/**
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* Project: Assignment 6 – Device Driver
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* File: writeup
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* Description: Describes the details on writing a device driver that loads and runs in Linux with minor functionality and includes the output screenshots of implementation of functionality.
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#Project

The project task is to develop a skeleton device driver in C language that has minor functionality like opening, reading, writing, releasing as well as minor input output control command functionality. The program can interact with the user that the user can input data number and the device driver writes to and reads back to the user.

#How to Run

mydevice.c is our source file and *application.c* is our test file for the device driver. Assuming we are running the program in the virtual box.

1. If it is downloaded from GitHub repo, then we will have to **make clean**
2. **Make** //builds the driver using Makefile
3. gcc -o application application.c //complies the program

4. sudo insmode ./mydevice.ko //inserts module to kernel
5. sudo ./application //test our application program

   it will ask for number to enter and does writing and reading to and from the driver.

   Also, we should be able to see the major minor number as well as the number entered using **dmesg** command.

#What I Did

For this project, we were given direction on how to approach it; setting up the file operations data structure where I have definitions of the functions I am going to implement in the program and then define structure for the file operations. I have defined and implemented seven file operations in the programs; open (), read (), write (), ioclt (), relseas (), start () and end ().

mydevice_open() is responsible for handling the opening of the device driver where it validates if the file is already opened and throws error with KERN_INFO and tracks the file open session. mydevice_read() is responsible for handling the reading of the value sent to the driver that the user wrote. It checks if the driver offset is NULL and throws error. IT validates the bytes read with number of bytes which is size length and keeps offset to increase as well as bytesread. mydevice_write () is responsible for handling the writing of value to the device driver from the user. It validates the offset value and handles error and then writes the updated offset value and the bytes written to the device driver. mydevice_ioctl () is responsible for basic input and output and is implemented with the application test program where the user can enter the value to write to driver and then read back from the driver. It has two cases to copy from and to the suer

WRITEVALUE and READVALUE. Mydevice_release() checks for the open state of the file and releases the device driver.

I have star () and end () to initialize and exit the device driver. mydevie_start () initializes the device driver and allocates major and minor number for driver. It creates and adds device structure as well as structure class to the device system. Whereas mydevice_end () will end and exit the device driver by destroying the device structure and the structure class and finally unregistering the device.

#Issues I Had

Opening, writing, reading and releasing of device driver was pretty straight where I used if statements to check the driver file conditions and then perform whether to open, read, write and releases the device. It took me quite to understand the implementation of ioctl () function for the reason I was overthinking instead of just trying to copy the data from the user to the driver and then read back the entered data sent to driver to the user. I then figured out to use simple two switch cases to copy from and to the user. Also, I was not sure where I would allocate major number and minor number for the device driver either as the driver opens or even before when I initialize the driver, but I allocated in the start of the device driver.

