

Project 1 Report

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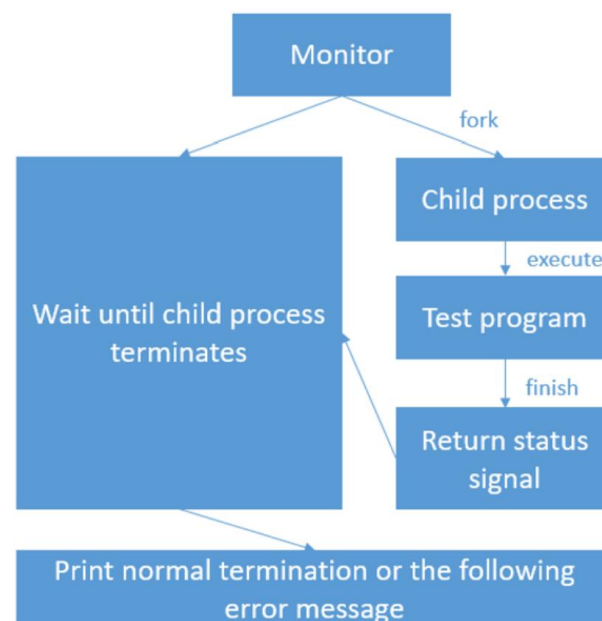
1. Design Process

Task 1:

In this task, it is required to implement a fork process from the perspective of the user mode. For implementation, we have 4 steps:

- Use **fork()** function to create a new child process.
- Use **execve()** function to execute the test file.
- At the same time, use **waitpid()** function to wait for the execution of child process and receive the return signal.
- Identify the termination information by the variable **status**.

Here is the logic flow chart:



Task 2:

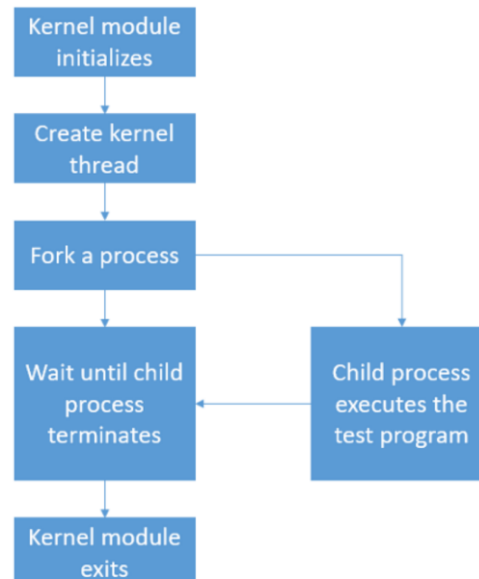
In this task, it is required to implement a fork process from the perspective of the kernel mode. For implementation, we have 5 steps:

- Use **kthread_create()** function to create a kernel thread "my_fork" and use **wake_up_process()** function to start running the thread.
- In "my_fork", use **kernel_thread()** function to create a new child process called "my_exec".
- In "my_exec", use **getname_kernel()** function to get the filename of the test file. Then use **do_execve()** function to execute the test file.

d. In the parent process (called “my_fork”), “my_wait” is use to wait until the child process terminates. In “my_wait”, we first set initial values of wait option arguments. Then, use **do_wait()** function to implement the waiting part. At last, we analyze the return signal by the variable “wo.wo_stat”.

e. Terminate the child process and exit the module.

Here is the logic flow chart:



2. Set Environment and Compile Kernel

Basic Environment:

Here are the versions of basic environment:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# cat /etc/issue
Ubuntu 16.04.7 LTS \n \l
```

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# uname -r
5.10.146
```

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# gcc --version
gcc (Ubuntu 5.4.0-6ubuntu1~16.04.12) 5.4.0 20160609
Copyright (C) 2015 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Task 1:

In task 1, the running process is quite simple. We just need to compile the c files and execute the files. We have 3 steps.

