

Report of CSC3150 assignment1

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1. Design

Task 1: First of all, I use `fork()` to fork a child process and get the process id. If the process id < 0 , then fork error. If process id = 0, which means it is a child process, I use `execve()` to execute the test program according to the argument. If process id > 0 , which means it is a parent process, I use `wait()` to wait and receive the signal from child process and print some responses.

Task 2: In the initialized part, I use `kthread_create()` to create a kthread and bind `my_fork()` to it. In `my_fork` function, I use `kernel_thread()` to create a process. In child process, I use `my_execv()` to execute the test program. In the parent process, I use `my_wait()` to wait until child process terminates and print the signal.

In `my_execv()`, I use `getname_kernel(filepath)` to get the input program and use `do_execve()` to execute the program. In `my_wait()`, I use `do_wait()` to wait the termination of child process and receive and print out the signals.

2. Set up

Task2: To use the `do_wait()`, `do_execv()` and `getname_kernel()` and `kernel_thread()` function, I put `EXPORT_SYMBOL(func)` under the source code of these functions and recompile the kernel starting from the step "make bzImage".

Task1 and 2: To implement linux-kernel-style clang-format to `program1.c` and `program2.c`, I update `clang-format-3.7` to `clang-format-8` and copy the `.clang-format` from `KERNEL_FILE` to the same directory as `program1.c` and `program2.c`. Then use `clang-format-8` to specify the format of my program.

3. Screenshot of output:

Task1:

abort:

```
make: Nothing to be done for 'all'.
root@ubuntu-xenial:/home/vagrant/csc3150/source/program1# ./program1 ./abort
Process start to fork
I'm the Parent Process, my pid = 11183
I'm the Child Process, my pid = 11184
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGABRT program

Parent process receiving SIGCHLD signal
```

alarm:

```
cc -o program1 program1.c
vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./alarm
Process start to fork
I'm the Parent Process, my pid = 17202
I'm the Child Process, my pid = 17203
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGALRM program

Parent process receiving SIGCHLD signal
status = 14
child process get SIGALRM signal
```

bus:

```
child process get SIGCHLD signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./bus
I'm the Child Process, my pid = 17248
Child process start to execute test program:
Process start to fork
I'm the Parent Process, my pid = 17247
-----CHILD PROCESS START-----
This is the SIGBUS program

Parent process receiving SIGCHLD signal
status = 135
child process get SIGBUS signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

floating:

```
child process get SIGBUS signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./floating
Process start to fork
I'm the Parent Process, my pid = 17286
I'm the Child Process, my pid = 17287
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGFPE program

Parent process receiving SIGCHLD signal
status = 136
child process get SIGFPE signal
```

normal:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program1# ./program1 ./normal
Process start to fork
I'm the Parent Process, my pid = 11229
I'm the Child Process, my pid = 11230
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the normal program

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

stop:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program1# ./program1 ./stop
Process start to fork
I'm the Parent Process, my pid = 11273
I'm the Child Process, my pid = 11274
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGSTOP program

Parent process receiving SIGCHLD signal
CHILD PROCESS STOPPED
```

hangup:

```
child process get SIGFPE signal
⊗ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./hangup
I'm the Child Process, my pid = 17302
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGHUP program

Process start to fork
I'm the Parent Process, my pid = 17301
Parent process receiving SIGCHLD signal
status = 1
child process get SIGHUP signal
```

interrupt:

```
child process get SIGHUP signal
⊗ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./interrupt
Process start to fork
I'm the Parent Process, my pid = 17339
I'm the Child Process, my pid = 17340
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGINT program

Parent process receiving SIGCHLD signal
status = 2
child process get SIGINT signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

kill:

```
child process get SIGINT signal
⊗ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./kill
Process start to fork
I'm the Parent Process, my pid = 17365
I'm the Child Process, my pid = 17366
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGKILL program

Parent process receiving SIGCHLD signal
status = 9
child process get SIGKILL signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

pipe:

```
child process get SIGKILL signal
❶ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./pipe
Process start to fork
I'm the Parent Process, my pid = 17424
I'm the Child Process, my pid = 17425
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGPIPE program

Parent process receiving SIGCHLD signal
status = 13
child process get SIGPIPE signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

quit:

```
child process get SIGPIPE signal
❶ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./quit
Process start to fork
I'm the Parent Process, my pid = 17465
I'm the Child Process, my pid = 17466
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGQUIT program

Parent process receiving SIGCHLD signal
status = 131
child process get SIGQUIT signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

terminate:

```
child process get SIGQUIT signal
❶ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./terminate
Process start to fork
I'm the Parent Process, my pid = 17492
I'm the Child Process, my pid = 17493
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGTERM program

Parent process receiving SIGCHLD signal
status = 15
child process get SIGTERM signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

trap:

```
child process get SIGTERM signal
❶ vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./trap
Process start to fork
I'm the Parent Process, my pid = 17506
I'm the Child Process, my pid = 17507
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGTRAP program

