

Dynamically inserting & removing LINUX module to LINUX Kernel

System configuration

Ubuntu version : ubuntu-18.04

System architecture : x86 → Check with `uname -m`

Objective : The inspiration driving this assignment is to introduce Linux Kernel programming concerning creating a Linux module. Portion code executes to some extent (piece mode) where program headings can arrange the microprocessor to play out any movement. This allows any action to be executed.

Pre-setup

Introduce ubuntu 18.04 on a virtual machine and run the accompanying commands

```
sudo apt update
```

```
sudo apt install make binutils gcc
```

Downloading the standard code for a kernel module

```
mkdir a3 cd a3 wget
```

```
http://faculty.washington.edu/wlloyd/courses/tcss422/assignments/hello\_module.tar.gz  
e.tar.gz tar xzf hello_module.tar.gz
```

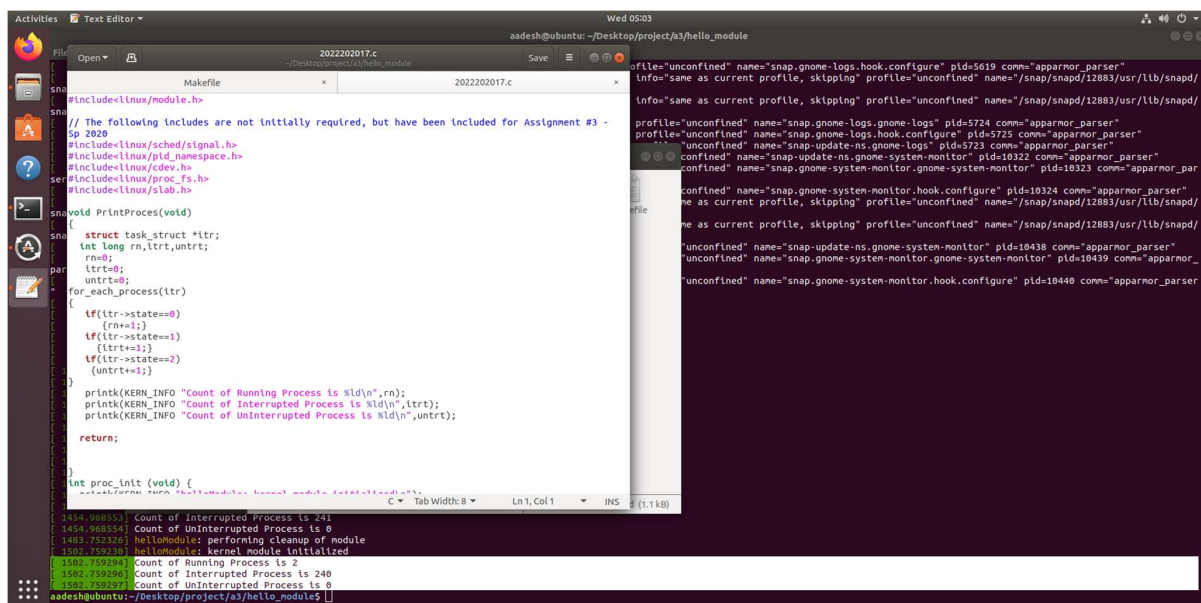
The **helloModule.c** contains the boiler plate code for the basic Kernel module.

The two functions that represent the crux while initializing & un-initializing kernel module are

1. **`int proc_init(void)` : called when the kernel is initialized**
2. **`void proc_cleanup(void)` : called when the kernel is removed**

