

EXERCISE

3.2 Including the initial parent process, how many processes are created by the program shown in Figure 3.31?

```
#include <stdio.h>
#include <unistd.h>

int main()
{
    /* fork a child process */
    fork();

    /* fork another child process */
    fork();

    /* and fork another */
    fork();

    return 0;
}
```

Figure 3.31 How many processes are created?

$2^3=8$ processes are created.

3.14 Using the program in Figure 3.34, identify the values of pid at lines A, B, C, and D. (Assume that the actual pids of the parent and child are 2600 and 2603, respectively.)

```
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>

int main()
{
    pid_t pid, pid1;

    /* fork a child process */
    pid = fork();

    if (pid < 0) { /* error occurred */
        fprintf(stderr, "Fork Failed");
        return 1;
    }
    else if (pid == 0) { /* child process */
        pid1 = getpid();
        printf("child: pid = %d",pid); /* A */
        printf("child: pid1 = %d",pid1); /* B */
    }
    else { /* parent process */
        pid1 = getpid();
        printf("parent: pid = %d",pid); /* C */
        printf("parent: pid1 = %d",pid1); /* D */
        wait(NULL);
    }

    return 0;
}
```

Figure 3.34 What are the pid values?

A: 0; B: 2603; C: 2603; D:2600

3.17 Using the program shown in Figure 3.35, explain what the output will be at lines X and Y.

```
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>

#define SIZE 5

int nums[SIZE] = {0,1,2,3,4};

int main()
{
    int i;
    pid_t pid;

    pid = fork();

    if (pid == 0) {
        for (i = 0; i < SIZE; i++) {
            nums[i] *= -i;
            printf("CHILD: %d ",nums[i]); /* LINE X */
        }
    }
    else if (pid > 0) {
        wait(NULL);
        for (i = 0; i < SIZE; i++)
            printf("PARENT: %d ",nums[i]); /* LINE Y */
    }

    return 0;
}
```

Figure 3.35 What output will be at Line X and Line Y?

Line X:

CHILD: 0 CHILD: -1 CHILD: -4 CHILD: -9 CHILD: -16

Line Y:

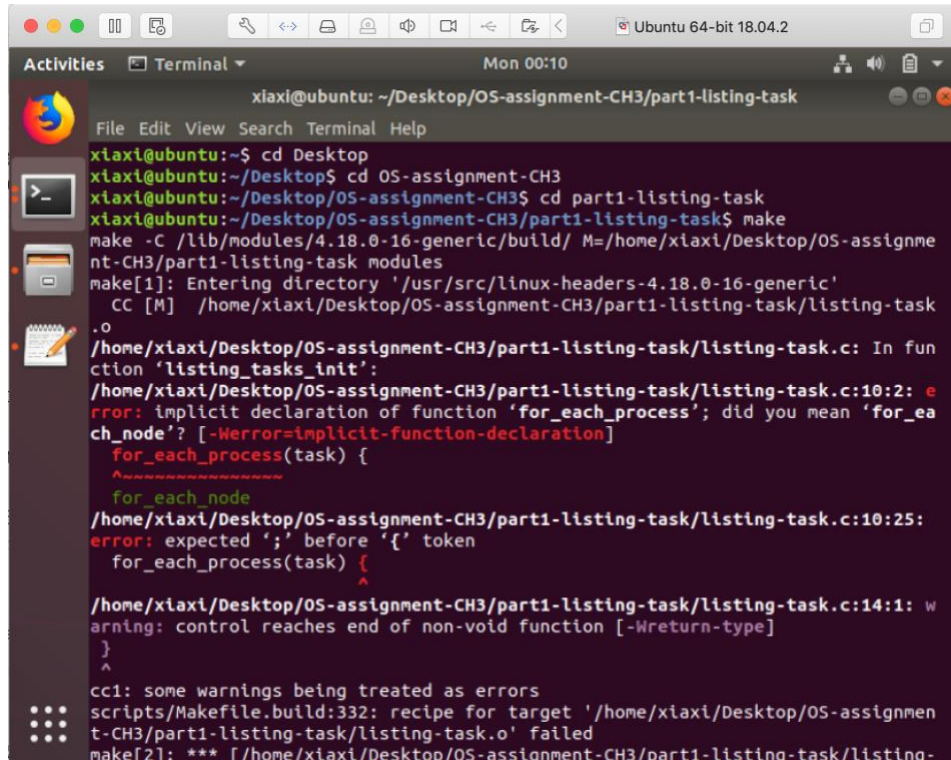
PARENT: 0 PARENT: 1 PARENT: 2 PARENT: 3 PARENT: 4

Programming Project

Project 2—Linux Kernel Module for Listing Tasks

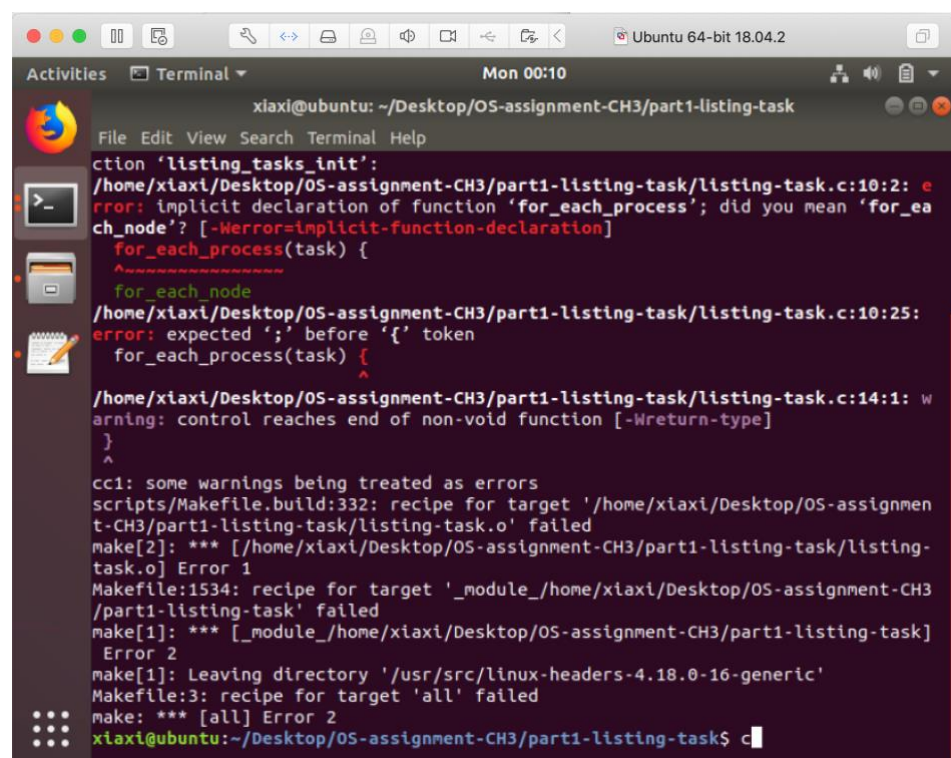
Part I—Iterating over Tasks Linearly

1. 到目标文件夹，make 编译



```
xiaxi@ubuntu: ~/Desktop/OS-assignment-CH3/part1-listing-task
File Edit View Search Terminal Help
xixi@ubuntu:~$ cd Desktop
xixi@ubuntu:~/Desktop$ cd OS-assignment-CH3
xixi@ubuntu:~/Desktop/OS-assignment-CH3$ cd part1-listing-task
xixi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ make
make -C /lib/modules/4.18.0-16-generic/build/ M=/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task modules
make[1]: Entering directory '/usr/src/linux-headers-4.18.0-16-generic'
  CC [M]  /home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c: In function 'listing_tasks_init':
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:10:2: error: implicit declaration of function 'for_each_process'; did you mean 'for_each_node'? [-Werror=implicit-function-declaration]
   for_each_process(task) {
   ^
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:10:25: error: expected ';', before '{' token
   for_each_process(task) {
   ^
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:14:1: warning: control reaches end of non-void function [-Wreturn-type]
   }
   ^
cc1: some warnings being treated as errors
scripts/Makefile.build:332: recipe for target '/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o' failed
make[1]: *** [/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o] Error 1
make[2]: *** [/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o] Error 1
make[1]: Leaving directory '/usr/src/linux-headers-4.18.0-16-generic'
Makefile:3: recipe for target 'all' failed
make: *** [all] Error 2
```

