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Assignment 6 – Device Driver

Description:
This assignment is to write a Linux char device driver that contains a purposeful functionality. It must contain an open, release, read, write, and at least one ioctl command. For this implementation, it will implement a Ceaser's Cypher, which will change the characters of the word or sentence passed in based on the key specified by default, or by the user using the ioctl function.

Approach / What I Did:
Research, research, research. As with the other assignments, research consumed most of the time while making preparations for this specific assignment. Two whole days were spent digesting "The Linux Kernel Module Programming Guide" by Peter Jay Salman, Michael Brian, Ari Pomerantz, Bob Mottram, and Jim Huang. Doing so provided me with a fundamental understanding of what needed to be done. Next was attempting to roadmap what was required of the functions (open, release, read, write, and the ioctl command). The SampleNullDev driver code was used as a base to build off of to grasp what actions we needed to perform in order to successfully complete the assignment. Also spending a decent chunk of time rewatching the lectures to make sure I didn't miss anything helped to refresh my understanding of the assignment every once in a while.

How to Use:
On first creation:
1. Navigate to Module
2. Make
3. Run script "./installlIt (bash ./installIt)

Testing within the command line
1. InstallIt script with encrypt the example.txt file provided in the repo
2. Cat /dev/ceasers
3. Check printk statements (sudo dimes -t | tail -3)

Testing from main.c
1. Navigate to Test folder
2. Make run

Issues and Resolutions:

My first issue was understanding the copy_from_user and copy_to_user functions, and what exactly they did.

I resolved it by digging through for the manpages for these functions, much like we did for the File System project. This gave me the base understanding of what the function was meant to do, and allowed me to catch the return values for error handling.

My next issue was struggling with implementing a user_data structure.

I resolved this by opting for static global variables. The variables are declared as static in an effort to not interfere with the declared global variables that exist in the kernel. The global variables performed as expected, and allowed me to perform the operations required between functions as intended. Unfortunately, I was unable to determine exactly why the data was not saving in the respective structure, even following along with the SampleNullDev code that we were allowed to use. My understanding of the demo was that the count variable actually saved the value, but any sort of implementation of our own struct variables did not save any data. At some point, I had to move on.

My last issue was implementing a test function.

I only partially resolved the issue. It required going back through the written functions in order to identify what might have gone wrong in the process of translating it from a main class, and actually using the logic in the shell. Using it in the shell works as intended, but somewhere within the function calls to use the functionality, it must be user error in the implementation. That is the only logically explanation that the testing within the Test folder is failing, and the testing within the Module folder passes.

Screen shot of compilation:

Driver File:

```
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$
 make clean
make -C /lib/modules/`uname -r`/build M=/home/parallels/Documents/csc415-device-driver-g
ojilikeog/Module clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-78-generic'
  CLEAN   /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/Module.symver
s
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-78-generic'
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$
 make
make -C /lib/modules/`uname -r`/build M=/home/parallels/Documents/csc415-device-driver-g
ojilikeog/Module modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-78-generic'
warning: the compiler differs from the one used to build the kernel
  The kernel was built by: gcc (Ubuntu 11.3.0-1ubuntu1~22.04.1) 11.3.0
  You are using:           gcc (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
  CC [M]  /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/ceasers.o
  MODPOST /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/Module.symver
s
  CC [M]  /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/ceasers.mod.o
  LD [M]  /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/ceasers.ko
  BTF [M] /home/parallels/Documents/csc415-device-driver-gojilikeog/Module/ceasers.ko
Skipping BTF generation for /home/parallels/Documents/csc415-device-driver-gojilikeog/Mo
dule/ceasers.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-78-generic'
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$
```

Test File:

```
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Test$
make clean
rm *.o Galvez_Oscar_HW6_main
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Test$
make
gcc -c -o Galvez_Oscar_HW6_main.o Galvez_Oscar_HW6_main.c -g -I.
gcc -o Galvez_Oscar_HW6_main Galvez_Oscar_HW6_main.o -g -I. -l pthread
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Test$
```

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

```
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$ bash ./installIt.sh
[sudo] password for parallels:
rfkill: input handler enabled
rfkill: input handler disabled
Register chardev suceeded 1: 0
Dev Add chardev suceeded 2: 0
Welcome - ceasers Driver is loaded
Dev Add chardev suceeded 2: 0
Welcome - ceasers Driver is loaded
Inside myOpen
We are inside myWrite now
This was passed in to the global variable: this is a test length: 15
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$ cat /dev/ceasers
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$ sudo dmesg -t | tail -3
Testing struct variable: 15
TEST: Encrypt mesg: ocdn
Test: Decrypt mesg: this
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog/Module$
```

```
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog
/Test$ make run
./Galvez_Oscar_HW6_main
Decrypting
Result of encrpytion:
Result of decryption:
parallels@ubuntu-linux-22-04-desktop:~/Documents/csc415-device-driver-gojilikeog
/Test$
```