Outputs for compiling, testing & test a kernel module

Source code for kernel module to find all, interrupted & uninterrupt processes.



```

// The following includes are not initially required, but have been included for Assignment #3 -
// Sp 2020
#include<linux/sched/signal.h>
#include<linux/pid_namespace.h>
#include<linux/cdev.h>
#include<linux/proc_fs.h>
#include<linux/slab.h>

void PrintProcs(void)
{
    struct task_struct *itr;
    int long rn,itr,untrt;
    rn=0;
    itr=0;
    untrt=0;
    for_each_process(itr)
    {
        if(itr->state==0)
        {
            (rn+=1);
        }
        if(itr->state==1)
        {
            (itr+=1);
        }
        if(itr->state==2)
        {
            (untrt+=1);
        }
    }
    printk(KERN_INFO "Count of Running Process is %ld\n",rn);
    printk(KERN_INFO "Count of Interrupted Process is %ld\n",itr);
    printk(KERN_INFO "Count of Uninterrupted Process is %ld\n",untrt);

    return;
}

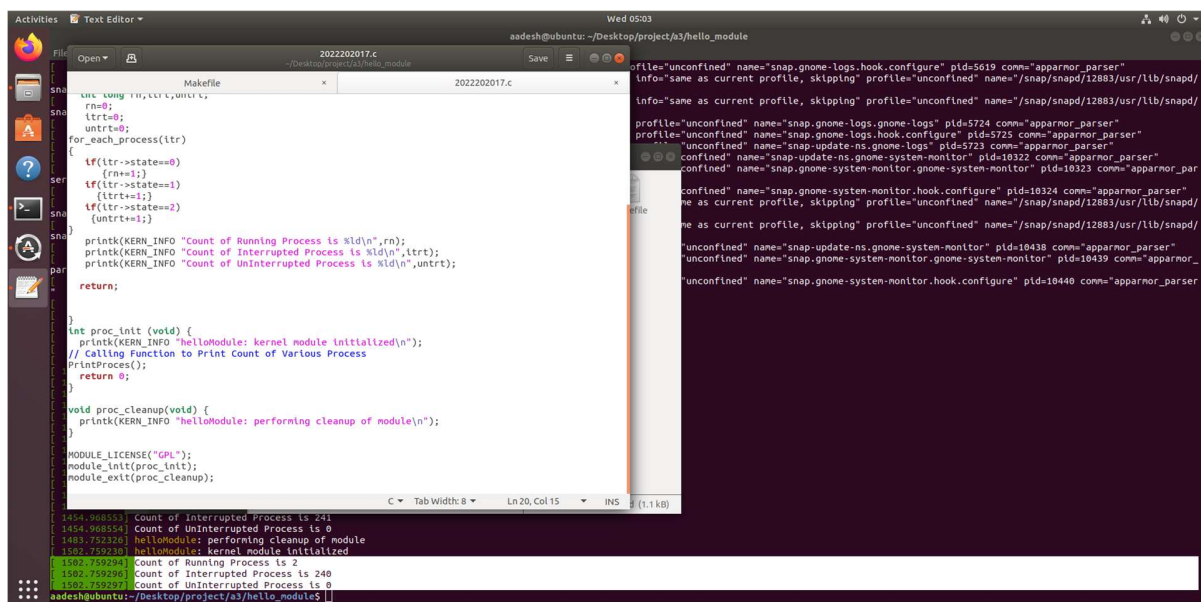
int proc_init (void) {
    printk(KERN_INFO "helloModule: kernel module initialized\n");
    PrintProcs();
}

int proc_cleanup (void) {
    printk(KERN_INFO "helloModule: performing cleanup of module\n");
}

MODULE_LICENSE("GPL");
module_init(proc_init);
module_exit(proc_cleanup);
  
```

```

1454.968553 Count of Interrupted Process is 241
1454.968554 Count of Uninterrupted Process is 0
1483.752326 helloModule: performing cleanup of module
1502.759230 helloModule: kernel module initialized
1502.759294 Count of Running Process is 2
1502.759296 Count of Interrupted Process is 240
1502.759297 Count of Uninterrupted Process is 0
aades@ubuntu: ~/Desktop/project/a3/hello_modules$
  
```



```

int long rn,itr,untrt;
rn=0;
itr=0;
untrt=0;
for_each_process(itr)
{
    if(itr->state==0)
    {
        (rn+=1);
    }
    if(itr->state==1)
    {
        (itr+=1);
    }
    if(itr->state==2)
    {
        (untrt+=1);
    }
}

printk(KERN_INFO "Count of Running Process is %ld\n",rn);
printk(KERN_INFO "Count of Interrupted Process is %ld\n",itr);
printk(KERN_INFO "Count of Uninterrupted Process is %ld\n",untrt);

return;
}

int proc_init (void) {
    printk(KERN_INFO "helloModule: kernel module initialized\n");
    // Calling Function to Print Count of Various Process
    PrintProcs();
    return 0;
}

void proc_cleanup(void) {
    printk(KERN_INFO "helloModule: performing cleanup of module\n");
}

MODULE_LICENSE("GPL");
module_init(proc_init);
module_exit(proc_cleanup);
  
