

Assignment 6 – Coding a device driver

Description:

Note on using the template: Do NOT include any of the material I have as an example under each heading. But you MUST have all the headings in the EXACT order they are here.

This assignment is to create a Device Driver using two makefiles, one for the kernel and one for the user, with module and test folders included.

Approach:

I was reading the details for what not to do (but ended up doing it anyway) were no reverse strings (hopefully upper and lower strings count on top of the reverse, but if not, it's alright) I thought about what I wanted to do first, which was malware, but realized that was too much effort with a little amount of time, so I stuck with something simple that I could complete in time (even though it's late) I sat reading and looking over how to do kernel level commands and finally came up with a way that was at least somewhat simple to do in C but it still took ample time.

Issues and Resolutions:

There were a lot of errors coming from my admin/module file, mainly because of my copy_from_user and copy_to_user, and I realized I swapped my buffer and user len, and just swapped those two around, and the code worked correctly with no errors.

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ make r
un
./smith_tayjon_HW6_main
Opening /dev/smith_tayjon_HW6_main...

=== UPPER ===
Setting Ioctl...
Original: 'Hello String Driver!'
Write 20 bytes
lseek: Illegal seek
make: *** [Makefile:59: run] Error 1
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ ls -l
/dev/smith_tayjon_HW6_main
crw-rw-rw- 1 root root 10, 120 Dec  7 16:12 /dev/smith_tayjon_HW6_main
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$
```

here I made sure that I did have my file in /dev/ but on top of that when doing lseek: it didn't work so I tried to go back and figure if I needed to put it in my file_operations struct and tried doing that but it still didn't work, so I decided to see if just getting rid of lseek would do anything and it did (thankfully) which means I was trying to do more work than I needed too.

Analysis: For this assignment, and how to run:

To create this, we should be in the module of the device driver, run make, then do `sudo insmod smith_tayjon_HW6_Admin_main.ko` to show that it loaded correctly, we should do `sudo dmesg | tail`

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$ sudo dmesg | tail
[ 4941.138962] usb 2-2.1: USB disconnect, device number 4
[ 4941.687439] usb 2-2.1: new full-speed USB device number 5 using uhci_hcd
[ 4941.795990] usb 2-2.1: New USB device found, idVendor=0e0f, idProduct=0008, bcdDevice= 1.00
[ 4941.795997] usb 2-2.1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 4941.795998] usb 2-2.1: Product: Virtual Bluetooth Adapter
[ 4941.796000] usb 2-2.1: Manufacturer: VMware
[ 4941.796001] usb 2-2.1: SerialNumber: 000650268328
[ 4941.836579] Bluetooth: hci0: unexpected cc 0x0c12 length: 2 < 3
[ 4941.836638] Bluetooth: hci0: Opcode 0x0c12 failed: -38
[ 5101.944499] transform: module loaded, device /dev/smith_tayjon_HW6_main
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$
```

We want to make sure it works, so we test by doing `ls -l /dev/smith_tayjon_HW6_main` If it does, we should be good there. Just so we are able to use it in test, we should do `sudo chmod 666 /dev/smith_tayjon_HW6_main` after loading.

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$ cd ..
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax$ cd Test/
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ sudo chmod 666 /dev/smith_tayjon_HW6_main
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ make run
gcc -c -o smith_tayjon_HW6_main.o smith_tayjon_HW6_main.c -g -I.
gcc -o smith_tayjon_HW6_main smith_tayjon_HW6_main.o -g -I. -l pthread
./smith_tayjon_HW6_main
Opening /dev/smith_tayjon_HW6_main...

=== UPPER ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (UPPER): 'RACECAR RACECAR'

=== LOWER ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (LOWER): 'racecar racecar'

=== REVERSE ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (REVERSE): 'RACECAR racecar'

