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1. 과제 개요

shell의 동작 원리를 이해하고, fork, exec, wait등의 시스템 콜을 사용하여 간단한 쉘을 구현, proc 파일 시스템을 이해하고, 이를 이용하여 top, ps 명령어를 직접 구현해 보는 것이 이 과제의 목표이다.

- **ssu_shell**

ssu_shell은 리눅스 내장 명령어를 실행하는 쉘이다. 입력된 명령어를 공백으로 토큰으로 분리하고, 그 토큰들을 이용해 명령어를 실행시킨다. 그리고 파이프 기능을 수행할 수 있어야 한다. 토큰 분리 등의 기능들은 이미 주어진 코드에 구현되어 있어 토큰을 이용한 명령어 실행, 파이프 기능만 새로 구현하였다.

파이프 기능은 재귀 함수를 이용하여 구현하였다. execute_command() 함수 내에서 fork, exec 시스템콜을 이용하여 명령어를 실행하였고, 파이프 명령어가 있을 시 자식 프로세스에서 exec 직전에 표준 입/출력을 파이프 파일로 바꾸어 파이프 앞의 프로세스와 뒤의 프로세스가 연결되도록 구현하였다.

또한 추가로 구현한 명령어 ttop과 pps는 파일의 위치를 환경변수에 등록하여 별도의 처리 없이 exec 함수를 사용하면 실행될 수 있도록 했다.

위 기능을 모두 ssu_shell.c 파일에 구현하였다.

- **ttop**

ttop은 리눅스 내장 명령어인 top과 유사한 기능을 하는 프로그램이다. 콘솔 크기에 맞춰 프로세스 정보를 출력한다. 위 아래 방향키를 이용해 스크롤을 할 수 있고, 스크롤시, 또는 3초마다 자동으로 갱신이 된다. 스크롤, 자동 갱신, 방향키 입력 등의 기능은 libcurses5-dev 패키지를 이용하여 구현하였다.

각종 프로세스의 정보들은 proc 파일 시스템을 이용하여 구하였다. 또한 프로세스 각각의 정보를 담고 있는 구조체를 두개 만들었다.

```
typedef struct _task_info { // 각 프로세스의 정보 담을 구조체
        pid_t pid;
        char user_name[MAX_USER_NAME + 1];
        long pr; // priority
        long ni; // nice
        unsigned long virt;
        unsigned long res;
        unsigned long shr;
        char s[2]; // status
```

```
                float cpu;

                float mem;

                unsigned long time; // process running time

                char command[BUFFER_SIZE];

        } Task_info;


        typedef struct _simple_task_info { // 간략한 프로세스의 정보를 담는 구조체

                pid_t pid;

                float cpu;

                unsigned long prev_cpu_time;

                unsigned long cur_cpu_time;

                int is_updated; // 갱신되었다면 1, 0이라면 사라진 프로세스로 간주하고 삭제해야함

                char s[2];

        } Simple_task_info;
```

Task_info는 구체적인 정보를 담는 구조체이고, Simple_task_info는 간략한 정보를 담는 구조체이다. top 명령어를 실행하면 프로세스의 목록이 pid와 cpu 사용량을 기준으로 정렬되어 보여지는 것을 알 수 있다. 이렇게 정렬을 하려면 모든 프로세스의 pid와 cpu 사용량을 알고 있어야만 한다. 그런데 모든 프로세스의 자세한 정보들을 3초마다 구하는 것은 비효율적이라고 생각했다. 그래서 우선 Simple_task_info를 이용하여 모든 프로세스의 간략한 정보 (pid와 cpu 사용량 등)만 먼저 구한 뒤에, 프로세스 목록을 정렬했다. 정렬한 프로세스 정보들을 이용하면 화면에 출력할 프로세스들의 리스트를 구할 수 있고, 이 리스트와 Task_info를 이용하여 화면에 출력할 프로세스만 따로 자세한 정보들을 구해 저장했다.

이렇게 화면 갱신이 필요할 때마다 먼저 Simple_task_info들을 갱신하고, 화면에 출력할 프로세스들의 Task_info를 만들어 화면에 출력하도록 했다.

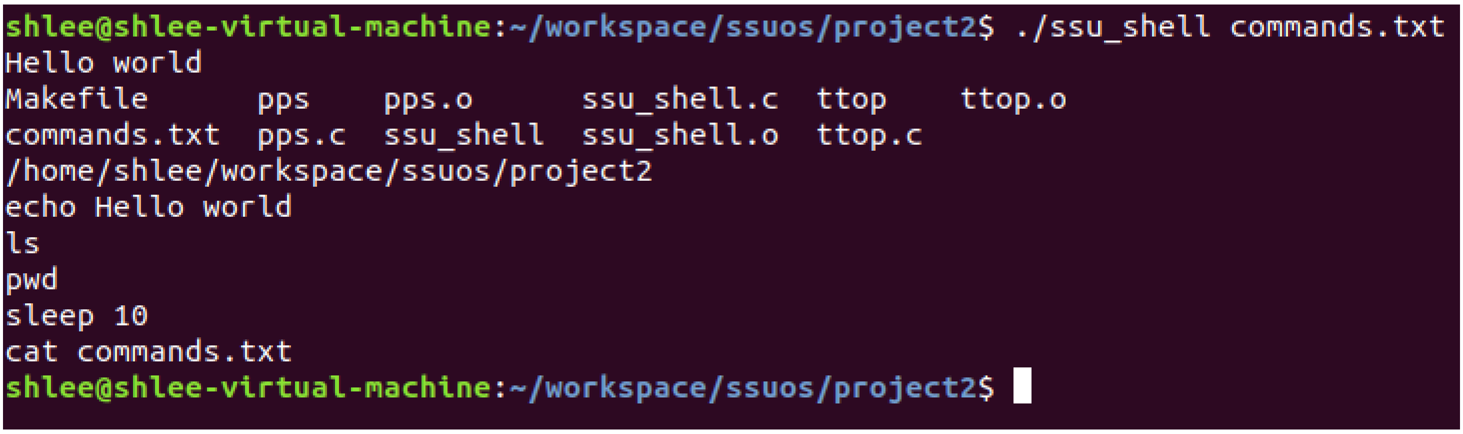
위 기능을 모두 ttop.c에 구현하였다.

- **pps**

pps는 ttop과는 달리 갱신이 필요 없고 결과를 한번만 출력하면 된다. 그래서 무작정 모든 프로세스에 대한 자세한 정보들을 구해 Task_info 구조체에 저장하였다. 여기서 사용한 Task_info 구조체는 ttop에서 사용한 것과 이름은 같지만 멤버 변수들이 조금 다르다. 일단 모든 프로세스의 정보들을 proc 파일 시스템 등을 통해 구한 뒤, 주어진 옵션에 따라 출력할 프로세스를 선별하여 화면에 출력하도록 했다. 그 외에 프로세스의 정보들을 가져오는 과정, 그 정보들을 알맞게 변환하는 과정들은 ttop과 유사하다.

위 기능을 모두 pps.c에 구현하였다.

2. 결과

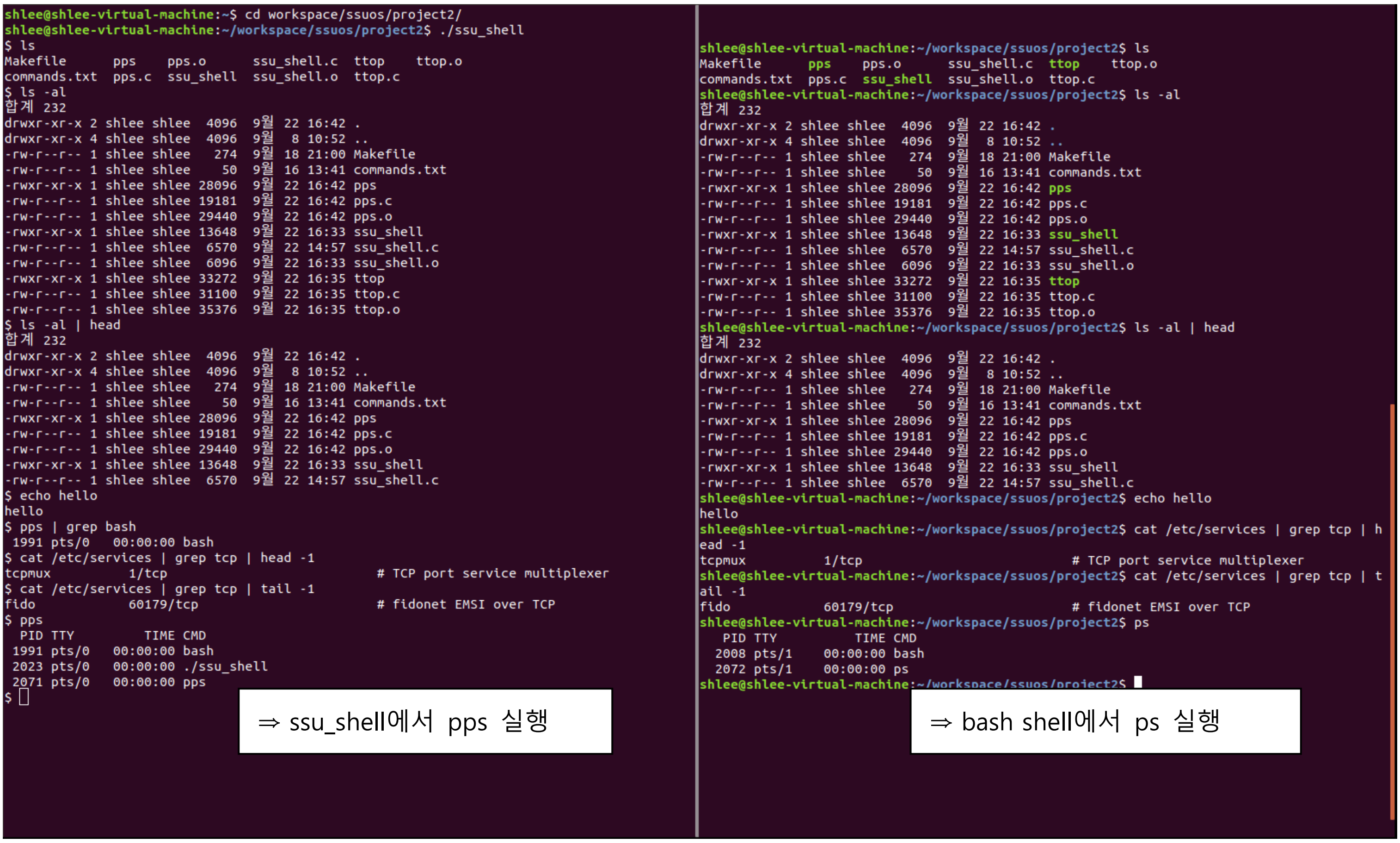


```
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ./ssu_shell commands.txt
Hello world
Makefile      pps    pps.o      ssu_shell.c  ttop    ttop.o
commands.txt  pps.c  ssu_shell  ssu_shell.o  ttop.c
/home/shlee/workspace/ssuos/project2
echo Hello world
ls
pwd
sleep 10
cat commands.txt
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ █
```

ssu_shell 배치식 모드

왼쪽이 ssu_shell

오른쪽이 bash shell



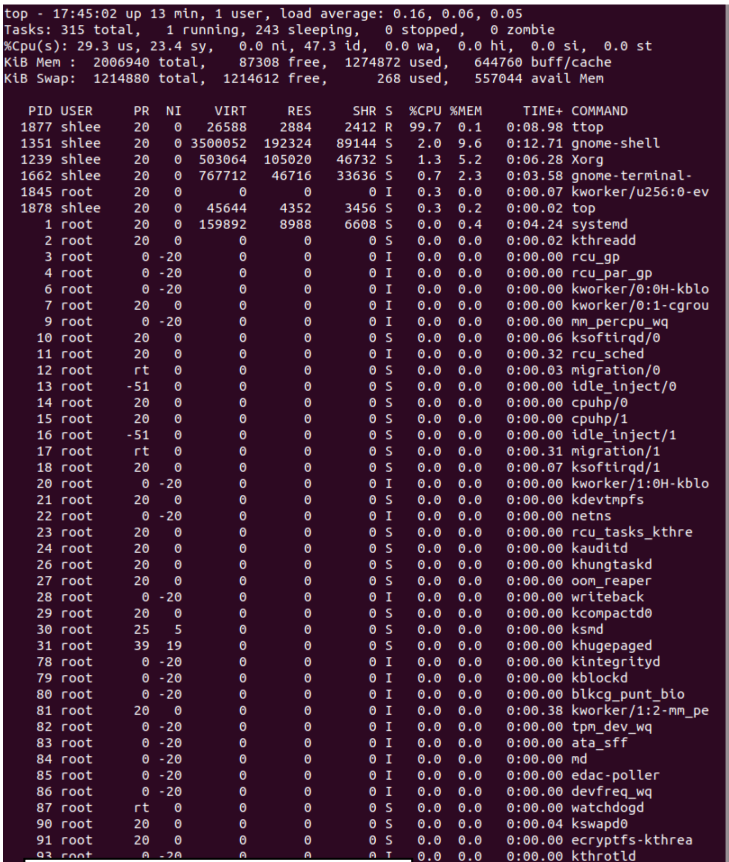
```
shlee@shlee-virtual-machine:~$ cd workspace/ssuos/project2/
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ./ssu_shell
$ ls
Makefile      pps    pps.o      ssu_shell.c  ttop    ttop.o
commands.txt  pps.c  ssu_shell  ssu_shell.o  ttop.c
$ ls -al
합계 232
drwxr-xr-x 2 shlee shlee  4096  9월 22 16:42 .
drwxr-xr-x 4 shlee shlee  4096  9월  8 10:52 ..
-rw-r--r-- 1 shlee shlee   274  9월 18 21:00 Makefile
-rw-r--r-- 1 shlee shlee    50  9월 16 13:41 commands.txt
-rwxr-xr-x 1 shlee shlee 28096  9월 22 16:42 pps
-rw-r--r-- 1 shlee shlee 19181  9월 22 16:42 pps.c
-rw-r--r-- 1 shlee shlee 29440  9월 22 16:42 pps.o
-rwxr-xr-x 1 shlee shlee 13648  9월 22 16:33 ssu_shell
-rw-r--r-- 1 shlee shlee  6570  9월 22 14:57 ssu_shell.c
-rw-r--r-- 1 shlee shlee  6096  9월 22 16:33 ssu_shell.o
-rwxr-xr-x 1 shlee shlee 33272  9월 22 16:35 ttop
-rw-r--r-- 1 shlee shlee 31100  9월 22 16:35 ttop.c
-rw-r--r-- 1 shlee shlee 35376  9월 22 16:35 ttop.o
$ ls -al | head
합계 232
drwxr-xr-x 2 shlee shlee  4096  9월 22 16:42 .
drwxr-xr-x 4 shlee shlee  4096  9월  8 10:52 ..
-rw-r--r-- 1 shlee shlee   274  9월 18 21:00 Makefile
-rw-r--r-- 1 shlee shlee    50  9월 16 13:41 commands.txt
-rwxr-xr-x 1 shlee shlee 28096  9월 22 16:42 pps
-rw-r--r-- 1 shlee shlee 19181  9월 22 16:42 pps.c
-rw-r--r-- 1 shlee shlee 29440  9월 22 16:42 pps.o
-rwxr-xr-x 1 shlee shlee 13648  9월 22 16:33 ssu_shell
-rw-r--r-- 1 shlee shlee  6570  9월 22 14:57 ssu_shell.c
$ echo hello
hello
$ pps | grep bash
 1991 pts/0   00:00:00 bash
$ cat /etc/services | grep tcp | head -1
tcpmux          1/tcp                          # TCP port service multiplexer
$ cat /etc/services | grep tcp | tail -1
fido            60179/tcp                      # fidonet EMSI over TCP
$ pps
  PID TTY          TIME CMD
 1991 pts/0   00:00:00 bash
 2023 pts/0   00:00:00 ./ssu_shell
 2071 pts/0   00:00:00 pps
$ ▯
```

⇒ ssu_shell에서 pps 실행

```
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ls
Makefile      pps    pps.o      ssu_shell.c  ttop    ttop.o
commands.txt  pps.c  ssu_shell  ssu_shell.o  ttop.c
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ls -al
합계 232
drwxr-xr-x 2 shlee shlee  4096  9월 22 16:42 .
drwxr-xr-x 4 shlee shlee  4096  9월  8 10:52 ..
-rw-r--r-- 1 shlee shlee   274  9월 18 21:00 Makefile
-rw-r--r-- 1 shlee shlee    50  9월 16 13:41 commands.txt
-rwxr-xr-x 1 shlee shlee 28096  9월 22 16:42 pps
-rw-r--r-- 1 shlee shlee 19181  9월 22 16:42 pps.c
-rw-r--r-- 1 shlee shlee 29440  9월 22 16:42 pps.o
-rwxr-xr-x 1 shlee shlee 13648  9월 22 16:33 ssu_shell
-rw-r--r-- 1 shlee shlee  6570  9월 22 14:57 ssu_shell.c
-rw-r--r-- 1 shlee shlee  6096  9월 22 16:33 ssu_shell.o
-rwxr-xr-x 1 shlee shlee 33272  9월 22 16:35 ttop
-rw-r--r-- 1 shlee shlee 31100  9월 22 16:35 ttop.c
-rw-r--r-- 1 shlee shlee 35376  9월 22 16:35 ttop.o
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ls -al | head
합계 232
drwxr-xr-x 2 shlee shlee  4096  9월 22 16:42 .
drwxr-xr-x 4 shlee shlee  4096  9월  8 10:52 ..
-rw-r--r-- 1 shlee shlee   274  9월 18 21:00 Makefile
-rw-r--r-- 1 shlee shlee    50  9월 16 13:41 commands.txt
-rwxr-xr-x 1 shlee shlee 28096  9월 22 16:42 pps
-rw-r--r-- 1 shlee shlee 19181  9월 22 16:42 pps.c
-rw-r--r-- 1 shlee shlee 29440  9월 22 16:42 pps.o
-rwxr-xr-x 1 shlee shlee 13648  9월 22 16:33 ssu_shell
-rw-r--r-- 1 shlee shlee  6570  9월 22 14:57 ssu_shell.c
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ echo hello
hello
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ cat /etc/services | grep tcp | h
ead -1
tcpmux          1/tcp                          # TCP port service multiplexer
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ cat /etc/services | grep tcp | t
ail -1
fido            60179/tcp                      # fidonet EMSI over TCP
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps
   PID TTY          TIME CMD
  2008 pts/1    00:00:00 bash
  2072 pts/1    00:00:00 ps
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ █
```

⇒ bash shell에서 ps 실행

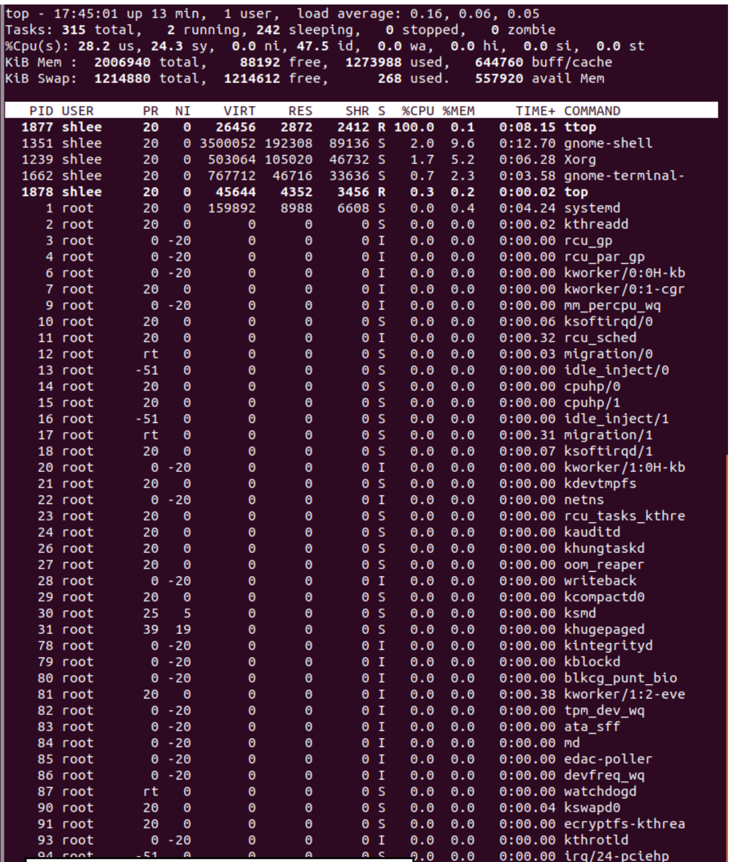
ssu_shell 대화식 모드에서 여러 명령어 실행 (다중 파이프 명령어 포함)



```
top - 17:45:02 up 13 min, 1 user, load average: 0.16, 0.06, 0.05
Tasks: 315 total,   1 running, 243 sleeping,   0 stopped,   0 zombie
%Cpu(s): 29.3 us, 23.4 sy,  0.0 ni, 47.3 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    87308 free,  1274872 used,   644760 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used,   557044 avail Mem

   PID USER      PR  NI    VIRT     RES     SHR S  %CPU %MEM     TIME+ COMMAND
  1877 shlee     20   0   26588    2884    2412 R  99.7  0.1   0:08.98 ttop
  1351 shlee     20   0 3500052  192324   89144 S   2.0  9.6   0:12.71 gnome-shell
  1239 shlee     20   0  503064  105020   46732 S   1.3  5.2   0:06.28 Xorg
  1662 shlee     20   0  767712   46716   33636 S   0.7  2.3   0:03.58 gnome-terminal-
  1845 root      20   0       0       0       0 I   0.3  0.0   0:00.07 kworker/u256:0-ev
  1878 shlee     20   0   45644    4352    3456 S   0.3  0.2   0:00.02 top
     1 root      20   0  159892    8988    6608 S   0.0  0.4   0:04.24 systemd
     2 root      20   0       0       0       0 S   0.0  0.0   0:00.02 kthreadd
     3 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 rcu_gp
     4 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 rcu_par_gp
     6 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kworker/0:0H-kblo
     7 root      20   0       0       0       0 I   0.0  0.0   0:00.00 kworker/0:1-cgrou
     9 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 mm_percpu_wq
    10 root      20   0       0       0       0 S   0.0  0.0   0:00.06 ksoftirqd/0
    11 root      20   0       0       0       0 I   0.0  0.0   0:00.32 rcu_sched
    12 root      rt   0       0       0       0 S   0.0  0.0   0:00.03 migration/0
    13 root     -51   0       0       0       0 S   0.0  0.0   0:00.00 idle_inject/0
    14 root      20   0       0       0       0 S   0.0  0.0   0:00.00 cpuhp/0
    15 root      20   0       0       0       0 S   0.0  0.0   0:00.00 cpuhp/1
    16 root     -51   0       0       0       0 S   0.0  0.0   0:00.00 idle_inject/1
    17 root      rt   0       0       0       0 S   0.0  0.0   0:00.31 migration/1
    18 root      20   0       0       0       0 S   0.0  0.0   0:00.07 ksoftirqd/1
    20 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kworker/1:0H-kblo
    21 root      20   0       0       0       0 S   0.0  0.0   0:00.00 kdevtmpfs
    22 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 netns
    23 root      20   0       0       0       0 S   0.0  0.0   0:00.00 rcu_tasks_kthre
    24 root      20   0       0       0       0 S   0.0  0.0   0:00.00 kauditd
    26 root      20   0       0       0       0 S   0.0  0.0   0:00.00 khungtaskd
    27 root      20   0       0       0       0 S   0.0  0.0   0:00.00 oom_reaper
    28 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 writeback
    29 root      20   0       0       0       0 S   0.0  0.0   0:00.00 kcompactd0
    30 root      25   5       0       0       0 S   0.0  0.0   0:00.00 ksmd
    31 root      39  19       0       0       0 S   0.0  0.0   0:00.00 khugepaged
    78 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kintegrityd
    79 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kblockd
    80 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 blkcg_punt_bio
    81 root      20   0       0       0       0 I   0.0  0.0   0:00.38 kworker/1:2-mm_pe
    82 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 tpm_dev_wq
    83 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 ata_sff
    84 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 md
    85 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 edac-poller
    86 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 devfreq_wq
    87 root      rt   0       0       0       0 S   0.0  0.0   0:00.00 watchdogd
    90 root      20   0       0       0       0 S   0.0  0.0   0:00.04 kswapd0
    91 root      20   0       0       0       0 S   0.0  0.0   0:00.00 ecryptfs-kthrea
    93 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kthrotld
```