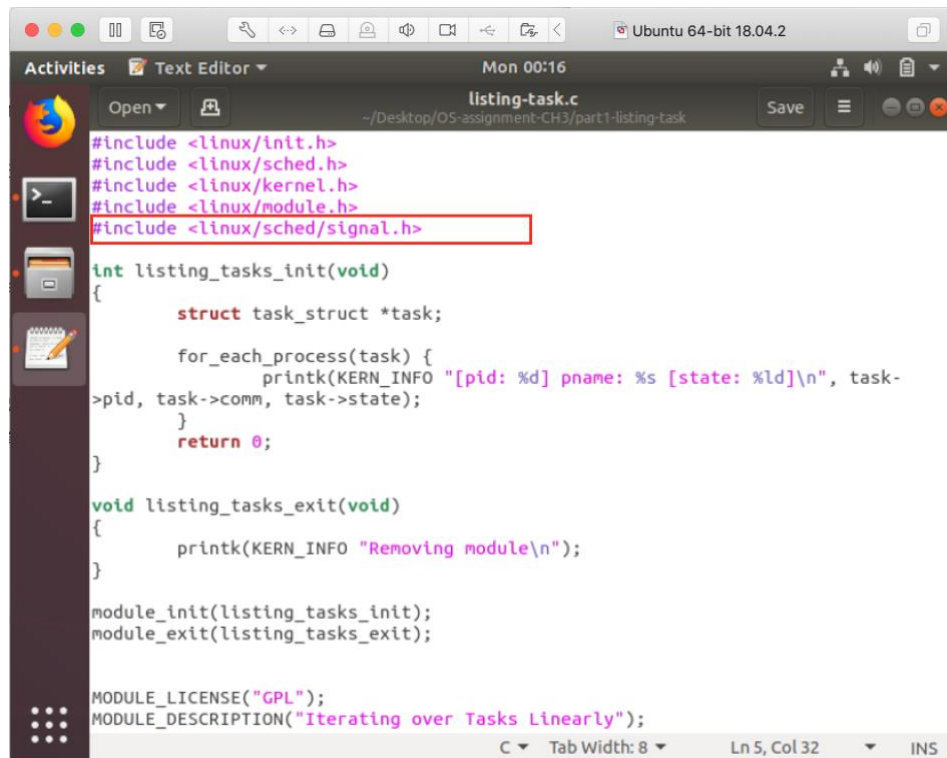
2. 发现报错



```
xiaxi@ubuntu: ~/Desktop/OS-assignment-CH3/part1-listing-task
File Edit View Search Terminal Help
xixi@ubuntu:~$ cd Desktop
xixi@ubuntu:~/Desktop$ cd OS-assignment-CH3
xixi@ubuntu:~/Desktop/OS-assignment-CH3$ cd part1-listing-task
xixi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ make
make -C /lib/modules/4.18.0-16-generic/build/ M=/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task modules
make[1]: Entering directory '/usr/src/linux-headers-4.18.0-16-generic'
  CC [M]  /home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c: In function 'listing_tasks_init':
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:10:2: error: implicit declaration of function 'for_each_process'; did you mean 'for_each_node'? [-Werror=implicit-function-declaration]
   for_each_process(task) {
   ^
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:10:25: error: expected ';' before '{' token
   for_each_process(task) {
   ^
/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.c:14:1: warning: control reaches end of non-void function [-Wreturn-type]
   }
   ^
cc1: some warnings being treated as errors
scripts/Makefile.build:332: recipe for target '/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o' failed
make[1]: *** [/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o] Error 1
make[2]: *** [/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o] Error 1
make[1]: Leaving directory '/usr/src/linux-headers-4.18.0-16-generic'
Makefile:3: recipe for target 'all' failed
make: *** [all] Error 2
xixi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ c
```

3. debug

此处报错是因为 `for_each_process` 的方法定义在 `include/linux/sched.h` 文件下，应该添加头文件的引用。



```
#include <linux/init.h>
#include <linux/sched.h>
#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/sched/signal.h>

int listing_tasks_init(void)
{
    struct task_struct *task;

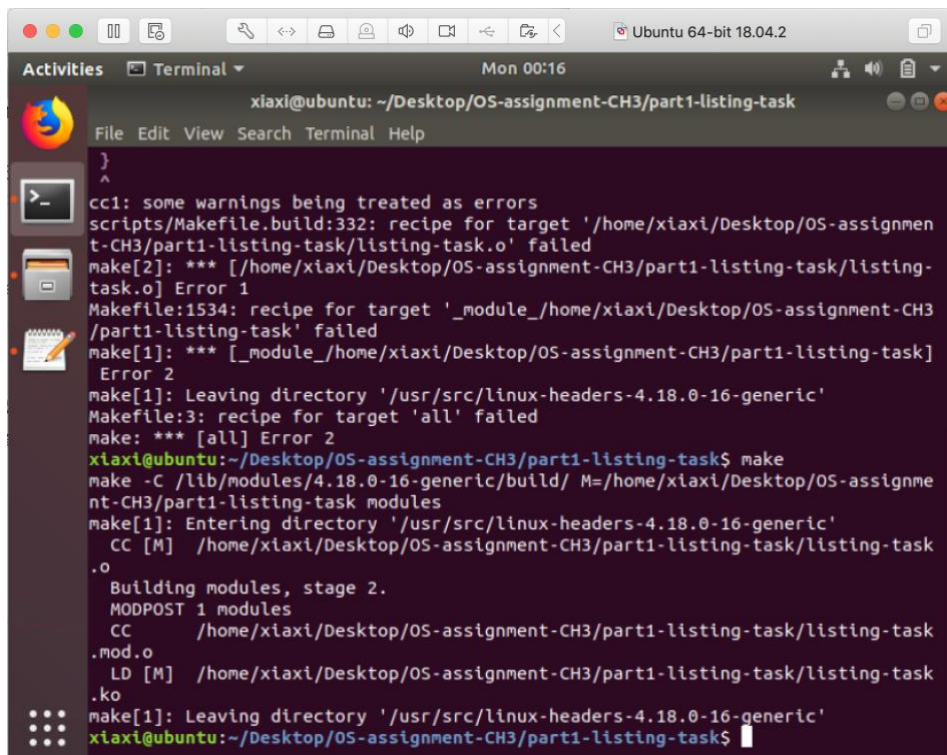
    for_each_process(task) {
        printk(KERN_INFO "[pid: %d] pname: %s [state: %ld]\n", task-
>pid, task->comm, task->state);
    }
    return 0;
}

void listing_tasks_exit(void)
{
    printk(KERN_INFO "Removing module\n");
}

module_init(listing_tasks_init);
module_exit(listing_tasks_exit);

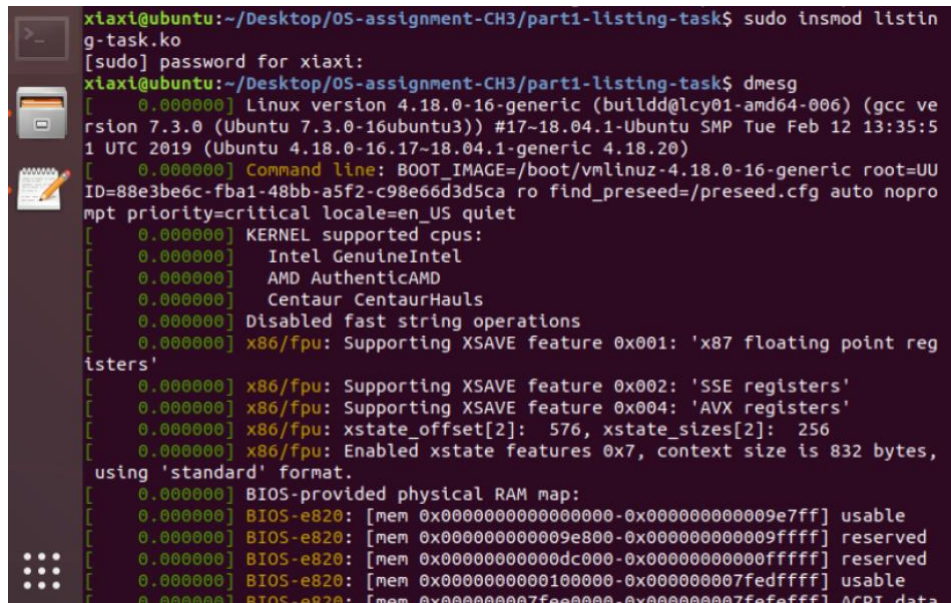
MODULE_LICENSE("GPL");
MODULE_DESCRIPTION("Iterating over Tasks Linearly");
```

