



<b>Academic Year</b>	<b>2023</b>
<b>Semester</b>	<input type="checkbox"/> Fall <input checked="" type="checkbox"/> Winter <input type="checkbox"/> Summer
<b>Course Code - Name</b>	CSCI 3310 – System Programming
<b>Instructor</b>	Dr. Razi Iqbal
<b>Assessment</b>	Lab 1
<b>Deadline</b>	Submit during the lab

## **Lab 1**

The main purpose of this lab is to test your knowledge of Kernel Modules.

### **Instructions:**

- You are required to submit this word document converted into PDF on canvas.
- Students having exactly similar code will get a straight 0.
- You are required to complete these questions using any Linux Distro.
- The deadline for submission of this lab is during the lab session. If for some reason, you are not able to complete this lab in the lab session, please inform the TAs.

## Question

In this lab you are required to perform the followings tasks:

1. Write a Kernel Module that displays a message “Welcome to System Programming” on the load of a kernel module into the Kernel. Just log the messages. DO NOT show message onto the Kernel Console.
2. Write a Kernel Module that displays a message “Cleaning up the Kernel Module” on the exit of a kernel module from the Kernel. Just log the messages. DO NOT show message onto the Kernel Console.
3. Create a Makefile for compiling the above module.
4. Make sure to add the following details to your Kernel:
  - a. Author details (<Student Name>:<Student ID>)
  - b. Description (<Student ID>:This is <Student Name's> first Kernel module)
5. Insert this Kernel module into the Kernel.
6. Verify the insertion by checking the system log.
7. Remove this Kernel module from the Kernel.
8. Verify the deletion by checking the system log.
9. VERY IMPORTANT: Provide screenshot of each step (Step 5-8).
10. VERY IMPORTANT: Provide C code along with makefile code in this word document. **P.S.:**

**For insertion and deletion messages, just create one C file with 2 separate methods.**

## Solution

### Lab 1.c

```
1 #include<linux/init.h>
2 #include<linux/module.h>
3 #include<linux/kernel.h>
4
5 MODULE_LICENSE("GPL");
6 MODULE_AUTHOR("Author Details(<Carl Reina>:<100780526>");
7 MODULE_DESCRIPTION("Description(<10078526>:This is Carl Reina's first kernel module)");
8
9 static int __init my_init_function(void)
10 {
11     printk(KERN_INFO "Welcome to System Programming!\n");
12     //printk(KERN_INFO "Author Details(<Carl Reina>:<100780526>\n");
13     //printk(KERN_INFO "Description(<10078526>:This is Carl Reina's first kernel module)\n");
14
15     return 0;
16 }
17
18 static void __exit my_exit_function(void)
19 {
20     printk(KERN_INFO "Cleaning up the kernel module\n");
21 }
22
23 module_init(my_init_function);
24 module_exit(my_exit_function);
```

### Makefile

```
1 CONFIG_MODULE_SIG=n
2 obj-m += Lab1.o
3
4 all:
5     make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
6 clean:
7     make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
8
```

### Output with commands:

```
accr@SystemsProgram:~/Documents/Systems/Lab1$ make
make -C /lib/modules/5.15.0-58-generic/build M=/home/accr/Documents/Systems/Lab1 modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-58-generic'
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-58-generic'
accr@SystemsProgram:~/Documents/Systems/Lab1$
```