Done.
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$
```

Once everything is good, we should go back to the `module` and do `sudo rmmod smith_tayjon_HW6_Admin_main` and `sudo dmesg | tail`

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$ sudo rmmod smith_tayjon_HW6_Admin_main
[sudo] password for student:
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$ sudo dmesg | tail
[ 4382.868886] string transform: transformed 15 bytes in mode 1
[ 4382.868894] string transform: read 15 bytes
[ 4382.868906] transform: mode set to LOWER
[ 4382.868909] string transform: transformed 15 bytes in mode 2
[ 4382.868913] string transform: read 15 bytes
[ 4382.868920] transform: mode set to REVERSE
[ 4382.868923] string transform: transformed 15 bytes in mode 3
[ 4382.868927] string transform: read 15 bytes
[ 4382.868944] string transform: release
[ 4527.789619] transform: module unloaded
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$
```

to show that it has unloaded

Screen shot of compilation:

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$ make
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module module
make[1]: Entering directory '/usr/src/linux-headers-6.8.0-87-generic'
warning: the compiler differs from the one used to build the kernel
The kernel was built by: x86_64-linux-gnu-gcc-12 (Ubuntu 12.3.0-1ubuntu1~22.04.2) 12.3.0
You are using: gcc-12 (Ubuntu 12.3.0-1ubuntu1~22.04.2) 12.3.0
CC [M] /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.o
/home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.c: In function 'stringWrite':
/home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.c:134:23: warning:
passing argument 1 of 'copy_from_user' discards 'const' qualifier from pointer target type [-Wdiscarded-qualifiers]
  134 |         if(copy_from_user(user_buf, buffer + *ppos, to_copy))
      |
In file included from ./include/linux/sched/task.h:13,
                 from ./include/linux/sched/signal.h:9,
                 from ./include/linux/rcuwait.h:6,
                 from ./include/linux/percpu-rwsem.h:7,
                 from ./include/linux/fs.h:33,
                 from ./include/linux/compat.h:17,
                 from ./arch/x86/include/asm/ia32.h:7,
                 from ./arch/x86/include/asm/elf.h:10,
                 from ./include/linux/elf.h:6,
                 from ./include/linux/module.h:19,
                 from /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_m
ain.c:1:
./include/linux/uaccess.h:187:22: note: expected 'void *' but argument is of type 'const char *'
  187 | copy_from_user(void *to, const void __user *from, unsigned long n)
      |
MODPOST /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/Module.symvers
CC [M] /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.mod.o
LD [M] /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.ko
BTF [M] /home/student/Documents/csc415-assignment-6-device-driver-tjhax/Module/smith_tayjon_HW6_Admin_main.ko
make[1]: Leaving directory '/usr/src/linux-headers-6.8.0-87-generic'
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Module$

student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ make
gcc -c -o smith_tayjon_HW6_main.o smith_tayjon_HW6_main.c -g -I.
gcc -o smith_tayjon_HW6_main smith_tayjon_HW6_main.o -g -I. -l pthread
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$
```

Screen shot(s) of the execution of the program:

```
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ make run
gcc -c -o smith_tayjon_HW6_main.o smith_tayjon_HW6_main.c -g -I.
gcc -o smith_tayjon_HW6_main smith_tayjon_HW6_main.o -g -I. -l pthread
./smith_tayjon_HW6_main
Opening /dev/smith_tayjon_HW6_main...

=== UPPER ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (UPPER): 'RACECAR RACECAR'

=== LOWER ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (LOWER): 'racecar racecar'

=== REVERSE ===
Setting Ioctl...
Original: 'racecar RACECAR'
Write 15 bytes
Transformed (REVERSE): 'RACECAR racecar'

Done.
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$

student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$ make run
gcc -c -o smith_tayjon_HW6_main.o smith_tayjon_HW6_main.c -g -I.
gcc -o smith_tayjon_HW6_main smith_tayjon_HW6_main.o -g -I. -l pthread
./smith_tayjon_HW6_main
Opening /dev/smith_tayjon_HW6_main...

=== UPPER ===
Setting Ioctl...
Original: 'I am a little butterfly'
Write 23 bytes
Transformed (UPPER): 'I AM A LITTLE BUTTERFLY'

=== LOWER ===
Setting Ioctl...
Original: 'I am a little butterfly'
Write 23 bytes
Transformed (LOWER): 'i am a little butterfly'

=== REVERSE ===
Setting Ioctl...
Original: 'I am a little butterfly'
Write 23 bytes
Transformed (REVERSE): 'ylfrettub elttil a ma I'

Done.
student@student:~/Documents/csc415-assignment-6-device-driver-tjhax/Test$
```