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Assignment 6 – Device Driver

Description:
This assignment is to create a device driver that takes in user input and either encrypts or decrypts the string depending on a key specified. The device driver provides functionalities to encrypt and decrypt data, read and write strings, and use IOCTL to set encryption/decryption mode and key. The encryption algorithm subtracts a fixed key value from each character, while the decryption algorithm adds it back. If IOCTL is set to encryption mode, the driver expects a string to be written, then it reads back the encrypted data. If IOCTL is set to decryption mode, the driver expects encrypted data to be written, and it reads back the original message.

Loading Device:

-in Module folder
-run make clean
-run make
-run ./removeIt.sh
-run ./installIt.sh
-go to Test folder
-run make clean
-run make
-make run

Interacting with the device:

-Choose either decrypt or encrypt mode
-Enter string
-See result

Approach:

Creating Device Driver:

-The first step of my approach was getting the knowledge I needed before I started coding. I got that by watching the professor's video on his device driver that he did in class. It was the Nov 18 video.

-Through the video, I found the necessary header files that I needed to be included such as <linux/module.h>,<linux/kernel.h>,<linux/fs.h>, <linux/cdev.h>, and <linux/vmalloc.h>.

-The module metadata such as author, description, and license is specified using macros like MODULE_AUTHOR, MODULE_DESCRIPTION, and MODULE_LICENSE. Also device info such as name and major and minor numbers.

-Own data struct to keep track of write and reads and mode

-Global variables such as kernelBuffer, actualRxSize, and my c_dev, and file functions such as myOpen, myRead, myClose, myWrite, myIoCtl, and personal functions for my device driver such as encrypt or decrypt.

-Init and cleanup functions to open and close the device driver.

Running Device Driver

-To run the device driver I first had to load it up using the name that I specified in the creation of it. I had to check if it could get and if it couldn't return an error.

-We need a fileDes to interact with it, an array to read the input of the user, and some ints to get whether the user wants to encrypt or decrypt and the return values for the read and write.

-To implement the user functionality I added a while loop to keep going until the user enters a number other than 1 or 2 which then exits the program. If they choose a correct number they can enter the string depending on what choice they make the resulting output will either be in encrypted mode or decrypted mode.

