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CSC415 Operating Systems

Assignment 6 – Device Driver

Description:
This assignment is to write a device driver that encrypts and decrypts a user text.

In the user interface, the user enters a text, and an integer key, then specifies wherever he wants the text to be encrypted or decrypted. By calling ioctl, the key and mode will be set in the device driver. After that, the call to write will write the user text into the device driver, and proceed to encryption or decryption. The user gets the result by calling read that will interact with the device driver to get the result.

In the device driver file, all the encryption and decryption are executed according to the user's text, key and mode.
If a mode or a key were not specified, their values will be set to the default values that are ENCRYPTION and 0 respectively.

Installation:

kernel module: run

- make
- sudo ./installIt.sh

test program: run

- make
- make run

Approach:

- Prompt for user text,
- prompt for user key, and make sure it is an integer.
- prompt for user mode, and make sure it is either 0 (encryption) or 1 (decryption)
- keep prompting for user input while it is incorrect
- call ioctl to set the key and the mode in the device driver. If the driver is able to get the information, it will set the mode and key, otherwise it will keep the default values.
- call write to pass the user text to the device driver. The device driver will read the text, and save it in the variable message; and will proceed to encryption or decryption of the message according to the mode specified.
- call read to get the result printed from the device driver. The device driver will pass the content of the message variable into the user's buffer using copy_to_user function.
- close the module by calling close.

Issues and Resolutions:

The biggest issue was installing the device driver. I had a lot of permission issues, but I managed to solve them by using sudo, and reading information on the internet.

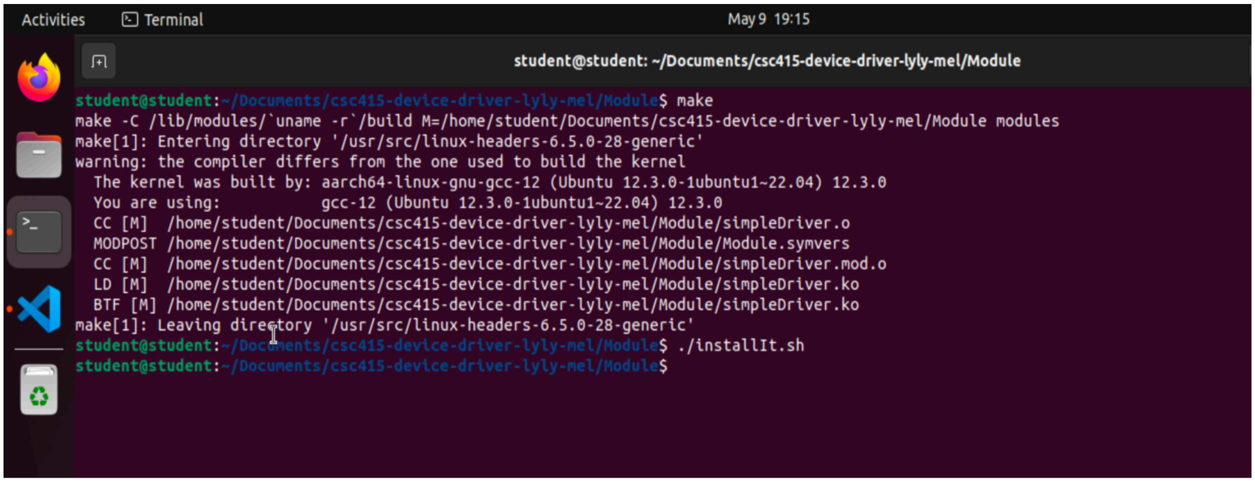
My second issue was to understand how to write code in kernel mode since it was different from user mode.

Also understanding how the device drive works and how it communicates with the user interface was a challenge. It took me some time to figure out how to use read, write and ioctl to transfer information between the device driver and the user. Then I figured out that the write is to provide data to the driver, read to get information from the driver, and ioctl is to give the driver a specific set of commands.