- `$ cd xx/Assignment_1_120090336/program1` //go to the program category
- `$ make` //compile the c files
- `$./program1 ./[Name of the test file]` //execute the program and test file

Here is an example of SIGABRT:

```
root@csc3150:/home/vagrant/csc3150# cd ../Assignment_1_120090336/program1 1
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# make 2
cc -o abort abort.c
cc -o alarm alarm.c
cc -o bus bus.c
cc -o floating floating.c
cc -o hangup hangup.c
cc -o illegal_instr illegal_instr.c
cc -o interrupt interrupt.c
cc -o kill kill.c
cc -o normal normal.c
cc -o pipe pipe.c
cc -o program1 program1.c
cc -o quit quit.c
cc -o segment_fault segment_fault.c
cc -o stop stop.c
cc -o terminate terminate.c
cc -o trap trap.c
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./abort 3
Process start to fork
I'm the Parent Process, my pid = 12777
I'm the Child Process, my pid = 12778
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGABRT program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by abort signal!
```

Output information

Task 2:

In task 2, we need to compile the kernel and insert our module. First, make sure the kernel version is 5.10.xxx and re-install the kernel after export_symbol in linux head files (export function **do_wait**, **do_execve**, **getname_kernel**, **kernel_thread**). Make sure the **path** variable in "my_exec" is **"/tmp/test"**. Make sure that we are in root account (enter by **"\$ sudo su"**).

After preparation, we have 9 steps to run the process.

- \$ cd xx/Assignment_1_120090336/program2** //go to the program category
- \$ make clean** //remove compiled files
- \$ make** //compile the program files
- \$ rm test** //remove compiled test file
- \$ gcc test.c -o test** //compile the test file
- \$ dmesg -c** //clear the previous log info
- \$ insmod program2.ko** //insert the module
- \$ rmmod program2.ko** //remove the module
- \$ dmesg | grep program2** //display the output info

Here is an example of SIGABRT:

```

root@csc3150:/home/vagrant/csc3150# cd ./Assignment_1_120090336/program2
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# make clean
make -C /lib/modules/5.10.146/build M=/home/vagrant/csc3150/Assignment_1_120090336/program2 clean
make[1]: Entering directory '/home/seed/work/linux-5.10.146'
CLEAN /home/vagrant/csc3150/Assignment_1_120090336/program2/Module.symvers
make[1]: Leaving directory '/home/seed/work/linux-5.10.146'
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# make
make -C /lib/modules/5.10.146/build M=/home/vagrant/csc3150/Assignment_1_120090336/program2 modules
make[1]: Entering directory '/home/seed/work/linux-5.10.146'
CC [M] /home/vagrant/csc3150/Assignment_1_120090336/program2/program2.o
MODPOST /home/vagrant/csc3150/Assignment_1_120090336/program2/Module.symvers
CC [M] /home/vagrant/csc3150/Assignment_1_120090336/program2/program2.mod.o
LD [M] /home/vagrant/csc3150/Assignment_1_120090336/program2/program2.ko
make[1]: Leaving directory '/home/seed/work/linux-5.10.146'
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rm test
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# gcc test.c -o test
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg -c
[73975.908492] [program2] : Module_init {Chen Dekun} {120090336}
[73975.910095] [program2] : module_init create kthread start
[73975.911516] [program2] : module_init kthread start
[73975.913327] [program2] : The child process has pid = 15570
[73975.914668] [program2] : This is the parent process, pid = 15569
[73975.926166] [program2] : child process
[73975.927801] [program2] : get Normal Termination signal
[73975.929446] [program2] : child process terminated
[73975.930710] [program2] : The return signal is 0
[73981.454520] [program2] : Module_exit
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[74120.671313] [program2] : Module_init {Chen Dekun} {120090336}
[74120.673177] [program2] : module_init create kthread start
[74120.674870] [program2] : module_init kthread start
[74120.676470] [program2] : The child process has pid = 16607
[74120.677912] [program2] : This is the parent process, pid = 16606
[74120.781614] [program2] : child process
[74120.782531] [program2] : get SIGABRT signal
[74120.783535] [program2] : child process terminated
[74120.784673] [program2] : The return signal is 6
[74124.878371] [program2] : Module_exit

```

Output info

3. Program Output (Actual code output shall prevail)

Task 1:

Abort:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./abort
Process start to fork
I'm the Parent Process, my pid = 29210
I'm the Child Process, my pid = 29211
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGABRT program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by abort signal!

```

Alarm:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./alarm
Process start to fork
I'm the Parent Process, my pid = 29276
I'm the Child Process, my pid = 29277
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGALRM program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by alarm signal!