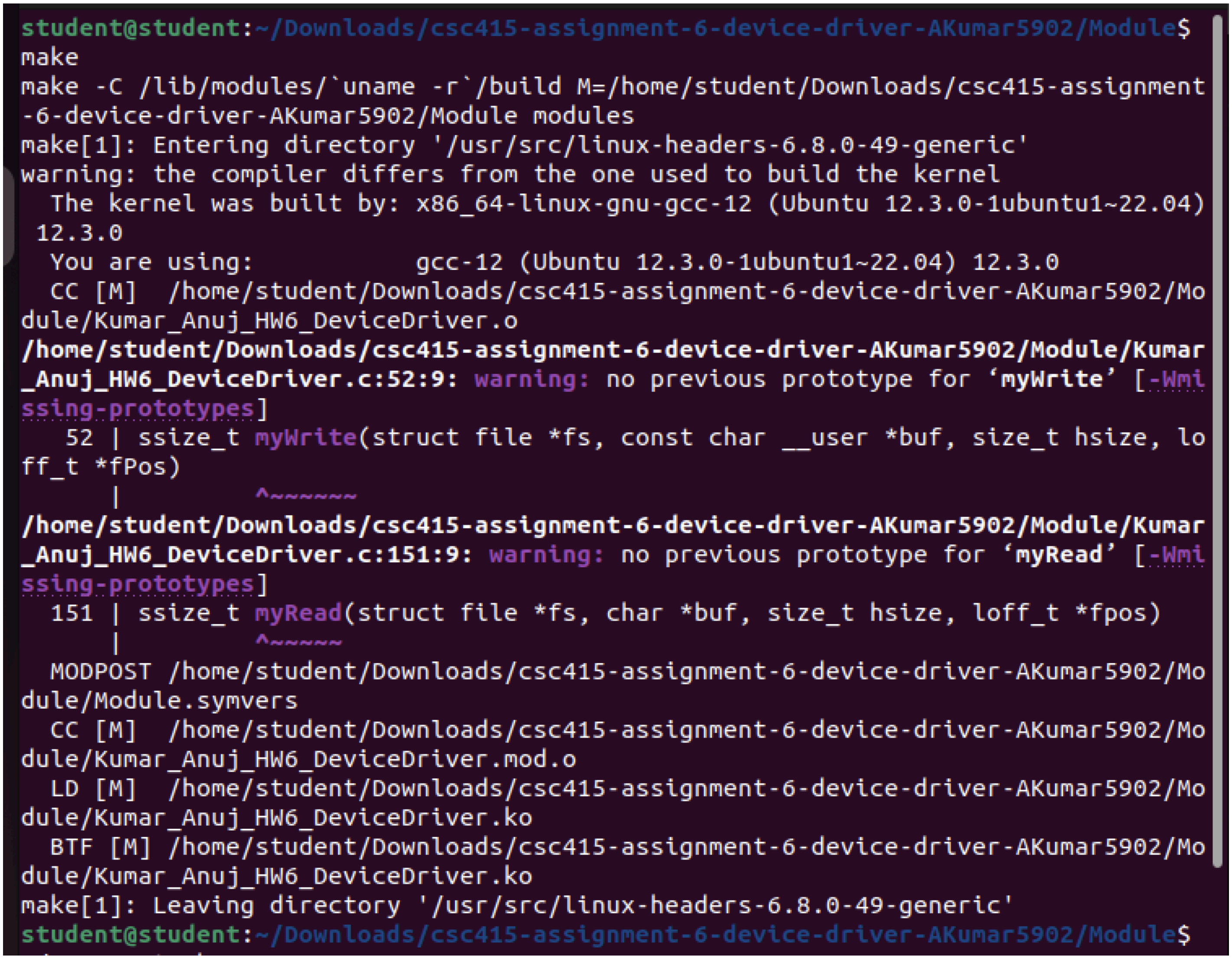
Issues and Resolutions:

My first issue was that I didn't know how to get installIt.sh, and removeIt.sh. I was watching the professor's video about the device driver and saw that he already had it in his directory. I didn't so I continued to watch his video to see how he got it. I then figured out that we had to create it ourselves and follow the script the professor had in his video.

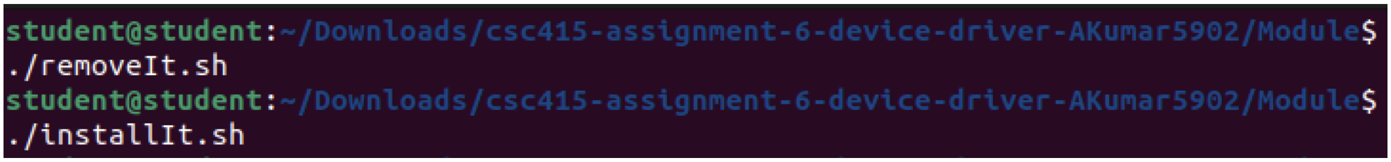
Another issue I had was my program not being able to open the device driver, I would always get the error device driver not found. I fixed this by first looking at my device name and then my file name. I saw that my device name was different from the one I specified in my installIt.sh and removeIt.sh. The original name was Kumar_Anuj_Devicedriver but in my script files, I named it Kumar_Anuj_HW6_DeviceDriver. I tried again but it still wasn't working. I then saw I had to add the /dev/ before it.

Another issue was that every time I ran the code it would add another character to the string. I tried fixing it by making sure every time I read or write I am making sure I am null-terminating the string and checking if the hsize is equal to rxsize to make sure the output is the same length as the input. I wasn't able to figure it out but I realized that it only happens when the previous string is bigger than the input of the next string. For example hi would become fg and hello would become fcggm but if I were to put hi again it would become fgllo. It would add the extra 3 characters. I tried debugging but I couldn't find the issue.