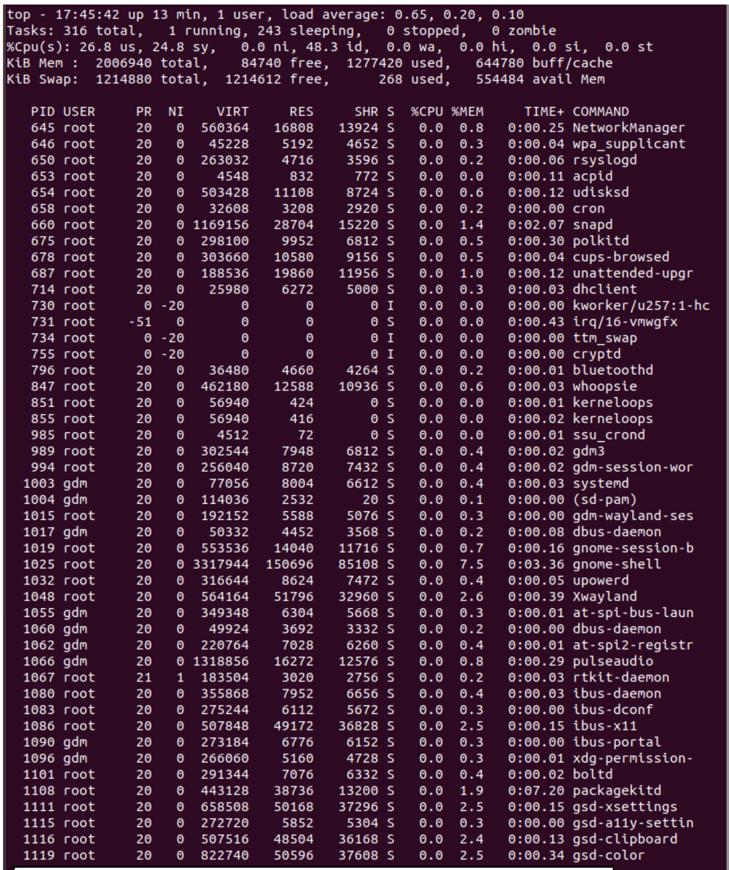
⇒ ssu_shell에서 ttop 실행



```
top - 17:45:01 up 13 min,  1 user,  load average: 0.16, 0.06, 0.05
Tasks: 315 total,   2 running, 242 sleeping,   0 stopped,   0 zombie
%Cpu(s): 28.2 us, 24.3 sy,  0.0 ni, 47.5 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    88192 free,  1273988 used,   644760 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used.   557920 avail Mem

   PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  1877 shlee     20   0   26456   2872   2412 R 100.0  0.1   0:08.15 ttop
  1351 shlee     20   0 3500052 192308  89136 S   2.0  9.6   0:12.70 gnome-shell
  1239 shlee     20   0  503064 105020  46732 S   1.7  5.2   0:06.28 Xorg
  1662 shlee     20   0  767712  46716  33636 S   0.7  2.3   0:03.58 gnome-terminal-
  1878 shlee     20   0   45644   4352   3456 R   0.3  0.2   0:00.02 top
     1 root      20   0  159892   8988   6608 S   0.0  0.4   0:04.24 systemd
     2 root      20   0       0      0      0 S   0.0  0.0   0:00.02 kthreadd
     3 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 rcu_gp
     4 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 rcu_par_gp
     6 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kworker/0:0H-kb
     7 root      20   0       0      0      0 I   0.0  0.0   0:00.00 kworker/0:1-cgr
     9 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 mm_percpu_wq
    10 root      20   0       0      0      0 S   0.0  0.0   0:00.06 ksoftirqd/0
    11 root      20   0       0      0      0 I   0.0  0.0   0:00.32 rcu_sched
    12 root      rt   0       0      0      0 S   0.0  0.0   0:00.03 migration/0
    13 root     -51   0       0      0      0 S   0.0  0.0   0:00.00 idle_inject/0
    14 root      20   0       0      0      0 S   0.0  0.0   0:00.00 cpuhp/0
    15 root      20   0       0      0      0 S   0.0  0.0   0:00.00 cpuhp/1
    16 root     -51   0       0      0      0 S   0.0  0.0   0:00.00 idle_inject/1
    17 root      rt   0       0      0      0 S   0.0  0.0   0:00.31 migration/1
    18 root      20   0       0      0      0 S   0.0  0.0   0:00.07 ksoftirqd/1
    20 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kworker/1:0H-kb
    21 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kdevtmpfs
    22 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 netns
    23 root      20   0       0      0      0 S   0.0  0.0   0:00.00 rcu_tasks_kthre
    24 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kauditd
    26 root      20   0       0      0      0 S   0.0  0.0   0:00.00 khungtaskd
    27 root      20   0       0      0      0 S   0.0  0.0   0:00.00 oom_reaper
    28 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 writeback
    29 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kcompactd0
    30 root      25   5       0      0      0 S   0.0  0.0   0:00.00 ksmd
    31 root      39  19       0      0      0 S   0.0  0.0   0:00.00 khugepaged
    78 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kintegrityd
    79 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kblockd
    80 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 blkcg_punt_bio
    81 root      20   0       0      0      0 I   0.0  0.0   0:00.38 kworker/1:2-eve
    82 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 tpm_dev_wq
    83 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 ata_sff
    84 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 md
    85 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 edac-poller
    86 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 devfreq_wq
    87 root      rt   0       0      0      0 S   0.0  0.0   0:00.00 watchdogd
    90 root      20   0       0      0      0 S   0.0  0.0   0:00.04 kswapd0
    91 root      20   0       0      0      0 S   0.0  0.0   0:00.00 ecryptfs-kthrea
    93 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kthrotld
    94 root     -51   0       0      0      0 S   0.0  0.0   0:00.00 irq/24-pciehp
```

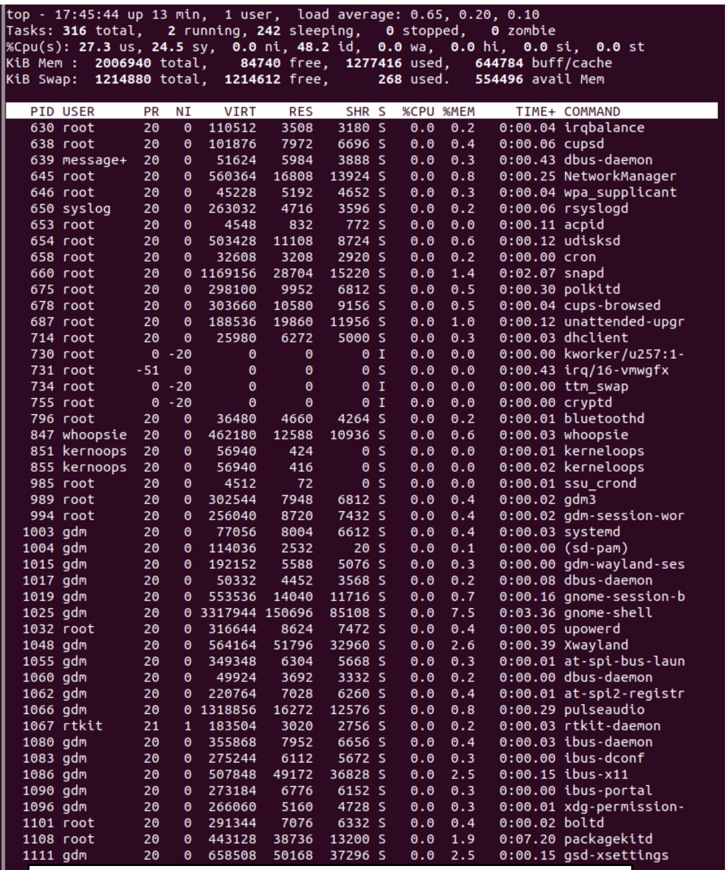
⇒ bash shell에서 top 실행



```
top - 17:45:42 up 13 min, 1 user, load average: 0.65, 0.20, 0.10
Tasks: 316 total,   1 running, 243 sleeping,   0 stopped,   0 zombie
%Cpu(s): 26.8 us, 24.8 sy,  0.0 ni, 48.3 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    84740 free,  1277420 used,   644780 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used,   554484 avail Mem

   PID USER      PR  NI    VIRT     RES     SHR S  %CPU %MEM     TIME+ COMMAND
   645 root      20   0  560364   16808   13924 S   0.0  0.8   0:00.25 NetworkManager
   646 root      20   0   45228    5192    4652 S   0.0  0.3   0:00.04 wpa_supplicant
   650 root      20   0  263032    4716    3596 S   0.0  0.2   0:00.06 rsyslogd
   653 root      20   0    4548     832     772 S   0.0  0.0   0:00.11 acpid
   654 root      20   0  503428   11108    8724 S   0.0  0.6   0:00.12 udisksd
   658 root      20   0   32608    3208    2920 S   0.0  0.2   0:00.00 cron
   660 root      20   0 1169156   28704   15220 S   0.0  1.4   0:02.07 snapd
   675 root      20   0  298100    9952    6812 S   0.0  0.5   0:00.30 polkitd
   678 root      20   0  303660   10580    9156 S   0.0  0.5   0:00.04 cups-browsed
   687 root      20   0  188536   19860   11956 S   0.0  1.0   0:00.12 unattended-upgr
   714 root      20   0   25980    6272    5000 S   0.0  0.3   0:00.03 dhclient
   730 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 kworker/u257:1-hc
   731 root     -51   0       0       0       0 S   0.0  0.0   0:00.43 irq/16-vmwgfx
   734 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 ttm_swap
   755 root       0 -20       0       0       0 I   0.0  0.0   0:00.00 cryptd
   796 root      20   0   36480    4660    4264 S   0.0  0.2   0:00.01 bluetoothd
   847 root      20   0  462180   12588   10936 S   0.0  0.6   0:00.03 whoopsie
   851 root      20   0   56940     424       0 S   0.0  0.0   0:00.01 kerneloops
   855 root      20   0   56940     416       0 S   0.0  0.0   0:00.02 kerneloops
   985 root      20   0    4512      72       0 S   0.0  0.0   0:00.01 ssu_crond
   989 root      20   0  302544    7948    6812 S   0.0  0.4   0:00.02 gdm3
   994 root      20   0  256040    8720    7432 S   0.0  0.4   0:00.02 gdm-session-wor
  1003 gdm       20   0   77056    8004    6612 S   0.0  0.4   0:00.03 systemd
  1004 gdm       20   0  114036    2532      20 S   0.0  0.1   0:00.00 (sd-pam)
  1015 root      20   0  192152    5588    5076 S   0.0  0.3   0:00.00 gdm-wayland-ses
  1017 gdm       20   0   50332    4452    3568 S   0.0  0.2   0:00.08 dbus-daemon
  1019 root      20   0  553536   14040   11716 S   0.0  0.7   0:00.16 gnome-session-b
  1025 root      20   0 3317944  150696   85108 S   0.0  7.5   0:03.36 gnome-shell
  1032 root      20   0  316644    8624    7472 S   0.0  0.4   0:00.05 upowerd
  1048 root      20   0  564164   51796   32960 S   0.0  2.6   0:00.39 Xwayland
  1055 gdm       20   0  349348    6304    5668 S   0.0  0.3   0:00.01 at-spi-bus-laun
  1060 gdm       20   0   49924    3692    3332 S   0.0  0.2   0:00.00 dbus-daemon
  1062 gdm       20   0  220764    7028    6260 S   0.0  0.4   0:00.01 at-spi2-registr
  1066 gdm       20   0 1318856   16272   12576 S   0.0  0.8   0:00.29 pulseaudio
  1067 root      21   1  183504    3020    2756 S   0.0  0.2   0:00.03 rtkit-daemon
  1080 root      20   0  355868    7952    6656 S   0.0  0.4   0:00.03 ibus-daemon
  1083 root      20   0  275244    6112    5672 S   0.0  0.3   0:00.00 ibus-dconf
  1086 root      20   0  507848   49172   36828 S   0.0  2.5   0:00.15 ibus-x11
  1090 gdm       20   0  273184    6776    6152 S   0.0  0.3   0:00.00 ibus-portal
  1096 gdm       20   0  266060    5160    4728 S   0.0  0.3   0:00.01 xdg-permission-
  1101 root      20   0  291344    7076    6332 S   0.0  0.4   0:00.02 boltd
  1108 root      20   0  443128   38736   13200 S   0.0  1.9   0:07.20 packagekitd
  1111 root      20   0  658508   50168   37296 S   0.0  2.5   0:00.15 gsd-xsettings
  1115 root      20   0  272720    5852    5304 S   0.0  0.3   0:00.00 gsd-a11y-settin
  1116 root      20   0  507516   48504   36168 S   0.0  2.4   0:00.13 gsd-clipboard
  1119 root      20   0  822740   50596   37608 S   0.0  2.5   0:00.34 gsd-color
```

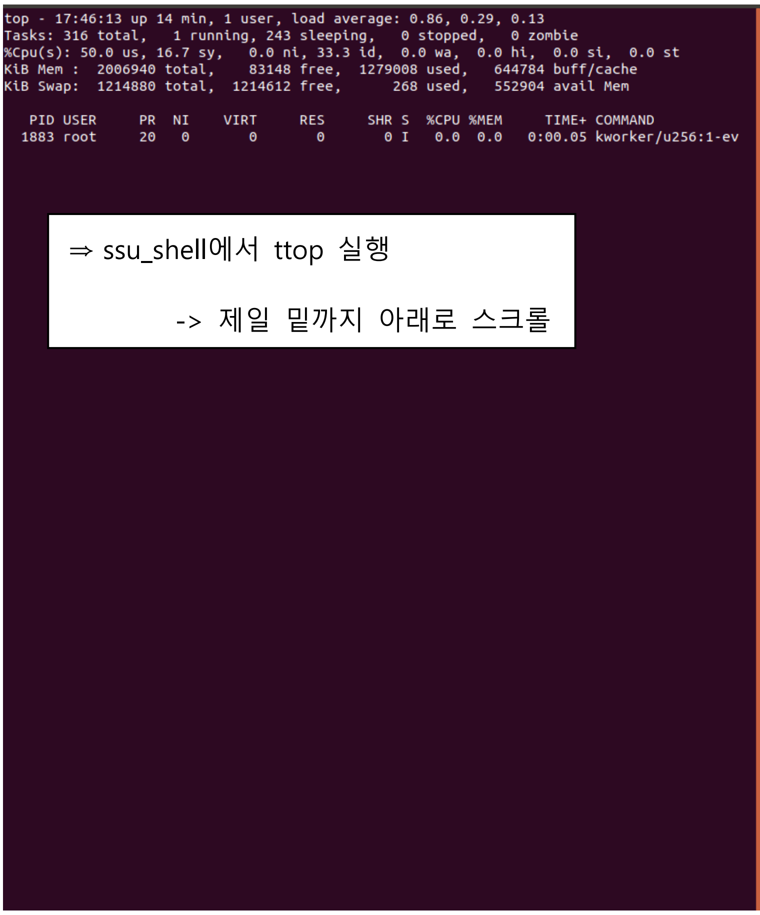
⇒ ssu_shell에서 ttop 실행 -> 아래로 스크롤



```
top - 17:45:44 up 13 min,  1 user,  load average: 0.65, 0.20, 0.10
Tasks: 316 total,   2 running, 242 sleeping,   0 stopped,   0 zombie
%Cpu(s): 27.3 us, 24.5 sy,  0.0 ni, 48.2 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    84740 free,  1277416 used,   644784 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used.   554496 avail Mem

   PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
   630 root      20   0  110512   3508   3180 S   0.0  0.2   0:00.04 irqbalance
   638 root      20   0  101876   7972   6696 S   0.0  0.4   0:00.06 cupsd
   639 message+  20   0   51624   5984   3888 S   0.0  0.3   0:00.43 dbus-daemon
   645 root      20   0  560364  16808  13924 S   0.0  0.8   0:00.25 NetworkManager
   646 root      20   0   45228   5192   4652 S   0.0  0.3   0:00.04 wpa_supplicant
   650 syslog    20   0  263032   4716   3596 S   0.0  0.2   0:00.06 rsyslogd
   653 root      20   0    4548    832    772 S   0.0  0.0   0:00.11 acpid
   654 root      20   0  503428  11108   8724 S   0.0  0.6   0:00.12 udisksd
   658 root      20   0   32608   3208   2920 S   0.0  0.2   0:00.00 cron
   660 root      20   0 1169156  28704  15220 S   0.0  1.4   0:02.07 snapd
   675 root      20   0  298100   9952   6812 S   0.0  0.5   0:00.30 polkitd
   678 root      20   0  303660  10580   9156 S   0.0  0.5   0:00.04 cups-browsed
   687 root      20   0  188536  19860  11956 S   0.0  1.0   0:00.12 unattended-upgr
   714 root      20   0   25980   6272   5000 S   0.0  0.3   0:00.03 dhclient
   730 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kworker/u257:1-
   731 root     -51   0       0      0      0 S   0.0  0.0   0:00.43 irq/16-vmwgfx
   734 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 ttm_swap
   755 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 cryptd
   796 root      20   0   36480   4660   4264 S   0.0  0.2   0:00.01 bluetoothd
   847 whoopsie  20   0  462180  12588  10936 S   0.0  0.6   0:00.03 whoopsie
   851 kernoops  20   0   56940    424      0 S   0.0  0.0   0:00.01 kerneloops
   855 kernoops  20   0   56940    416      0 S   0.0  0.0   0:00.02 kerneloops
   985 root      20   0    4512     72      0 S   0.0  0.0   0:00.01 ssu_crond
   989 root      20   0  302544   7948   6812 S   0.0  0.4   0:00.02 gdm3
   994 root      20   0  256040   8720   7432 S   0.0  0.4   0:00.02 gdm-session-wor
  1003 gdm       20   0   77056   8004   6612 S   0.0  0.4   0:00.03 systemd
  1004 gdm       20   0  114036   2532     20 S   0.0  0.1   0:00.00 (sd-pam)
  1015 gdm       20   0  192152   5588   5076 S   0.0  0.3   0:00.00 gdm-wayland-ses
  1017 gdm       20   0   50332   4452   3568 S   0.0  0.2   0:00.08 dbus-daemon
  1019 gdm       20   0  553536  14040  11716 S   0.0  0.7   0:00.16 gnome-session-b
  1025 gdm       20   0 3317944 150696  85108 S   0.0  7.5   0:03.36 gnome-shell
  1032 root      20   0  316644   8624   7472 S   0.0  0.4   0:00.05 upowerd
  1048 gdm       20   0  564164  51796  32960 S   0.0  2.6   0:00.39 Xwayland
  1055 gdm       20   0  349348   6304   5668 S   0.0  0.3   0:00.01 at-spi-bus-laun
  1060 gdm       20   0   49924   3692   3332 S   0.0  0.2   0:00.00 dbus-daemon
  1062 gdm       20   0  220764   7028   6260 S   0.0  0.4   0:00.01 at-spi2-registr
  1066 gdm       20   0 1318856  16272  12576 S   0.0  0.8   0:00.29 pulseaudio
  1067 rtkit     21   1  183504   3020   2756 S   0.0  0.2   0:00.03 rtkit-daemon
  1080 gdm       20   0  355868   7952   6656 S   0.0  0.4   0:00.03 ibus-daemon
  1083 gdm       20   0  275244   6112   5672 S   0.0  0.3   0:00.00 ibus-dconf
  1086 gdm       20   0  507848  49172  36828 S   0.0  2.5   0:00.15 ibus-x11
  1090 gdm       20   0  273184   6776   6152 S   0.0  0.3   0:00.00 ibus-portal
  1096 gdm       20   0  266060   5160   4728 S   0.0  0.3   0:00.01 xdg-permission-
  1101 root      20   0  291344   7076   6332 S   0.0  0.4   0:00.02 boltd
  1108 root      20   0  443128  38736  13200 S   0.0  1.9   0:07.20 packagekitd
  1111 gdm       20   0  658508  50168  37296 S   0.0  2.5   0:00.15 gsd-xsettings
```

