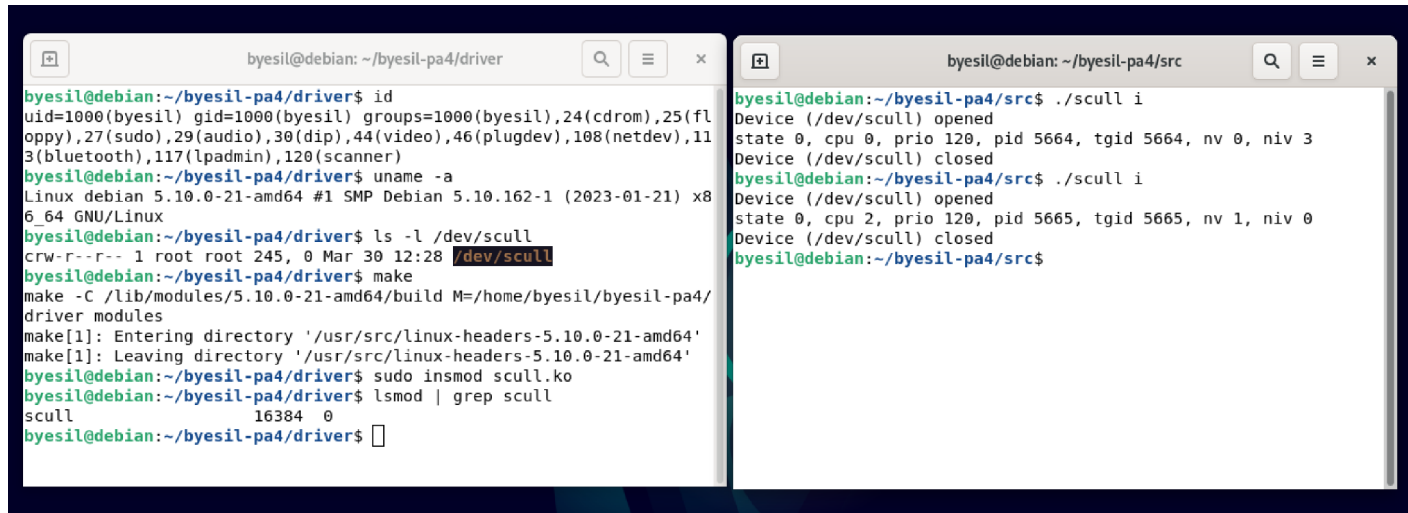
Burak Yesil
Operating Systems

Programming Assignment 4

"I pledge my honor that I have abided by the Stevens Honor System"

Section 3.2 Screenshot:

The screenshot below shows my module successfully being loaded into the kernel and the i flag successfully being invoked twice.