4. 重新 make 编译



```
cc1: some warnings being treated as errors
scripts/Makefile.build:332: recipe for target '/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o' failed
make[2]: *** [/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o] Error 1
Makefile:1534: recipe for target '_module_/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task' failed
make[1]: *** [_module_/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task] Error 2
make[1]: Leaving directory '/usr/src/linux-headers-4.18.0-16-generic'
Makefile:3: recipe for target 'all' failed
make: *** [all] Error 2
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ make
make -C /lib/modules/4.18.0-16-generic/build/ M=/home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task modules
make[1]: Entering directory '/usr/src/linux-headers-4.18.0-16-generic'
  CC [M] /home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC /home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.mod.o
  LD [M] /home/xiaxi/Desktop/OS-assignment-CH3/part1-listing-task/listing-task.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.18.0-16-generic'
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$
```


5. 插入模块

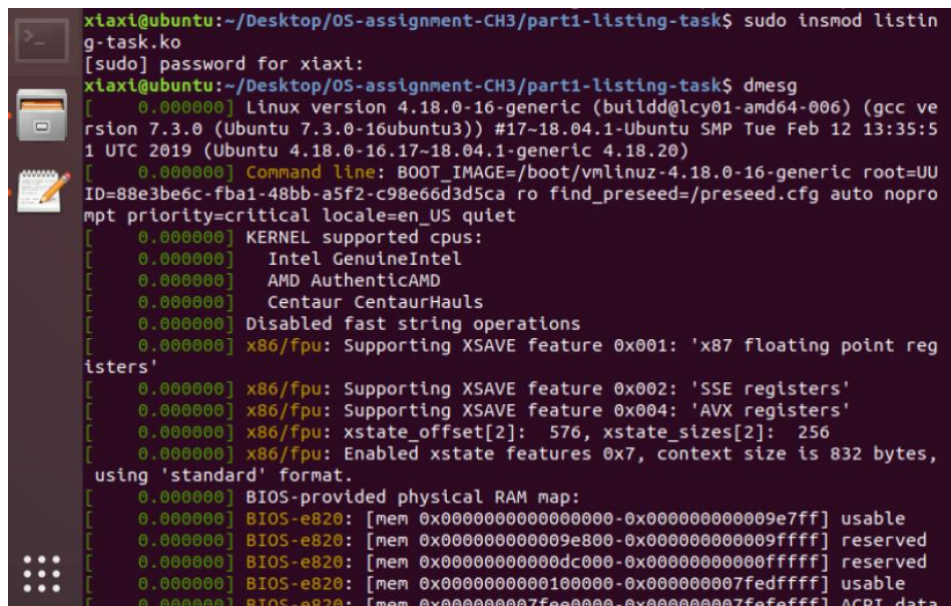


```

xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ sudo insmod listing-task.ko
[sudo] password for xiaxi:
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ dmesg
[ 0.000000] Linux version 4.18.0-16-generic (buildd@lcy01-amd64-006) (gcc ve
rsion 7.3.0 (Ubuntu 7.3.0-16ubuntu3)) #17~18.04.1-Ubuntu SMP Tue Feb 12 13:35:5
1 UTC 2019 (Ubuntu 4.18.0-16.17~18.04.1-generic 4.18.20)
[ 0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-4.18.0-16-generic root=UU
ID=88e3be6c-fba1-48bb-a5f2-c98e66d3d5ca ro find_preseed=/preseed.cfg auto nopro
mpt priority=critical locale=en_US quiet
[ 0.000000] KERNEL supported cpus:
[ 0.000000] Intel GenuineIntel
[ 0.000000] AMD AuthenticAMD
[ 0.000000] Centaur CentaurHauls
[ 0.000000] Disabled fast string operations
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point reg
isters'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
[ 0.000000] x86/fpu: xstate_offset[2]: 576, xstate_sizes[2]: 256
[ 0.000000] x86/fpu: Enabled xstate features 0x7, context size is 832 bytes,
using 'standard' format.
[ 0.000000] BIOS-provided physical RAM map:
[ 0.000000] BIOS-e820: [mem 0x0000000000000000-0x0000000000009e7ff] usable
[ 0.000000] BIOS-e820: [mem 0x0000000000009e800-0x0000000000009ffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000000dc000-0x000000000000ffffff] reserved
[ 0.000000] BIOS-e820: [mem 0x00000000000100000-0x0000000000007fedffff] usable
[ 0.000000] BIOS-e820: [mem 0x000000000007fee0000-0x000000000007fefeffff] ACPI data

```

6. dmsg 检查



```

xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ sudo insmod listing-task.ko
[sudo] password for xiaxi:
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ dmesg
[ 0.000000] Linux version 4.18.0-16-generic (buildd@lcy01-amd64-006) (gcc ve
rsion 7.3.0 (Ubuntu 7.3.0-16ubuntu3)) #17~18.04.1-Ubuntu SMP Tue Feb 12 13:35:5
1 UTC 2019 (Ubuntu 4.18.0-16.17~18.04.1-generic 4.18.20)
[ 0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-4.18.0-16-generic root=UU
ID=88e3be6c-fba1-48bb-a5f2-c98e66d3d5ca ro find_preseed=/preseed.cfg auto nopro
mpt priority=critical locale=en_US quiet
[ 0.000000] KERNEL supported cpus:
[ 0.000000] Intel GenuineIntel
[ 0.000000] AMD AuthenticAMD
[ 0.000000] Centaur CentaurHauls
[ 0.000000] Disabled fast string operations
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point reg
isters'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
[ 0.000000] x86/fpu: xstate_offset[2]: 576, xstate_sizes[2]: 256
[ 0.000000] x86/fpu: Enabled xstate features 0x7, context size is 832 bytes,
using 'standard' format.
[ 0.000000] BIOS-provided physical RAM map:
[ 0.000000] BIOS-e820: [mem 0x0000000000000000-0x0000000000009e7ff] usable
[ 0.000000] BIOS-e820: [mem 0x0000000000009e800-0x0000000000009ffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000000dc000-0x000000000000ffffff] reserved
[ 0.000000] BIOS-e820: [mem 0x00000000000100000-0x0000000000007fedffff] usable
[ 0.000000] BIOS-e820: [mem 0x000000000007fee0000-0x000000000007fefeffff] ACPI data