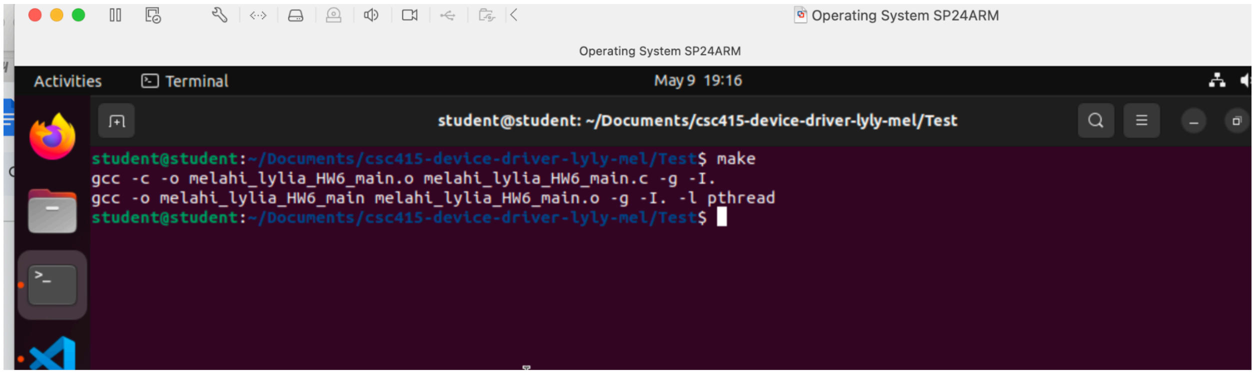
Also navigating between the user inputs and the driver inputs was a bit confusing at first.

Analysis: (If required for the assignment)

Screen shot of compilation:


Activities
Terminal
May 9 19:15
student@student: ~/Documents/csc415-device-driver-lyly-mel/Module

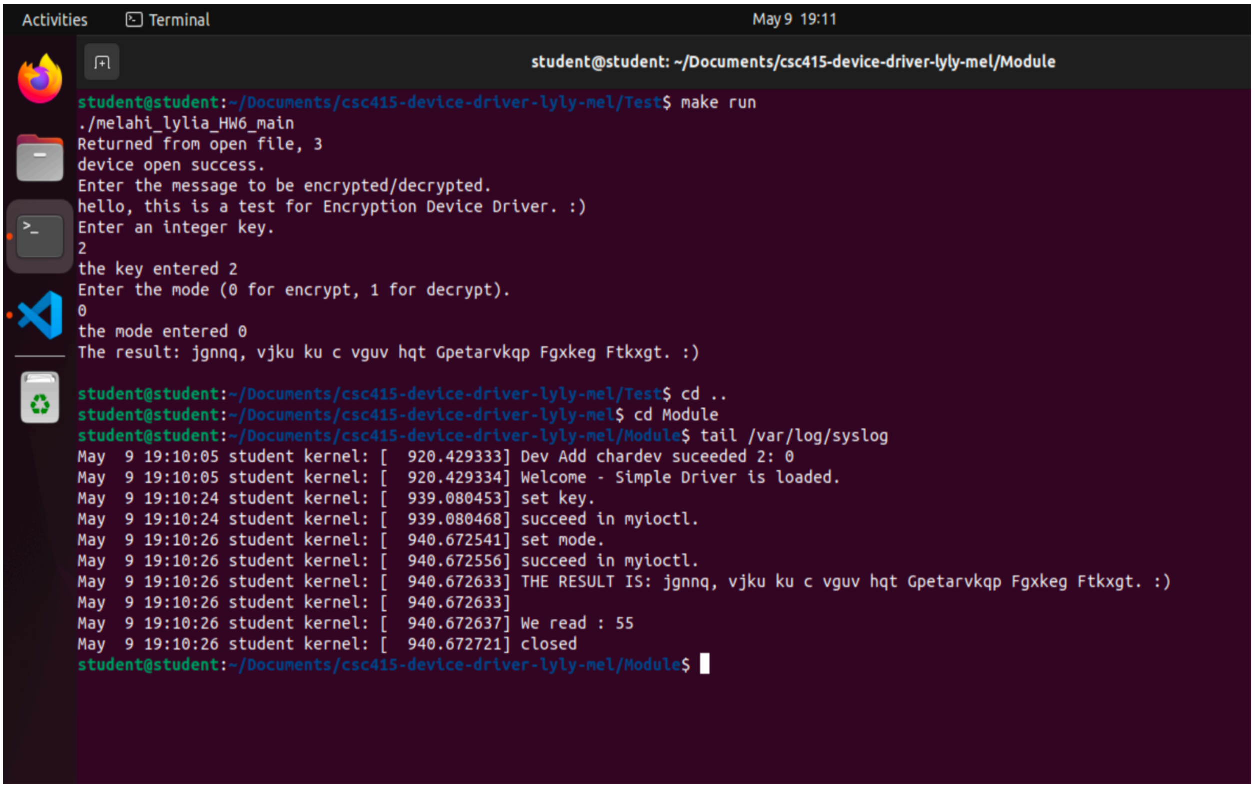
```
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$ make
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-device-driver-lyly-mel/Module modules
make[1]: Entering directory '/usr/src/linux-headers-6.5.0-28-generic'
warning: the compiler differs from the one used to build the kernel
  The kernel was built by: aarch64-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/Documents/csc415-device-driver-lyly-mel/Module/simpleDriver.o
  MODPOST /home/student/Documents/csc415-device-driver-lyly-mel/Module/Module.symvers
  CC [M]  /home/student/Documents/csc415-device-driver-lyly-mel/Module/simpleDriver.mod.o
  LD [M]  /home/student/Documents/csc415-device-driver-lyly-mel/Module/simpleDriver.ko
  BTF [M] /home/student/Documents/csc415-device-driver-lyly-mel/Module/simpleDriver.ko
make[1]: Leaving directory '/usr/src/linux-headers-6.5.0-28-generic'
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$ ./installIt.sh
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$
```



```
student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ make
gcc -c -o melahi_lylia_HW6_main.o melahi_lylia_HW6_main.c -g -I.
gcc -o melahi_lylia_HW6_main melahi_lylia_HW6_main.o -g -I. -l pthread
student@student:~/Documents/csc415-device-driver-lyly-mel/Test$
```