#Output

```
student@student-VirtualBox:~/Desktop/mydevice$ make clean
make -C /lib/modules/`uname -r`/build M=/home/student/Desktop/mydevice clean
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-42-generic'
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-42-generic'
student@student-VirtualBox:~/Desktop/mydevice$ make
make -C /lib/modules/`uname -r`/build M=/home/student/Desktop/mydevice modules
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-42-generic'
  CC [M]  /home/student/Desktop/mydevice/mydevice.o
  Building modules, stage 2.
  MODPOST 1 modules
WARNING: modpost: missing MODULE_LICENSE() in /home/student/Desktop/mydevice/mydevice.o
see include/linux/module.h for more information
  CC [M]  /home/student/Desktop/mydevice/mydevice.mod.o
  LD [M]  /home/student/Desktop/mydevice/mydevice.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-42-generic'
student@student-VirtualBox:~/Desktop/mydevice$
```

```
student@student-VirtualBox:~/Desktop/mydevice$ ls -la
total 152
drwx------ 3 student student   4096 Dec 17 01:14 .
drwxr-xr-x 3 student student   4096 Dec 16 23:59 ..
-rwxr-xr-x 1 student student   8584 Dec 17 01:12 application
-rw-r--r-- 1 student student   1549 Dec 17 01:07 application.c
drwx------ 2 student student   4096 Dec 16 23:48 .dist
-rw-r--r-- 1 student student    293 Dec 17 00:01 Makefile
-rw-r--r-- 1 student student     43 Dec 17 01:13 modules.order
-rw-r--r-- 1 student student      0 Dec 17 01:13 Module.symvers
crw-r--r-- 1 root    root    240, 0 Dec 17 01:14 mydevice
-rw-r--r-- 1 student student   4889 Dec 17 01:12 mydevice.c
-rw-r--r-- 1 student student   8112 Dec 17 01:13 mydevice.ko
-rw-r--r-- 1 student student    282 Dec 17 01:13 .mydevice.ko.cmd
-rw-r--r-- 1 student student     43 Dec 17 01:13 mydevice.mod
-rw-r--r-- 1 student student    560 Dec 17 01:13 mydevice.mod.c
-rw-r--r-- 1 student student    156 Dec 17 01:13 .mydevice.mod.cmd
-rw-r--r-- 1 student student   2808 Dec 17 01:13 mydevice.mod.o
-rw-r--r-- 1 student student  31006 Dec 17 01:13 .mydevice.mod.o.cmd
-rw-r--r-- 1 student student   6104 Dec 17 01:13 mydevice.o
-rw-r--r-- 1 student student  39463 Dec 17 01:13 .mydevice.o.cmd
student@student-VirtualBox:~/Desktop/mydevice$
```

```
student@student-VirtualBox:~/Desktop/mydevice$ gcc -o application application.c
student@student-VirtualBox:~/Desktop/mydevice$ sudo ./application
        --Device Driver Application Test --

 -- Opening Device Driver --
Enter Number to Send to Device Driver:
```

```
student@student-VirtualBox:~/Desktop/mydevice$ gcc -o application application.c
student@student-VirtualBox:~/Desktop/mydevice$ sudo ./application
        --Device Driver Application Test --

         -- Opening Device Driver --

Enter Number to Send to Device Driver: 44

        -- Writing Entered Number to Device Driver --
...

         -- Reading Number from Devie Driver --
...

Number Written and Read from Device Driver is 44

        -- Closing Device Driver Driver --
success.
student@student-VirtualBox:~/Desktop/mydevice$
```

```
student@student-VirtualBox:~/Desktop/mydevice$ sudo ./application
        --Device Driver Application Test --

         -- Opening Device Driver --

Enter Number to Send to Device Driver: 34

        -- Writing Entered Number to Device Driver --
ntu Software

         -- Reading Number from Devie Driver --
...

Number Written and Read from Device Driver is: 34

        -- Closing Device Driver Driver --
success.
student@student-VirtualBox:~/Desktop/mydevice$ sudo ./application
        --Device Driver Application Test --

         -- Opening Device Driver --

Enter Number to Send to Device Driver: 33

        -- Writing Entered Number to Device Driver --
...

         -- Reading Number from Devie Driver --
...

Number Written and Read from Device Driver is: 33

        -- Closing Device Driver Driver --
success.
```

```
[   10.947581] 07:41:20.952866 main     6.1.2 r135662 started. Verbose level = 0
[   10.948968] 07:41:20.953974 main     vbglR3GuestCtrlDetectPeekGetCancelSupport: Supported (#1)
[   31.965477] rfkill: input handler disabled
[  736.491839] Major = 240 Minor = 0
[  736.493706] Device Driver Insert...Done!!!
[  842.019842] Device File Opened...!!!
[  845.955912] Value = 43
[  845.955997] Device File Closed...!!!
student@student-VirtualBox:~/Desktop/mydevice$
```

```
[  759.963634] Device File Opened...!!!
[  762.132867] Value = 33
[  762.132928] Device File Closed...!!!
[  843.576097] Device File Opened...!!!
[  846.366363] Value = 56
[  846.366387] Device File Closed...!!!
[  966.500771] mydevice: module license 'unspecified' taints kernel.
[  966.500773] Disabling lock debugging due to kernel taint
[  988.496264] Device File Opened...!!!
[  993.349069] Value = 40
[  993.349085] Device File Closed...!!!
[ 1178.424919] Device File Opened...!!!
[ 1181.325484] Value = 55
[ 1181.325520] Device File Closed...!!!
[ 1263.907728] Device File Opened...!!!
[ 1266.185855] Value = 34
[ 1266.185871] Device File Closed...!!!
[ 1275.445140] Device File Opened...!!!
[ 1278.728766] Value = 33
[ 1278.728784] Device File Closed...!!!
[ 1300.851682] Device File Opened...!!!
[ 1303.044597] Value = 99
[ 1303.044611] Device File Closed...!!!
[ 1306.989740] Device File Opened...!!!
[ 1309.071563] Value = 11
[ 1309.071592] Device File Closed...!!!
student@student-VirtualBox:~/Desktop/mydevice$
```