```

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```

[ 3961.392723] [pid: 1609] pname: gvfsd-metadata [state: 1]
[ 3961.392724] [pid: 1717] pname: dhclient [state: 1]
[ 3961.392725] [pid: 1788] pname: nautilus [state: 1]
[ 3961.392726] [pid: 1830] pname: gvfsd-recent [state: 1]
[ 3961.392726] [pid: 1846] pname: zeitgeist-daemo [state: 1]
[ 3961.392727] [pid: 1852] pname: zeitgeist-fts [state: 1]
[ 3961.392728] [pid: 1859] pname: gnome-software [state: 1]
[ 3961.392729] [pid: 1861] pname: update-notifier [state: 1]
[ 3961.392729] [pid: 1879] pname: fwupd [state: 1]
[ 3961.392730] [pid: 1954] pname: deja-dup-monito [state: 1]
[ 3961.392731] [pid: 2064] pname: 155409952928890 [state: 1]
[ 3961.392732] [pid: 2065] pname: sleep [state: 1]
[ 3961.392732] [pid: 2066] pname: ukuu-gtk [state: 1]
[ 3961.392733] [pid: 2616] pname: loop10 [state: 1]
[ 3961.392734] [pid: 2674] pname: loop11 [state: 1]
[ 3961.392734] [pid: 2753] pname: loop12 [state: 1]
[ 3961.392735] [pid: 2832] pname: loop13 [state: 1]
[ 3961.392736] [pid: 2912] pname: loop14 [state: 1]
[ 3961.392736] [pid: 3076] pname: loop15 [state: 1]
[ 3961.392737] [pid: 3598] pname: gedit [state: 1]
[ 3961.392738] [pid: 3631] pname: gnome-terminal- [state: 1]
[ 3961.392739] [pid: 3642] pname: bash [state: 1]
[ 3961.392739] [pid: 4106] pname: kworker/u256:0 [state: 1026]
[ 3961.392740] [pid: 4677] pname: kworker/u256:1 [state: 1026]
[ 3961.392741] [pid: 4698] pname: loop16 [state: 1]
[ 3961.392741] [pid: 4747] pname: snapd [state: 1]
[ 3961.392742] [pid: 4812] pname: sudo [state: 1]
[ 3961.392743] [pid: 4813] pname: insmod [state: 0]
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ ps -el

```

7. 对比 ps -el 显示的信息

```

[ 3961.392743] [pid: 4813] pname: insmod [state: 0]
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$ ps -el

```

F	S	UID	PID	PPID	C	PRI	NI	ADDR	SZ	WCHAN	TTY	TIME	CMD
4	S	0	1	0	0	80	0	-40035	-	-	?	00:00:04	systemd
1	S	0	2	0	0	80	0	-	0	-	?	00:00:00	kthreadd
1	I	0	3	2	0	60	-20	-	0	-	?	00:00:00	rcu_gp
1	I	0	4	2	0	60	-20	-	0	-	?	00:00:00	rcu_par_gp
1	I	0	6	2	0	60	-20	-	0	-	?	00:00:00	kworker/0:0
1	I	0	8	2	0	60	-20	-	0	-	?	00:00:00	mm_percpu_w
1	S	0	9	2	0	80	0	-	0	-	?	00:00:01	ksoftirqd/0
1	I	0	10	2	0	80	0	-	0	-	?	00:00:01	rcu_sched
1	I	0	11	2	0	80	0	-	0	-	?	00:00:00	rcu_bh
1	S	0	12	2	0	-40	-	-	0	-	?	00:00:00	migration/0
5	S	0	13	2	0	-40	-	-	0	-	?	00:00:00	watchdog/0
1	S	0	14	2	0	80	0	-	0	-	?	00:00:00	cpuhp/0
5	S	0	15	2	0	80	0	-	0	-	?	00:00:00	kdevtmpfs
1	I	0	16	2	0	60	-20	-	0	-	?	00:00:00	netns
1	S	0	17	2	0	80	0	-	0	-	?	00:00:00	rcu_tasks_k
1	S	0	18	2	0	80	0	-	0	-	?	00:00:00	kaudtd
1	S	0	19	2	0	80	0	-	0	-	?	00:00:00	khungtaskd
1	S	0	20	2	0	80	0	-	0	-	?	00:00:00	oom_reaper
1	I	0	21	2	0	60	-20	-	0	-	?	00:00:00	writeback
1	S	0	22	2	0	80	0	-	0	-	?	00:00:00	kcompactd0
1	S	0	23	2	0	85	5	-	0	-	?	00:00:00	ksmd
1	S	0	24	2	0	99	19	-	0	-	?	00:00:00	khugepaged
1	I	0	25	2	0	60	-20	-	0	-	?	00:00:00	crypto
1	I	0	26	2	0	60	-20	-	0	-	?	00:00:00	kintegrityd
1	I	0	27	2	0	60	-20	-	0	-	?	00:00:00	kblockd
1	I	0	28	2	0	60	-20	-	0	-	?	00:00:00	ata_sff

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```

File Edit View Search Terminal Help
0 S 1000 1609 1145 0 80 0 - 51137 poll_s ? 00:00:00 gvfsd-metad
4 S 0 1717 538 0 80 0 - 6415 - ? 00:00:00 dhclient
0 S 1000 1788 1145 0 80 0 - 250394 poll_s ? 00:00:07 nautilus
0 S 1000 1830 1304 0 80 0 - 94179 poll_s ? 00:00:00 gvfsd-recen
0 S 1000 1846 1145 0 80 0 - 108370 poll_s ? 00:00:00 zeitgeist-d
0 S 1000 1852 1145 0 80 0 - 81677 poll_s ? 00:00:00 zeitgeist-f
0 S 1000 1859 1176 0 80 0 - 283444 poll_s tty2 00:00:04 gnome-softw
4 S 1000 1861 1176 0 80 0 - 148640 poll_s tty2 00:00:00 update-noti
0 S 0 1879 1 0 80 0 - 138897 - ? 00:00:00 fwupd
0 S 1000 1954 1176 0 80 0 - 215378 poll_s tty2 00:00:00 deja-dup-mo
0 S 1000 2064 1 0 80 0 - 4998 wait tty2 00:00:00 15540995292
0 S 1000 2065 1507 0 80 0 - 3644 hrttime tty2 00:00:00 sleep
0 S 1000 2066 2064 0 80 0 - 106255 poll_s tty2 00:00:00 ukuu-gtk
1 S 0 2616 2 0 60 -20 - 0 - ? 00:00:00 loop10
1 S 0 2674 2 0 60 -20 - 0 - ? 00:00:00 loop11
1 S 0 2753 2 0 60 -20 - 0 - ? 00:00:00 loop12
1 S 0 2832 2 0 60 -20 - 0 - ? 00:00:00 loop13
1 S 0 2912 2 0 60 -20 - 0 - ? 00:00:00 loop14
1 S 0 3076 2 0 60 -20 - 0 - ? 00:00:00 loop15
0 S 1000 3598 1145 0 80 0 - 188079 poll_s ? 00:00:01 gedit
0 S 1000 3631 1145 0 80 0 - 200775 poll_s ? 00:00:03 gnome-termi
0 S 1000 3642 3631 0 80 0 - 7421 wait pts/1 00:00:00 bash
1 I 0 4106 2 0 80 0 - 0 - ? 00:00:00 kworker/u25
1 S 0 4698 2 0 60 -20 - 0 - ? 00:00:00 loop16
4 S 0 4747 1 0 80 0 - 160085 - ? 00:00:01 snapd
1 I 0 4857 2 0 80 0 - 0 - ? 00:00:00 kworker/u25
0 R 1000 4883 3642 0 80 0 - 9004 - pts/1 00:00:00 ps
xiixi@ubuntu:~/Desktop/OS-assignment-CH3/part1-listing-task$