⇒ bash shell에서 top 실행 -> 아래로 스크롤

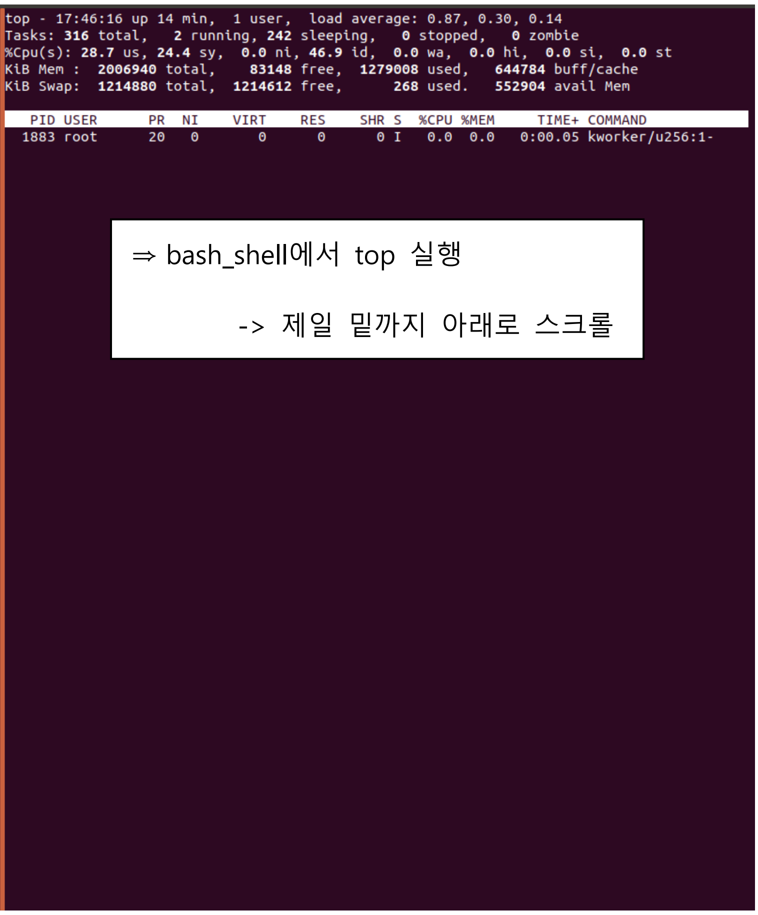


```
top - 17:46:13 up 14 min, 1 user, load average: 0.86, 0.29, 0.13
Tasks: 316 total,   1 running, 243 sleeping,   0 stopped,   0 zombie
%Cpu(s): 50.0 us, 16.7 sy,   0.0 ni, 33.3 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    83148 free,  1279008 used,   644784 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used,   552904 avail Mem

   PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  1883 root      20   0       0      0      0 I   0.0  0.0   0:00.05 kworker/u256:1-ev
```

⇒ ssu_shell에서 ttop 실행

-> 제일 밑까지 아래로 스크롤

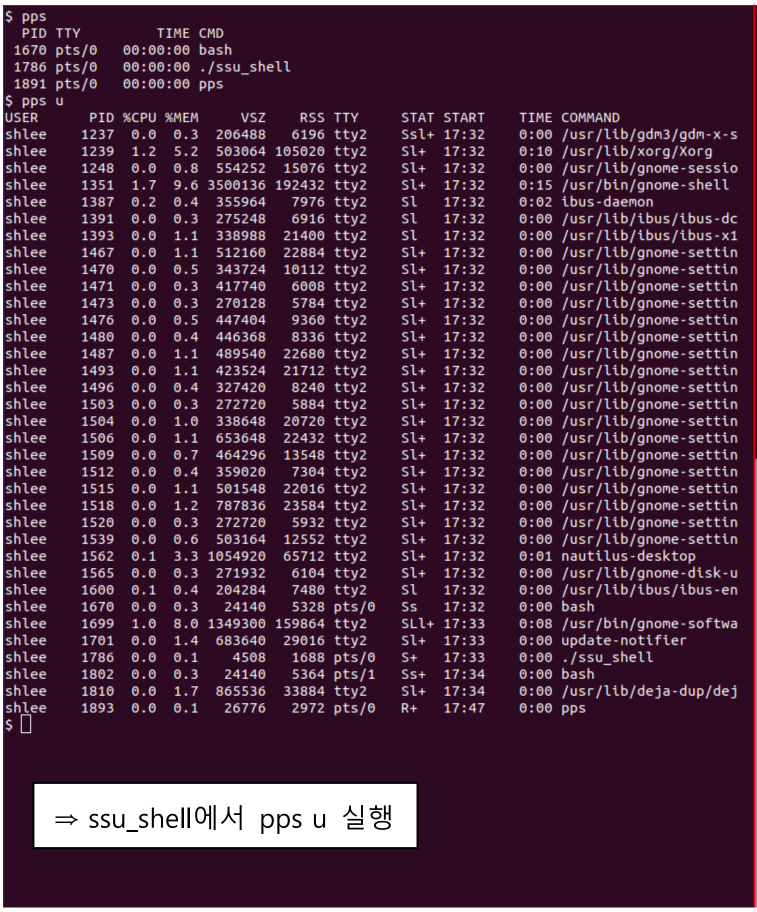


```
top - 17:46:16 up 14 min,  1 user,  load average: 0.87, 0.30, 0.14
Tasks: 316 total,   2 running, 242 sleeping,   0 stopped,   0 zombie
%Cpu(s): 28.7 us, 24.4 sy,  0.0 ni, 46.9 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  2006940 total,    83148 free,  1279008 used,   644784 buff/cache
KiB Swap:  1214880 total,  1214612 free,      268 used.   552904 avail Mem

   PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  1883 root      20   0       0      0      0 I   0.0  0.0   0:00.05 kworker/u256:1-
```

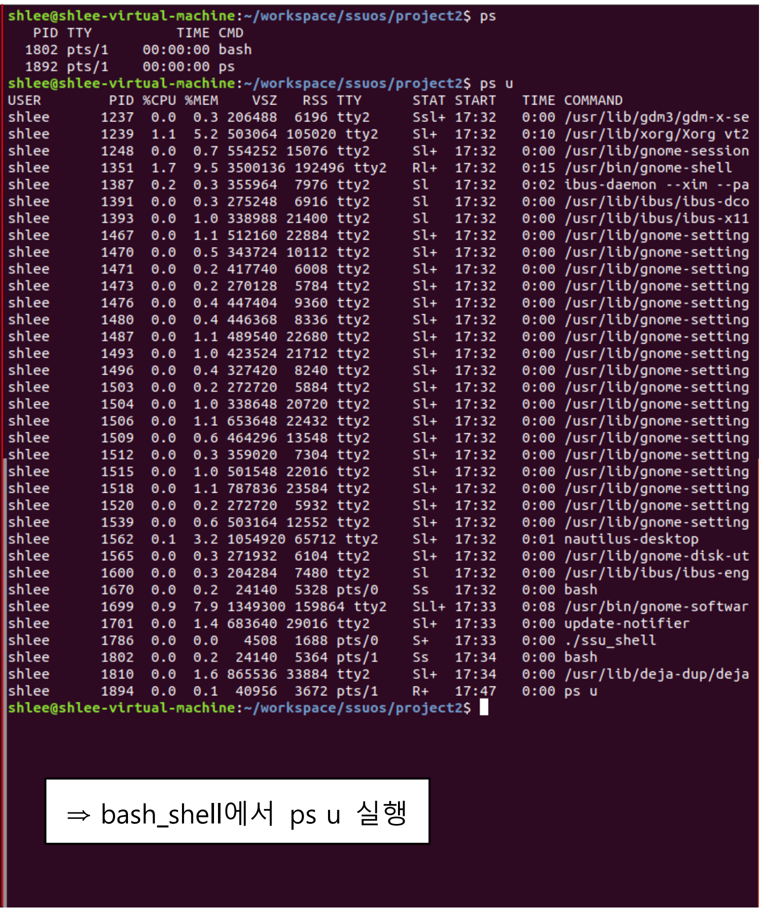
⇒ bash_shell에서 top 실행

-> 제일 밑까지 아래로 스크롤



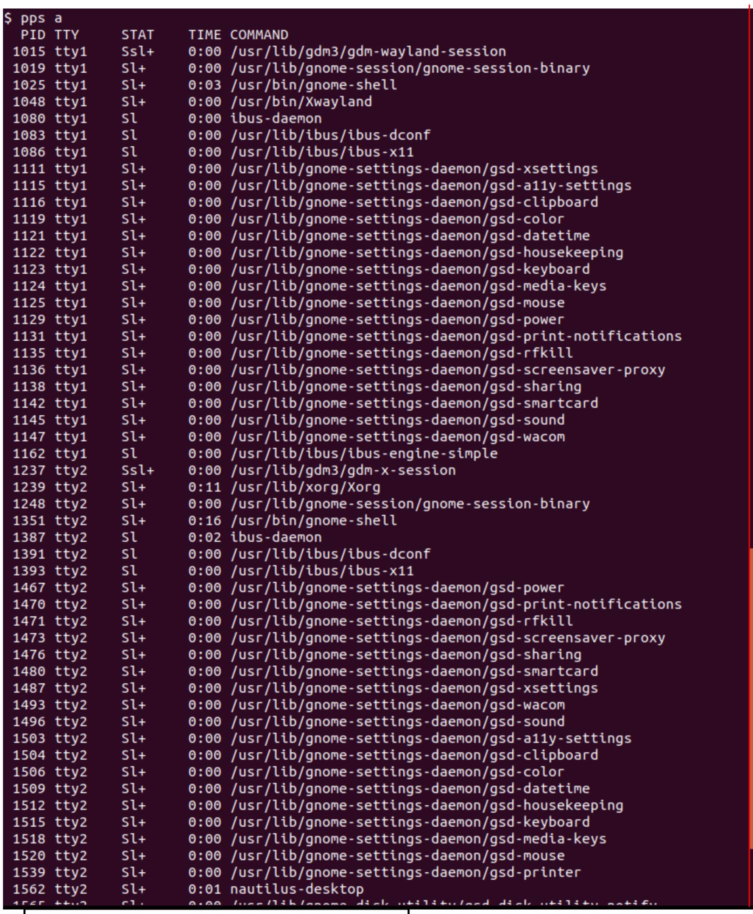
```
$ pps
  PID TTY          TIME CMD
 1670 pts/0    00:00:00 bash
 1786 pts/0    00:00:00 ./ssu_shell
 1891 pts/0    00:00:00 pps
$ pps u
USER       PID %CPU %MEM     VSZ    RSS TTY      STAT START    TIME COMMAND
shlee     1237  0.0  0.3  206488   6196 tty2     Ssl+ 17:32    0:00 /usr/lib/gdm3/gdm-x-s
shlee     1239  1.2  5.2  503064 105020 tty2     Sl+  17:32    0:10 /usr/lib/xorg/Xorg
shlee     1248  0.0  0.8  554252  15076 tty2     Sl+  17:32    0:00 /usr/lib/gnome-sessio
shlee     1351  1.7  9.6 3500136 192432 tty2     Sl+  17:32    0:15 /usr/bin/gnome-shell
shlee     1387  0.2  0.4  355964   7976 tty2     Sl   17:32    0:02 ibus-daemon
shlee     1391  0.0  0.3  275248   6916 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-dc
shlee     1393  0.0  1.1  338988  21400 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-x1
shlee     1467  0.0  1.1  512160  22884 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1470  0.0  0.5  343724  10112 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1471  0.0  0.3  417740   6008 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1473  0.0  0.3  270128   5784 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1476  0.0  0.5  447404   9360 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1480  0.0  0.4  446368   8336 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1487  0.0  1.1  489540  22680 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1493  0.0  1.1  423524  21712 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1496  0.0  0.4  327420   8240 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1503  0.0  0.3  272720   5884 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1504  0.0  1.0  338648  20720 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1506  0.0  1.1  653648  22432 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1509  0.0  0.7  464296  13548 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1512  0.0  0.4  359020   7304 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1515  0.0  1.1  501548  22016 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1518  0.0  1.2  787836  23584 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1520  0.0  0.3  272720   5932 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1539  0.0  0.6  503164  12552 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1562  0.1  3.3 1054920  65712 tty2     Sl+  17:32    0:01 nautilus-desktop
shlee     1565  0.0  0.3  271932   6104 tty2     Sl+  17:32    0:00 /usr/lib/gnome-disk-u
shlee     1600  0.1  0.4  204284   7480 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-en
shlee     1670  0.0  0.3   24140   5328 pts/0    Ss   17:32    0:00 bash
shlee     1699  1.0  8.0 1349300 159864 tty2     SLl+ 17:33    0:08 /usr/bin/gnome-softwa
shlee     1701  0.0  1.4  683640  29016 tty2     Sl+  17:33    0:00 update-notifier
shlee     1786  0.0  0.1    4508   1688 pts/0    S+   17:33    0:00 ./ssu_shell
shlee     1802  0.0  0.3   24140   5364 pts/1    Ss+  17:34    0:00 bash
shlee     1810  0.0  1.7  865536  33884 tty2     Sl+  17:34    0:00 /usr/lib/deja-dup/dej
shlee     1893  0.0  0.1   26776   2972 pts/0    R+   17:47    0:00 pps
$ 
```

⇒ ssu_shell에서 pps u 실행



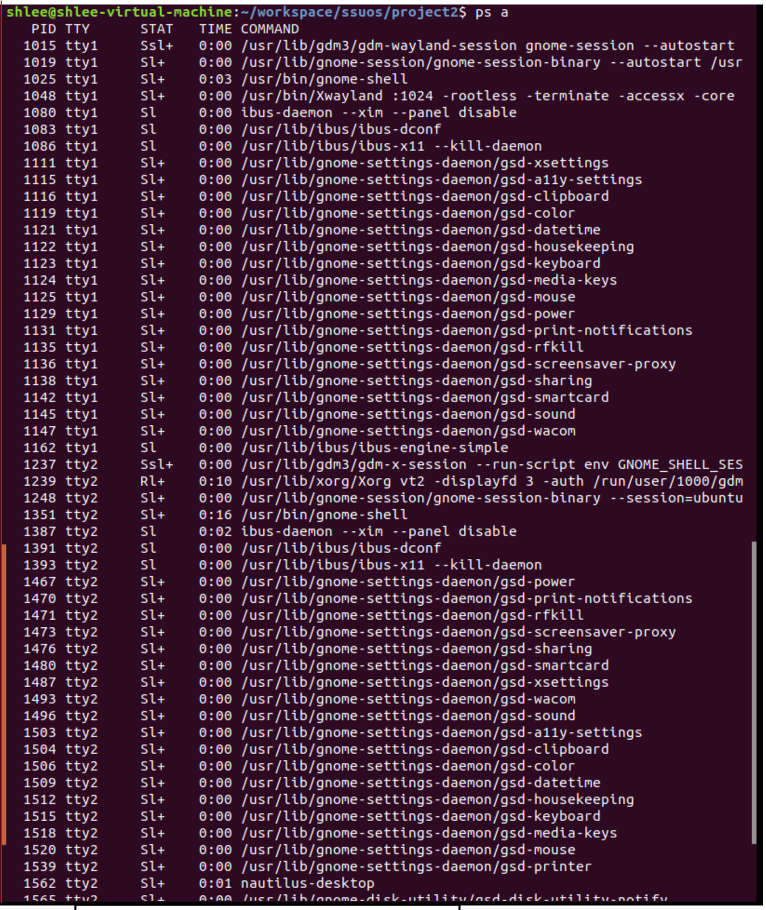
```
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps
  PID TTY          TIME CMD
 1802 pts/1    00:00:00 bash
 1892 pts/1    00:00:00 ps
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps u
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
shlee     1237  0.0  0.3 206488  6196 tty2     Ssl+ 17:32   0:00 /usr/lib/gdm3/gdm-x-se
shlee     1239  1.1  5.2 503064 105020 tty2    Sl+  17:32   0:10 /usr/lib/xorg/Xorg vt2
shlee     1248  0.0  0.7 554252 15076 tty2     Sl+  17:32   0:00 /usr/lib/gnome-session
shlee     1351  1.7  9.5 3500136 192496 tty2   Rl+  17:32   0:15 /usr/bin/gnome-shell
shlee     1387  0.2  0.3 355964  7976 tty2     Sl   17:32   0:02 ibus-daemon --xim --pa
shlee     1391  0.0  0.3 275248  6916 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-dco
shlee     1393  0.0  1.0 338988 21400 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-x11
shlee     1467  0.0  1.1 512160 22884 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1470  0.0  0.5 343724 10112 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1471  0.0  0.2 417740  6008 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1473  0.0  0.2 270128  5784 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1476  0.0  0.4 447404  9360 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1480  0.0  0.4 446368  8336 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1487  0.0  1.1 489540 22680 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1493  0.0  1.0 423524 21712 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1496  0.0  0.4 327420  8240 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1503  0.0  0.2 272720  5884 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1504  0.0  1.0 338648 20720 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1506  0.0  1.1 653648 22432 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1509  0.0  0.6 464296 13548 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1512  0.0  0.3 359020  7304 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1515  0.0  1.0 501548 22016 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1518  0.0  1.1 787836 23584 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1520  0.0  0.2 272720  5932 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1539  0.0  0.6 503164 12552 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee     1562  0.1  3.2 1054920 65712 tty2    Sl+  17:32   0:01 nautilus-desktop
shlee     1565  0.0  0.3 271932  6104 tty2     Sl+  17:32   0:00 /usr/lib/gnome-disk-ut
shlee     1600  0.0  0.3 204284  7480 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-eng
shlee     1670  0.0  0.2  24140  5328 pts/0    Ss   17:32   0:00 bash
shlee     1699  0.9  7.9 1349300 159864 tty2   SLl+ 17:33   0:08 /usr/bin/gnome-softwar
shlee     1701  0.0  1.4 683640 29016 tty2     Sl+  17:33   0:00 update-notifier
shlee     1786  0.0  0.0   4508  1688 pts/0    S+   17:33   0:00 ./ssu_shell
shlee     1802  0.0  0.2  24140  5364 pts/1    Ss   17:34   0:00 bash
shlee     1810  0.0  1.6 865536 33884 tty2     Sl+  17:34   0:00 /usr/lib/deja-dup/deja
shlee     1894  0.0  0.1  40956  3672 pts/1    R+   17:47   0:00 ps u
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ 
```

⇒ bash_shell에서 ps u 실행



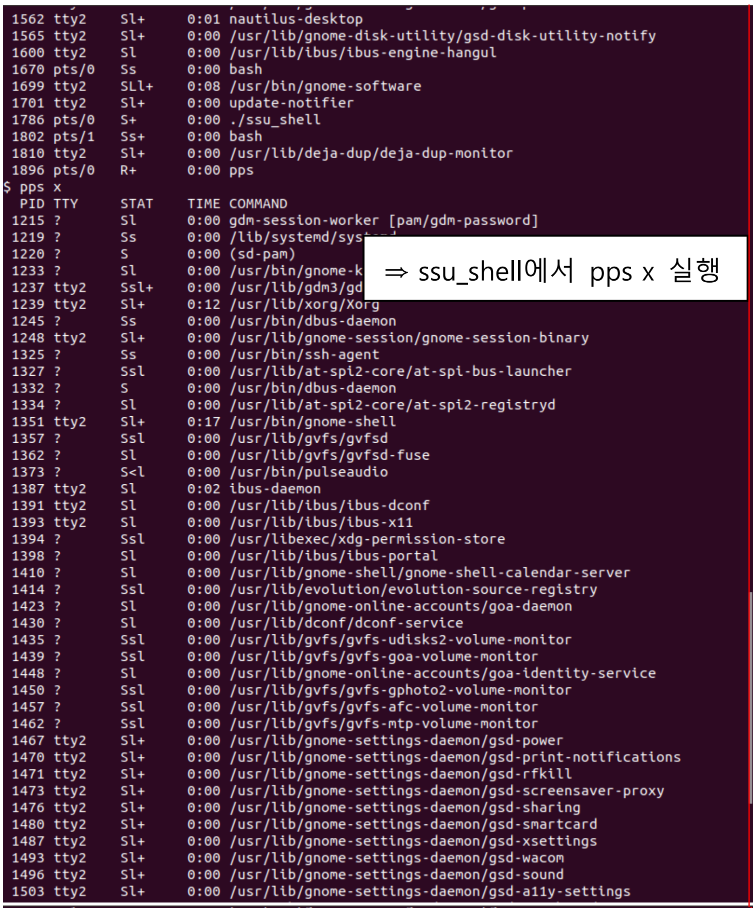
```
$ pps a
  PID TTY      STAT   TIME COMMAND
 1015 tty1     Ssl+   0:00 /usr/lib/gdm3/gdm-wayland-session
 1019 tty1     Sl+    0:00 /usr/lib/gnome-session/gnome-session-binary
 1025 tty1     Sl+    0:03 /usr/bin/gnome-shell
 1048 tty1     Sl+    0:00 /usr/bin/Xwayland
 1080 tty1     Sl     0:00 ibus-daemon
 1083 tty1     Sl     0:00 /usr/lib/ibus/ibus-dconf
 1086 tty1     Sl     0:00 /usr/lib/ibus/ibus-x11
 1111 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1115 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1116 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1119 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1121 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1122 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1123 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1124 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1125 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1129 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1131 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1135 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1136 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1138 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1142 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1145 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1147 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1162 tty1     Sl     0:00 /usr/lib/ibus/ibus-engine-simple
 1237 tty2     Ssl+   0:00 /usr/lib/gdm3/gdm-x-session
 1239 tty2     Sl+    0:11 /usr/lib/xorg/Xorg
 1248 tty2     Sl+    0:00 /usr/lib/gnome-session/gnome-session-binary
 1351 tty2     Sl+    0:16 /usr/bin/gnome-shell
 1387 tty2     Sl     0:02 ibus-daemon
 1391 tty2     Sl     0:00 /usr/lib/ibus/ibus-dconf
 1393 tty2     Sl     0:00 /usr/lib/ibus/ibus-x11
 1467 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1470 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1471 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1473 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1476 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1480 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1487 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1493 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1496 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1503 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1504 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1506 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1509 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1512 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1515 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1518 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1520 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1539 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-printer
 1562 tty2     Sl+    0:01 nautilus-desktop
 1565 tty2     Sl+    0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
```