### Used sudo dmesg

```
08 31 02 31 [11242.266040] Welcome to System Programming!
[11242.266051] Author Details(<Carl Reina>:<100780526>)
[11242.266052] Description(<10078526>:This is Carl Reina's first kernel module)
[11473.912313] Cleaning up the kernel module
[11495.902639] Welcome to System Programming!
[11713.726381] Cleaning up the kernel module
[11721.813857] tracker-mtner-F[5930] segfault at 28 1p 00007f023f7f05b3 ip 00007fff3b7790d9 error 4 in [libtracker-mtner-3.0.0.so]7f023f769000-1c0000
[11721.813870] Code: 48 01 fd 85 f6 0f 84 3c 01 00 00 48 8d 7d 38 e8 93 35 ff ff 48 8b 7d 30 e8 6a 35 ff ff 48 8b 45 78 8b 35 94 ba 01 00 4c 89 e7 <8b> 50 28 44 8b 48 20 44 8b 40 1c 52 8b 50 24 52 48 8b
08 31 02 31 [11752.221519] Welcome to System Programming!
[11809.754215] Cleaning up the kernel module
[11882.902679] Welcome to System Programming!
[12305.114940] Cleaning up the kernel module
[12374.688679] Welcome to System Programming!
accr@SystemsProgram:~/Documents/Systems/Lab1$
```

## Author and Description details can be seen here

```
dnseg: read kernel buffer failed: operation not permitted
accr@SystemsProgram:~/Documents/Systems/Labi$ sudo dmesg | tail
[11242.266051] Author Details(<Carl Reina>:<100780526>)
[11242.266052] Description(<10078526>:This is Carl Reina's first kernel module)
[11473.912313] Cleaning up the kernel module
[11495.932639] Welcome to System Programming!
[11713.726381] Cleaning up the kernel module
[11721.813857] tracker-miner-f[5938]: segfault at 28 ip 00007f023f7f85b3 sp 00007fff3b7798d0 error 4 in libtracker-miner-3.0.so[7f023f7e9000+1c000]
[11721.813870] Code: 48 01 fd 85 f6 0f 84 3c 01 00 00 48 8d 7d 38 e8 93 35 ff ff 48 8b 7d 30 e8 6a 35 ff ff 48 8b 45 78 8b 35 94 ba 01 00 4c 89 e7 <8b> 50 28 44 8b 48 20 44 8b 40 1c 52 8b 50 24 52 48 8
08 31 d2 31
[11752.221319] Welcome to System Programming!
[11869.754215] Cleaning up the kernel module
[11882.902679] Welcome to System Programming!
accr@SystemsProgram:~/Documents/Systems/Labi$
```

## Used tail /var/log/syslog

```
accr@SystemsProgram:~/Documents/Systems/Labi$ sudo rmmod Lab1
accr@SystemsProgram:~/Documents/Systems/Labi$ su
Password:
root@SystemsProgram:/home/accr/Documents/Systems/Labi# tail /var/log/syslog
Jan 18 12:52:12 SystemsProgram systemd[862]: Started Tracker metadata extractor.
Jan 18 12:54:13 SystemsProgram dbus-daemon[903]: [session uid=1000 pid=903] Activating vla systemd: service name='org.freedesktop.Tracker3.Miner.Extract' unit='tracker-extract-3.service' requested by ':1
.74' (uid=1000 pid=1574 comm="/usr/libexec/tracker-miner-fs-3 --label=unconfined")
Jan 18 12:54:13 SystemsProgram systemd[862]: Starting Tracker metadata extractor...
Jan 18 12:54:13 SystemsProgram dbus-daemon[903]: [session uid=1000 pid=903] Successfully activated service 'org.freedesktop.Tracker3.Miner.Extract'
Jan 18 12:54:13 SystemsProgram systemd[862]: Started Tracker metadata extractor.
Jan 18 12:54:34 SystemsProgram pulseaudio[895]: ALSA woke us up to write new data to the device, but there was actually nothing to write.
Jan 18 12:54:34 SystemsProgram pulseaudio[895]: Most likely this is a bug in the ALSA driver 'snd_intel8x0'. Please report this issue to the ALSA developers.
Jan 18 12:54:34 SystemsProgram pulseaudio[895]: We were woken up with POLLOUT set -- however a subsequent snd_pcm_avail() returned 0 or another value < min_avail.
Jan 18 12:54:41 SystemsProgram kernel: [ 1097.248255] Welcome to System Programming!
Jan 18 12:57:36 SystemsProgram kernel: [ 1272.527620] Cleaning up the kernel module
root@SystemsProgram:/home/accr/Documents/Systems/Labi#
```