```

可以看到两种方式列出的 task 差不多，比如 loop10, loop11, loop12, loop13 ...这些。

Part II—Iterating over Tasks with a Depth-First Search Tree

1. cd 到文件夹，make 编译

```

xiixi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$ make
make -C /lib/modules/4.18.0-16-generic/build/ M=/home/xiixi/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks modules
make[1]: Entering directory '/usr/src/linux-headers-4.18.0-16-generic'
CC [M] /home/xiixi/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks/dfs-tree-tasks.o
Building modules, stage 2.
MODPOST 1 modules
CC /home/xiixi/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks/dfs-tree-tasks.mod.o
LD [M] /home/xiixi/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks/dfs-tree-tasks.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.18.0-16-generic'

```

注：从 Linux 内核 4.11 开始，变量 `init_task` 在 `linux/sched/task.h` 被声明，而不是在 `linux/sched.h`

```

Open ▾ | dfs-tree-tasks.c | Save |
~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks
#include <linux/init.h>
#include <linux/sched/task.h>
#include <linux/kernel.h>
#include <linux/module.h>

void dfs(struct task_struct *task)
{
    struct task_struct *next_task;
    struct list_head *list;
    list_for_each(list, &task->children) {
        next_task = list_entry(list, struct task_struct, sibling);
        printk(KERN_INFO "[pid: %d] pname: %s [state: %ld]\n", next_task-
        >pid, next_task->comm, next_task->state);
        dfs(next_task);
    }
}

int dfs_tree_tasks_init(void)
{
    printk(KERN_INFO "Loading module\n");
    dfs(&init_task);
    return 0;
}

void dfs_tree_tasks_exit(void)
{
    printk(KERN_INFO "Removing module\n");
}

```

2. 插入模块

```
xiexi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$ sudo insmod dfs-tree-tasks.ko
```

3. dmesg 检查

```

xiexi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$ dmesg
[ 0.000000] Linux version 4.18.0-16-generic (build@lcy01-amd64-006) (gcc ve
rsion 7.3.0 (Ubuntu 7.3.0-16ubuntu3)) #17~18.04.1-Ubuntu SMP Tue Feb 12 13:35:5
1 UTC 2019 (Ubuntu 4.18.0-16.17~18.04.1-generic 4.18.20)
[ 0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-4.18.0-16-generic root=UU
ID=88e3be6c-fba1-48bb-a5f2-c98e66d3d5ca ro find_preseed=/preseed.cfg auto nopro
mpt priority=critical locale=en_US quiet
[ 0.000000] KERNEL supported cpus:
[ 0.000000] Intel GenuineIntel
[ 0.000000] AMD AuthenticAMD
[ 0.000000] Centaur CentaurHauls
[ 0.000000] Disabled fast string operations
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point reg
isters'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[ 0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
[ 0.000000] x86/fpu: xstate_offset[2]: 576, xstate_sizes[2]: 256
[ 0.000000] x86/fpu: Enabled xstate features 0x7, context size is 832 bytes,
using 'standard' format.
[ 0.000000] BIOS-provided physical RAM map:
[ 0.000000] BIOS-e820: [mem 0x0000000000000000-0x00000000000009e7ff] usable
[ 0.000000] BIOS-e820: [mem 0x00000000000009e800-0x0000000000000fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x0000000000000dc000-0x0000000000000fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000000100000-0x0000000000007fedffff] usable
[ 0.000000] BIOS-e820: [mem 0x0000000000007fee0000-0x0000000000007fefffff] ACPI data
[ 0.000000] BIOS-e820: [mem 0x0000000000007feff000-0x0000000000007fefffff] ACPI NVS

```

...

...

(中间还有很多)

...

...


```
arser"
[ 3961.373455] listing_task: loading out-of-tree module taints kernel.
[ 3961.375009] listing_task: module verification failed: signature and/or requi
red key missing - tainting kernel
[ 3961.392468] [pid: 1] pname: systemd [state: 1]
[ 3961.392469] [pid: 2] pname: kthreadd [state: 1]
[ 3961.392470] [pid: 3] pname: rcu_gp [state: 1026]
[ 3961.392471] [pid: 4] pname: rcu_par_gp [state: 1026]
[ 3961.392471] [pid: 6] pname: kworker/0:0H [state: 1026]
[ 3961.392472] [pid: 8] pname: mm_percpu_wq [state: 1026]
[ 3961.392473] [pid: 9] pname: ksoftirqd/0 [state: 1]
[ 3961.392473] [pid: 10] pname: rcu_sched [state: 1026]
[ 3961.392474] [pid: 11] pname: rcu_bh [state: 1026]
```

...

...

(中间还有很多)

...

...

```
[ 3961.392735] [pid: 2852] pname: loop13 [state: 1]
[ 3961.392736] [pid: 2912] pname: loop14 [state: 1]
[ 3961.392736] [pid: 3076] pname: loop15 [state: 1]
[ 3961.392737] [pid: 3598] pname: gedit [state: 1]
[ 3961.392738] [pid: 3631] pname: gnome-terminal- [state: 1]
[ 3961.392739] [pid: 3642] pname: bash [state: 1]
[ 3961.392739] [pid: 4106] pname: kworker/u256:0 [state: 1026]
[ 3961.392740] [pid: 4677] pname: kworker/u256:1 [state: 1026]
[ 3961.392741] [pid: 4698] pname: loop16 [state: 1]
[ 3961.392741] [pid: 4747] pname: snapd [state: 1]
[ 3961.392742] [pid: 4812] pname: sudo [state: 1]
[ 3961.392743] [pid: 4813] pname: insmod [state: 0]
[ 7815.789710] e1000: ens33 NIC Link is Down
[ 7821.838105] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control:
None
[ 7950.232058] Loading module
[ 7950.232060] [pid: 1] pname: systemd [state: 1]
[ 7950.232061] [pid: 334] pname: systemd-journal [state: 1]
[ 7950.232062] [pid: 355] pname: vmware-vmblock- [state: 1]
[ 7950.232062] [pid: 373] pname: systemd-udev [state: 0]
[ 7950.232063] [pid: 375] pname: vmttoolsd [state: 1]
[ 7950.232064] [pid: 459] pname: systemd-timesyn [state: 1]
[ 7950.232064] [pid: 461] pname: systemd-resolve [state: 1]
[ 7950.232065] [pid: 511] pname: dbus-daemon [state: 1]
[ 7950.232066] [pid: 538] pname: NetworkManager [state: 1]
[ 7950.232067] [pid: 5530] pname: dhclient [state: 1]
[ 7950.232067] [pid: 545] pname: acpid [state: 1]
[ 7950.232068] [pid: 548] pname: udiskd [state: 1]
[ 7950.232069] [pid: 549] pname: systemd-logind [state: 1]
```