⇒ ssu_shell에서 pps a 실행



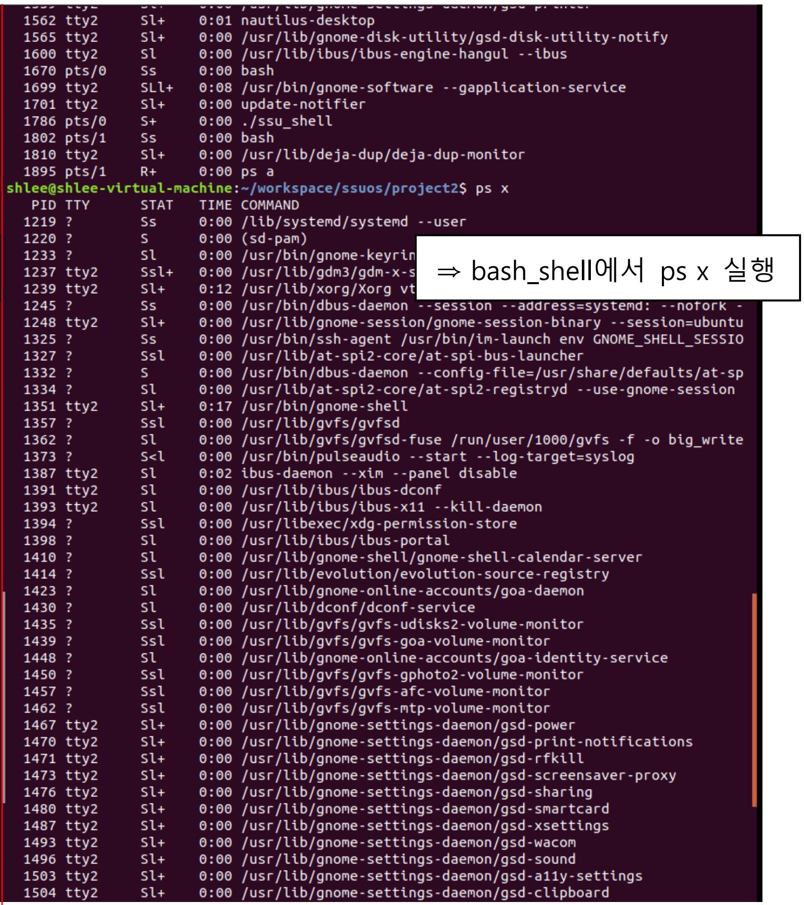
```
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps a
  PID TTY      STAT   TIME COMMAND
 1015 tty1     Ssl+   0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart
 1019 tty1     Sl+    0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr
 1025 tty1     Sl+    0:03 /usr/bin/gnome-shell
 1048 tty1     Sl+    0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx -core
 1080 tty1     Sl     0:00 ibus-daemon --xim --panel disable
 1083 tty1     Sl     0:00 /usr/lib/ibus/ibus-dconf
 1086 tty1     Sl     0:00 /usr/lib/ibus/ibus-x11 --kill-daemon
 1111 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1115 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1116 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1119 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1121 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1122 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1123 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1124 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1125 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1129 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1131 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1135 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1136 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1138 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1142 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1145 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1147 tty1     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1162 tty1     Sl     0:00 /usr/lib/ibus/ibus-engine-simple
 1237 tty2     Ssl+   0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SES
 1239 tty2     Rl+    0:10 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm
 1248 tty2     Sl+    0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubuntu
 1351 tty2     Sl+    0:16 /usr/bin/gnome-shell
 1387 tty2     Sl     0:02 ibus-daemon --xim --panel disable
 1391 tty2     Sl     0:00 /usr/lib/ibus/ibus-dconf
 1393 tty2     Sl     0:00 /usr/lib/ibus/ibus-x11 --kill-daemon
 1467 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1470 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1471 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1473 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1476 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1480 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1487 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1493 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1496 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1503 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1504 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1506 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1509 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1512 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1515 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1518 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1520 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1539 tty2     Sl+    0:00 /usr/lib/gnome-settings-daemon/gsd-printer
 1562 tty2     Sl+    0:01 nautilus-desktop
 1565 tty2     Sl+    0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
```

⇒ bash_shell에서 ps a 실행



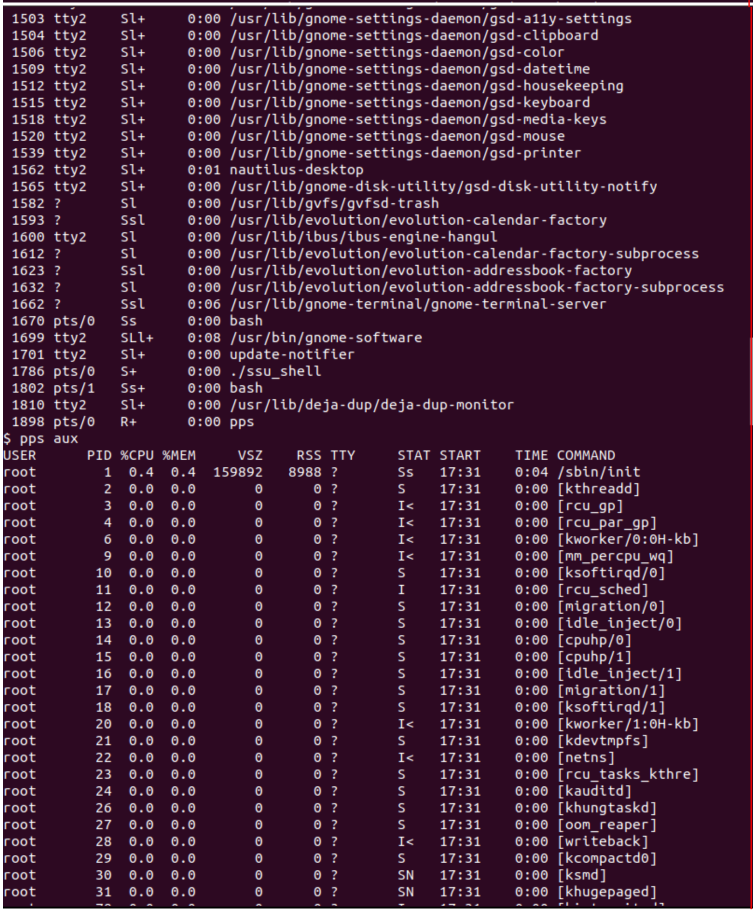
```
 1562 tty2     Sl+      0:01 nautilus-desktop
 1565 tty2     Sl+      0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
 1600 tty2     Sl       0:00 /usr/lib/ibus/ibus-engine-hangul
 1670 pts/0    Ss       0:00 bash
 1699 tty2     SLl+     0:08 /usr/bin/gnome-software
 1701 tty2     Sl+      0:00 update-notifier
 1786 pts/0    S+       0:00 ./ssu_shell
 1802 pts/1    Ss+      0:00 bash
 1810 tty2     Sl+      0:00 /usr/lib/deja-dup/deja-dup-monitor
 1896 pts/0    R+       0:00 pps
$ pps x
  PID TTY      STAT     TIME COMMAND
 1215 ?        Sl       0:00 gdm-session-worker [pam/gdm-password]
 1219 ?        Ss       0:00 /lib/systemd/sys
 1220 ?        S        0:00 (sd-pam)
 1233 ?        Sl       0:00 /usr/bin/gnome-k
 1237 tty2     Ssl+     0:00 /usr/lib/gdm3/gd
 1239 tty2     Sl+      0:12 /usr/lib/xorg/Xorg
 1245 ?        Ss       0:00 /usr/bin/dbus-daemon
 1248 tty2     Sl+      0:00 /usr/lib/gnome-session/gnome-session-binary
 1325 ?        Ss       0:00 /usr/bin/ssh-agent
 1327 ?        Ssl      0:00 /usr/lib/at-spi2-core/at-spi-bus-launcher
 1332 ?        S        0:00 /usr/bin/dbus-daemon
 1334 ?        Sl       0:00 /usr/lib/at-spi2-core/at-spi2-registryd
 1351 tty2     Sl+      0:17 /usr/bin/gnome-shell
 1357 ?        Ssl      0:00 /usr/lib/gvfs/gvfsd
 1362 ?        Sl       0:00 /usr/lib/gvfs/gvfsd-fuse
 1373 ?        S<l      0:00 /usr/bin/pulseaudio
 1387 tty2     Sl       0:02 ibus-daemon
 1391 tty2     Sl       0:00 /usr/lib/ibus/ibus-dconf
 1393 tty2     Sl       0:00 /usr/lib/ibus/ibus-x11
 1394 ?        Ssl      0:00 /usr/libexec/xdg-permission-store
 1398 ?        Sl       0:00 /usr/lib/ibus/ibus-portal
 1410 ?        Sl       0:00 /usr/lib/gnome-shell/gnome-shell-calendar-server
 1414 ?        Ssl      0:00 /usr/lib/evolution/evolution-source-registry
 1423 ?        Sl       0:00 /usr/lib/gnome-online-accounts/goa-daemon
 1430 ?        Sl       0:00 /usr/lib/dconf/dconf-service
 1435 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-udisks2-volume-monitor
 1439 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-goa-volume-monitor
 1448 ?        Sl       0:00 /usr/lib/gnome-online-accounts/goa-identity-service
 1450 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-gphoto2-volume-monitor
 1457 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-afc-volume-monitor
 1462 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-mtp-volume-monitor
 1467 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1470 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1471 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1473 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1476 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1480 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1487 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1493 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1496 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1503 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
```

⇒ ssu_shell에서 pps x 실행



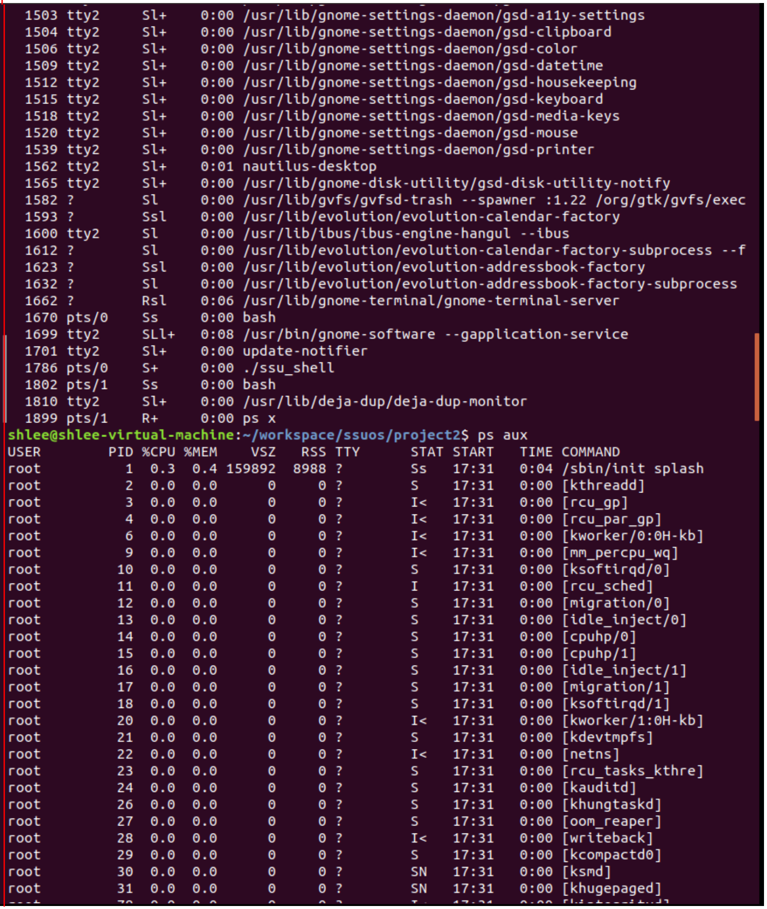
```
 1562 tty2     Sl+      0:01 nautilus-desktop
 1565 tty2     Sl+      0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
 1600 tty2     Sl       0:00 /usr/lib/ibus/ibus-engine-hangul --ibus
 1670 pts/0    Ss       0:00 bash
 1699 tty2     SLl+     0:08 /usr/bin/gnome-software --gapplication-service
 1701 tty2     Sl+      0:00 update-notifier
 1786 pts/0    S+       0:00 ./ssu_shell
 1802 pts/1    Ss       0:00 bash
 1810 tty2     Sl+      0:00 /usr/lib/deja-dup/deja-dup-monitor
 1895 pts/1    R+       0:00 ps a
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps x
  PID TTY      STAT     TIME COMMAND
 1219 ?        Ss       0:00 /lib/systemd/systemd --user
 1220 ?        S        0:00 (sd-pam)
 1233 ?        Sl       0:00 /usr/bin/gnome-keyrin
 1237 tty2     Ssl+     0:00 /usr/lib/gdm3/gdm-x-s
 1239 tty2     Sl+      0:12 /usr/lib/xorg/Xorg vt
 1245 ?        Ss       0:00 /usr/bin/dbus-daemon --session --address=systemd: --nofork -
 1248 tty2     Sl+      0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubuntu
 1325 ?        Ss       0:00 /usr/bin/ssh-agent /usr/bin/im-launch env GNOME_SHELL_SESSIO
 1327 ?        Ssl      0:00 /usr/lib/at-spi2-core/at-spi-bus-launcher
 1332 ?        S        0:00 /usr/bin/dbus-daemon --config-file=/usr/share/defaults/at-sp
 1334 ?        Sl       0:00 /usr/lib/at-spi2-core/at-spi2-registryd --use-gnome-session
 1351 tty2     Sl+      0:17 /usr/bin/gnome-shell
 1357 ?        Ssl      0:00 /usr/lib/gvfs/gvfsd
 1362 ?        Sl       0:00 /usr/lib/gvfs/gvfsd-fuse /run/user/1000/gvfs -f -o big_write
 1373 ?        S<l      0:00 /usr/bin/pulseaudio --start --log-target=syslog
 1387 tty2     Sl       0:02 ibus-daemon --xim --panel disable
 1391 tty2     Sl       0:00 /usr/lib/ibus/ibus-dconf
 1393 tty2     Sl       0:00 /usr/lib/ibus/ibus-x11 --kill-daemon
 1394 ?        Ssl      0:00 /usr/libexec/xdg-permission-store
 1398 ?        Sl       0:00 /usr/lib/ibus/ibus-portal
 1410 ?        Sl       0:00 /usr/lib/gnome-shell/gnome-shell-calendar-server
 1414 ?        Ssl      0:00 /usr/lib/evolution/evolution-source-registry
 1423 ?        Sl       0:00 /usr/lib/gnome-online-accounts/goa-daemon
 1430 ?        Sl       0:00 /usr/lib/dconf/dconf-service
 1435 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-udisks2-volume-monitor
 1439 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-goa-volume-monitor
 1448 ?        Sl       0:00 /usr/lib/gnome-online-accounts/goa-identity-service
 1450 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-gphoto2-volume-monitor
 1457 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-afc-volume-monitor
 1462 ?        Ssl      0:00 /usr/lib/gvfs/gvfs-mtp-volume-monitor
 1467 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-power
 1470 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
 1471 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
 1473 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
 1476 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
 1480 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
 1487 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
 1493 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
 1496 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-sound
 1503 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1504 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
```

⇒ bash_shell에서 ps x 실행



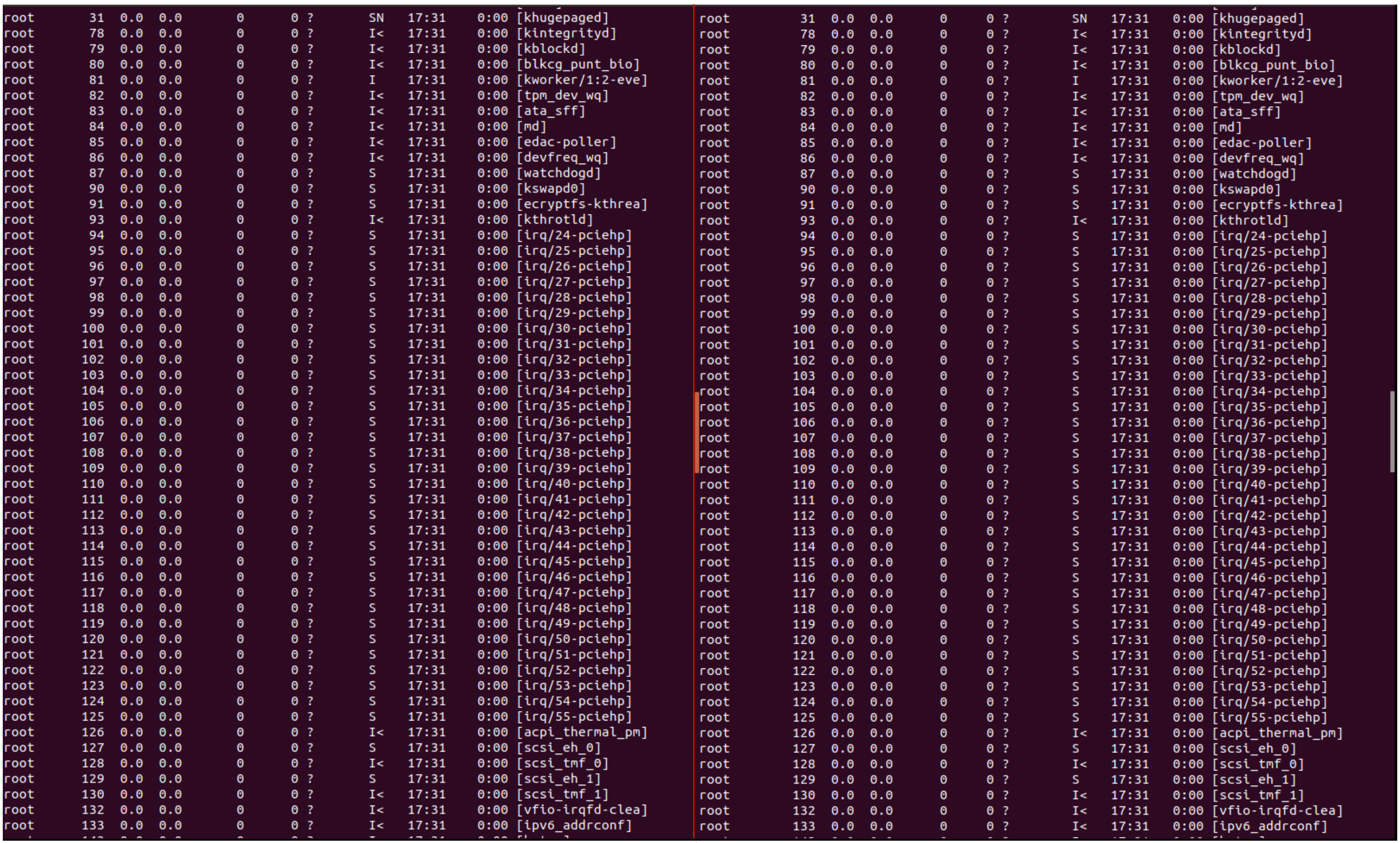
```
 1503 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1504 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1506 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1509 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1512 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1515 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1518 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1520 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1539 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-printer
 1562 tty2     Sl+      0:01 nautilus-desktop
 1565 tty2     Sl+      0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
 1582 ?        Sl       0:00 /usr/lib/gvfs/gvfsd-trash
 1593 ?        Ssl      0:00 /usr/lib/evolution/evolution-calendar-factory
 1600 tty2     Sl       0:00 /usr/lib/ibus/ibus-engine-hangul
 1612 ?        Sl       0:00 /usr/lib/evolution/evolution-calendar-factory-subprocess
 1623 ?        Ssl      0:00 /usr/lib/evolution/evolution-addressbook-factory
 1632 ?        Sl       0:00 /usr/lib/evolution/evolution-addressbook-factory-subprocess
 1662 ?        Ssl      0:06 /usr/lib/gnome-terminal/gnome-terminal-server
 1670 pts/0    Ss       0:00 bash
 1699 tty2     SLl+     0:08 /usr/bin/gnome-software
 1701 tty2     Sl+      0:00 update-notifier
 1786 pts/0    S+       0:00 ./ssu_shell
 1802 pts/1    Ss+      0:00 bash
 1810 tty2     Sl+      0:00 /usr/lib/deja-dup/deja-dup-monitor
 1898 pts/0    R+       0:00 pps
$ pps aux
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.4  0.4 159892  8988 ?        Ss   17:31   0:04 /sbin/init
root         2  0.0  0.0      0     0 ?        S    17:31   0:00 [kthreadd]
root         3  0.0  0.0      0     0 ?        I<   17:31   0:00 [rcu_gp]
root         4  0.0  0.0      0     0 ?        I<   17:31   0:00 [rcu_par_gp]
root         6  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/0:0H-kb]
root         9  0.0  0.0      0     0 ?        I<   17:31   0:00 [mm_percpu_wq]
root        10  0.0  0.0      0     0 ?        S    17:31   0:00 [ksoftirqd/0]
root        11  0.0  0.0      0     0 ?        I    17:31   0:00 [rcu_sched]
root        12  0.0  0.0      0     0 ?        S    17:31   0:00 [migration/0]
root        13  0.0  0.0      0     0 ?        S    17:31   0:00 [idle_inject/0]
root        14  0.0  0.0      0     0 ?        S    17:31   0:00 [cpuhp/0]
root        15  0.0  0.0      0     0 ?        S    17:31   0:00 [cpuhp/1]
root        16  0.0  0.0      0     0 ?        S    17:31   0:00 [idle_inject/1]
root        17  0.0  0.0      0     0 ?        S    17:31   0:00 [migration/1]
root        18  0.0  0.0      0     0 ?        S    17:31   0:00 [ksoftirqd/1]
root        20  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/1:0H-kb]
root        21  0.0  0.0      0     0 ?        S    17:31   0:00 [kdevtmpfs]
root        22  0.0  0.0      0     0 ?        I<   17:31   0:00 [netns]
root        23  0.0  0.0      0     0 ?        S    17:31   0:00 [rcu_tasks_kthre]
root        24  0.0  0.0      0     0 ?        S    17:31   0:00 [kauditd]
root        26  0.0  0.0      0     0 ?        S    17:31   0:00 [khungtaskd]
root        27  0.0  0.0      0     0 ?        S    17:31   0:00 [oom_reaper]
root        28  0.0  0.0      0     0 ?        I<   17:31   0:00 [writeback]
root        29  0.0  0.0      0     0 ?        S    17:31   0:00 [kcompactd0]
root        30  0.0  0.0      0     0 ?        SN   17:31   0:00 [ksmd]
root        31  0.0  0.0      0     0 ?        SN   17:31   0:00 [khugepaged]
```

