

Assignment 6 – Device Driver

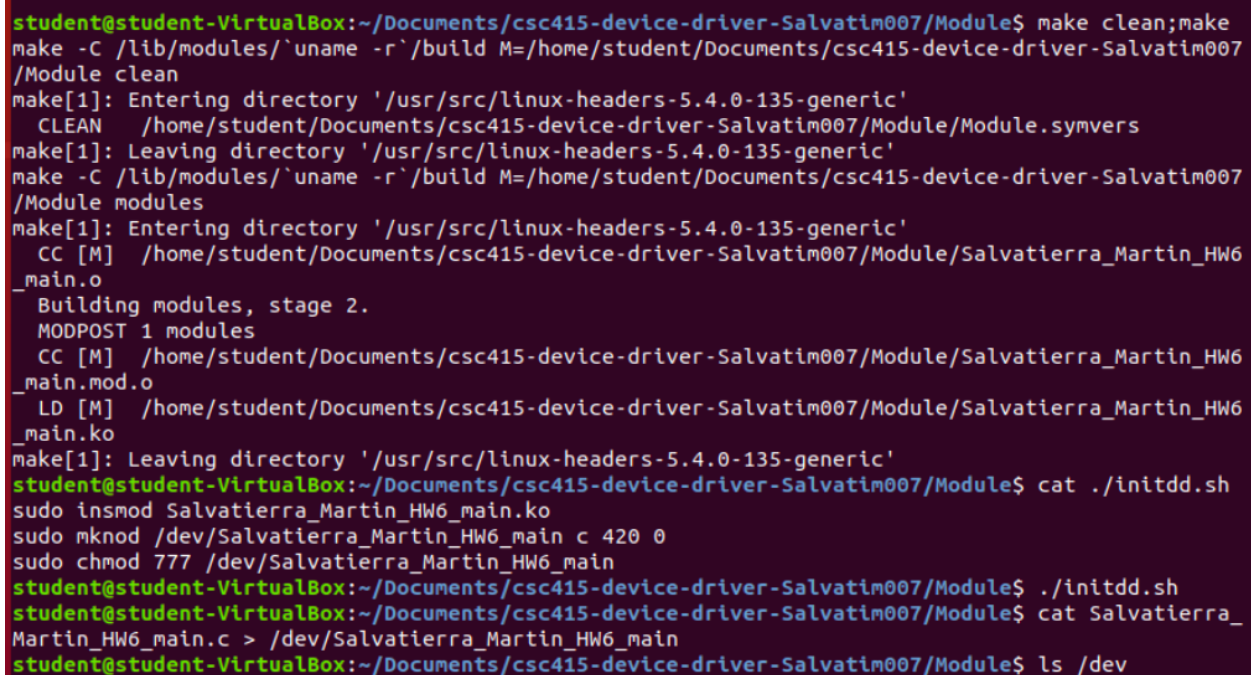
Description:

Assignment 6 is about creating a device driver that works with the user and talks to the kernel. I decided to make a simple encryption/decryption Device Driver that takes a string from the user and asks for a key to cypher their text. This will create a cryptographed message that requires a key to undo. All of this is done and stored in the kernel, rather than in the user space.

Approach / What I Did:

Since this task is very dangerous because we are messing with the kernel space I had to make sure to initiate and remove the Driver carefully. The code provided to us in class helped with this part immensely. Image one and two are of this process.

IMG1



```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ make clean;make
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-device-driver-Salvatim007/Module clean
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-135-generic'
CLEAN /home/student/Documents/csc415-device-driver-Salvatim007/Module/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-135-generic'
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-device-driver-Salvatim007/Module modules
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-135-generic'
CC [M] /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.o
Building modules, stage 2.
MODPOST 1 modules
CC [M] /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.mod.o
LD [M] /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-135-generic'
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ cat ./initdd.sh
sudo insmod Salvatierra_Martin_HW6_main.ko
sudo mknod /dev/Salvatierra_Martin_HW6_main c 420 0
sudo chmod 777 /dev/Salvatierra_Martin_HW6_main
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ ./initdd.sh
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ cat Salvatierra_Martin_HW6_main.c > /dev/Salvatierra_Martin_HW6_main
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ ls /dev
```