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

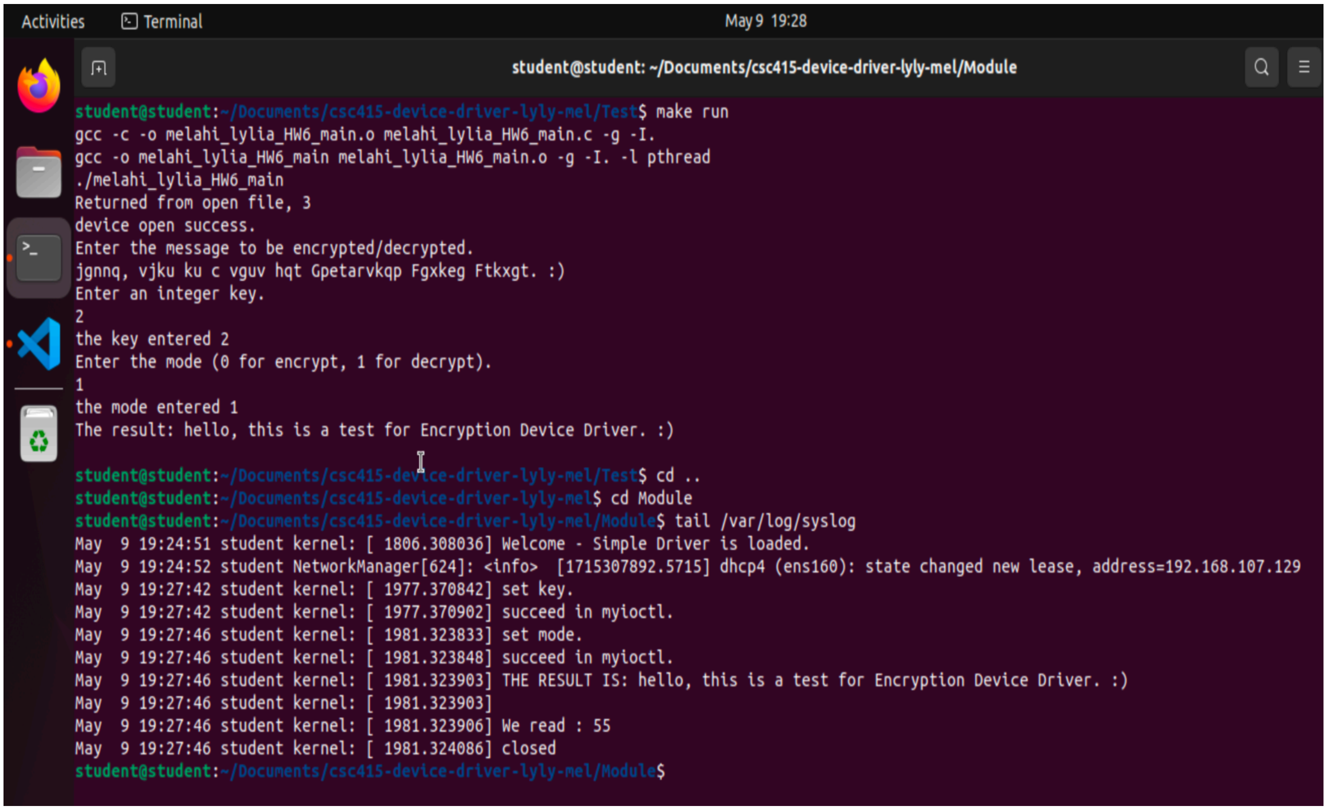
shows an example of text encryption


Activities
Terminal
May 9 19:11
student@student: ~/Documents/csc415-device-driver-lyly-mel/Module

```
student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ make run
./melahi_lylia_HW6_main
Returned from open file, 3
device open success.
Enter the message to be encrypted/decrypted.
hello, this is a test for Encryption Device Driver. :)
Enter an integer key.
2
the key entered 2
Enter the mode (0 for encrypt, 1 for decrypt).
0
the mode entered 0
The result: jgnnq, vjku ku c vguv hqt Gpetarvkqp Fgxkeg Ftkxgt. :)

student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ cd ..
student@student:~/Documents/csc415-device-driver-lyly-mel$ cd Module
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$ tail /var/log/syslog
May  9 19:10:05 student kernel: [  920.429333] Dev Add chardev suceeded 2: 0
May  9 19:10:05 student kernel: [  920.429334] Welcome - Simple Driver is loaded.
May  9 19:10:24 student kernel: [  939.080453] set key.
May  9 19:10:24 student kernel: [  939.080468] succeed in myioctl.
May  9 19:10:26 student kernel: [  940.672541] set mode.
May  9 19:10:26 student kernel: [  940.672556] succeed in myioctl.
May  9 19:10:26 student kernel: [  940.672633] THE RESULT IS: jgnnq, vjku ku c vguv hqt Gpetarvkqp Fgxkeg Ftkxgt. :)
May  9 19:10:26 student kernel: [  940.672633]
May  9 19:10:26 student kernel: [  940.672637] We read : 55
May  9 19:10:26 student kernel: [  940.672721] closed
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$
```