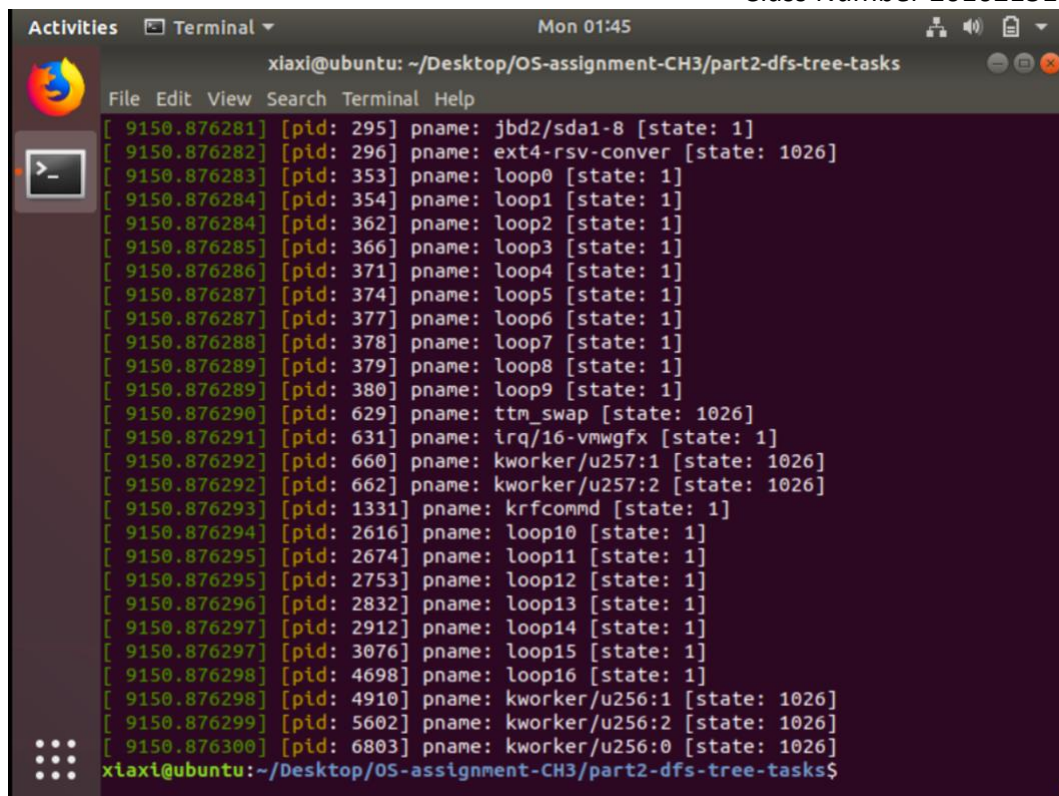
...

...

(中间还有很多)

...

...

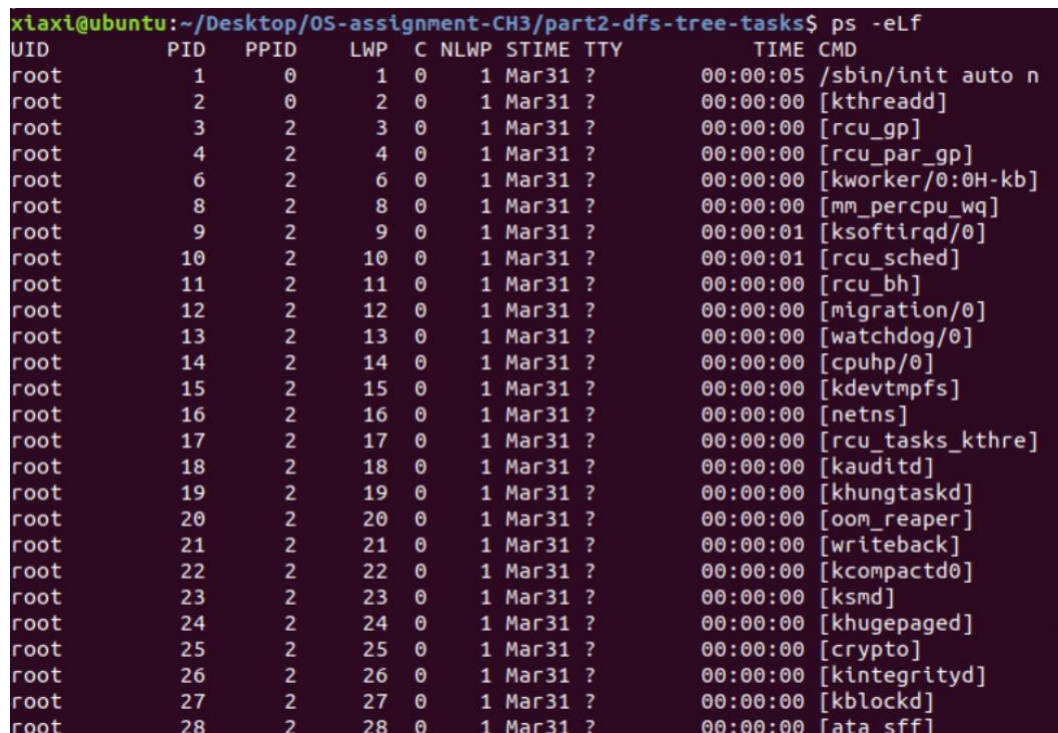


```

Activities  Terminal  Mon 01:45
xiaxi@ubuntu: ~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks
File Edit View Search Terminal Help
[ 9150.876281] [pid: 295] pname: jbd2/sda1-8 [state: 1]
[ 9150.876282] [pid: 296] pname: ext4-rsv-conver [state: 1026]
[ 9150.876283] [pid: 353] pname: loop0 [state: 1]
[ 9150.876284] [pid: 354] pname: loop1 [state: 1]
[ 9150.876284] [pid: 362] pname: loop2 [state: 1]
[ 9150.876285] [pid: 366] pname: loop3 [state: 1]
[ 9150.876286] [pid: 371] pname: loop4 [state: 1]
[ 9150.876287] [pid: 374] pname: loop5 [state: 1]
[ 9150.876287] [pid: 377] pname: loop6 [state: 1]
[ 9150.876288] [pid: 378] pname: loop7 [state: 1]
[ 9150.876289] [pid: 379] pname: loop8 [state: 1]
[ 9150.876289] [pid: 380] pname: loop9 [state: 1]
[ 9150.876290] [pid: 629] pname: ttm_swap [state: 1026]
[ 9150.876291] [pid: 631] pname: irq/16-vmwgfx [state: 1]
[ 9150.876292] [pid: 660] pname: kworker/u257:1 [state: 1026]
[ 9150.876292] [pid: 662] pname: kworker/u257:2 [state: 1026]
[ 9150.876293] [pid: 1331] pname: krfcomm [state: 1]
[ 9150.876294] [pid: 2616] pname: loop10 [state: 1]
[ 9150.876295] [pid: 2674] pname: loop11 [state: 1]
[ 9150.876295] [pid: 2753] pname: loop12 [state: 1]
[ 9150.876296] [pid: 2832] pname: loop13 [state: 1]
[ 9150.876297] [pid: 2912] pname: loop14 [state: 1]
[ 9150.876297] [pid: 3076] pname: loop15 [state: 1]
[ 9150.876298] [pid: 4698] pname: loop16 [state: 1]
[ 9150.876298] [pid: 4910] pname: kworker/u256:1 [state: 1026]
[ 9150.876299] [pid: 5602] pname: kworker/u256:2 [state: 1026]
[ 9150.876300] [pid: 6803] pname: kworker/u256:0 [state: 1026]
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$