Parent process receiving SIGCHLD signal
status = 133
child process get SIGTRAP signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

illegal_instr:

```
child process get SIGTRAP signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./illegal_instr
Process start to fork
I'm the Parent Process, my pid = 17595
I'm the Child Process, my pid = 17596
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGILL program

Parent process receiving SIGCHLD signal
status = 132
child process get SIGILL signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

segment_fault:

```
child process get SIGILL signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$ ./program1 ./segment_fault
Process start to fork
I'm the Parent Process, my pid = 17636
I'm the Child Process, my pid = 17637
Child process start to execute test program:
-----CHILD PROCESS START-----
This is the SIGSEGV program

Parent process receiving SIGCHLD signal
status = 139
child process get SIGSEGV signal
vagrant@ubuntu-xenial:~/csc3150/source/program1$
```

Task2:

Abort:

```
[20034.732213] [program2] : module_init {Li Nanxuan} {120090860}
[20713.258830] [program2] : module_init create kthread start
[20713.261047] [program2] : module_init kthread start
[20713.262884] [program2] : The child process has pid = 18707
[20713.264920] [program2] : This is the parent process, pid = 18706
[20713.267074] [program2] : child process
[20713.269678] [program2] : get SIGABRT signal
[20713.375835] [program2] : child process terminated
[20713.377397] [program2] : The return signal is 6
[20713.378722] [program2] : module_exit./my
[20716.812851] [program2] : module_exit./my
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2#
```

Alarm:

```
[22352.599698] [program2] : module_init {Li Nanxuan} {120090860}
[22352.603014] [program2] : module_init create kthread start
[22352.605692] [program2] : module_init kthread start
[22352.607891] [program2] : The child process has pid = 26314
[22352.610179] [program2] : This is the parent process, pid = 26313
[22352.613481] [program2] : child process
[22352.615839] [program2] : do wait start:
[22354.609830] [program2] : get SIGALRM signal
[22354.618151] [program2] : child process terminated
[22354.627839] [program2] : The return signal is 14
[22355.376666] [program2] : module_exit./my
```


Bus:

```
[11840.922985] [program2] : module_init {Li Nanxuan} {120090860}
[11840.928754] [program2]: module_init create kthread start
[11840.931317] [program2]: module_init kthread start
[11840.933810] [program2] : The child process has pid = 10895
[11840.936006] [program2] : This is the parent process, pid = 10894
[11840.938543] [program2] : child process
[11841.060060] [program2] : get SIGBUS signal
[11841.061763] [program2] : child process terminated
[11841.063675] [program2] : The return signal is 7
[11845.070238] [program2] : module_exit./my
```

Floating:

```
[20759.749552] CR2: ffffffff06830d3 CR3: 000000015a60a005 CR4: 0000000000706e0
[20983.654616] [program2] : module_init {Li Nanxuan} {120090860}
[20983.658117] [program2]: module_init create kthread start
[20983.660369] [program2]: module_init kthread start
[20983.662330] [program2] : The child process has pid = 19653
[20983.663968] [program2] : This is the parent process, pid = 19652
[20983.665733] [program2] : child process
[20983.778734] [program2] : get SIGFPE signal
[20983.779983] [program2] : child process terminated
[20983.781370] [program2] : The return signal is 8
[20986.103090] [program2] : module_exit./my
```

Hangup:

```
[20986.103090] [program2] : module_exit./my
[21036.529085] [program2] : module_init {Li Nanxuan} {120090860}
[21036.532232] [program2]: module_init create kthread start
[21036.534584] [program2]: module_init kthread start
[21036.537319] [program2] : The child process has pid = 20109
[21036.540034] [program2] : This is the parent process, pid = 20107
[21036.542690] [program2] : child process
[21036.544278] [program2] : get SIGHUP signal
[21036.546469] [program2] : child process terminated
[21036.548914] [program2] : The return signal is 1
[21038.402673] [program2] : module_exit./my
```

Illegal:

```
[21038.402673] [program2] : module_exit./my
[21087.362029] [program2] : module_init {Li Nanxuan} {120090860}
[21087.365144] [program2]: module_init create kthread start
[21087.367609] [program2]: module_init kthread start
[21087.369606] [program2] : The child process has pid = 20531
[21087.373615] [program2] : This is the parent process, pid = 20530
[21087.376037] [program2] : child process
[21087.494293] [program2] : get SIGILL signal
[21087.496182] [program2] : child process terminated
[21087.498352] [program2] : The return signal is 4
[21088.916274] [program2] : module_exit./my
```

Interrupt:

```
[21127.866133] [program2] : module_init {Li Nanxuan} {120090860}
[21127.868593] [program2]: module_init create kthread start
[21127.870524] [program2]: module_init kthread start
[21127.872241] [program2] : The child process has pid = 20955
[21127.875497] [program2] : This is the parent process, pid = 20954
[21127.878228] [program2] : child process
[21127.879900] [program2] : get SIGINT signal
[21127.881603] [program2] : child process terminated
[21127.883949] [program2] : The return signal is 2
[21129.464257] [program2] : module_exit./my
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2#
```

Kill:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21176.061319] [program2] : module_init {Li Nanxuan} {120090860}
[21176.064565] [program2]: module_init create kthread start
[21176.067036] [program2]: module_init kthread start
[21176.069795] [program2] : The child process has pid = 21420
[21176.072190] [program2] : This is the parent process, pid = 21419
[21176.075182] [program2] : child process
[21176.077331] [program2] : get SIGKILL signal
[21176.079879] [program2] : child process terminated
[21176.085154] [program2] : The return signal is 9
[21177.548669] [program2] : module_exit./my
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2#
```

Normal:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21177.548669] [program2] : module_exit./my
[21399.910131] [program2] : module_init {Li Nanxuan} {120090860}
[21399.914937] [program2]: module_init create kthread start
[21399.918264] [program2]: module_init kthread start
[21399.920644] [program2] : The child process has pid = 21908
[21399.924961] [program2] : This is the parent process, pid = 21907
[21399.928673] [program2] : child process
[21399.930486] [program2] : child process terminated normally
[21399.933196] [program2] : The exit status is 0
[21401.292481] [program2] : module_exit./my
```

Pipe:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21465.104488] [program2] : module_init {Li Nanxuan} {120090860}
[21465.107390] [program2]: module_init create kthread start
[21465.109603] [program2]: module_init kthread start
[21465.112277] [program2] : The child process has pid = 22334
[21465.114921] [program2] : This is the parent process, pid = 22333
[21465.117529] [program2] : child process
[21465.119301] [program2] : get SIGPIPE signal
[21465.121225] [program2] : child process terminated
[21465.124829] [program2] : The return signal is 13
[21466.665769] [program2] : module_exit./my
```

Quit:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21498.930368] [program2] : module_init {Li Nanxuan} {120090860}
[21498.932849] [program2]: module_init create kthread start
[21498.935363] [program2]: module_init kthread start
[21498.941566] [program2] : The child process has pid = 22758
[21498.944215] [program2] : This is the parent process, pid = 22757
[21498.947588] [program2] : child process
[21499.058396] [program2] : get SIGQUIT signal
[21499.060745] [program2] : child process terminated
[21499.062615] [program2] : The return signal is 3
[21500.424846] [program2] : module_exit./my
```

Segment_fault:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21534.570756] [program2] : module_init {Li Nanxuan} {120090860}
[21534.573728] [program2]: module_init create kthread start
[21534.576192] [program2]: module_init kthread start
[21534.578334] [program2] : The child process has pid = 23184
[21534.581239] [program2] : This is the parent process, pid = 23183
[21534.583990] [program2] : child process
[21534.691901] [program2] : get SIGSEGV signal
[21534.693649] [program2] : child process terminated
[21534.695590] [program2] : The return signal is 11
[21535.878098] [program2] : module_exit./my
```

Stop:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21576.330458] [program2] : module_init {Li Nanxuan} {120090860}
[21576.333807] [program2]: module_init create kthread start
[21576.336386] [program2]: module_init kthread start
[21576.338899] [program2] : The child process has pid = 23611
[21576.341076] [program2] : This is the parent process, pid = 23609
[21576.342747] [program2] : child process
[21576.344256] [program2] : get SIGSTOP signal
[21576.345723] [program2] : child process stopped
[21576.347113] [program2] : The return signal is 0
[21579.061839] [program2] : module_exit./my
```

Terminate:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21611.698306] [program2] : module_init {Li Nanxuan} {120090860}
[21611.703178] [program2]: module_init create kthread start
[21611.706270] [program2]: module_init kthread start
[21611.709528] [program2] : The child process has pid = 24034
[21611.712845] [program2] : This is the parent process, pid = 24033
[21611.715453] [program2] : child process
[21611.717553] [program2] : get SIGTERM signal
[21611.719599] [program2] : child process terminated
[21611.722146] [program2] : The return signal is 15
[21613.406769] [program2] : module_exit./my
```


Trap:

```
root@ubuntu-xenial:/home/vagrant/csc3150/source/program2# dmesg | tail -n 10
[21648.487731] [program2] : module_init {Li Nanxuan} {120090860}
[21648.490441] [program2]: module_init create kthread start
[21648.492960] [program2]: module_init kthread start
[21648.495413] [program2] : The child process has pid = 24458
[21648.497598] [program2] : This is the parent process, pid = 24457
[21648.500878] [program2] : child process
[21648.611800] [program2] : get SIGTRAP signal
[21648.613550] [program2] : child process terminated
[21648.615860] [program2] : The return signal is 5
[21650.743047] [program2] : module_exit./my
```

4. Gain

I learned a lot from this task. I learned how to program in the Linux user mode and kernel mode and how to compile Linux kernel. I also learned how to fork a process and create a thread both in user mode and kernel mode. Moreover, I learned some basic commands and knowledge of Linux operating system.