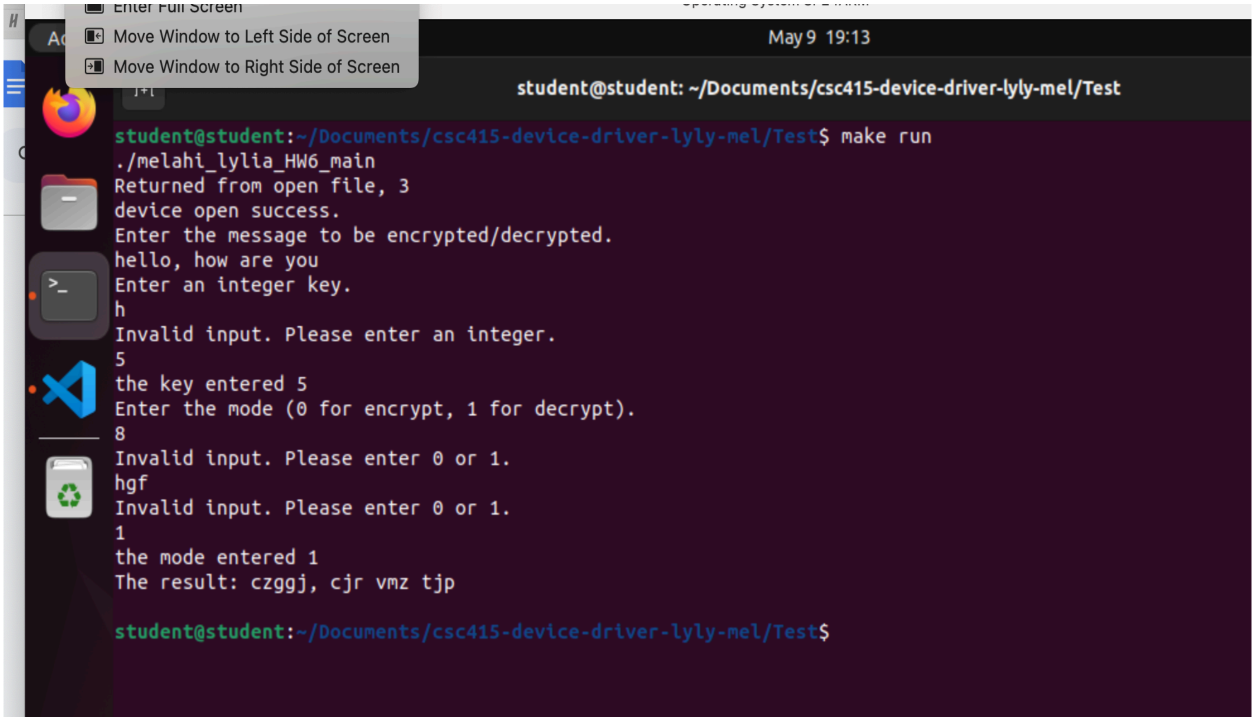
shows an example of text decryption


Activities
Terminal
May 9 19:28
student@student: ~/Documents/csc415-device-driver-lyly-mel/Module

```
student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ make run
gcc -c -o melahi_lylia_HW6_main.o melahi_lylia_HW6_main.c -g -I.
gcc -o melahi_lylia_HW6_main melahi_lylia_HW6_main.o -g -I. -l pthread
./melahi_lylia_HW6_main
Returned from open file, 3
device open success.
Enter the message to be encrypted/decrypted.
jgnnq, vjku ku c vguv hqt Gpetarvkqp Fgxkeg Ftkxgt. :)
Enter an integer key.
2
the key entered 2
Enter the mode (0 for encrypt, 1 for decrypt).
1
the mode entered 1
The result: hello, this is a test for Encryption Device Driver. :)

student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ cd ..
student@student:~/Documents/csc415-device-driver-lyly-mel$ cd Module
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$ tail /var/log/syslog
May  9 19:24:51 student kernel: [ 1806.308036] Welcome - Simple Driver is loaded.
May  9 19:24:52 student NetworkManager[624]: <info>  [1715307892.5715] dhcp4 (ens160): state changed new lease, address=192.168.107.129
May  9 19:27:42 student kernel: [ 1977.370842] set key.
May  9 19:27:42 student kernel: [ 1977.370902] succeed in myioctl.
May  9 19:27:46 student kernel: [ 1981.323833] set mode.
May  9 19:27:46 student kernel: [ 1981.323848] succeed in myioctl.
May  9 19:27:46 student kernel: [ 1981.323903] THE RESULT IS: hello, this is a test for Encryption Device Driver. :)
May  9 19:27:46 student kernel: [ 1981.323903]
May  9 19:27:46 student kernel: [ 1981.323906] We read : 55
May  9 19:27:46 student kernel: [ 1981.324086] closed
student@student:~/Documents/csc415-device-driver-lyly-mel/Module$
```

some error handling


Enter Full Screen
Move Window to Left Side of Screen
Move Window to Right Side of Screen
May 9 19:13
student@student: ~/Documents/csc415-device-driver-lyly-mel/Test

```
student@student:~/Documents/csc415-device-driver-lyly-mel/Test$ make run
./melahi_lylia_HW6_main
Returned from open file, 3
device open success.
Enter the message to be encrypted/decrypted.
hello, how are you
Enter an integer key.
h
Invalid input. Please enter an integer.
5
the key entered 5
Enter the mode (0 for encrypt, 1 for decrypt).
8
Invalid input. Please enter 0 or 1.
hgf
Invalid input. Please enter 0 or 1.
1
the mode entered 1
The result: czggj, cjr vmz tjp

student@student:~/Documents/csc415-device-driver-lyly-mel/Test$
```