```

Bus:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./bus
Process start to fork
I'm the Parent Process, my pid = 29368
I'm the Child Process, my pid = 29369
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGBUS program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by bus signal!

```

Floating:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./floating
Process start to fork
I'm the Child Process, my pid = 29436
Child process start to execute test program:
I'm the Parent Process, my pid = 29435
-----CHILD PROCESS START-----
This is the SIGFPE program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by floating signal!

```

Hangup:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./hangup
Process start to fork
I'm the Parent Process, my pid = 29480
I'm the Child Process, my pid = 29481
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGHUP program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by hangup signal!

```

Illegal_instr:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./illegal_instr
Process start to fork
I'm the Parent Process, my pid = 29578
I'm the Child Process, my pid = 29579
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGILL program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by illegal_instr signal!

```

Interrupt:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./interrupt
Process start to fork
I'm the Parent Process, my pid = 29667
I'm the Child Process, my pid = 29668
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGINT program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by interrupt signal!

```

Kill:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./kill
Process start to fork
I'm the Parent Process, my pid = 29745
I'm the Child Process, my pid = 29746
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGKILL program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by kill signal!

```

Normal:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./normal
Process start to fork
I'm the Parent Process, my pid = 29811
I'm the Child Process, my pid = 29812
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the normal program

-----CHILD PROCESS END-----
Parent process receives SIGCHLD signal
Normal termination with EXIT STATUS = 0
```

Pipe:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./pipe
Process start to fork
I'm the Child Process, my pid = 29858
Child process start to execute test program:
I'm the Parent Process, my pid = 29857
-----CHILD PROCESS START-----
This is the SIGPIPE program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by pipe signal!
```

Quit:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./quit
Process start to fork
I'm the Parent Process, my pid = 29922
I'm the Child Process, my pid = 29923
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGQUIT program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by quit signal!
```

Segment_fault:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./segment_fault
Process start to fork
I'm the Child Process, my pid = 29981
Child process start to execute test program:
I'm the Parent Process, my pid = 29980
-----CHILD PROCESS START-----
This is the SIGSEGV program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by segment_fault signal!
```

Stop:

```
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./stop
Process start to fork
I'm the Parent Process, my pid = 30056
I'm the Child Process, my pid = 30057
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGSTOP program

Parent process receives SIGCHLD signal
CHILD PROCESS STOPPED: 19
```

Terminate:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./terminate
Process start to fork
I'm the Parent Process, my pid = 30101
I'm the Child Process, my pid = 30102
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGTERM program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by terminate signal!

```

Trap:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program1# ./program1 ./trap
Process start to fork
I'm the Parent Process, my pid = 30145
I'm the Child Process, my pid = 30146
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGTRAP program

Parent process receives SIGCHLD signal
CHILD EXECUTION FAILED by trap signal!

```

Task 2:

Abort:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39080.361594] [program2] : Module_init {Chen Dekun} {120090336}
[39080.362798] [program2] : module_init create kthread start
[39080.363877] [program2] : module_init kthread start
[39080.365188] [program2] : The child process has pid = 10272
[39080.366571] [program2] : This is the parent process, pid = 10271
[39080.466836] [program2] : child process
[39080.467551] [program2] : get SIGABRT signal
[39080.468359] [program2] : child process terminated
[39080.469192] [program2] : The return signal is 6
[39083.375964] [program2] : Module_exit

```

Alarm:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39122.722940] [program2] : Module_init {Chen Dekun} {120090336}
[39122.724846] [program2] : module_init create kthread start
[39122.726956] [program2] : module_init kthread start
[39122.728648] [program2] : The child process has pid = 10396
[39122.729987] [program2] : This is the parent process, pid = 10395
[39122.731930] [program2] : child process
[39122.733145] [program2] : get SIGALRM signal
[39122.734539] [program2] : child process terminated
[39122.736133] [program2] : The return signal is 14
[39123.940392] [program2] : Module_exit