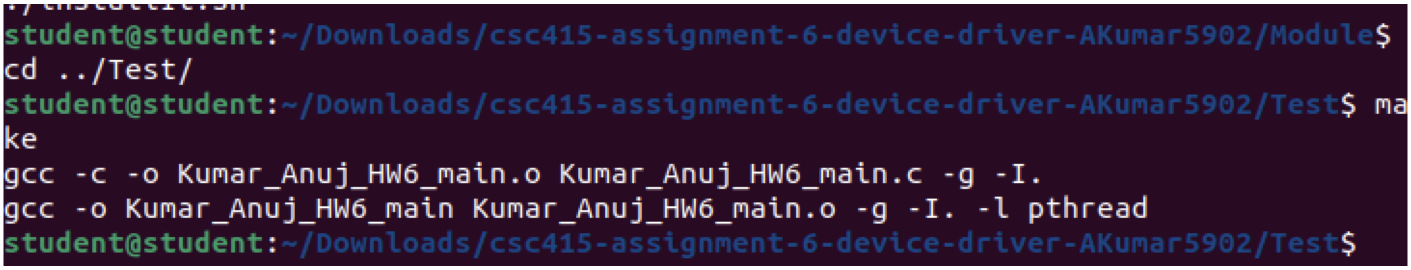
Screen shot of compilation:



```
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module$
make
make -C /lib/modules/`uname -r`/build M=/home/student/Downloads/csc415-assignment
-6-device-driver-AKumar5902/Module modules
make[1]: Entering directory '/usr/src/linux-headers-6.8.0-49-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)
 12.3.0
  You are using:           gcc-12 (Ubuntu 12.3.0-1ubuntu1~22.04) 12.3.0
  CC [M]  /home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Mo
dule/Kumar_Anuj_HW6_DeviceDriver.o
/home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module/Kumar
_Anuj_HW6_DeviceDriver.c:52:9: warning: no previous prototype for ‘myWrite’ [-Wmi
ssing-prototypes]
   52 | ssize_t myWrite(struct file *fs, const char __user *buf, size_t hsize, lo
ff_t *fPos)
      |         ^~~~~~~
/home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module/Kumar
_Anuj_HW6_DeviceDriver.c:151:9: warning: no previous prototype for ‘myRead’ [-Wmi
ssing-prototypes]
  151 | ssize_t myRead(struct file *fs, char *buf, size_t hsize, loff_t *fpos)
      |         ^~~~~~
  MODPOST /home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Mo
dule/Module.symvers
  CC [M]  /home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Mo
dule/Kumar_Anuj_HW6_DeviceDriver.mod.o
  LD [M]  /home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Mo
dule/Kumar_Anuj_HW6_DeviceDriver.ko
  BTF [M] /home/student/Downloads/csc415-assignment-6-device-driver-AKumar5902/Mo
dule/Kumar_Anuj_HW6_DeviceDriver.ko
make[1]: Leaving directory '/usr/src/linux-headers-6.8.0-49-generic'
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module$
```