⇒ ssu_shell에서 pps aux 실행



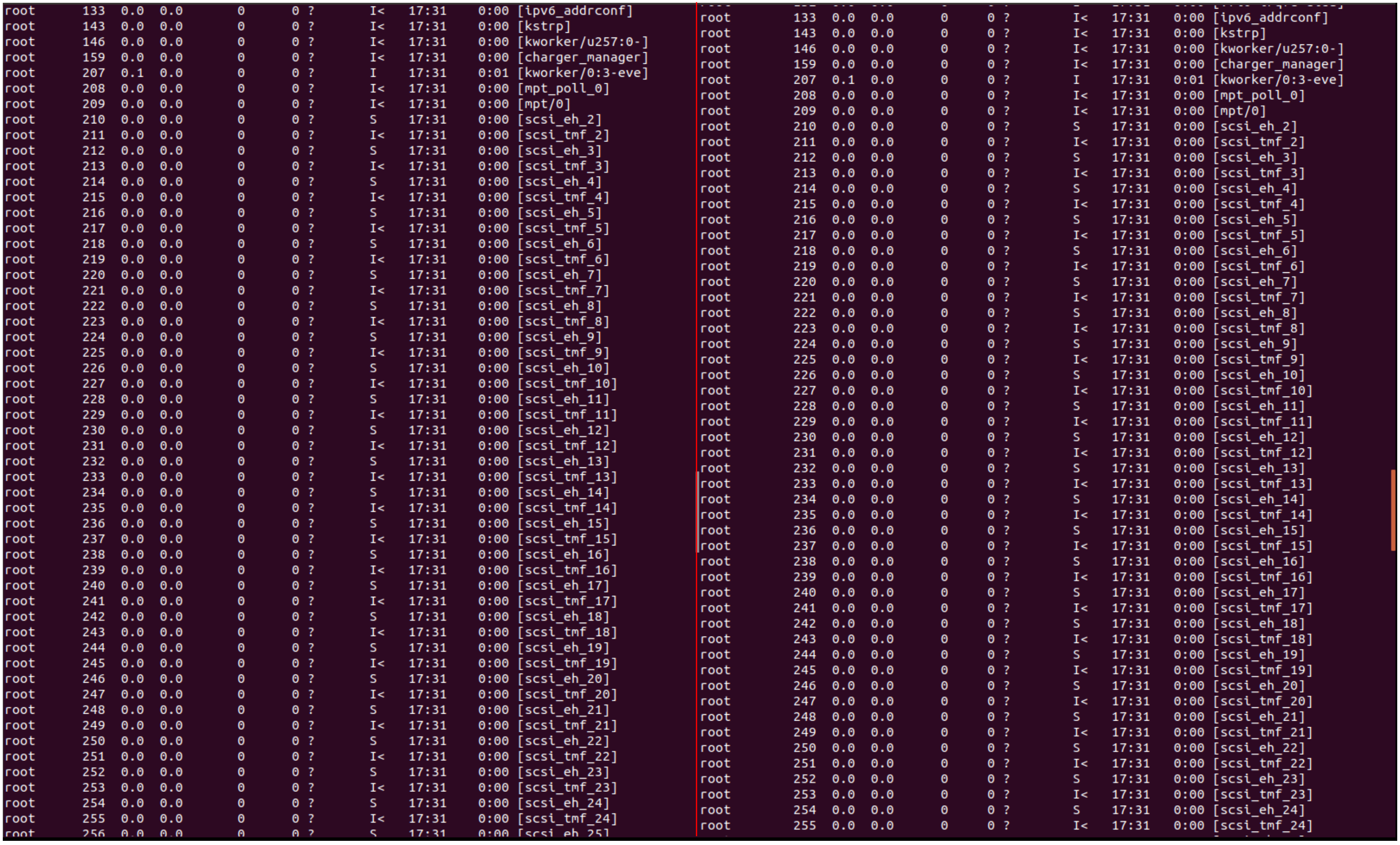
```
 1503 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
 1504 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard
 1506 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-color
 1509 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
 1512 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
 1515 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
 1518 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
 1520 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
 1539 tty2     Sl+      0:00 /usr/lib/gnome-settings-daemon/gsd-printer
 1562 tty2     Sl+      0:01 nautilus-desktop
 1565 tty2     Sl+      0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
 1582 ?        Sl       0:00 /usr/lib/gvfs/gvfsd-trash --spawner :1.22 /org/gtk/gvfs/exec
 1593 ?        Ssl      0:00 /usr/lib/evolution/evolution-calendar-factory
 1600 tty2     Sl       0:00 /usr/lib/ibus/ibus-engine-hangul --ibus
 1612 ?        Sl       0:00 /usr/lib/evolution/evolution-calendar-factory-subprocess --f
 1623 ?        Ssl      0:00 /usr/lib/evolution/evolution-addressbook-factory
 1632 ?        Sl       0:00 /usr/lib/evolution/evolution-addressbook-factory-subprocess
 1662 ?        Rsl      0:06 /usr/lib/gnome-terminal/gnome-terminal-server
 1670 pts/0    Ss       0:00 bash
 1699 tty2     SLl+     0:08 /usr/bin/gnome-software --gapplication-service
 1701 tty2     Sl+      0:00 update-notifier
 1786 pts/0    S+       0:00 ./ssu_shell
 1802 pts/1    Ss       0:00 bash
 1810 tty2     Sl+      0:00 /usr/lib/deja-dup/deja-dup-monitor
 1899 pts/1    R+       0:00 ps x
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$ ps aux
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root           1  0.3  0.4 159892  8988 ?        Ss   17:31   0:04 /sbin/init splash
root           2  0.0  0.0      0     0 ?        S    17:31   0:00 [kthreadd]
root           3  0.0  0.0      0     0 ?        I<   17:31   0:00 [rcu_gp]
root           4  0.0  0.0      0     0 ?        I<   17:31   0:00 [rcu_par_gp]
root           6  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/0:0H-kb]
root           9  0.0  0.0      0     0 ?        I<   17:31   0:00 [mm_percpu_wq]
root          10  0.0  0.0      0     0 ?        S    17:31   0:00 [ksoftirqd/0]
root          11  0.0  0.0      0     0 ?        I    17:31   0:00 [rcu_sched]
root          12  0.0  0.0      0     0 ?        S    17:31   0:00 [migration/0]
root          13  0.0  0.0      0     0 ?        S    17:31   0:00 [idle_inject/0]
root          14  0.0  0.0      0     0 ?        S    17:31   0:00 [cpuhp/0]
root          15  0.0  0.0      0     0 ?        S    17:31   0:00 [cpuhp/1]
root          16  0.0  0.0      0     0 ?        S    17:31   0:00 [idle_inject/1]
root          17  0.0  0.0      0     0 ?        S    17:31   0:00 [migration/1]
root          18  0.0  0.0      0     0 ?        S    17:31   0:00 [ksoftirqd/1]
root          20  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/1:0H-kb]
root          21  0.0  0.0      0     0 ?        S    17:31   0:00 [kdevtmpfs]
root          22  0.0  0.0      0     0 ?        I<   17:31   0:00 [netns]
root          23  0.0  0.0      0     0 ?        S    17:31   0:00 [rcu_tasks_kthre]
root          24  0.0  0.0      0     0 ?        S    17:31   0:00 [kauditd]
root          26  0.0  0.0      0     0 ?        S    17:31   0:00 [khungtaskd]
root          27  0.0  0.0      0     0 ?        S    17:31   0:00 [oom_reaper]
root          28  0.0  0.0      0     0 ?        I<   17:31   0:00 [writeback]
root          29  0.0  0.0      0     0 ?        S    17:31   0:00 [kcompactd0]
root          30  0.0  0.0      0     0 ?        SN   17:31   0:00 [ksmd]
root          31  0.0  0.0      0     0 ?        SN   17:31   0:00 [khugepaged]
```

⇒ bash_shell에서 ps aux 실행



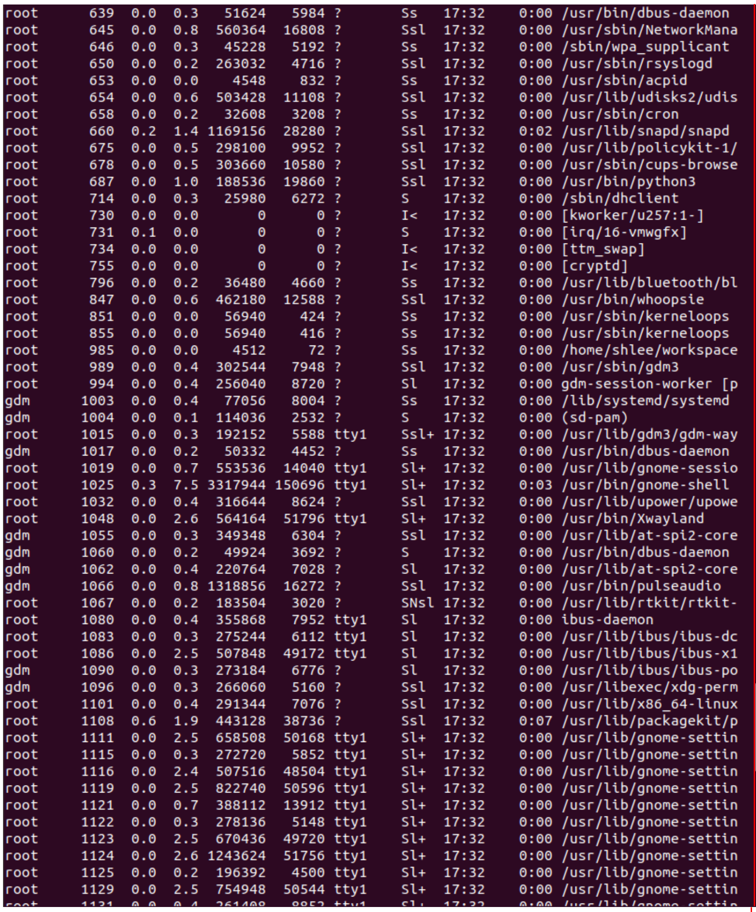
```
root        31  0.0  0.0      0     0 ?        SN   17:31   0:00 [khugepaged]
root        78  0.0  0.0      0     0 ?        I<   17:31   0:00 [kintegrityd]
root        79  0.0  0.0      0     0 ?        I<   17:31   0:00 [kblockd]
root        80  0.0  0.0      0     0 ?        I<   17:31   0:00 [blkcg_punt_bio]
root        81  0.0  0.0      0     0 ?        I    17:31   0:00 [kworker/1:2-eve]
root        82  0.0  0.0      0     0 ?        I<   17:31   0:00 [tpm_dev_wq]
root        83  0.0  0.0      0     0 ?        I<   17:31   0:00 [ata_sff]
root        84  0.0  0.0      0     0 ?        I<   17:31   0:00 [md]
root        85  0.0  0.0      0     0 ?        I<   17:31   0:00 [edac-poller]
root        86  0.0  0.0      0     0 ?        I<   17:31   0:00 [devfreq_wq]
root        87  0.0  0.0      0     0 ?        S    17:31   0:00 [watchdogd]
root        90  0.0  0.0      0     0 ?        S    17:31   0:00 [kswapd0]
root        91  0.0  0.0      0     0 ?        S    17:31   0:00 [ecryptfs-kthrea]
root        93  0.0  0.0      0     0 ?        I<   17:31   0:00 [kthrotld]
root        94  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/24-pciehp]
root        95  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/25-pciehp]
root        96  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/26-pciehp]
root        97  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/27-pciehp]
root        98  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/28-pciehp]
root        99  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/29-pciehp]
root       100  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/30-pciehp]
root       101  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/31-pciehp]
root       102  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/32-pciehp]
root       103  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/33-pciehp]
root       104  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/34-pciehp]
root       105  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/35-pciehp]
root       106  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/36-pciehp]
root       107  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/37-pciehp]
root       108  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/38-pciehp]
root       109  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/39-pciehp]
root       110  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/40-pciehp]
root       111  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/41-pciehp]
root       112  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/42-pciehp]
root       113  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/43-pciehp]
root       114  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/44-pciehp]
root       115  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/45-pciehp]
root       116  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/46-pciehp]
root       117  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/47-pciehp]
root       118  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/48-pciehp]
root       119  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/49-pciehp]
root       120  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/50-pciehp]
root       121  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/51-pciehp]
root       122  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/52-pciehp]
root       123  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/53-pciehp]
root       124  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/54-pciehp]
root       125  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/55-pciehp]
root       126  0.0  0.0      0     0 ?        I<   17:31   0:00 [acpi_thermal_pm]
root       127  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_0]
root       128  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_0]
root       129  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_1]
root       130  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_1]
root       132  0.0  0.0      0     0 ?        I<   17:31   0:00 [vfio-irqfd-clea]
root       133  0.0  0.0      0     0 ?        I<   17:31   0:00 [ipv6_addrconf]
```

```
root        31  0.0  0.0      0     0 ?        SN   17:31   0:00 [khugepaged]
root        78  0.0  0.0      0     0 ?        I<   17:31   0:00 [kintegrityd]
root        79  0.0  0.0      0     0 ?        I<   17:31   0:00 [kblockd]
root        80  0.0  0.0      0     0 ?        I<   17:31   0:00 [blkcg_punt_bio]
root        81  0.0  0.0      0     0 ?        I    17:31   0:00 [kworker/1:2-eve]
root        82  0.0  0.0      0     0 ?        I<   17:31   0:00 [tpm_dev_wq]
root        83  0.0  0.0      0     0 ?        I<   17:31   0:00 [ata_sff]
root        84  0.0  0.0      0     0 ?        I<   17:31   0:00 [md]
root        85  0.0  0.0      0     0 ?        I<   17:31   0:00 [edac-poller]
root        86  0.0  0.0      0     0 ?        I<   17:31   0:00 [devfreq_wq]
root        87  0.0  0.0      0     0 ?        S    17:31   0:00 [watchdogd]
root        90  0.0  0.0      0     0 ?        S    17:31   0:00 [kswapd0]
root        91  0.0  0.0      0     0 ?        S    17:31   0:00 [ecryptfs-kthrea]
root        93  0.0  0.0      0     0 ?        I<   17:31   0:00 [kthrotld]
root        94  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/24-pciehp]
root        95  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/25-pciehp]
root        96  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/26-pciehp]
root        97  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/27-pciehp]
root        98  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/28-pciehp]
root        99  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/29-pciehp]
root       100  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/30-pciehp]
root       101  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/31-pciehp]
root       102  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/32-pciehp]
root       103  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/33-pciehp]
root       104  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/34-pciehp]
root       105  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/35-pciehp]
root       106  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/36-pciehp]
root       107  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/37-pciehp]
root       108  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/38-pciehp]
root       109  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/39-pciehp]
root       110  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/40-pciehp]
root       111  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/41-pciehp]
root       112  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/42-pciehp]
root       113  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/43-pciehp]
root       114  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/44-pciehp]
root       115  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/45-pciehp]
root       116  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/46-pciehp]
root       117  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/47-pciehp]
root       118  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/48-pciehp]
root       119  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/49-pciehp]
root       120  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/50-pciehp]
root       121  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/51-pciehp]
root       122  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/52-pciehp]
root       123  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/53-pciehp]
root       124  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/54-pciehp]
root       125  0.0  0.0      0     0 ?        S    17:31   0:00 [irq/55-pciehp]
root       126  0.0  0.0      0     0 ?        I<   17:31   0:00 [acpi_thermal_pm]
root       127  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_0]
root       128  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_0]
root       129  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_1]
root       130  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_1]
root       132  0.0  0.0      0     0 ?        I<   17:31   0:00 [vfio-irqfd-clea]
root       133  0.0  0.0      0     0 ?        I<   17:31   0:00 [ipv6_addrconf]
```

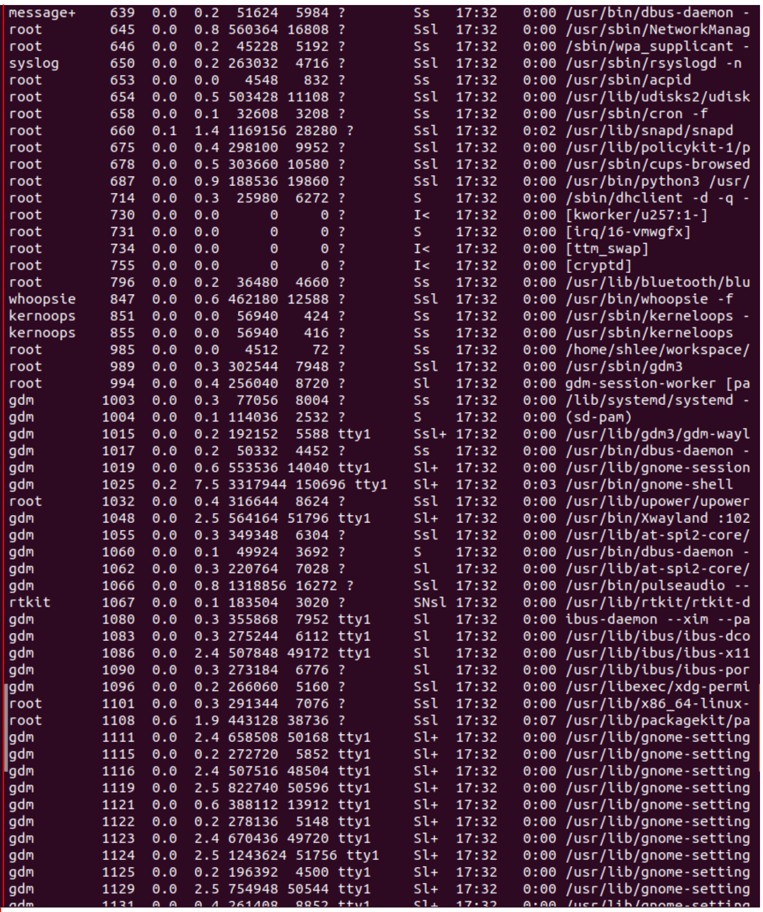


```
root       133  0.0  0.0      0     0 ?        I<   17:31   0:00 [ipv6_addrconf]
root       143  0.0  0.0      0     0 ?        I<   17:31   0:00 [kstrp]
root       146  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/u257:0-]
root       159  0.0  0.0      0     0 ?        I<   17:31   0:00 [charger_manager]
root       207  0.1  0.0      0     0 ?        I    17:31   0:01 [kworker/0:3-eve]
root       208  0.0  0.0      0     0 ?        I<   17:31   0:00 [mpt_poll_0]
root       209  0.0  0.0      0     0 ?        I<   17:31   0:00 [mpt/0]
root       210  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_2]
root       211  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_2]
root       212  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_3]
root       213  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_3]
root       214  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_4]
root       215  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_4]
root       216  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_5]
root       217  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_5]
root       218  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_6]
root       219  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_6]
root       220  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_7]
root       221  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_7]
root       222  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_8]
root       223  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_8]
root       224  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_9]
root       225  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_9]
root       226  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_10]
root       227  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_10]
root       228  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_11]
root       229  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_11]
root       230  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_12]
root       231  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_12]
root       232  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_13]
root       233  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_13]
root       234  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_14]
root       235  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_14]
root       236  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_15]
root       237  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_15]
root       238  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_16]
root       239  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_16]
root       240  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_17]
root       241  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_17]
root       242  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_18]
root       243  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_18]
root       244  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_19]
root       245  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_19]
root       246  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_20]
root       247  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_20]
root       248  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_21]
root       249  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_21]
root       250  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_22]
root       251  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_22]
root       252  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_23]
root       253  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_23]
root       254  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_24]
root       255  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_24]
root       256  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_25]
```

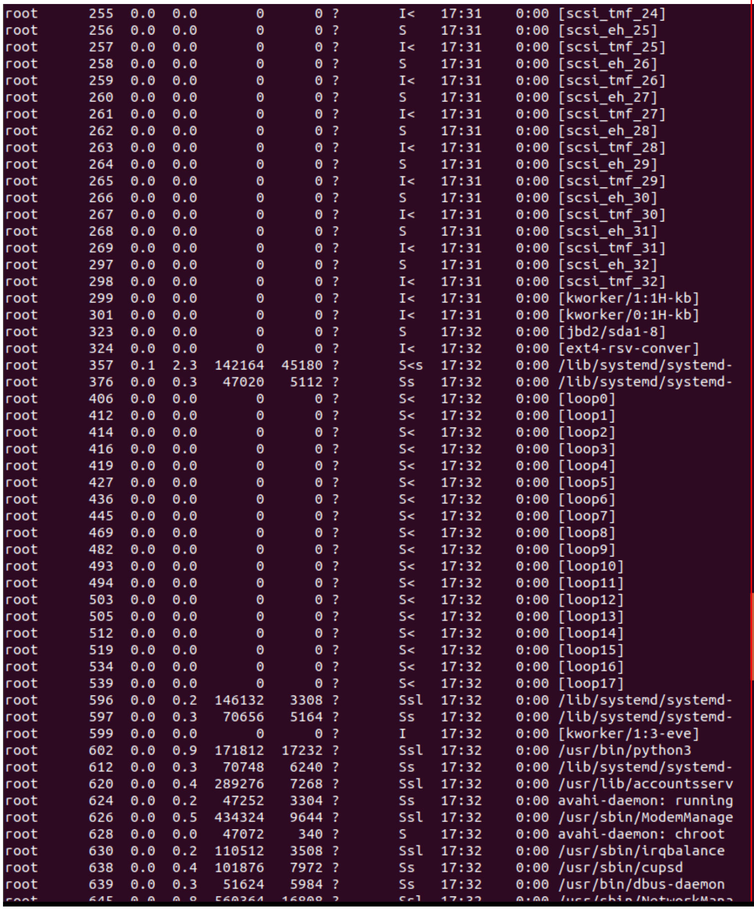
```
root       133  0.0  0.0      0     0 ?        I<   17:31   0:00 [ipv6_addrconf]
root       143  0.0  0.0      0     0 ?        I<   17:31   0:00 [kstrp]
root       146  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/u257:0-]
root       159  0.0  0.0      0     0 ?        I<   17:31   0:00 [charger_manager]
root       207  0.1  0.0      0     0 ?        I    17:31   0:01 [kworker/0:3-eve]
root       208  0.0  0.0      0     0 ?        I<   17:31   0:00 [mpt_poll_0]
root       209  0.0  0.0      0     0 ?        I<   17:31   0:00 [mpt/0]
root       210  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_2]
root       211  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_2]
root       212  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_3]
root       213  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_3]
root       214  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_4]
root       215  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_4]
root       216  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_5]
root       217  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_5]
root       218  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_6]
root       219  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_6]
root       220  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_7]
root       221  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_7]
root       222  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_8]
root       223  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_8]
root       224  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_9]
root       225  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_9]
root       226  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_10]
root       227  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_10]
root       228  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_11]
root       229  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_11]
root       230  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_12]
root       231  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_12]
root       232  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_13]
root       233  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_13]
root       234  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_14]
root       235  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_14]
root       236  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_15]
root       237  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_15]
root       238  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_16]
root       239  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_16]
root       240  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_17]
root       241  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_17]
root       242  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_18]
root       243  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_18]
root       244  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_19]
root       245  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_19]
root       246  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_20]
root       247  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_20]
root       248  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_21]
root       249  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_21]
root       250  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_22]
root       251  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_22]
root       252  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_23]
root       253  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_23]
root       254  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_24]
root       255  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_24]
```