```

Bus:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39161.059368] [program2] : Module_init {Chen Dekun} {120090336}
[39161.061192] [program2] : module_init create kthread start
[39161.063111] [program2] : module_init kthread start
[39161.064777] [program2] : The child process has pid = 10538
[39161.065764] [program2] : This is the parent process, pid = 10536
[39161.173335] [program2] : child process
[39161.174079] [program2] : get SIGBUS signal
[39161.174857] [program2] : child process terminated
[39161.175752] [program2] : The return signal is 7
[39161.277047] [program2] : Module_exit

```

Floating:


```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39183.198552] [program2] : Module_init {Chen Dekun} {120090336}
[39183.200240] [program2] : module_init create kthread start
[39183.202298] [program2] : module_init kthread start
[39183.203982] [program2] : The child process has pid = 10597
[39183.205744] [program2] : This is the parent process, pid = 10596
[39183.325349] [program2] : child process
[39183.326290] [program2] : get SIGFPE signal
[39183.327280] [program2] : child process terminated
[39183.328518] [program2] : The return signal is 8
[39183.460093] [program2] : Module_exit

```

Hangup:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39202.992368] [program2] : Module_init {Chen Dekun} {120090336}
[39202.993488] [program2] : module_init create kthread start
[39202.994700] [program2] : module_init kthread start
[39202.996226] [program2] : The child process has pid = 10681
[39202.997314] [program2] : This is the parent process, pid = 10679
[39202.998458] [program2] : child process
[39202.999199] [program2] : get SIGHUP signal
[39203.000037] [program2] : child process terminated
[39203.001129] [program2] : The return signal is 1
[39211.259203] [program2] : Module_exit

```

Illegal_instr:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39226.379353] [program2] : Module_init {Chen Dekun} {120090336}
[39226.381471] [program2] : module_init create kthread start
[39226.383252] [program2] : module_init kthread start
[39226.385388] [program2] : The child process has pid = 10760
[39226.387048] [program2] : This is the parent process, pid = 10759
[39226.511185] [program2] : child process
[39226.512208] [program2] : get SIGILL signal
[39226.513249] [program2] : child process terminated
[39226.514698] [program2] : The return signal is 4
[39228.075069] [program2] : Module_exit

```

Interrupt:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39243.597788] [program2] : Module_init {Chen Dekun} {120090336}
[39243.599395] [program2] : module_init create kthread start
[39243.601036] [program2] : module_init kthread start
[39243.602425] [program2] : The child process has pid = 10841
[39243.604288] [program2] : This is the parent process, pid = 10840
[39243.605994] [program2] : child process
[39243.607006] [program2] : get SIGINT signal
[39243.608099] [program2] : child process terminated
[39243.609334] [program2] : The return signal is 2
[39244.046923] [program2] : Module_exit

```

Kill:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39283.472983] [program2] : Module_init {Chen Dekun} {120090336}
[39283.474099] [program2] : module_init create kthread start
[39283.475285] [program2] : module_init kthread start
[39283.476487] [program2] : The child process has pid = 10900
[39283.478320] [program2] : This is the parent process, pid = 10899
[39283.480337] [program2] : child process
[39283.481816] [program2] : get SIGKILL signal
[39283.483256] [program2] : child process terminated
[39283.484473] [program2] : The return signal is 9
[39283.784967] [program2] : Module_exit

```

Pipe:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39302.018023] [program2] : Module_init {Chen Dekun} {120090336}
[39302.019534] [program2] : module_init create kthread start
[39302.021142] [program2] : module_init kthread start
[39302.022701] [program2] : The child process has pid = 10980
[39302.023813] [program2] : This is the parent process, pid = 10979
[39302.025365] [program2] : child process
[39302.026582] [program2] : get SIGPIPE signal
[39302.027617] [program2] : child process terminated
[39302.028925] [program2] : The return signal is 13
[39302.766081] [program2] : Module_exit