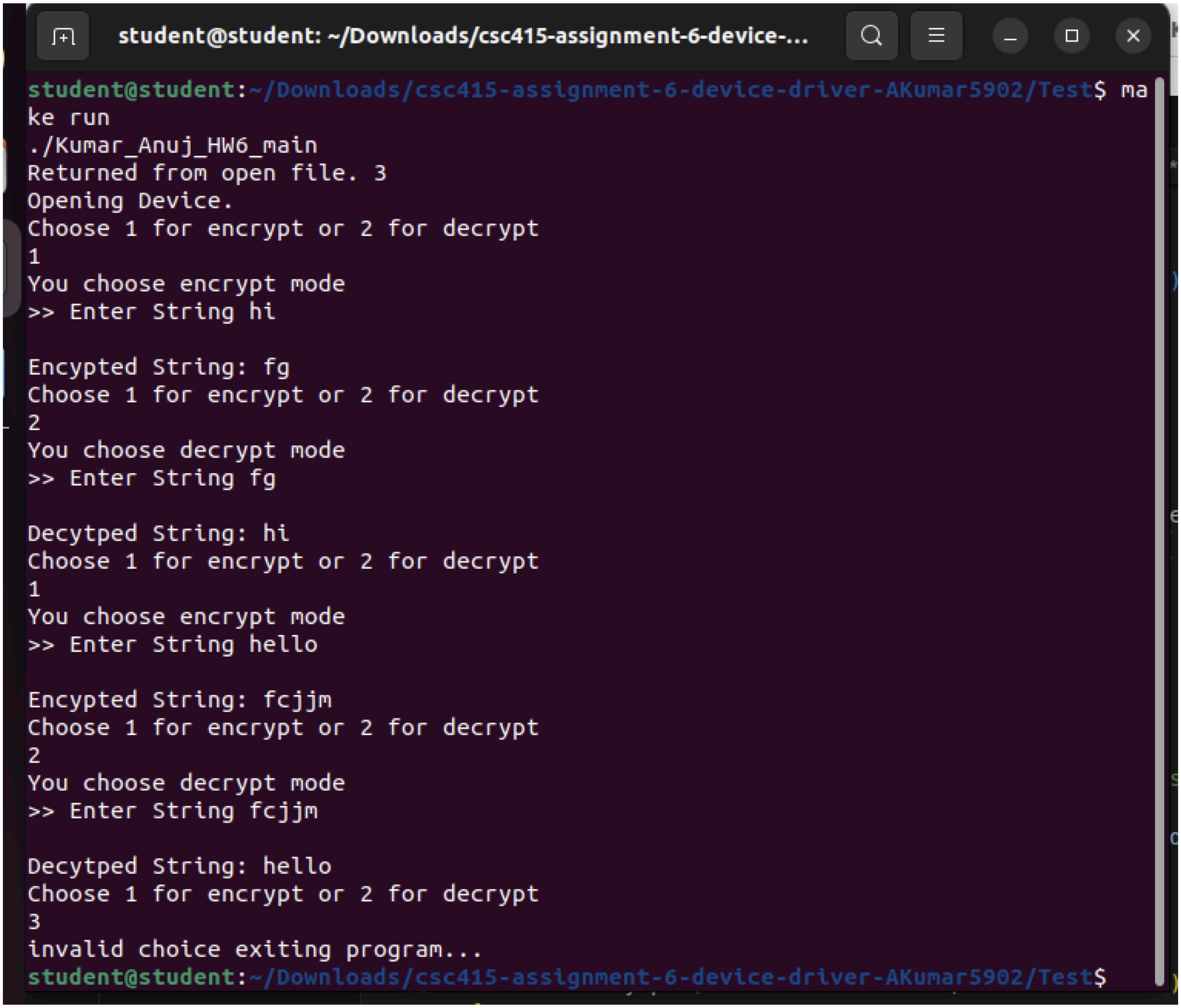


```
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module$
./removeIt.sh
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module$
./installIt.sh
```



```
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Module$
cd ../Test/
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Test$ ma
ke
gcc -c -o Kumar_Anuj_HW6_main.o Kumar_Anuj_HW6_main.c -g -I.
gcc -o Kumar_Anuj_HW6_main Kumar_Anuj_HW6_main.o -g -I. -l pthread
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Test$
```

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



```
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Test$ ma
ke run
./Kumar_Anuj_HW6_main
Returned from open file. 3
Opening Device.
Choose 1 for encrypt or 2 for decrypt
1
You choose encrypt mode
>> Enter String hi

Encypted String: fg
Choose 1 for encrypt or 2 for decrypt
2
You choose decrypt mode
>> Enter String fg

Decytped String: hi
Choose 1 for encrypt or 2 for decrypt
1
You choose encrypt mode
>> Enter String hello

Encypted String: fcjjm
Choose 1 for encrypt or 2 for decrypt
2
You choose decrypt mode
>> Enter String fcjjm

Decytped String: hello
Choose 1 for encrypt or 2 for decrypt
3
invalid choice exiting program...
student@student:~/Downloads/csc415-assignment-6-device-driver-AKumar5902/Test$
```