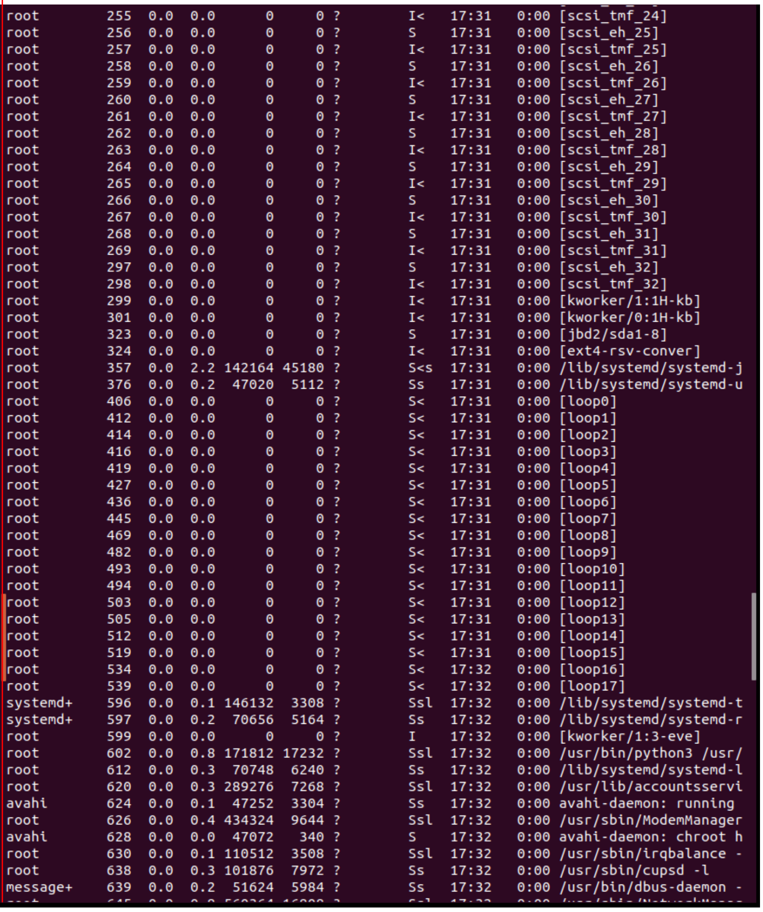
```
root       639  0.0  0.3   51624   5984 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon
root       645  0.0  0.8  560364  16808 ?        Ssl  17:32   0:00 /usr/sbin/NetworkMana
root       646  0.0  0.3   45228   5192 ?        Ss   17:32   0:00 /sbin/wpa_supplicant
root       650  0.0  0.2  263032   4716 ?        Ssl  17:32   0:00 /usr/sbin/rsyslogd
root       653  0.0  0.0    4548    832 ?        Ss   17:32   0:00 /usr/sbin/acpid
root       654  0.0  0.6  503428  11108 ?        Ssl  17:32   0:00 /usr/lib/udisks2/udis
root       658  0.0  0.2   32608   3208 ?        Ss   17:32   0:00 /usr/sbin/cron
root       660  0.2  1.4 1169156  28280 ?        Ssl  17:32   0:02 /usr/lib/snapd/snapd
root       675  0.0  0.5  298100   9952 ?        Ssl  17:32   0:00 /usr/lib/policykit-1/
root       678  0.0  0.5  303660  10580 ?        Ssl  17:32   0:00 /usr/sbin/cups-browse
root       687  0.0  1.0  188536  19860 ?        Ssl  17:32   0:00 /usr/bin/python3
root       714  0.0  0.3   25980   6272 ?        S    17:32   0:00 /sbin/dhclient
root       730  0.0  0.0       0      0 ?        I<   17:32   0:00 [kworker/u257:1-]
root       731  0.1  0.0       0      0 ?        S    17:32   0:00 [irq/16-vmwgfx]
root       734  0.0  0.0       0      0 ?        I<   17:32   0:00 [ttm_swap]
root       755  0.0  0.0       0      0 ?        I<   17:32   0:00 [cryptd]
root       796  0.0  0.2   36480   4660 ?        Ss   17:32   0:00 /usr/lib/bluetooth/bl
root       847  0.0  0.6  462180  12588 ?        Ssl  17:32   0:00 /usr/bin/whoopsie
root       851  0.0  0.0   56940    424 ?        Ss   17:32   0:00 /usr/sbin/kerneloops
root       855  0.0  0.0   56940    416 ?        Ss   17:32   0:00 /usr/sbin/kerneloops
root       985  0.0  0.0    4512     72 ?        Ss   17:32   0:00 /home/shlee/workspace
root       989  0.0  0.4  302544   7948 ?        Ssl  17:32   0:00 /usr/sbin/gdm3
root       994  0.0  0.4  256040   8720 ?        Sl   17:32   0:00 gdm-session-worker [p
gdm       1003  0.0  0.4   77056   8004 ?        Ss   17:32   0:00 /lib/systemd/systemd
gdm       1004  0.0  0.1  114036   2532 ?        S    17:32   0:00 (sd-pam)
root      1015  0.0  0.3  192152   5588 tty1     Ssl+ 17:32   0:00 /usr/lib/gdm3/gdm-way
gdm       1017  0.0  0.2   50332   4452 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon
root      1019  0.0  0.7  553536  14040 tty1     Sl+  17:32   0:00 /usr/lib/gnome-sessio
root      1025  0.3  7.5 3317944 150696 tty1     Sl+  17:32   0:03 /usr/bin/gnome-shell
root      1032  0.0  0.4  316644   8624 ?        Ssl  17:32   0:00 /usr/lib/upower/upowe
root      1048  0.0  2.6  564164  51796 tty1     Sl+  17:32   0:00 /usr/bin/Xwayland
gdm       1055  0.0  0.3  349348   6304 ?        Ssl  17:32   0:00 /usr/lib/at-spi2-core
gdm       1060  0.0  0.2   49924   3692 ?        S    17:32   0:00 /usr/bin/dbus-daemon
gdm       1062  0.0  0.4  220764   7028 ?        Sl   17:32   0:00 /usr/lib/at-spi2-core
gdm       1066  0.0  0.8 1318856  16272 ?        Ssl  17:32   0:00 /usr/bin/pulseaudio
root      1067  0.0  0.2  183504   3020 ?        SNsl 17:32   0:00 /usr/lib/rtkit/rtkit-
root      1080  0.0  0.4  355868   7952 tty1     Sl   17:32   0:00 ibus-daemon
root      1083  0.0  0.3  275244   6112 tty1     Sl   17:32   0:00 /usr/lib/ibus/ibus-dc
root      1086  0.0  2.5  507848  49172 tty1     Sl   17:32   0:00 /usr/lib/ibus/ibus-x1
gdm       1090  0.0  0.3  273184   6776 ?        Sl   17:32   0:00 /usr/lib/ibus/ibus-po
gdm       1096  0.0  0.3  266060   5160 ?        Ssl  17:32   0:00 /usr/libexec/xdg-perm
root      1101  0.0  0.4  291344   7076 ?        Ssl  17:32   0:00 /usr/lib/x86_64-linux
root      1108  0.6  1.9  443128  38736 ?        Ssl  17:32   0:07 /usr/lib/packagekit/p
root      1111  0.0  2.5  658508  50168 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1115  0.0  0.3  272720   5852 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1116  0.0  2.4  507516  48504 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1119  0.0  2.5  822740  50596 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1121  0.0  0.7  388112  13912 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1122  0.0  0.3  278136   5148 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1123  0.0  2.5  670436  49720 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1124  0.0  2.6 1243624  51756 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1125  0.0  0.2  196392   4500 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1129  0.0  2.5  754948  50544 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
root      1131  0.0  0.4  261408   8852 tty1     Sl+  17:32   0:00 /usr/lib/gnome-settin
```



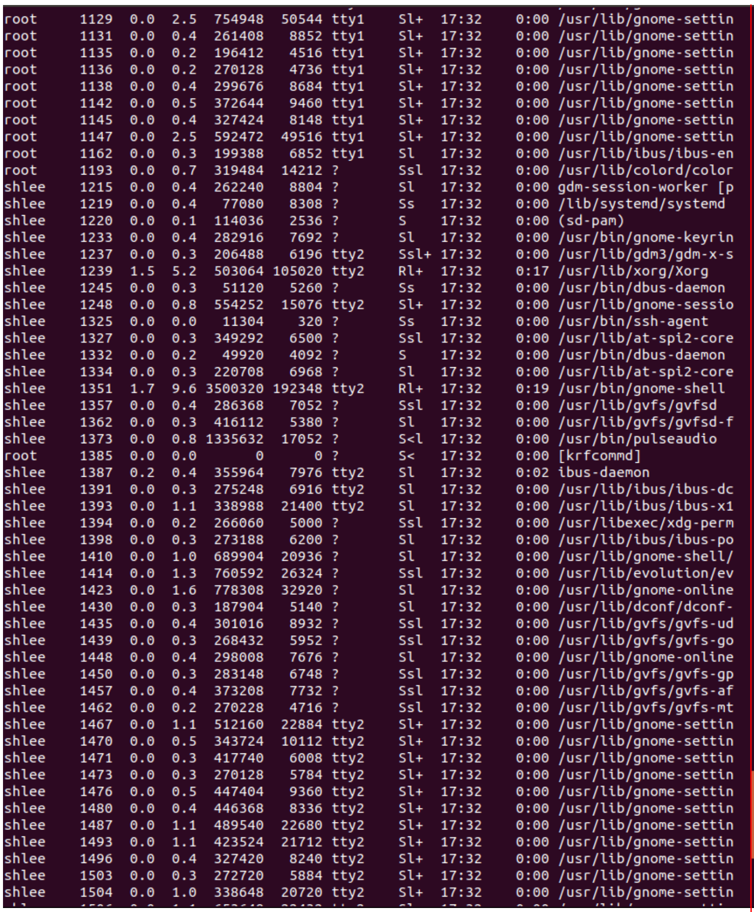
```
message+   639  0.0  0.2  51624  5984 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon -
root       645  0.0  0.8 560364 16808 ?        Ssl  17:32   0:00 /usr/sbin/NetworkManag
root       646  0.0  0.2  45228  5192 ?        Ss   17:32   0:00 /sbin/wpa_supplicant -
syslog     650  0.0  0.2 263032  4716 ?        Ssl  17:32   0:00 /usr/sbin/rsyslogd -n
root       653  0.0  0.0   4548   832 ?        Ss   17:32   0:00 /usr/sbin/acpid
root       654  0.0  0.5 503428 11108 ?        Ssl  17:32   0:00 /usr/lib/udisks2/udisk
root       658  0.0  0.1  32608  3208 ?        Ss   17:32   0:00 /usr/sbin/cron -f
root       660  0.1  1.4 1169156 28280 ?       Ssl  17:32   0:02 /usr/lib/snapd/snapd
root       675  0.0  0.4 298100  9952 ?        Ssl  17:32   0:00 /usr/lib/policykit-1/p
root       678  0.0  0.5 303660 10580 ?        Ssl  17:32   0:00 /usr/sbin/cups-browsed
root       687  0.0  0.9 188536 19860 ?        Ssl  17:32   0:00 /usr/bin/python3 /usr/
root       714  0.0  0.3  25980  6272 ?        S    17:32   0:00 /sbin/dhclient -d -q -
root       730  0.0  0.0      0     0 ?        I<   17:32   0:00 [kworker/u257:1-]
root       731  0.0  0.0      0     0 ?        S    17:32   0:00 [irq/16-vmwgfx]
root       734  0.0  0.0      0     0 ?        I<   17:32   0:00 [ttm_swap]
root       755  0.0  0.0      0     0 ?        I<   17:32   0:00 [cryptd]
root       796  0.0  0.2  36480  4660 ?        Ss   17:32   0:00 /usr/lib/bluetooth/blu
whoopsie   847  0.0  0.6 462180 12588 ?        Ssl  17:32   0:00 /usr/bin/whoopsie -f
kernoops   851  0.0  0.0  56940   424 ?        Ss   17:32   0:00 /usr/sbin/kerneloops -
kernoops   855  0.0  0.0  56940   416 ?        Ss   17:32   0:00 /usr/sbin/kerneloops
root       985  0.0  0.0   4512    72 ?        Ss   17:32   0:00 /home/shlee/workspace/
root       989  0.0  0.3 302544  7948 ?        Ssl  17:32   0:00 /usr/sbin/gdm3
root       994  0.0  0.4 256040  8720 ?        Sl   17:32   0:00 gdm-session-worker [pa
gdm       1003  0.0  0.3  77056  8004 ?        Ss   17:32   0:00 /lib/systemd/systemd -
gdm       1004  0.0  0.1 114036  2532 ?        S    17:32   0:00 (sd-pam)
gdm       1015  0.0  0.2 192152  5588 tty1     Ssl+ 17:32   0:00 /usr/lib/gdm3/gdm-wayl
gdm       1017  0.0  0.2  50332  4452 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon -
gdm       1019  0.0  0.6 553536 14040 tty1     Sl+  17:32   0:00 /usr/lib/gnome-session
gdm       1025  0.2  7.5 3317944 150696 tty1   Sl+  17:32   0:03 /usr/bin/gnome-shell
root      1032  0.0  0.4 316644  8624 ?        Ssl  17:32   0:00 /usr/lib/upower/upower
gdm       1048  0.0  2.5 564164 51796 tty1     Sl+  17:32   0:00 /usr/bin/Xwayland :102
gdm       1055  0.0  0.3 349348  6304 ?        Ssl  17:32   0:00 /usr/lib/at-spi2-core/
gdm       1060  0.0  0.1  49924  3692 ?        S    17:32   0:00 /usr/bin/dbus-daemon -
gdm       1062  0.0  0.3 220764  7028 ?        Sl   17:32   0:00 /usr/lib/at-spi2-core/
gdm       1066  0.0  0.8 1318856 16272 ?       Ssl  17:32   0:00 /usr/bin/pulseaudio --
rtkit     1067  0.0  0.1 183504  3020 ?        SNsl 17:32   0:00 /usr/lib/rtkit/rtkit-d
gdm       1080  0.0  0.3 355868  7952 tty1     Sl   17:32   0:00 ibus-daemon --xim --pa
gdm       1083  0.0  0.3 275244  6112 tty1     Sl   17:32   0:00 /usr/lib/ibus/ibus-dco
gdm       1086  0.0  2.4 507848 49172 tty1     Sl   17:32   0:00 /usr/lib/ibus/ibus-x11
gdm       1090  0.0  0.3 273184  6776 ?        Sl   17:32   0:00 /usr/lib/ibus/ibus-por
gdm       1096  0.0  0.2 266060  5160 ?        Ssl  17:32   0:00 /usr/libexec/xdg-permi
root      1101  0.0  0.3 291344  7076 ?        Ssl  17:32   0:00 /usr/lib/x86_64-linux-
root      1108  0.6  1.9 443128 38736 ?        Ssl  17:32   0:07 /usr/lib/packagekit/pa
gdm       1111  0.0  2.4 658508 50168 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1115  0.0  0.2 272720  5852 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1116  0.0  2.4 507516 48504 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1119  0.0  2.5 822740 50596 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1121  0.0  0.6 388112 13912 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1122  0.0  0.2 278136  5148 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1123  0.0  2.4 670436 49720 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1124  0.0  2.5 1243624 51756 tty1    Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1125  0.0  0.2 196392  4500 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1129  0.0  2.5 754948 50544 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm       1131  0.0  0.4 261408  8852 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
```



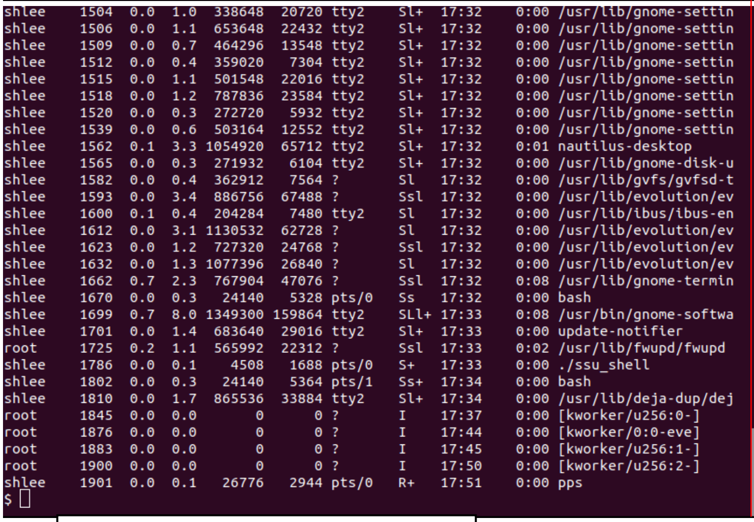
```
root       255  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_24]
root       256  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_25]
root       257  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_25]
root       258  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_26]
root       259  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_26]
root       260  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_27]
root       261  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_27]
root       262  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_28]
root       263  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_28]
root       264  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_29]
root       265  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_29]
root       266  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_30]
root       267  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_30]
root       268  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_31]
root       269  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_31]
root       297  0.0  0.0       0      0 ?        S    17:31   0:00 [scsi_eh_32]
root       298  0.0  0.0       0      0 ?        I<   17:31   0:00 [scsi_tmf_32]
root       299  0.0  0.0       0      0 ?        I<   17:31   0:00 [kworker/1:1H-kb]
root       301  0.0  0.0       0      0 ?        I<   17:31   0:00 [kworker/0:1H-kb]
root       323  0.0  0.0       0      0 ?        S    17:32   0:00 [jbd2/sda1-8]
root       324  0.0  0.0       0      0 ?        I<   17:32   0:00 [ext4-rsv-conver]
root       357  0.1  2.3  142164  45180 ?        S<s  17:32   0:00 /lib/systemd/systemd-
root       376  0.0  0.3   47020   5112 ?        Ss   17:32   0:00 /lib/systemd/systemd-
root       406  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop0]
root       412  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop1]
root       414  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop2]
root       416  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop3]
root       419  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop4]
root       427  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop5]
root       436  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop6]
root       445  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop7]
root       469  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop8]
root       482  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop9]
root       493  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop10]
root       494  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop11]
root       503  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop12]
root       505  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop13]
root       512  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop14]
root       519  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop15]
root       534  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop16]
root       539  0.0  0.0       0      0 ?        S<   17:32   0:00 [loop17]
root       596  0.0  0.2  146132   3308 ?        Ssl  17:32   0:00 /lib/systemd/systemd-
root       597  0.0  0.3   70656   5164 ?        Ss   17:32   0:00 /lib/systemd/systemd-
root       599  0.0  0.0       0      0 ?        I    17:32   0:00 [kworker/1:3-eve]
root       602  0.0  0.9  171812  17232 ?        Ssl  17:32   0:00 /usr/bin/python3
root       612  0.0  0.3   70748   6240 ?        Ss   17:32   0:00 /lib/systemd/systemd-
root       620  0.0  0.4  289276   7268 ?        Ssl  17:32   0:00 /usr/lib/accountsserv
root       624  0.0  0.2   47252   3304 ?        Ss   17:32   0:00 avahi-daemon: running
root       626  0.0  0.5  434324   9644 ?        Ssl  17:32   0:00 /usr/sbin/ModemManage
root       628  0.0  0.0   47072    340 ?        S    17:32   0:00 avahi-daemon: chroot
root       630  0.0  0.2  110512   3508 ?        Ssl  17:32   0:00 /usr/sbin/irqbalance
root       638  0.0  0.4  101876   7972 ?        Ss   17:32   0:00 /usr/sbin/cupsd
root       639  0.0  0.3   51624   5984 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon
root       645  0.0  0.8  560364  16808 ?        Ssl  17:32   0:00 /usr/sbin/NetworkMana
```



```
root       255  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_24]
root       256  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_25]
root       257  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_25]
root       258  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_26]
root       259  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_26]
root       260  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_27]
root       261  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_27]
root       262  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_28]
root       263  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_28]
root       264  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_29]
root       265  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_29]
root       266  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_30]
root       267  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_30]
root       268  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_31]
root       269  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_31]
root       297  0.0  0.0      0     0 ?        S    17:31   0:00 [scsi_eh_32]
root       298  0.0  0.0      0     0 ?        I<   17:31   0:00 [scsi_tmf_32]
root       299  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/1:1H-kb]
root       301  0.0  0.0      0     0 ?        I<   17:31   0:00 [kworker/0:1H-kb]
root       323  0.0  0.0      0     0 ?        S    17:31   0:00 [jbd2/sda1-8]
root       324  0.0  0.0      0     0 ?        I<   17:31   0:00 [ext4-rsv-conver]
root       357  0.0  2.2 142164 45180 ?        S<s  17:31   0:00 /lib/systemd/systemd-j
root       376  0.0  0.2  47020  5112 ?        Ss   17:31   0:00 /lib/systemd/systemd-u
root       406  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop0]
root       412  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop1]
root       414  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop2]
root       416  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop3]
root       419  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop4]
root       427  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop5]
root       436  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop6]
root       445  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop7]
root       469  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop8]
root       482  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop9]
root       493  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop10]
root       494  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop11]
root       503  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop12]
root       505  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop13]
root       512  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop14]
root       519  0.0  0.0      0     0 ?        S<   17:31   0:00 [loop15]
root       534  0.0  0.0      0     0 ?        S<   17:32   0:00 [loop16]
root       539  0.0  0.0      0     0 ?        S<   17:32   0:00 [loop17]
systemd+   596  0.0  0.1 146132  3308 ?        Ssl  17:32   0:00 /lib/systemd/systemd-t
systemd+   597  0.0  0.2  70656  5164 ?        Ss   17:32   0:00 /lib/systemd/systemd-r
root       599  0.0  0.0      0     0 ?        I    17:32   0:00 [kworker/1:3-eve]
root       602  0.0  0.8 171812 17232 ?        Ssl  17:32   0:00 /usr/bin/python3 /usr/
root       612  0.0  0.3  70748  6240 ?        Ss   17:32   0:00 /lib/systemd/systemd-l
root       620  0.0  0.3 289276  7268 ?        Ssl  17:32   0:00 /usr/lib/accountsservi
avahi      624  0.0  0.1  47252  3304 ?        Ss   17:32   0:00 avahi-daemon: running
root       626  0.0  0.4 434324  9644 ?        Ssl  17:32   0:00 /usr/sbin/ModemManager
avahi      628  0.0  0.0  47072   340 ?        S    17:32   0:00 avahi-daemon: chroot h
root       630  0.0  0.1 110512  3508 ?        Ssl  17:32   0:00 /usr/sbin/irqbalance -
root       638  0.0  0.3 101876  7972 ?        Ss   17:32   0:00 /usr/sbin/cupsd -l
message+   639  0.0  0.2  51624  5984 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon -
```

