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CSC415 Operating Systems

Assignment 6 – Device Driver

Description:
This assignment was designed to teach us about device drivers; how they work and how to actually implement one. Device Drivers are very useful in Linux as well as many other operating systems as they are the link between user and kernel space and are the sole reason that hardware can communicate with software.

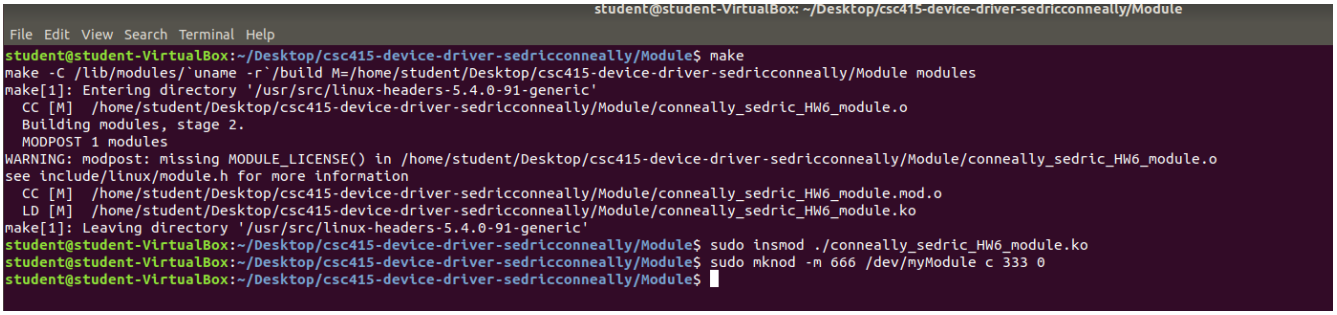
Approach / What I Did:
The first thing I did, as usual, was clone my GitHub repository so that it was accessible in my Linux environment. After that, I got started on my module file. I knew the functions that I needed to implement from class which included an init and exit routine as well as an open, read, write, and close functions. I was a bit confused, but with some help from a YouTube video by creator BOPV (https://youtu.be/Zi6ooCultI0), I was able to get my module working with everything except the ioctl function. Once I knew my functions were properly working, I started creating my test application. This was fairly straightforward once I realized what needed to be done, but I used an article from derekmolloy.ie to help get me started (http://derekmolloy.ie/writing-a-linux-kernel-module-part-2-a-character-device/). After my test application was up and running and I had confirmed that all my functions were being called correctly and doing what they were intended to do, I focused on completing the ioctl function. Again, I used the BOPV YouTube video to aid in the development of this function, but after a few days of hard work, everything was functioning as intended.

Issues and Resolution:
My first biggest issue was that I was struggling with my original idea, which was supposed to have a user input their birth date and have the Device Driver output how many days there were until their birthday. Unfortunately, I was struggling to find a solution that would help me gain access to the current date from the kernel space. I was familiar with the time() function from the C Standard Library, but my kernel program could not make use of the C Standard Library. This is when I decided to shift gears and focus on a Device Driver that would reverse a string. It is a pretty simple idea but I knew that I could do it, so I took it and ran with it. Something else that I struggled with was finding good resources to base my project off of. Device Driver programming was completely foreign to me so it is not something I could just wing and hope that it worked. I needed something that was proven, and that I could trust. Unsurprisingly, there are many ways to write Device Drivers, so it seemed the more I looked, the more I was confusing myself. I went back to what I knew from class and in combination with the resources above, I was able to get everything working. One last thing that I had trouble with was actually running my code on my machine. Every time I compiled and ran my code on my machine, it would cause my virtual machine to crash. This created all sorts of headaches, but my resolution was to send my code to my friend, and have them compile it for me on their machine where for some

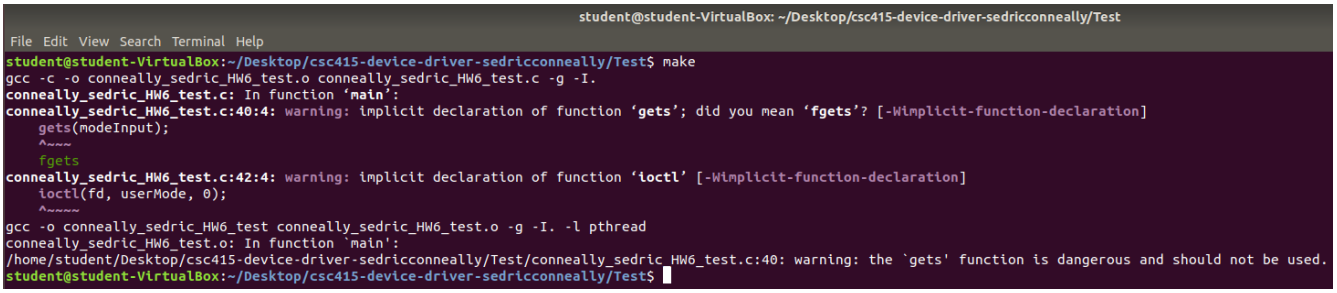
reason, everything worked just fine. Although this Device Driver is not very impressive, I was just trying to meet the requirements, and I believe that I did just that.