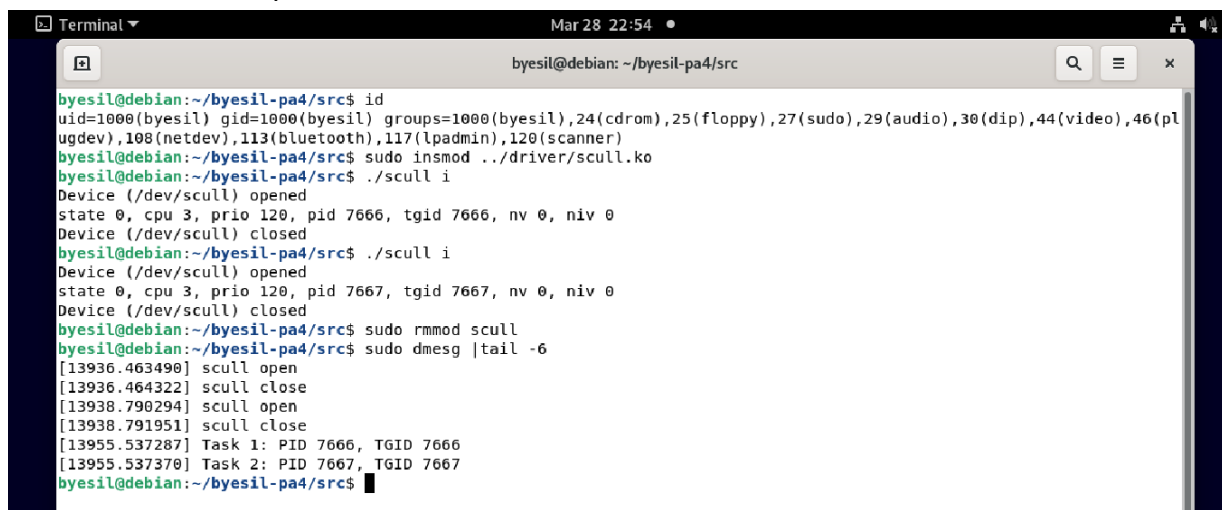


```
byesil@debian: ~/byesil-pa4/driver
byesil@debian:~/byesil-pa4/driver$ id
uid=1000(byesil) gid=1000(byesil) groups=1000(byesil),24(cdrom),25(floppy),27(sudo),29(audio),30(dip),44(video),46(plugdev),108(netdev),113(bluetooth),117(lpadmin),120(scanner)
byesil@debian:~/byesil-pa4/driver$ uname -a
Linux debian 5.10.0-21-amd64 #1 SMP Debian 5.10.162-1 (2023-01-21) x86_64 GNU/Linux
byesil@debian:~/byesil-pa4/driver$ ls -l /dev/scull
crw-r--r-- 1 root root 245, 0 Mar 30 12:28 /dev/scull
byesil@debian:~/byesil-pa4/driver$ make
make -C /lib/modules/5.10.0-21-amd64/build M=/home/byesil/byesil-pa4/driver modules
make[1]: Entering directory '/usr/src/linux-headers-5.10.0-21-amd64'
make[1]: Leaving directory '/usr/src/linux-headers-5.10.0-21-amd64'
byesil@debian:~/byesil-pa4/driver$ sudo insmod scull.ko
byesil@debian:~/byesil-pa4/driver$ lsmod | grep scull
scull                16384  0
byesil@debian:~/byesil-pa4/driver$

byesil@debian: ~/byesil-pa4/src
byesil@debian:~/byesil-pa4/src$ ./scull i
Device (/dev/scull) opened
state 0, cpu 0, prio 120, pid 5664, tgid 5664, nv 0, niv 3
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$ ./scull i
Device (/dev/scull) opened
state 0, cpu 2, prio 120, pid 5665, tgid 5665, nv 1, niv 0
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$
```

Section 4.1 Screenshot:

The following screenshot shows the i flag for the scull user level program being invoked twice, which stores the process info in a linked list once the device driver is uninstalled, the contents of the linked list are outputted to the screen.