```

Quit:


```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39324.769259] [program2] : Module_init {Chen Dekun} {120090336}
[39324.770881] [program2] : module_init create kthread start
[39324.772562] [program2] : module_init kthread start
[39324.773889] [program2] : The child process has pid = 11060
[39324.775098] [program2] : This is the parent process, pid = 11059
[39324.878369] [program2] : child process
[39324.879020] [program2] : get SIGQUIT signal
[39324.879881] [program2] : child process terminated
[39324.880661] [program2] : The return signal is 3
[39324.999888] [program2] : Module_exit

```

Segment_fault:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39346.108151] [program2] : Module_init {Chen Dekun} {120090336}
[39346.109744] [program2] : module_init create kthread start
[39346.111450] [program2] : module_init kthread start
[39346.112648] [program2] : The child process has pid = 11121
[39346.114069] [program2] : This is the parent process, pid = 11120
[39346.236503] [program2] : child process
[39346.237726] [program2] : get SIGSEGV signal
[39346.238972] [program2] : child process terminated
[39346.240522] [program2] : The return signal is 11
[39346.385384] [program2] : Module_exit

```

Terminate:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39363.771434] [program2] : Module_init {Chen Dekun} {120090336}
[39363.772944] [program2] : module_init create kthread start
[39363.774624] [program2] : module_init kthread start
[39363.776049] [program2] : The child process has pid = 11203
[39363.777224] [program2] : This is the parent process, pid = 11202
[39363.778341] [program2] : child process
[39363.779091] [program2] : get SIGTERM signal
[39363.780096] [program2] : child process terminated
[39363.781215] [program2] : The return signal is 15
[39364.411397] [program2] : Module_exit

```

Trap:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39384.419520] [program2] : Module_init {Chen Dekun} {120090336}
[39384.421756] [program2] : module_init create kthread start
[39384.423962] [program2] : module_init kthread start
[39384.426070] [program2] : The child process has pid = 11285
[39384.427788] [program2] : This is the parent process, pid = 11283
[39384.535537] [program2] : child process
[39384.536527] [program2] : get SIGTRAP signal
[39384.537566] [program2] : child process terminated
[39384.538823] [program2] : The return signal is 5
[39384.685871] [program2] : Module_exit

```

Stop:

```

root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[115845.823845] [program2] : Module_init {Chen Dekun} {120090336}
[115845.825355] [program2] : module_init create kthread start
[115845.827020] [program2] : module_init kthread start
[115845.828355] [program2] : The child process has pid = 28877
[115845.829400] [program2] : This is the parent process, pid = 28876
[115845.830575] [program2] : child process
[115845.831323] [program2] : get SIGSTOP signal
[115845.832167] [program2] : child process terminated
[115845.833102] [program2] : The return signal is 19
[115849.862767] [program2] : Module_exit

```

Normal:

```

rmmod program2.koroot@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# insmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# rmmod program2.ko
root@csc3150:/home/vagrant/csc3150/Assignment_1_120090336/program2# dmesg | grep program2
[39455.071870] [program2] : Module_init {Chen Dekun} {120090336}
[39455.073038] [program2] : module_init create kthread start
[39455.074275] [program2] : module_init kthread start
[39455.075294] [program2] : The child process has pid = 11447
[39455.077103] [program2] : This is the parent process, pid = 11446
[39455.078808] [program2] : child process
[39455.079994] [program2] : get SIGCHLD signal
[39455.081167] [program2] : child process terminated
[39455.082635] [program2] : The return signal is 0
[39455.309906] [program2] : Module_exit

```

4. Harvest of this Task:

As the first assignment of operating system, it guided us to learn process from shallow to deep. Task 1 taught us to build child process from the user mode, which is suitable to get familiar with process related functions. And task 2 is more challenging to access the knowledge of kernel. By completing this task, we will have a more complete and in-depth understanding of the kernel process.

Additionally, I think the most important thing is the precious experience about Linux programming. By doing this assignment, I learn much about Linux environment, including Linux commands, Linux kernel, and environment configuration. I think it is significant for coding and work in the future.