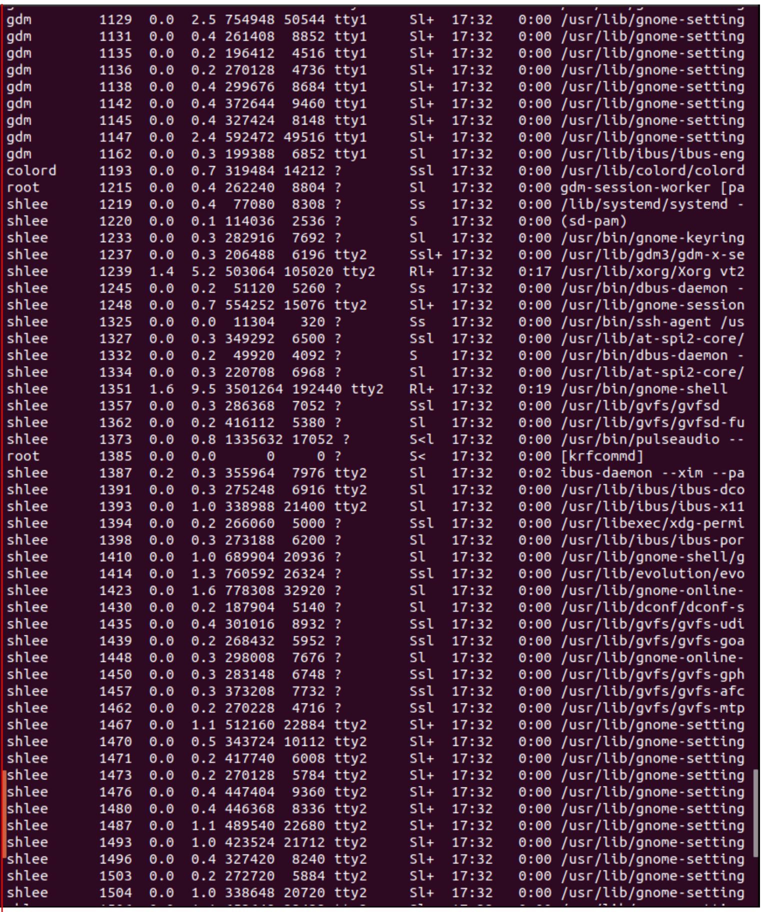


```
root      1129  0.0  2.5  754948  50544 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1131  0.0  0.4  261408   8852 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1135  0.0  0.2  196412   4516 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1136  0.0  0.2  270128   4736 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1138  0.0  0.4  299676   8684 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1142  0.0  0.5  372644   9460 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1145  0.0  0.4  327424   8148 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1147  0.0  2.5  592472  49516 tty1     Sl+  17:32    0:00 /usr/lib/gnome-settin
root      1162  0.0  0.3  199388   6852 tty1     Sl   17:32    0:00 /usr/lib/ibus/ibus-en
root      1193  0.0  0.7  319484  14212 ?        Ssl  17:32    0:00 /usr/lib/colord/color
shlee     1215  0.0  0.4  262240   8804 ?        Sl   17:32    0:00 gdm-session-worker [p
shlee     1219  0.0  0.4   77080   8308 ?        Ss   17:32    0:00 /lib/systemd/systemd
shlee     1220  0.0  0.1  114036   2536 ?        S    17:32    0:00 (sd-pam)
shlee     1233  0.0  0.4  282916   7692 ?        Sl   17:32    0:00 /usr/bin/gnome-keyrin
shlee     1237  0.0  0.3  206488   6196 tty2     Ssl+ 17:32    0:00 /usr/lib/gdm3/gdm-x-s
shlee     1239  1.5  5.2  503064 105020 tty2     Rl+  17:32    0:17 /usr/lib/xorg/Xorg
shlee     1245  0.0  0.3   51120   5260 ?        Ss   17:32    0:00 /usr/bin/dbus-daemon
shlee     1248  0.0  0.8  554252  15076 tty2     Sl+  17:32    0:00 /usr/lib/gnome-sessio
shlee     1325  0.0  0.0   11304    320 ?        Ss   17:32    0:00 /usr/bin/ssh-agent
shlee     1327  0.0  0.3  349292   6500 ?        Ssl  17:32    0:00 /usr/lib/at-spi2-core
shlee     1332  0.0  0.2   49920   4092 ?        S    17:32    0:00 /usr/bin/dbus-daemon
shlee     1334  0.0  0.3  220708   6968 ?        Sl   17:32    0:00 /usr/lib/at-spi2-core
shlee     1351  1.7  9.6 3500320 192348 tty2     Rl+  17:32    0:19 /usr/bin/gnome-shell
shlee     1357  0.0  0.4  286368   7052 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfsd
shlee     1362  0.0  0.3  416112   5380 ?        Sl   17:32    0:00 /usr/lib/gvfs/gvfsd-f
shlee     1373  0.0  0.8 1335632  17052 ?        S<l  17:32    0:00 /usr/bin/pulseaudio
root      1385  0.0  0.0       0      0 ?        S<   17:32    0:00 [krfcommd]
shlee     1387  0.2  0.4  355964   7976 tty2     Sl   17:32    0:02 ibus-daemon
shlee     1391  0.0  0.3  275248   6916 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-dc
shlee     1393  0.0  1.1  338988  21400 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-x1
shlee     1394  0.0  0.2  266060   5000 ?        Ssl  17:32    0:00 /usr/libexec/xdg-perm
shlee     1398  0.0  0.3  273188   6200 ?        Sl   17:32    0:00 /usr/lib/ibus/ibus-po
shlee     1410  0.0  1.0  689904  20936 ?        Sl   17:32    0:00 /usr/lib/gnome-shell/
shlee     1414  0.0  1.3  760592  26324 ?        Ssl  17:32    0:00 /usr/lib/evolution/ev
shlee     1423  0.0  1.6  778308  32920 ?        Sl   17:32    0:00 /usr/lib/gnome-online
shlee     1430  0.0  0.3  187904   5140 ?        Sl   17:32    0:00 /usr/lib/dconf/dconf-
shlee     1435  0.0  0.4  301016   8932 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfs-ud
shlee     1439  0.0  0.3  268432   5952 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfs-go
shlee     1448  0.0  0.4  298008   7676 ?        Sl   17:32    0:00 /usr/lib/gnome-online
shlee     1450  0.0  0.3  283148   6748 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfs-gp
shlee     1457  0.0  0.4  373208   7732 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfs-af
shlee     1462  0.0  0.2  270228   4716 ?        Ssl  17:32    0:00 /usr/lib/gvfs/gvfs-mt
shlee     1467  0.0  1.1  512160  22884 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1470  0.0  0.5  343724  10112 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1471  0.0  0.3  417740   6008 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1473  0.0  0.3  270128   5784 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1476  0.0  0.5  447404   9360 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1480  0.0  0.4  446368   8336 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1487  0.0  1.1  489540  22680 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1493  0.0  1.1  423524  21712 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1496  0.0  0.4  327420   8240 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1503  0.0  0.3  272720   5884 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1504  0.0  1.0  338648  20720 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
```

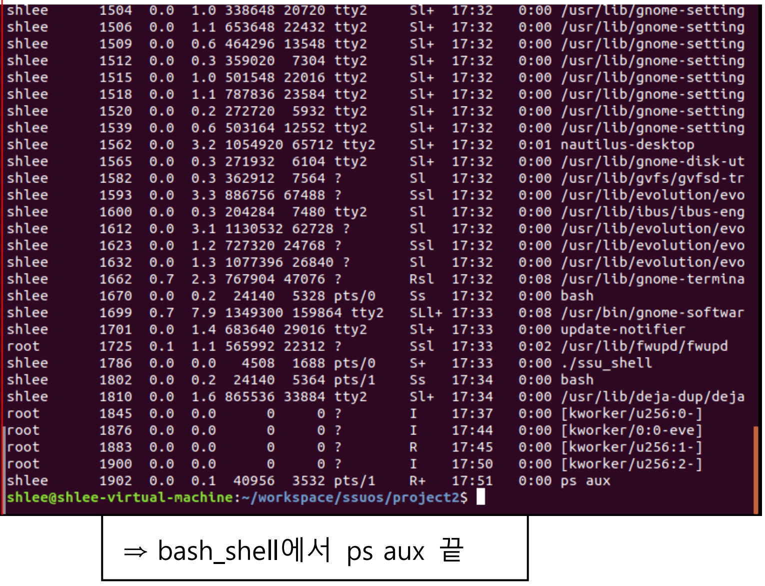


```
shlee     1504  0.0  1.0  338648  20720 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1506  0.0  1.1  653648  22432 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1509  0.0  0.7  464296  13548 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1512  0.0  0.4  359020   7304 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1515  0.0  1.1  501548  22016 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1518  0.0  1.2  787836  23584 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1520  0.0  0.3  272720   5932 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1539  0.0  0.6  503164  12552 tty2     Sl+  17:32    0:00 /usr/lib/gnome-settin
shlee     1562  0.1  3.3 1054920  65712 tty2     Sl+  17:32    0:01 nautilus-desktop
shlee     1565  0.0  0.3  271932   6104 tty2     Sl+  17:32    0:00 /usr/lib/gnome-disk-u
shlee     1582  0.0  0.4  362912   7564 ?        Sl   17:32    0:00 /usr/lib/gvfs/gvfsd-t
shlee     1593  0.0  3.4  886756  67488 ?        Ssl  17:32    0:00 /usr/lib/evolution/ev
shlee     1600  0.1  0.4  204284   7480 tty2     Sl   17:32    0:00 /usr/lib/ibus/ibus-en
shlee     1612  0.0  3.1 1130532  62728 ?        Sl   17:32    0:00 /usr/lib/evolution/ev
shlee     1623  0.0  1.2  727320  24768 ?        Ssl  17:32    0:00 /usr/lib/evolution/ev
shlee     1632  0.0  1.3 1077396  26840 ?        Sl   17:32    0:00 /usr/lib/evolution/ev
shlee     1662  0.7  2.3  767904  47076 ?        Ssl  17:32    0:08 /usr/lib/gnome-termin
shlee     1670  0.0  0.3   24140   5328 pts/0    Ss   17:32    0:00 bash
shlee     1699  0.7  8.0 1349300 159864 tty2     SLl+ 17:33    0:08 /usr/bin/gnome-softwa
shlee     1701  0.0  1.4  683640  29016 tty2     Sl+  17:33    0:00 update-notifier
root      1725  0.2  1.1  565992  22312 ?        Ssl  17:33    0:02 /usr/lib/fwupd/fwupd
shlee     1786  0.0  0.1    4508   1688 pts/0    S+   17:33    0:00 ./ssu_shell
shlee     1802  0.0  0.3   24140   5364 pts/1    Ss+  17:34    0:00 bash
shlee     1810  0.0  1.7  865536  33884 tty2     Sl+  17:34    0:00 /usr/lib/deja-dup/dej
root      1845  0.0  0.0       0      0 ?        I    17:37    0:00 [kworker/u256:0-]
root      1876  0.0  0.0       0      0 ?        I    17:44    0:00 [kworker/0:0-eve]
root      1883  0.0  0.0       0      0 ?        I    17:45    0:00 [kworker/u256:1-]
root      1900  0.0  0.0       0      0 ?        I    17:50    0:00 [kworker/u256:2-]
shlee     1901  0.0  0.1   26776   2944 pts/0    R+   17:51    0:00 pps
$
```

⇒ ssu_shell에서 pps aux 끝



```
gdm        1129  0.0  2.5 754948 50544 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1131  0.0  0.4 261408  8852 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1135  0.0  0.2 196412  4516 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1136  0.0  0.2 270128  4736 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1138  0.0  0.4 299676  8684 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1142  0.0  0.4 372644  9460 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1145  0.0  0.4 327424  8148 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1147  0.0  2.4 592472 49516 tty1     Sl+  17:32   0:00 /usr/lib/gnome-setting
gdm        1162  0.0  0.3 199388  6852 tty1     Sl   17:32   0:00 /usr/lib/ibus/ibus-eng
colord     1193  0.0  0.7 319484 14212 ?        Ssl  17:32   0:00 /usr/lib/colord/colord
root       1215  0.0  0.4 262240  8804 ?        Sl   17:32   0:00 gdm-session-worker [pa
shlee      1219  0.0  0.4  77080  8308 ?        Ss   17:32   0:00 /lib/systemd/systemd -
shlee      1220  0.0  0.1 114036  2536 ?        S    17:32   0:00 (sd-pam)
shlee      1233  0.0  0.3 282916  7692 ?        Sl   17:32   0:00 /usr/bin/gnome-keyring
shlee      1237  0.0  0.3 206488  6196 tty2     Ssl+ 17:32   0:00 /usr/lib/gdm3/gdm-x-se
shlee      1239  1.4  5.2 503064 105020 tty2    Rl+  17:32   0:17 /usr/lib/xorg/Xorg vt2
shlee      1245  0.0  0.2  51120  5260 ?        Ss   17:32   0:00 /usr/bin/dbus-daemon -
shlee      1248  0.0  0.7 554252 15076 tty2     Sl+  17:32   0:00 /usr/lib/gnome-session
shlee      1325  0.0  0.0  11304   320 ?        Ss   17:32   0:00 /usr/bin/ssh-agent /us
shlee      1327  0.0  0.3 349292  6500 ?        Ssl  17:32   0:00 /usr/lib/at-spi2-core/
shlee      1332  0.0  0.2  49920  4092 ?        S    17:32   0:00 /usr/bin/dbus-daemon -
shlee      1334  0.0  0.3 220708  6968 ?        Sl   17:32   0:00 /usr/lib/at-spi2-core/
shlee      1351  1.6  9.5 3501264 192440 tty2   Rl+  17:32   0:19 /usr/bin/gnome-shell
shlee      1357  0.0  0.3 286368  7052 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfsd
shlee      1362  0.0  0.2 416112  5380 ?        Sl   17:32   0:00 /usr/lib/gvfs/gvfsd-fu
shlee      1373  0.0  0.8 1335632 17052 ?       S<l  17:32   0:00 /usr/bin/pulseaudio --
root       1385  0.0  0.0      0     0 ?        S<   17:32   0:00 [krfcommd]
shlee      1387  0.2  0.3 355964  7976 tty2     Sl   17:32   0:02 ibus-daemon --xim --pa
shlee      1391  0.0  0.3 275248  6916 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-dco
shlee      1393  0.0  1.0 338988 21400 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-x11
shlee      1394  0.0  0.2 266060  5000 ?        Ssl  17:32   0:00 /usr/libexec/xdg-permi
shlee      1398  0.0  0.3 273188  6200 ?        Sl   17:32   0:00 /usr/lib/ibus/ibus-por
shlee      1410  0.0  1.0 689904 20936 ?        Sl   17:32   0:00 /usr/lib/gnome-shell/g
shlee      1414  0.0  1.3 760592 26324 ?        Ssl  17:32   0:00 /usr/lib/evolution/evo
shlee      1423  0.0  1.6 778308 32920 ?        Sl   17:32   0:00 /usr/lib/gnome-online-
shlee      1430  0.0  0.2 187904  5140 ?        Sl   17:32   0:00 /usr/lib/dconf/dconf-s
shlee      1435  0.0  0.4 301016  8932 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfs-udi
shlee      1439  0.0  0.2 268432  5952 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfs-goa
shlee      1448  0.0  0.3 298008  7676 ?        Sl   17:32   0:00 /usr/lib/gnome-online-
shlee      1450  0.0  0.3 283148  6748 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfs-gph
shlee      1457  0.0  0.3 373208  7732 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfs-afc
shlee      1462  0.0  0.2 270228  4716 ?        Ssl  17:32   0:00 /usr/lib/gvfs/gvfs-mtp
shlee      1467  0.0  1.1 512160 22884 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1470  0.0  0.5 343724 10112 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1471  0.0  0.2 417740  6008 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1473  0.0  0.2 270128  5784 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1476  0.0  0.4 447404  9360 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1480  0.0  0.4 446368  8336 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1487  0.0  1.1 489540 22680 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1493  0.0  1.0 423524 21712 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1496  0.0  0.4 327420  8240 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1503  0.0  0.2 272720  5884 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1504  0.0  1.0 338648 20720 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
```



```
shlee      1504  0.0  1.0 338648 20720 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1506  0.0  1.1 653648 22432 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1509  0.0  0.6 464296 13548 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1512  0.0  0.3 359020  7304 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1515  0.0  1.0 501548 22016 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1518  0.0  1.1 787836 23584 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1520  0.0  0.2 272720  5932 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1539  0.0  0.6 503164 12552 tty2     Sl+  17:32   0:00 /usr/lib/gnome-setting
shlee      1562  0.0  3.2 1054920 65712 tty2    Sl+  17:32   0:01 nautilus-desktop
shlee      1565  0.0  0.3 271932  6104 tty2     Sl+  17:32   0:00 /usr/lib/gnome-disk-ut
shlee      1582  0.0  0.3 362912  7564 ?        Sl   17:32   0:00 /usr/lib/gvfs/gvfsd-tr
shlee      1593  0.0  3.3 886756 67488 ?        Ssl  17:32   0:00 /usr/lib/evolution/evo
shlee      1600  0.0  0.3 204284  7480 tty2     Sl   17:32   0:00 /usr/lib/ibus/ibus-eng
shlee      1612  0.0  3.1 1130532 62728 ?       Sl   17:32   0:00 /usr/lib/evolution/evo
shlee      1623  0.0  1.2 727320 24768 ?        Ssl  17:32   0:00 /usr/lib/evolution/evo
shlee      1632  0.0  1.3 1077396 26840 ?       Sl   17:32   0:00 /usr/lib/evolution/evo
shlee      1662  0.7  2.3 767904 47076 ?        Rsl  17:32   0:08 /usr/lib/gnome-termina
shlee      1670  0.0  0.2  24140  5328 pts/0    Ss   17:32   0:00 bash
shlee      1699  0.7  7.9 1349300 159864 tty2   SLl+ 17:33   0:08 /usr/bin/gnome-softwar
shlee      1701  0.0  1.4 683640 29016 tty2     Sl+  17:33   0:00 update-notifier
root       1725  0.1  1.1 565992 22312 ?        Ssl  17:33   0:02 /usr/lib/fwupd/fwupd
shlee      1786  0.0  0.0   4508  1688 pts/0    S+   17:33   0:00 ./ssu_shell
shlee      1802  0.0  0.2  24140  5364 pts/1    Ss   17:34   0:00 bash
shlee      1810  0.0  1.6 865536 33884 tty2     Sl+  17:34   0:00 /usr/lib/deja-dup/deja
root       1845  0.0  0.0      0     0 ?        I    17:37   0:00 [kworker/u256:0-]
root       1876  0.0  0.0      0     0 ?        I    17:44   0:00 [kworker/0:0-eve]
root       1883  0.0  0.0      0     0 ?        R    17:45   0:00 [kworker/u256:1-]
root       1900  0.0  0.0      0     0 ?        I    17:50   0:00 [kworker/u256:2-]
shlee      1902  0.0  0.1  40956  3532 pts/1    R+   17:51   0:00 ps aux
shlee@shlee-virtual-machine:~/workspace/ssuos/project2$
```

⇒ bash_shell에서 ps aux 끝

위와 같이 ssu_shell과 bash shell에서의 결과가 동일함을 확인하였음.