```

4. ps-elf 检查



```

xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$ ps -elf
UID      PID  PPID    LWP  C  NLWP  STIME  TTY          TIME CMD
root         1      0        1  0      1  Mar31  ?           00:00:05 /sbin/init auto n
root         2      0        2  0      1  Mar31  ?           00:00:00 [kthreadd]
root         3      2        3  0      1  Mar31  ?           00:00:00 [rcu_gp]
root         4      2        4  0      1  Mar31  ?           00:00:00 [rcu_par_gp]
root         6      2        6  0      1  Mar31  ?           00:00:00 [kworker/0:0H-kb]
root         8      2        8  0      1  Mar31  ?           00:00:00 [mm_percpu_wq]
root         9      2        9  0      1  Mar31  ?           00:00:01 [ksoftirqd/0]
root        10      2       10  0      1  Mar31  ?           00:00:01 [rcu_sched]
root        11      2       11  0      1  Mar31  ?           00:00:00 [rcu_bh]
root        12      2       12  0      1  Mar31  ?           00:00:00 [migration/0]
root        13      2       13  0      1  Mar31  ?           00:00:00 [watchdog/0]
root        14      2       14  0      1  Mar31  ?           00:00:00 [cpuhp/0]
root        15      2       15  0      1  Mar31  ?           00:00:00 [kdevtmpfs]
root        16      2       16  0      1  Mar31  ?           00:00:00 [netns]
root        17      2       17  0      1  Mar31  ?           00:00:00 [rcu_tasks_kthre]
root        18      2       18  0      1  Mar31  ?           00:00:00 [kauditd]
root        19      2       19  0      1  Mar31  ?           00:00:00 [khungtaskd]
root        20      2       20  0      1  Mar31  ?           00:00:00 [oom_reaper]
root        21      2       21  0      1  Mar31  ?           00:00:00 [writeback]
root        22      2       22  0      1  Mar31  ?           00:00:00 [kcompactd0]
root        23      2       23  0      1  Mar31  ?           00:00:00 [ksmd]
root        24      2       24  0      1  Mar31  ?           00:00:00 [khugepaged]
root        25      2       25  0      1  Mar31  ?           00:00:00 [crypto]
root        26      2       26  0      1  Mar31  ?           00:00:00 [kintegrityd]
root        27      2       27  0      1  Mar31  ?           00:00:00 [kblockd]
root        28      2       28  0      1  Mar31  ?           00:00:00 [ata_sff]

```

...

...

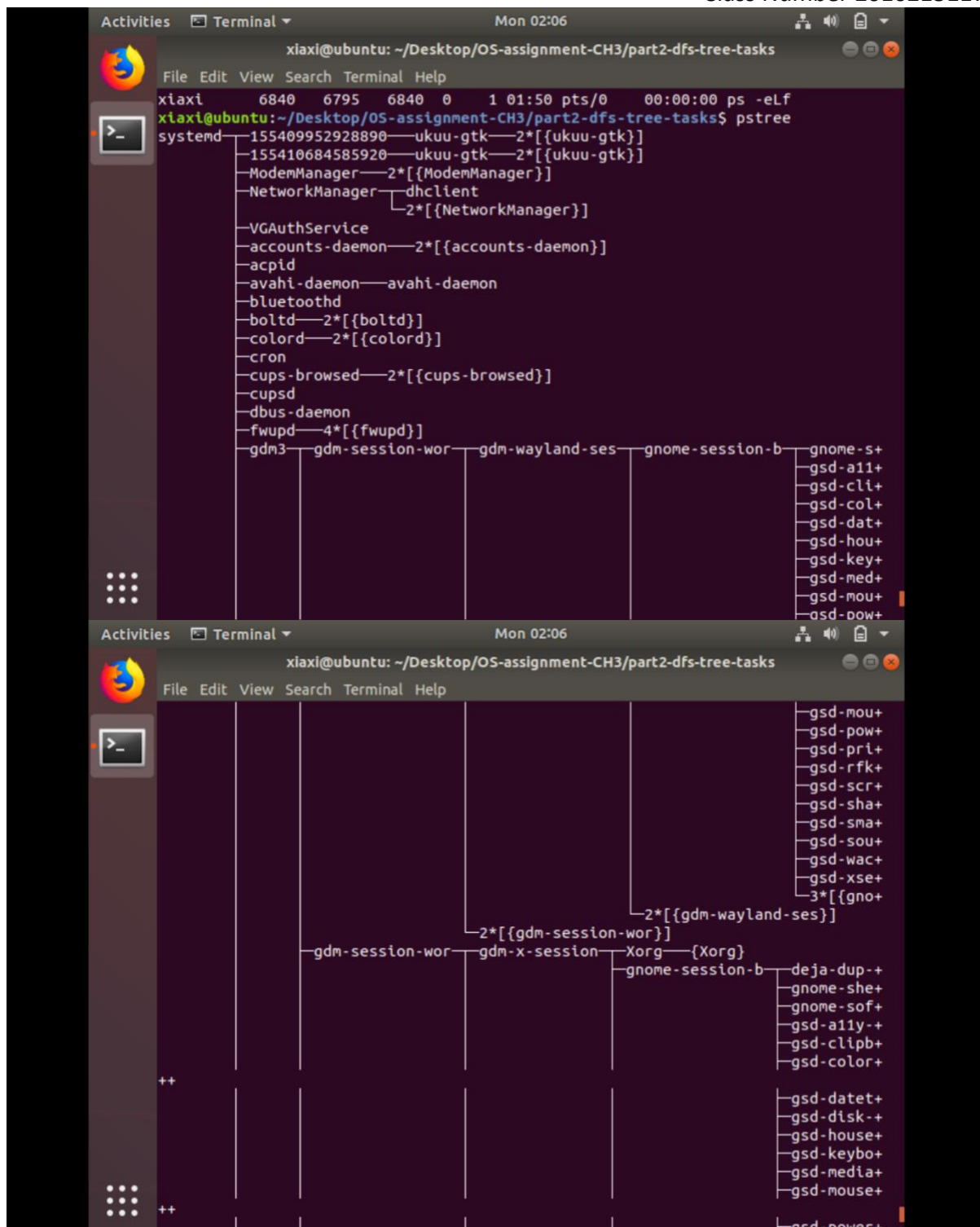
(中间还有很多)

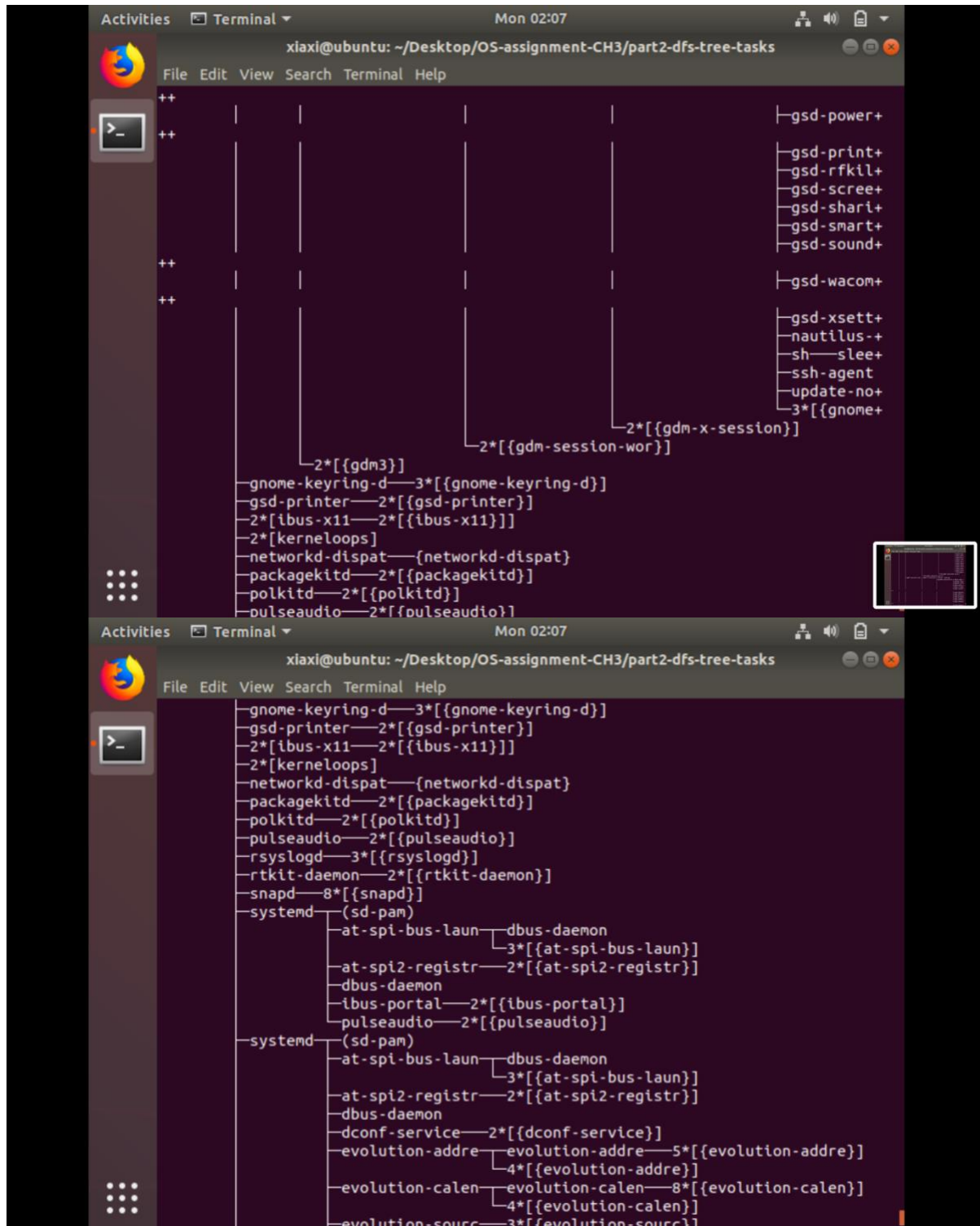
...