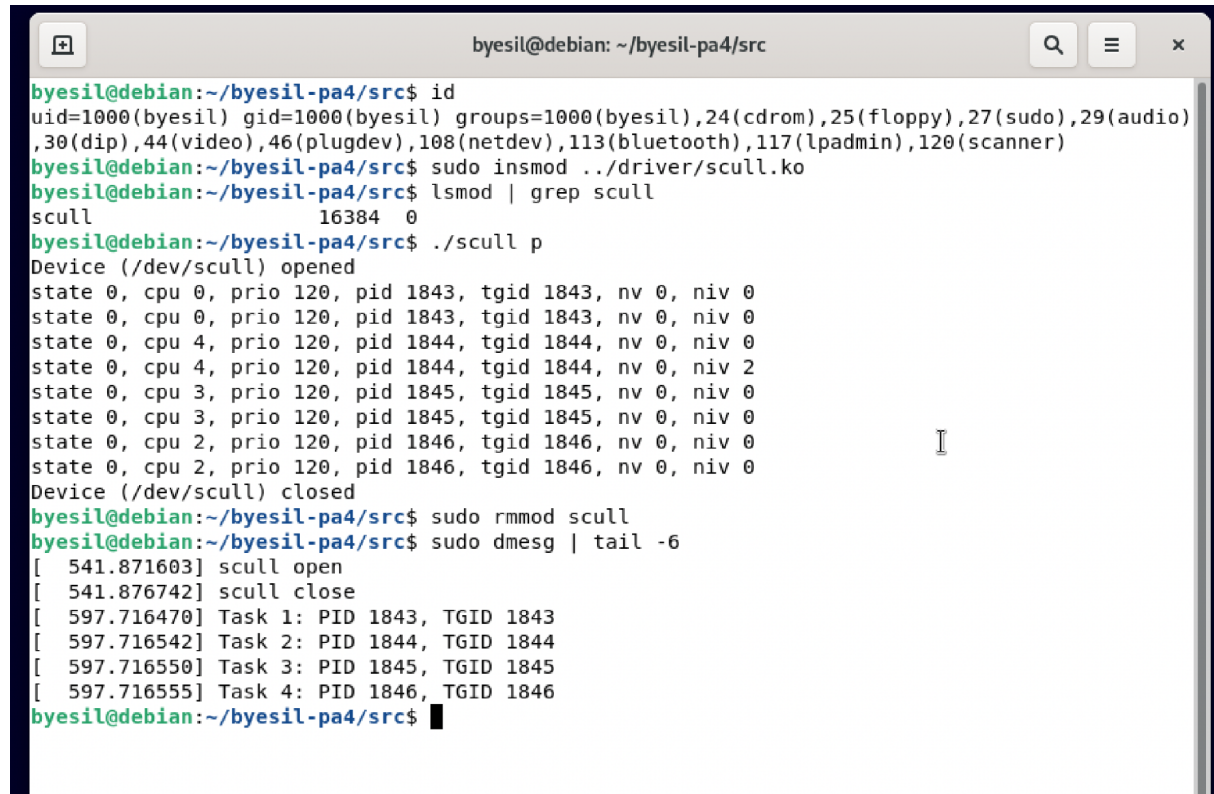


```
Terminal
Mar 28 22:54
byesil@debian: ~/byesil-pa4/src
byesil@debian:~/byesil-pa4/src$ id
uid=1000(byesil) gid=1000(byesil) groups=1000(byesil),24(cdrom),25(floppy),27(sudo),29(audio),30(dip),44(video),46(plugdev),108(netdev),113(bluetooth),117(lpadmin),120(scanner)
byesil@debian:~/byesil-pa4/src$ sudo insmod ../driver/scull.ko
byesil@debian:~/byesil-pa4/src$ ./scull i
Device (/dev/scull) opened
state 0, cpu 3, prio 120, pid 7666, tgid 7666, nv 0, niv 0
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$ ./scull i
Device (/dev/scull) opened
state 0, cpu 3, prio 120, pid 7667, tgid 7667, nv 0, niv 0
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$ sudo rmmod scull
byesil@debian:~/byesil-pa4/src$ sudo dmesg |tail -6
[13936.463490] scull open
[13936.464322] scull close
[13938.790294] scull open
[13938.791951] scull close
[13955.537287] Task 1: PID 7666, TGID 7666
[13955.537370] Task 2: PID 7667, TGID 7667
byesil@debian:~/byesil-pa4/src$
```

Section 4.2 Screenshot:

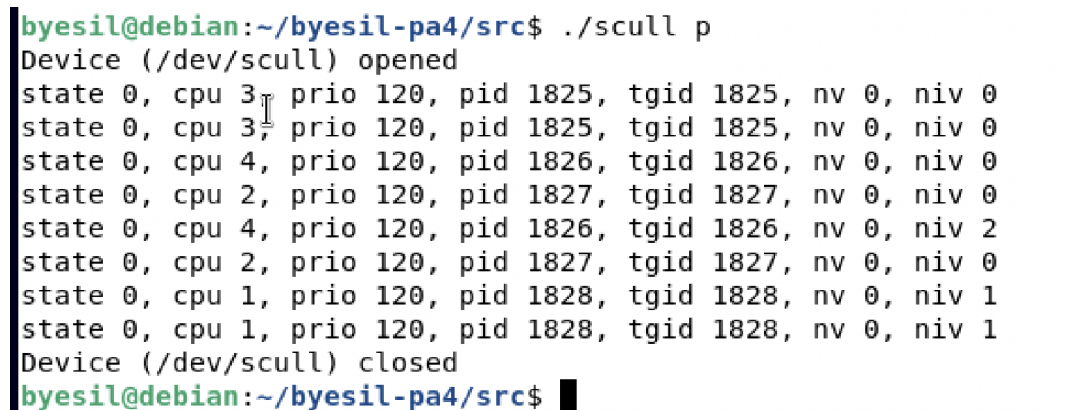
The following screenshot shows the p flag in the user level program being tested out. We're testing out the log information using processes. However, since these processes aren't running for super long, having a random order interleaving is not often so I have attached two screen shots for this section: The first is the screenshot as instructed in the pdf instructions and the second is a potential randomized interleaving.