IMG2

```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ ./removedd.sh
[sudo] password for student:
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ ls /dev
autofs          log             loop9          stdin          tty30          tty55          ttyS20         vcs1
block           loop0           loop-control  stdout         tty31          tty56          ttyS21         vcs2
bsg             loop1           mapper        tty            tty32          tty57          ttyS22         vcs3
btrfs-control  loop10         mcelog        tty0           tty33          tty58          ttyS23         vcs4
bus             loop11         mem           tty1           tty34          tty59          ttyS24         vcs5
cdrom           loop12         queue         tty10          tty35          tty6           ttyS25         vcs6
char            loop13         net           tty11          tty36          tty60          ttyS26         vcsa
console         loop14         null          tty12          tty37          tty61          ttyS27         vcsa1
core            loop15         nvram         tty13          tty38          tty62          ttyS28         vcsa2
cpu_dma_latency loop16         port          tty14          tty39          tty63          ttyS29         vcsa3
cuse            loop17         ppp           tty15          tty4           tty7           ttyS3          vcsa4
disk            loop18         psaux         tty16          tty40          tty8           ttyS30         vcsa5
dri             loop19         ptmx          tty17          tty41          tty9           ttyS31         vcsa6
dvd             loop2           pts           tty18          tty42          ttyprintk      ttyS4          vcsu
ecryptfs        loop20         random        tty19          tty43          ttyS0          ttyS5          vcsu1
fb0             loop21         rfkill        tty2           tty44          ttyS1          ttyS6          vcsu2
fd              loop22         rtc           tty20          tty45          ttyS10         ttyS7          vcsu3
full            loop23         rtc0          tty21          tty46          ttyS11         ttyS8          vcsu4
fuse            loop24         sda           tty22          tty47          ttyS12         ttyS9          vcsu5
hidraw0         loop25         sda1          tty23          tty48          ttyS13         udmabuf        vcsu6
hpet            loop26         sg0           tty24          tty49          ttyS14         uhid           vfio
hugepages       loop3           sg1           tty25          tty5           ttyS15         uinput         vga_arbiter
hwrng           loop4           shm           tty26          tty50          ttyS16         urandom        vhci
i2c-0           loop5           snapshot      tty27          tty51          ttyS17         userio         vhost-net
initctl         loop6           snd           tty28          tty52          ttyS18         vboxguest      vhost-vsock
input           loop7           sr0           tty29          tty53          ttyS19         vboxuser       zero
kmsg            loop8           stderr        tty3           tty54          ttyS2          vcs            zfs
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ cat removedd.sh
sudo rm /dev/Salvatierra_Martin_HW6_main
sudo rmdir Salvatierra_Martin_HW6_main.ko
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$
```

Issues and Resolutions:

The biggest issue that I had was dealing with IOCTL function that is the backdoor to the Driver. Img3 shows how I was successful in encrypting and decrypting the same user data. My issue was correctly passing the key that would allow for dynamic key set. With a manually key it worked perfectly and can be seen in IMG4.

IMG3

```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make clean
rm *.o Salvatierra_Martin_HW6_main
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make run
gcc -c -o Salvatierra_Martin_HW6_main.o Salvatierra_Martin_HW6_main.c -g -I.
gcc -o Salvatierra_Martin_HW6_main Salvatierra_Martin_HW6_main.o -g -I. -l pthread
./Salvatierra_Martin_HW6_main
returned from open file: 3
device open successfully:
****Welcome to encryption generator****
Do you wish to encrypt? Enter 1
Do you wish to decrypt? Enter 0
1
Good Choice
Now Enter the Key which you wish to use
Current key accepted [2- 20]
hello

Dont forget this Key: 0
encoding set to : 1
enter up to 100 characters
wrote 5 characters
your encryption is:
gnnq

student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ tail -f /var/log/syslog
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918779] **in myIOCTL, encryption state**: 1 encryption key:2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918792] in myWrite readStat 0
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918796] **in kernel, encryption state**: 1 encryption key:2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918796] in myRead read stat : 0, hsize :5
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797] in myRead my message :gnnq
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797]
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797] here
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead my message key :2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead Buf :gnnq
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798]
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$
```