Screen shot of compilation:

Making and installing the module:

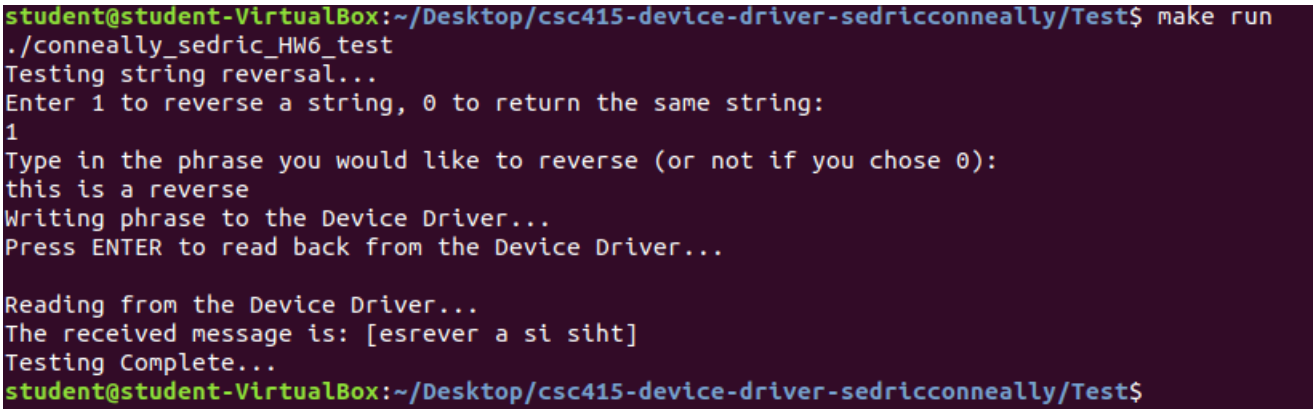


Making the test application:



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

Testing reverse output (ioctl option 1):



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Testing standard output (ioctl option 0):

```
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$ make run
./conneally_sedric_HW6_test
Testing string reversal...
Enter 1 to reverse a string, 0 to return the same string:
0
Type in the phrase you would like to reverse (or not if you chose 0):
this is the same string
Writing phrase to the Device Driver...
Press ENTER to read back from the Device Driver...

Reading from the Device Driver...
The received message is: [this is the same string]
Testing Complete...
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$
```

Everything from above in one screenshot:

```
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$ make
gcc -c -o conneally_sedric_HW6_test.o conneally_sedric_HW6_test.c -g -I.
conneally_sedric_HW6_test.c: In function ‘main’:
conneally_sedric_HW6_test.c:40:4: warning: implicit declaration of function ‘gets’; did you mean ‘fgets’? [-Wimplicit-function-declaration]
    gets(modeInput);
    ^~~~
    fgets
conneally_sedric_HW6_test.c:42:4: warning: implicit declaration of function ‘ioctl’ [-Wimplicit-function-declaration]
    ioctl(fd, userMode, 0);
    ^~~~~
gcc -o conneally_sedric_HW6_test conneally_sedric_HW6_test.o -g -I. -l pthread
conneally_sedric_HW6_test.o: In function `main':
/home/student/Desktop/csc415-device-driver-sedricconneally/Test/conneally_sedric_HW6_test.c:40: warning: the `gets' function is dangerous and should not be used.
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$ make run
./conneally_sedric_HW6_test
Testing string reversal...
Enter 1 to reverse a string, 0 to return the same string:
1
Type in the phrase you would like to reverse (or not if you chose 0):
this is a reverse
Writing phrase to the Device Driver...
Press ENTER to read back from the Device Driver...

Reading from the Device Driver...
The received message is: [esrever a si siht]
Testing Complete...
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$ make run
./conneally_sedric_HW6_test
Testing string reversal...
Enter 1 to reverse a string, 0 to return the same string:
0
Type in the phrase you would like to reverse (or not if you chose 0):
this is the same string
Writing phrase to the Device Driver...
Press ENTER to read back from the Device Driver...

Reading from the Device Driver...
The received message is: [this is the same string]
Testing Complete...
student@student-VirtualBox:~/Desktop/csc415-device-driver-sedricconneally/Test$
```

Unloading the module:

```
parallels@ubuntu-linux-20-04-desktop:~/Documents/csc415-device-driver-sedricconneally/Module$ sudo rmmod conneally_sedric_HW6_module.ko
parallels@ubuntu-linux-20-04-desktop:~/Documents/csc415-device-driver-sedricconneally/Module$
```