As Pdf Instructions Asked:



```
byesil@debian: ~/byesil-pa4/src
byesil@debian:~/byesil-pa4/src$ id
uid=1000(byesil) gid=1000(byesil) groups=1000(byesil),24(cdrom),25(floppy),27(sudo),29(audio),30(dip),44(video),46(plugdev),108(netdev),113(bluetooth),117(lpadmin),120(scanner)
byesil@debian:~/byesil-pa4/src$ sudo insmod ../driver/scull.ko
byesil@debian:~/byesil-pa4/src$ lsmod | grep scull
scull                16384  0
byesil@debian:~/byesil-pa4/src$ ./scull p
Device (/dev/scull) opened
state 0, cpu 0, prio 120, pid 1843, tgid 1843, nv 0, niv 0
state 0, cpu 0, prio 120, pid 1843, tgid 1843, nv 0, niv 0
state 0, cpu 4, prio 120, pid 1844, tgid 1844, nv 0, niv 0
state 0, cpu 4, prio 120, pid 1844, tgid 1844, nv 0, niv 2
state 0, cpu 3, prio 120, pid 1845, tgid 1845, nv 0, niv 0
state 0, cpu 3, prio 120, pid 1845, tgid 1845, nv 0, niv 0
state 0, cpu 2, prio 120, pid 1846, tgid 1846, nv 0, niv 0
state 0, cpu 2, prio 120, pid 1846, tgid 1846, nv 0, niv 0
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$ sudo rmmod scull
byesil@debian:~/byesil-pa4/src$ sudo dmesg | tail -6
[ 541.871603] scull open
[ 541.876742] scull close
[ 597.716470] Task 1: PID 1843, TGID 1843
[ 597.716542] Task 2: PID 1844, TGID 1844
[ 597.716550] Task 3: PID 1845, TGID 1845
[ 597.716555] Task 4: PID 1846, TGID 1846
byesil@debian:~/byesil-pa4/src$
```

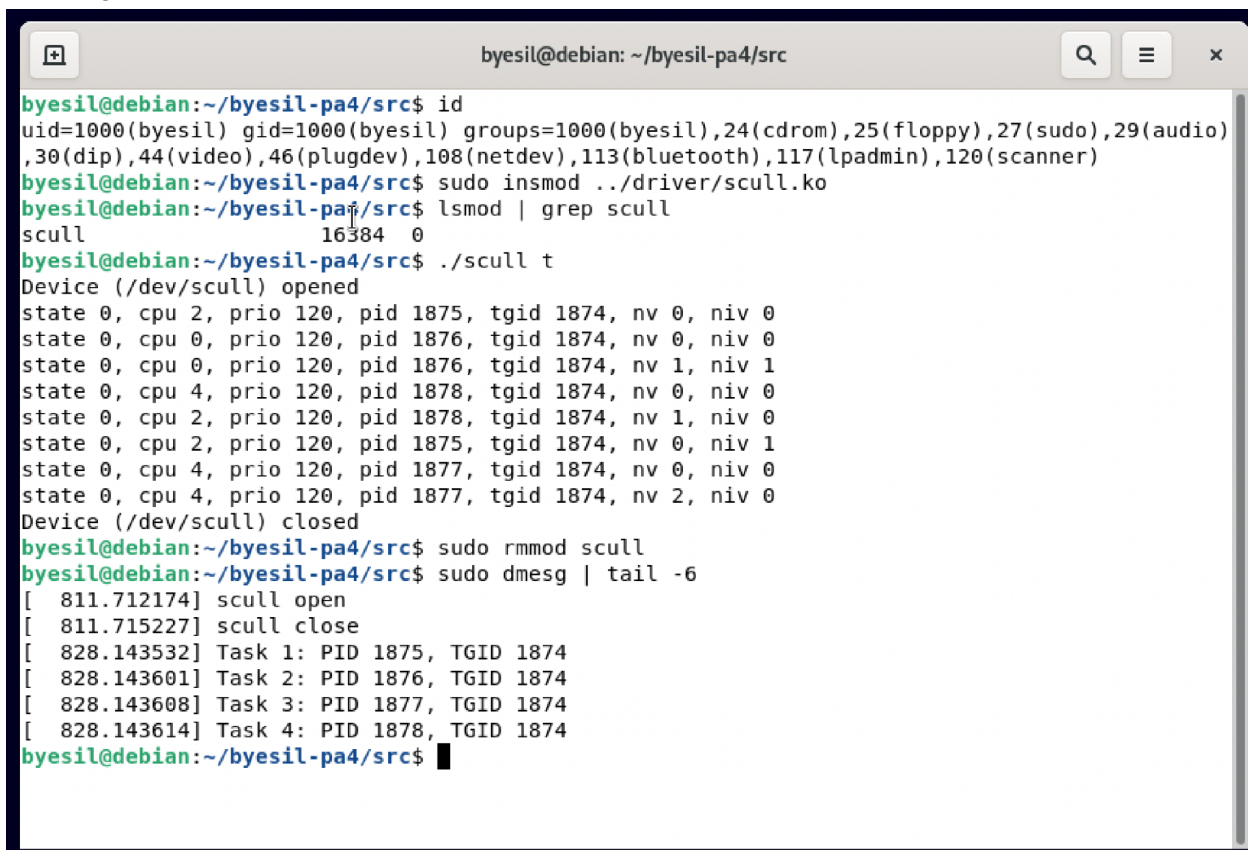
Random Interleaving: As you can see between the two separate calls made by PID 1827 we have PID 1826.



```
byesil@debian:~/byesil-pa4/src$ ./scull p
Device (/dev/scull) opened
state 0, cpu 3, prio 120, pid 1825, tgid 1825, nv 0, niv 0
state 0, cpu 3, prio 120, pid 1825, tgid 1825, nv 0, niv 0
state 0, cpu 4, prio 120, pid 1826, tgid 1826, nv 0, niv 0
state 0, cpu 2, prio 120, pid 1827, tgid 1827, nv 0, niv 0
state 0, cpu 4, prio 120, pid 1826, tgid 1826, nv 0, niv 2
state 0, cpu 2, prio 120, pid 1827, tgid 1827, nv 0, niv 0
state 0, cpu 1, prio 120, pid 1828, tgid 1828, nv 0, niv 1
state 0, cpu 1, prio 120, pid 1828, tgid 1828, nv 0, niv 1
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$
```