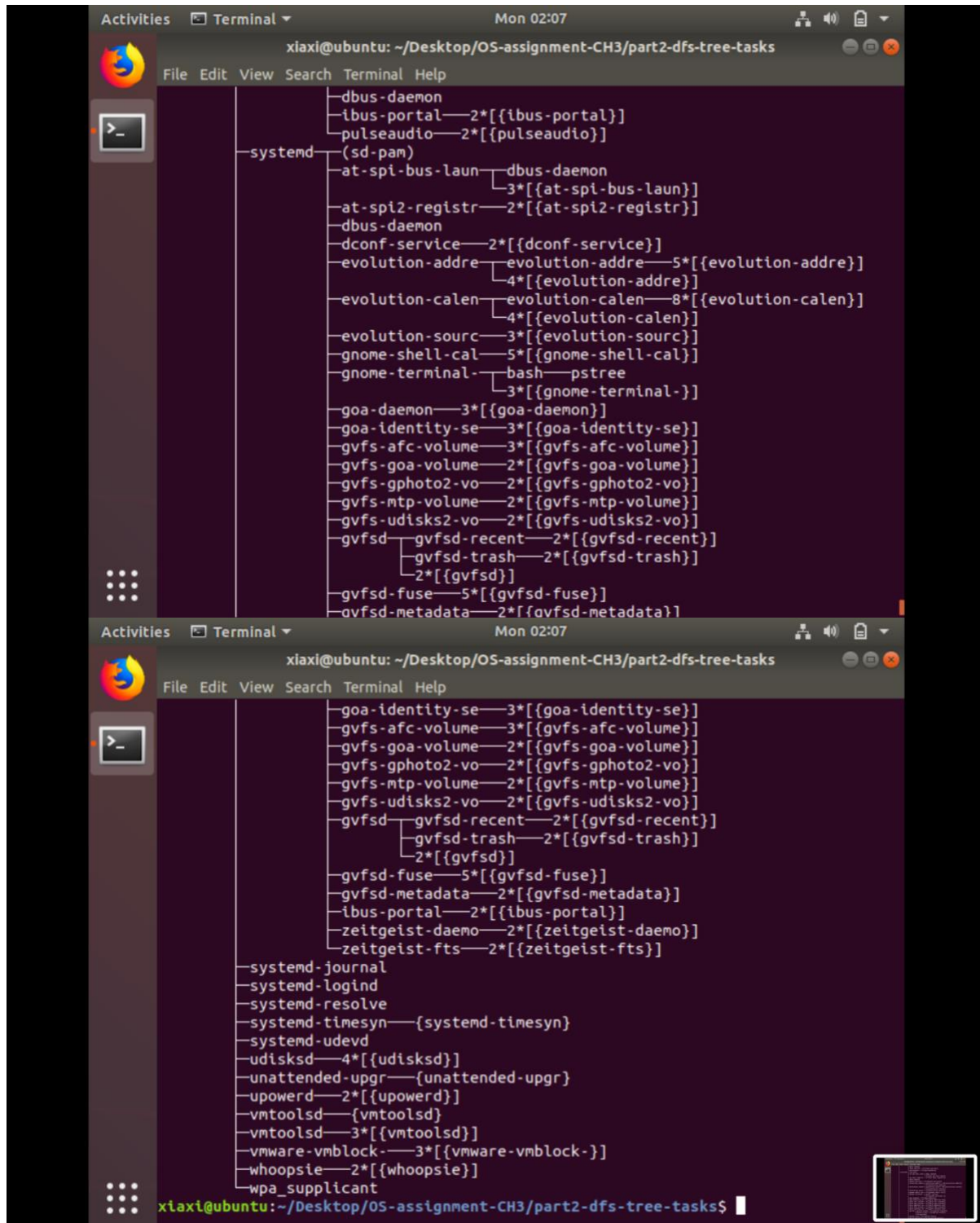
...

```
root      2832      2    2832    0      1 Mar31 ?      00:00:00 [loop13]
root      2912      2    2912    0      1 Mar31 ?      00:00:00 [loop14]
root      3076      2    3076    0      1 00:04 ?      00:00:00 [loop15]
root      4698      2    4698    0      1 00:17 ?      00:00:00 [loop16]
root      4747      1    4747    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4754    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4755    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4756    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4757    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4760    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4761    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4806    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
root      4747      1    4807    0      9 00:17 ?      00:00:00 /usr/lib/snapd/sn
xiaxi     5491        1    5491    0      1 01:20 tty2     00:00:00 /bin/bash /tmp/uk
xiaxi     5492     1507    5492    0      1 01:20 tty2     00:00:00 sleep 2h
xiaxi     5493     5491    5493    0      3 01:20 tty2     00:00:00 ukuu-gtk --notify
xiaxi     5493     5491    5494    0      3 01:20 tty2     00:00:00 ukuu-gtk --notify
xiaxi     5493     5491    5495    0      3 01:20 tty2     00:00:00 ukuu-gtk --notify
root      5530      538    5530    0      1 01:23 ?      00:00:00 /sbin/dhclient -d
root      5602        2    5602    0      1 01:23 ?      00:00:00 [kworker/u256:2-]
xiaxi     6785     1145    6785    0      4 01:43 ?      00:00:01 /usr/lib/gnome-te
xiaxi     6785     1145    6786    0      4 01:43 ?      00:00:00 /usr/lib/gnome-te
xiaxi     6785     1145    6787    0      4 01:43 ?      00:00:00 /usr/lib/gnome-te
xiaxi     6785     1145    6788    0      4 01:43 ?      00:00:00 /usr/lib/gnome-te
xiaxi     6795     6785    6795    0      1 01:43 pts/0     00:00:00 bash
root      6803        2    6803    0      1 01:44 ?      00:00:00 [kworker/u256:0-]
xiaxi     6840     6795    6840    0      1 01:50 pts/0     00:00:00 ps -eLf
xiaxi@ubuntu:~/Desktop/OS-assignment-CH3/part2-dfs-tree-tasks$
```

5. pstree 检查







可以看到各进程的树关系。