```

```

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aades@ubuntu: ~/Desktop/project/a3/hello_modules$
  
```

Printing the output after dynamically removing the kernel module

```

[ 247.347160] audit: type=1400 audit(1667997712.819:44): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.gnome-logs.hook.configure" pid=5619 comm="apparmor_parser"
[ 251.693142] audit: type=1400 audit(1667997717.166:46): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="/snap/snapd/12883/usr/lib/snapd/snap-confine" pid=5721 comm="apparmor_parser"
[ 251.693142] audit: type=1400 audit(1667997717.166:46): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="/snap/snapd/12883/usr/lib/snapd/snap-confine/mount-namespace-capture-helper" pid=5721 comm="apparmor_parser"
[ 252.547358] audit: type=1400 audit(1667997718.018:47): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.gnome-logs.gnome-logs" pid=5724 comm="apparmor_parser"
[ 252.567194] audit: type=1400 audit(1667997718.438:48): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.gnome-logs.hook.configure" pid=5725 comm="apparmor_parser"
[ 253.007812] audit: type=1400 audit(1667997718.482:49): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap-update-ns.gnome-logs" pid=5723 comm="apparmor_parser"
[ 326.861477] audit: type=1400 audit(1667997792.326:50): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap-update-ns.gnome-system-monitor" pid=10322 comm="apparmor_parser"
[ 326.884542] audit: type=1400 audit(1667997792.346:51): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.gnome-system-monitor.gnome-system-monitor" pid=10323 comm="apparmor_parser"
[ 326.908557] audit: type=1400 audit(1667997792.454:52): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap.gnome-system-monitor.hook.configure" pid=10324 comm="apparmor_parser"
[ 331.341697] audit: type=1400 audit(1667997796.805:53): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="/snap/snapd/12883/usr/lib/snapd/snap-confine" pid=10436 comm="apparmor_parser"
[ 331.341697] audit: type=1400 audit(1667997796.805:54): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="/snap/snapd/12883/usr/lib/snapd/snap-confine/mount-namespace-capture-helper" pid=10436 comm="apparmor_parser"
[ 332.495809] audit: type=1400 audit(1667997797.957:55): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap-update-ns.gnome-system-monitor" pid=10438 comm="apparmor_parser"
[ 332.687113] audit: type=1400 audit(1667997798.069:56): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.gnome-system-monitor.gnome-system-monitor" pid=10439 comm="apparmor_parser"
[ 332.734637] audit: type=1400 audit(1667997798.197:57): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.gnome-system-monitor.hook.configure" pid=10440 comm="apparmor_parser"
[ 812.648296] helloModule: loading out-of-tree module taints kernel.
[ 812.648350] helloModule: module verification failed: signature and/or required key missing - tainting kernel
[ 812.649160] helloModule: kernel module initialized
[ 812.649160] Count of Running Process is 0
[ 812.649163] Count of Interrupted Process is 1
[ 812.649165] Count of Uninterrupted Process is 0
[ 1002.812593] helloModule: performing cleanup of module
[ 1023.906409] helloModule: kernel module initialized
[ 1023.906412] Count of Running Process is 0
[ 1023.906412] Count of Interrupted Process is 1
[ 1023.906414] Count of Uninterrupted Process is 0
[ 1191.350685] helloModule: performing cleanup of module
[ 1203.011084] helloModule: kernel module initialized
[ 1203.011144] Count of Running Process is 1
[ 1203.011145] Count of Interrupted Process is 241
[ 1203.011146] Count of Uninterrupted Process is 0
[ 1228.398220] helloModule: performing cleanup of module
[ 1454.968493] helloModule: kernel module initialized
[ 1454.968522] Count of Running Process is 1
[ 1454.968523] Count of Interrupted Process is 241
[ 1454.968554] Count of Uninterrupted Process is 0
[ 1483.752320] helloModule: performing cleanup of module
[ 1502.752920] helloModule: kernel module initialized
[ 1502.752926] Count of Running Process is 2
[ 1502.752926] Count of Interrupted Process is 240
[ 1502.752927] Count of Uninterrupted Process is 0
asdesh@ubuntu: ~/Desktop/project/h3/hello_module$

```