IMG4

```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ tail -f /var/log/syslog
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918779] **in myIOCTL, encryption state**: 1 encryption key:2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918792] in myWrite readStat 0
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918796] **in kernel, encryption state**: 1 encryption key:2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918796] in myRead read stat : 0, hsize :5
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797] in myRead my message :gnnq
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797]
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918797] here
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead my message key :2
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead Buf :gnnq
Dec 5 22:57:57 student-VirtualBox kernel: [21603.918798]
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ cd ..
```

Analysis:

There is no analysis for this assignment.

Screen shot of compilation:

Example:

```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ tail /var/log/syslog
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918779] **in myIOCTL, encryption state**: 1 encryption key:2
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918792] in myWrite readStat 0
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918796] **in kernel, encryption state**: 1 encryption key:2
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918796] in myRead read stat : 0, hsize :5
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918797] in myRead my message :gnnq
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918797]
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918797] here
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead my message key :2
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918798] in myRead Buf :gnnq
Dec  5 22:57:57 student-VirtualBox kernel: [21603.918798]
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ cd ..
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007$ git add .
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007$ git commit -m "final submission"
[main a3dbc57] final submission
 7 files changed, 59 insertions(+), 125 deletions(-)
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007$ git push
Counting objects: 11, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (11/11), done.
Writing objects: 100% (11/11), 3.84 KiB | 3.84 MiB/s, done.
Total 11 (delta 8), reused 0 (delta 0)
remote: Resolving deltas: 100% (8/8), completed with 8 local objects.
To https://github.com/CSC415-2022-Fall/csc415-device-driver-Salvatim007.git
 068afd5..a3dbc57  main -> main
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007$ cd Module
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ ./removedd.sh
[sudo] password for student:
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ make clean all
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-device-driver-Salvatim007/Module clean
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-135-generic'
  CLEAN   /home/student/Documents/csc415-device-driver-Salvatim007/Module/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-135-generic'
make -C /lib/modules/`uname -r`/build M=/home/student/Documents/csc415-device-driver-Salvatim007/Module modules
make[1]: Entering directory '/usr/src/linux-headers-5.4.0-135-generic'
  CC [M]   /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC [M]   /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.mod.o
  LD [M]   /home/student/Documents/csc415-device-driver-Salvatim007/Module/Salvatierra_Martin_HW6_main.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.4.0-135-generic'
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ █
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Module$ cd ../Test
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make clean
rm *.o Salvatierra_Martin_HW6_main
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make
gcc -c -o Salvatierra_Martin_HW6_main.o Salvatierra_Martin_HW6_main.c -g -I.
gcc -o Salvatierra_Martin_HW6_main Salvatierra_Martin_HW6_main.o -g -I. -l pthread
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ █
```

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


```
student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make run
./Salvatierra_Martin_HW6_main
returned from open file: 3
device open successfully:
****Welcome to encryption generator****
Do you wish to encrypt? Enter 1
Do you wish to decrypt? Enter 0
1
Good Choice
Now Enter the Key which you wish to use
Current key accepted [2- 20]
2

Dont forget this Key: 2
encoding set to : 1
enter up to 100 characters
hello
wrote 6 characters
your encrytion is:
jgnnq

student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$ make run
./Salvatierra_Martin_HW6_main
returned from open file: 3
device open successfully:
****Welcome to encryption generator****
Do you wish to encrypt? Enter 1
Do you wish to decrypt? Enter 0
0
Good Choice
Now Enter the Key which you wish to use
Current key accepted [2- 20]
2

Dont forget this Key: 2
encoding set to : 0
enter up to 100 characters
jgnnq
wrote 6 characters
your encrytion is:
hello

student@student-VirtualBox:~/Documents/csc415-device-driver-Salvatim007/Test$
```