Section 4.3 Screenshot:

The following screenshot shows a similar process as the previous one except now we're using the t flag for threads instead of p for processes.

A terminal window titled 'byesil@debian: ~/byesil-pa4/src' showing a series of commands and their outputs. The user runs 'id' showing they are byesil with uid=1000. Then 'sudo insmod ../driver/scull.ko' loads the driver. 'lsmod | grep scull' shows 'scull' loaded at address 16384. Then './scull t' is run, which opens the device and lists several tasks with their state, CPU, priority, PID, TGID, and other parameters. Finally, 'sudo rmmod scull' unloads the driver, and 'sudo dmesg | tail -6' shows the kernel messages for the driver's open, close, and task creation events.

```
byesil@debian:~/byesil-pa4/src$ id
uid=1000(byesil) gid=1000(byesil) groups=1000(byesil),24(cdrom),25(floppy),27(sudo),29(audio),30(dip),44(video),46(plugdev),108(netdev),113(bluetooth),117(lpadmin),120(scanner)
byesil@debian:~/byesil-pa4/src$ sudo insmod ../driver/scull.ko
byesil@debian:~/byesil-pa4/src$ lsmod | grep scull
scull                16384  0
byesil@debian:~/byesil-pa4/src$ ./scull t
Device (/dev/scull) opened
state 0, cpu 2, prio 120, pid 1875, tgid 1874, nv 0, niv 0
state 0, cpu 0, prio 120, pid 1876, tgid 1874, nv 0, niv 0
state 0, cpu 0, prio 120, pid 1876, tgid 1874, nv 1, niv 1
state 0, cpu 4, prio 120, pid 1878, tgid 1874, nv 0, niv 0
state 0, cpu 2, prio 120, pid 1878, tgid 1874, nv 1, niv 0
state 0, cpu 2, prio 120, pid 1875, tgid 1874, nv 0, niv 1
state 0, cpu 4, prio 120, pid 1877, tgid 1874, nv 0, niv 0
state 0, cpu 4, prio 120, pid 1877, tgid 1874, nv 2, niv 0
Device (/dev/scull) closed
byesil@debian:~/byesil-pa4/src$ sudo rmmod scull
byesil@debian:~/byesil-pa4/src$ sudo dmesg | tail -6
[ 811.712174] scull open
[ 811.715227] scull close
[ 828.143532] Task 1: PID 1875, TGID 1874
[ 828.143601] Task 2: PID 1876, TGID 1874
[ 828.143608] Task 3: PID 1877, TGID 1874
[ 828.143614] Task 4: PID 1878, TGID 1874
byesil@debian:~/byesil-pa4/src$
```