3. 소스코드

ssu_shell.c

```
#include <sys/types.h>
#include <sys/wait.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <signal.h>

#define BUFFER_SIZE 1024
#define MAX_INPUT_SIZE 1024
#define MAX_TOKEN_SIZE 64
#define MAX_NUM_TOKENS 64

void execute_command(char **tokens, int command_start_index, int stdin_fd); // 명령어실행 함수
int get_next_pipe_index(char **tokens, int command_start_index); // 다음 파이프 명령어의 인덱스를 찾아 반환하는 함수
int check_exit_status(int status); // 자식 프로세스의 종료 상태를 확인하는 함수

/* Splits the string by space and returns the array of tokens
*
*/
char **tokenize(char *line)
{
   char **tokens = (char **)malloc(MAX_NUM_TOKENS * sizeof(char *)); // 분리된 토큰들을 저장할 배열
   char *token = (char *)malloc(MAX_TOKEN_SIZE * sizeof(char)); // 토큰을 분리하는데 사용할 배열
   int i, tokenIndex = 0, tokenNo = 0;
```

```
  // 명령어(line)에서 white space로 구분된 토큰들을 분류해서 tokens에 각각 저장한다
  for(i =0; i < strlen(line); i++){

    char readChar = line[i]; // line을 한글자씩 읽는다

    if (readChar == ' ' || readChar == '₩n' || readChar == '₩t'){ // 읽은 문자가 white space라면
      token[tokenIndex] = '₩0';
      if (tokenIndex != 0){ // 읽어들인 토큰이 있는 경우 (해당 토큰을 다 읽어들임)
        tokens[tokenNo] = (char*)malloc(MAX_TOKEN_SIZE*sizeof(char)); // 토큰을 저장할 새로운 저장공간 할당
        strcpy(tokens[tokenNo++], token); // 새로운 저장공간에 분리해둔 토큰을 복사
        tokenIndex = 0; // tokenIndex를 0으로 초기화 하여 다음 토큰을 읽을 준비를 한다.
      }
    } else { // 읽은 문자가 white space가 아닌 경우 (토큰을 구성하는 문자인 경우)
      token[tokenIndex++] = readChar; // token 배열에 덧붙여 저장.
    }
  }

  free(token);
  tokens[tokenNo] = NULL ; // 끝이라는걸 표시하기 위해 마지막 토큰 다음에 NULL을 넣는다.
  return tokens; // 분리된 토큰들 리턴
}


int main(int argc, char* argv[]) {
        char    line[MAX_INPUT_SIZE]; // 명령어 입력받을 배열
        char    **tokens; // 명령어에서 분리한 토큰들이 저장된 배열을 담을 포인터
```

```
int i;
char current_dir_name[BUFFER_SIZE];
char *path_env_value;
char new_path_env_value[BUFFER_SIZE];

// for run ttop and pps commands, add current working directory to PATH env
getcwd(current_dir_name, BUFFER_SIZE);
path_env_value = getenv("PATH");
sprintf(new_path_env_value, "%s:%s", path_env_value, current_dir_name);
setenv("PATH", new_path_env_value, 1);

FILE* fp;
if(argc == 2) { // 배치식인 경우 파일 open
	fp = fopen(argv[1],"r");
	if(fp < 0) {
		printf("File doesn't exists.");
		return -1;
	}
}


while(1) {
	/* BEGIN: TAKING INPUT */
	bzero(line, sizeof(line));
	if(argc == 2) { // batch mode
		if(fgets(line, sizeof(line), fp) == NULL) { // file reading finished
			break;
```

```
            }
            line[strlen(line) - 1] = '₩0';
        } else { // interactive mode
            printf("$ ");
            scanf("%[^₩n]", line);
            getchar();
        }
        //printf("Command entered: %s (remove this debug output later)₩n", line);
        /* END: TAKING INPUT */

        line[strlen(line)] = '₩n'; //terminate with new line -> tokenize()의 정상적 수행을 위해 명령어 마지막 문자를 white space로 해야함
        tokens = tokenize(line);

    //do whatever you want with the commands, here we just print them

//      for(i=0;tokens[i]!=NULL;i++){
//          printf("found token %s (remove this debug output later)₩n", tokens[i]);
//      }



        // 여기서 토큰 이용해 명령어 실행
        execute_command(tokens, 0, 0);


        // Freeing the allocated memory
        for(i=0;tokens[i]!=NULL;i++){
                free(tokens[i]);
            }
            free(tokens);

        }
        return 0;
}

void execute_command(char **tokens, int command_start_index, int stdin_fd){
        pid_t pid;
        int status;
        int pipe_fd[2];
        int pipe_index;

        if (!tokens[command_start_index]) { // 첫번째 토큰이 NULL인 경우
            return;
        }

        if ((pipe_index = get_next_pipe_index(tokens, command_start_index)) > 0) { // 실행하지 않은 토큰 중 파이프 명령어 있다면
            tokens[pipe_index] = NULL;
            if (pipe(pipe_fd) == -1) { // pipe 생성
                fprintf(stderr, "pipe() error.₩n");
            }
        }

        if ((pid = fork()) > 0) { // 부모 프로세스
            waitpid(pid, &status, WUNTRACED);
            if (!check_exit_status(status)){ // 자식 프로세스가 적절하게 종료되었는지 확인한다
                return; // 제대로 종료되지 않았다면 여기서 바로 함수 종료
            }
            if (pipe_index > 0) { // 파이프 명령어 있었다면
                close(pipe_fd[1]); // 안쓰는 파이프 파일 close
                // execute_command 재귀호출하며 stdin_fd로 파이프 넘겨줌, command_start_index는
pipe_index + 1
                execute_command(tokens, pipe_index + 1, pipe_fd[0]);
                // pipe close
                close(pipe_fd[0]);
            }
        } else if (pid == 0) { // 자식 프로세스
            if (pipe_index > 0) {
                close(pipe_fd[0]); // 안쓰는 파이프 파일 close
                if (dup2(pipe_fd[1], 1) != 1) { // 표준 출력을 파이프로 리디렉션, 이 이후부터 exec 까지 표준 출
력에 출력 하면 절대 안됨!!!
                fprintf(stderr, "dup2() error 2₩n");
                }
            }

            if (stdin_fd > 0) { // 파이프 뒤에 있는 명령어의 경우
                dup2(stdin_fd, 0); // 표준 입력을 파이프로 리디렉션
            }

            if (execvp(tokens[command_start_index], tokens + command_start_index) < 0) { // 명령어 실행
                fprintf(stderr, "SSUShell : Incorrect command₩n");
                exit(1);
```

```
		}

	} else { // fork 에러
		fprintf(stderr, "fork() error.₩n");
	}

	return;
}

int check_exit_status(int status) {
	if (WIFEXITED(status)) {
		return 1;
	} else if (WIFSIGNALED(status)) {
		fprintf(stderr, "abnormal termination, signal number = %d%s₩n",
				WTERMSIG(status),
#ifdef WCOREDUMP
				WCOREDUMP(status) ? " (core file generated)" : "");
#else
				"");
#endif
		return 0;
	} else if (WIFSTOPPED(status)) {
		fprintf(stderr, "child stopped, signal number = %d₩n", WSTOPSIG(status));
		return 0;
	}

	return 0;
```

```
}


// 토큰중에서 command_start_index 뒤의 첫번째 pipe의 인덱스 리턴, 없을경우 -1 리턴
int get_next_pipe_index(char **tokens, int command_start_index){
	int pipe_index = -1;
	int token_index = command_start_index;

	while (tokens[token_index]) {
		if (!strcmp(tokens[token_index], "|")) {
			pipe_index = token_index; // 파이프 찾으면 인덱스 저장하고
			break; // break
		}
		++token_index; // 다음 토큰으로 이동
	}

	return pipe_index;
}
```

ttop.c

```
#include <stdio.h>
#include <ncurses.h>
#include <stdlib.h>
#include <unistd.h>
#include <time.h>
#include <string.h>
#include <utmpx.h>
#include <dirent.h>
#include <ctype.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <pwd.h>

#define BUFFER_SIZE (128)
#define MAX_USER_NAME (32)
#define INIT_LIST_SIZE (1024)
#define MILLIS (1000)
const unsigned long NANOS = 1000000000;
int page_size_in_KiB;
unsigned int print_start_index;
int running; // running 상태인 프로세스의 개수를 저장할 변수
int sleeping; // sleeping 상태인 프로세스의 개수를 저장할 변수
int stopped; // stopped 상태인 프로세스의 개수를 저장할 변수
int zombie; // zombie 상태인 프로세스의 개수를 저장할 변수

void init_screen(); // 콘솔 초기화 함수
void refresh_page(int row, int col); // ttop 내용 새로고침

void print_system_infos(int col); // ttop 명령어 상단의 system 정보 출력
char *print_current_time(); // 현재시간 문자열 만들어 리턴하는 함수
char *print_running_time(); // 실행 시간 문자열 만들어 리턴하는 함수
char *print_user_count(); // 유저 수 문자열로 만들어 리턴하는 함수
char *print_load_average(); // load average 문자열로 만들어 리턴하는 함수
void print_cpu_infos(int col); // cpu정보 문자열로 만들어 리턴하는 함수
void print_mem_infos(int col); // mem정보 문자열로 만들어 리턴하는 함수
void print_task_infos(int col); // tasks 정보들 문자열로 만들어 리턴하는 함수
void check_task_status(); // task들의 상태 체그해 각 상태별 task개수 저장하는 함수

void free_simple_task_list();
void free_task_list();
void init_task_list(); // Task_list 초기화하는 함수
void init_simple_task_list(); // Simple_task_list 초기화하는 함수

void increase_print_start_index(); // 출력 시작할 task의 인덱스를 증가시키는 함수
void decrease_print_start_index(); // 출력 시작할 task의 인덱스를 감소시키는 함수
unsigned long get_current_time(); // 밀리초 단위의 현재시간 리턴하는 함수
void update_time(); // cur_time, prev_time 갱신하는 함수
void update_cpu_time();// cpu time 갱신하는 함수
void update_simple_task_status(); // simple_task_list 갱신하는 함수
void update_task_status(int max_count); // task_list 갱신하는 함수
void print_process_infos(int row, int col); // 프로세스들의 정보를 출력하는 함수
void print_process_info(int index, int col); // 특정 프로세스의 정보 출력하는 함수
char *convert_time_format(unsigned long time); // clock tick 단위의 시간을 문자열 형태로 변환하여 리턴
```

```
unsigned long prev_cpu_idle; // 이전에 측정한 cpu idle time

unsigned long prev_cpu_nonidle; // 이전에 측정한 cpu nonidle time

unsigned long prev_cpu_time; // 이전에 측정한 cpu time

unsigned long cur_cpu_idle; // 새로 측정한 cpu idle time

unsigned long cur_cpu_nonidle; // 새로 측정한 cpu nonidle time

unsigned long cur_cpu_time; // 새로 측정한 cpu time

unsigned long prev_time; // 이전에 측정한 시간

unsigned long cur_time; // 새로 측정한 시간


typedef struct _task_info { // 각 프로세스의 정보 담을 구조체

            pid_t pid;

            char user_name[MAX_USER_NAME + 1];

            long pr; // priority

            long ni; // nice

            unsigned long virt;

            unsigned long res;

            unsigned long shr;

            char s[2]; // status

            float cpu;

            float mem;

            unsigned long time; // process running time

            char command[BUFFER_SIZE];

} Task_info;


struct _task_list { // Task_info 배열 관리 구조체

            Task_info **list;
```

```
	int len; // 원소 개수

	int size; // 배열 길이

	int is_sorted_by_pid; // pid 기준으로 정렬되어있다면 1

	int is_sorted_by_cpu_and_pid; // cpu, pid 기준으로 정렬되어있다면 1

} Task_list;


typedef struct _simple_task_info { // 간략한 프로세스의 정보를 담는 구조체

	pid_t pid;

	float cpu;

	unsigned long prev_cpu_time;

	unsigned long cur_cpu_time;

	int is_updated; // 갱신되었다면 1, 0이라면 사라진 프로세스로 간주하고 삭제해야함

	char s[2];

} Simple_task_info;


struct _simple_task_list {

	Simple_task_info **list;

	int len;

	int size;

	int is_sorted_by_pid;

	int is_sorted_by_cpu_and_pid;

} Simple_task_list;


struct cpu_info{ // /proc/stat 첫째줄의 cpu 정보들 담는 구조체

	unsigned long us;

	unsigned long sy;

	unsigned long ni;
```

```
        unsigned long id;

        unsigned long wa;

        unsigned long hi;

        unsigned long si;

        unsigned long st;

        unsigned long total;

} cur_cpu_info, prev_cpu_info;


int main(void) {

        int row, col; // 터미널 크기 저장하는데 사용

        int exit_flag = 0;


        init_screen(); // ncurses 이용하여 화면 초기화


        page_size_in_KiB = getpagesize() / 1024; // KiB 단위의 페이지 크기 계산

        update_time(); // 현재시간 갱신

        update_cpu_time(); // 현재 cpu시간 갱신

        init_task_list(); // Task_list 초기화

        init_simple_task_list(); // Simple_task_list 초기화

        update_simple_task_status(); // Simple_task_list 갱신


        while(1) {

                getmaxyx(stdscr, row, col); // 창 크기 확인

                refresh_page(row, col); // 프로세스 정보들 갱신하여 화면에 출력

                while (get_current_time() - cur_time < 3 * MILLIS) { // 이전 화면 갱신으로부터 3초가 지나지 않았다면

                        int refresh_page_flag = 0;

                        int key_input;
                if ((key_input = getch()) != ERR) { // 키가 입력됐다면
                    switch (key_input) {
                        case 'q': // q 입력됐다면
                            exit_flag = 1;
                            break;
                        case KEY_UP: // 위쪽 방향키 입력됐다면
                            decrease_print_start_index();
                            refresh_page_flag = 1;
                            break;
                        case KEY_DOWN: // 아래 방향키 입력됐다면
                            increase_print_start_index();
                            refresh_page_flag = 1;
                            break;
                        default:
                            break;

                    }
                    if (refresh_page_flag || exit_flag) break;
                }
            }
            if (exit_flag) break;
        }

        free_task_list();
        free_simple_task_list();
        endwin();
```

```
	return 0;
}


void init_screen() {
	initscr();
	cbreak();
	noecho();
	keypad(stdscr, TRUE); // 방향키 입력을 위하여
	nodelay(stdscr, TRUE);
	curs_set(0); // 커서 안보이도록

	return;
}


void refresh_page(int row, int col) {
	update_time(); // 시간 갱신
	update_cpu_time(); // cpu 시간 갱신
	update_simple_task_status(); // simple_task_list 갱신
	update_task_status(row - 7); // task_list 갱신
	check_task_status(); // task들 상태 개수 갱신

	clear(); // 화면 내용 지움
	print_system_infos(col); // ttop 명령어 상단의 정보들 출력
	print_process_infos(row, col); // ttop 명령어 하단의 프로세스 정보 출력
	refresh(); // 새로운 화면 내용 표시

	return;
```

```
}


void print_system_infos(int col) {
	char info_string[1024];
	char *current_time_string, *running_time_string, *user_count_string, *load_average_string;
	// 출력할 각종 정보들 문자열 만듦
	current_time_string = print_current_time();
	running_time_string = print_running_time();
	user_count_string = print_user_count();
	load_average_string = print_load_average();
	sprintf(info_string, "top - %s up %s, %s user, load average: %s", current_time_string, running_time_string, user_count_string, load_average_string);
	//printf("%s", info_string);
	addnstr(info_string, col - 1);
	free(current_time_string );
	free(running_time_string );
	free(user_count_string );
	free(load_average_string );

	// tasks 정보 출력
	print_task_infos(col);

	// cpu 정보 출력
	print_cpu_infos(col);

	// mem 정보 출력
	print_mem_infos(col);
```

```
        printw("₩n");

        return;
}

char *print_current_time() {
        time_t raw_time;
        struct tm *time_info;
        char *time_text;
        char *current_time_text;
        current_time_text = (char *)calloc(16 ,sizeof(char));

        time(&raw_time);
        time_info = localtime(&raw_time);
        time_text = asctime(time_info);
        strncpy(current_time_text, time_text + 11, sizeof(current_time_text) / sizeof(current_time_text[0]));
        //printf("%s", current_time_text);

        return current_time_text;
}

char *print_running_time() {
        // ~ min
        // ~:~~
        FILE *fp;
        const char* fname = "/proc/uptime";
        const char* mode = "r";
```

```
float fuptime;
int hour = 0;
int minute = 0;
char *running_time_text;
running_time_text = (char *)malloc(16 * sizeof(char));

// /proc/uptime 정보들 가져옴
if ((fp = fopen(fname, mode)) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", fname);
        endwin();
        exit(1);
}
fscanf(fp, "%f", &fuptime);
fclose(fp);

// 시간 계산
hour = fuptime / (60 * 60);
minute = (fuptime - (hour *60 * 60)) / 60;

// 문자열 형식으로 변환
if (hour == 0) {
        sprintf(running_time_text, "%d min", minute);
} else {
        sprintf(running_time_text, "%d:%02d", hour, minute);
}

return running_time_text;
```

```
}


char *print_user_count() {
	struct utmpx *utmpxp;
	int logged_in_user_count = 0;
	char *user_count_string;
	user_count_string = (char *)malloc(8 * sizeof(char));

	// 로그인 된 유저 수 계산
	setutxent();
	while ((utmpxp = getutxent()) != NULL) {
		if (utmpxp->ut_type == USER_PROCESS) {
			++logged_in_user_count;
		}
	}
	endutxent();

	sprintf(user_count_string, "%d", logged_in_user_count);

	return user_count_string;
}


char *print_load_average() {
	FILE *fp;
	const char *fname = "/proc/loadavg";
	const char* mode = "r";
	float _1_min_avg, _5_min_avg, _15_min_avg;
	char *load_average_string;
	load_average_string = (char *)malloc(32 * sizeof(char));

	// /proc/loadavg에서 load average 정보 읽음
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}

	fscanf(fp, "%f%f%f", &_1_min_avg, &_5_min_avg, &_15_min_avg);
	fclose(fp);

	sprintf(load_average_string, "%.2f, %.2f, %.2f", _1_min_avg, _5_min_avg, _15_min_avg);

	return load_average_string;
}

void print_task_infos(int col) {
	char task_info_string[1024];

	sprintf(task_info_string, "₩nTasks: %3d total, %3d running, %3d sleeping, %3d stopped, %3d zombie", Simple_task_list.len, running, sleeping, stopped, zombie);
	//printf("%s", task_info_string);
	addnstr(task_info_string, col);

	return;
```

```
}


void print_cpu_infos(int col) {
	FILE *fp;
	const char *fname = "/proc/stat";
	const char *mode = "r";
	char tmp[BUFFER_SIZE];
	unsigned long us, sy, ni, id, wa, hi, si, st, total;
	float fus, fsy, fni, fid, fwa, fhi, fsi, fst;
	char cpu_info_string[1024];
	float interval = sysconf(_SC_CLK_TCK) * (cur_time - prev_time);

	// /proc/stat에서 cpu 정보들 읽음
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}
	fscanf(fp, "%s%lu%lu%lu%lu%lu%lu%lu%lu", tmp, &us, &ni, &sy, &id, &wa, &hi, &si, &st);
	fclose(fp);
	total = us + sy + ni + id + wa + hi + si + st;

	prev_cpu_info = cur_cpu_info;
	cur_cpu_info.us = us;
	cur_cpu_info.sy = sy;
	cur_cpu_info.ni = ni;
	cur_cpu_info.id = id;
	cur_cpu_info.wa = wa;

	cur_cpu_info.hi = hi;

	cur_cpu_info.si = si;

	cur_cpu_info.st = st;

	cur_cpu_info.total = total;


	// 각각의 사용량 계산

	fus = ((us - prev_cpu_info.us) / (float)(total - prev_cpu_info.total)) * 100.0;

	fsy = ((sy - prev_cpu_info.sy) / (float)(total - prev_cpu_info.total)) * 100.0;

	fni = ((ni - prev_cpu_info.ni) / (float)(total - prev_cpu_info.total)) * 100.0;

	fid = ((id - prev_cpu_info.id) / (float)(total - prev_cpu_info.total)) * 100.0;

	fwa = ((wa - prev_cpu_info.wa) / (float)(total - prev_cpu_info.total)) * 100.0;

	fhi = ((hi - prev_cpu_info.hi) / (float)(total - prev_cpu_info.total)) * 100.0;

	fsi = ((si - prev_cpu_info.si) / (float)(total - prev_cpu_info.total)) * 100.0;

	fst = ((st - prev_cpu_info.st) / (float)(total - prev_cpu_info.total)) * 100.0;

	sprintf(cpu_info_string, "₩n%%Cpu(s): %4.1f us, %4.1f sy,   %4.1f ni, %4.1f id, %4.1f wa, %4.1f hi, %4.1f si, %4.1f st", fus, fsy, fni, fid, fwa, fhi, fsi, fst);

	//printf("%s", cpu_info_string);

	addnstr(cpu_info_string, col);


	return;

}


void check_task_status() {

	int i;

	// 프로세스들의 상태 개수 갱신

	running = 0;
	sleeping = 0;
	stopped = 0;
	zombie = 0;

	for (i = 0; i < Simple_task_list.len; ++i) {
		if (!strcmp(Simple_task_list.list[i]->s, "R")) {
			running += 1;
		} else if (!strcmp(Simple_task_list.list[i]->s, "S")) {
			sleeping += 1;
		} else if (!strcmp(Simple_task_list.list[i]->s, "T") || !strcmp(Simple_task_list.list[i]->s, "t")) {
			stopped += 1;
		} else if (!strcmp(Simple_task_list.list[i]->s, "Z")) {
			zombie += 1;
		}
	}

	return;
}

void print_mem_infos(int col) {
	FILE *fp;
	const char *fname = "/proc/meminfo";
	const char *mode = "r";
	int mem_total, mem_free, mem_used, mem_cached, mem_buffers, mem_SReclaimable, mem_available, mem_cache;
	int swap_total, swap_free, swap_used;
	char tmp[BUFFER_SIZE];
	char info_string[1024];
```

```
int i;


// used -> total - free - buffers - cache

// buffers -> Buffers in /proc/meminfo

// cache -> Cached and SReclaimable in /proc/meminfo


// /proc/meminfo에서 메모리 관련 정보들 읽음

if ((fp = fopen(fname, mode)) == NULL) {

	fprintf(stderr, "fopen error for %s₩n", fname);

	endwin();

	exit(1);

}


fscanf(fp, "%s%d%s", tmp, &mem_total, tmp);

fscanf(fp, "%s%d%s", tmp, &mem_free, tmp);

fscanf(fp, "%s%d%s", tmp, &mem_available, tmp);

fscanf(fp, "%s%d%s", tmp, &mem_buffers, tmp);

fscanf(fp, "%s%d%s", tmp, &mem_cached, tmp);

for (i = 0; i < 9; ++i)

	fscanf(fp, "%s%s%s", tmp, tmp, tmp);

fscanf(fp, "%s%d%s", tmp, &swap_total, tmp);

fscanf(fp, "%s%d%s", tmp, &swap_free, tmp);

for (i = 0; i < 7; ++i)

	fscanf(fp, "%s%s%s", tmp, tmp, tmp);

fscanf(fp, "%s%d%s", tmp, &mem_SReclaimable, tmp);


fclose(fp);
```

```
    // 각 항목 계산하여 출력
    mem_cache = mem_cached + mem_SReclaimable;
    mem_used = mem_total - mem_free - mem_buffers - mem_cache;
    swap_used = swap_total - swap_free;
    sprintf(info_string, "₩nKiB Mem : %8d total, %8d free, %8d used, %8d buff/cache", mem_total, mem_free, mem_used, mem_buffers + mem_cache);
    addnstr(info_string, col);
    sprintf(info_string, "₩nKiB Swap: %8d total, %8d free, %8d used, %8d avail Mem", swap_total, swap_free, swap_used, mem_available);
    addnstr(info_string, col);

}
/////////////////////////////////////////////////////////
// task info
void free_task_list() {
    if (Task_list.list != NULL) {
        int i;
        for (i = 0; i < Task_list.len; ++i) {
            if (Task_list.list[i] != NULL) {
                free(Task_list.list[i]);
            }
        }
        free(Task_list.list);

        Task_list.list = NULL;
        Task_list.len = 0;
        Task_list.size = 0;
```

```
	}

	return;
}

void init_task_list() { // Task_list 초기화
	free_task_list();
	Task_list.list = (Task_info **)malloc(INIT_LIST_SIZE * sizeof(Task_info));
	if (Task_list.list == NULL) {
		fprintf(stderr, "malloc error in init_task_list₩n");
		endwin();
		exit(1);
	}
	Task_list.len = 0;
	Task_list.size = INIT_LIST_SIZE;
	Task_list.is_sorted_by_pid = 0;
	Task_list.is_sorted_by_cpu_and_pid = 0;

	return;
}

void append_to_task_list(Task_info* new_info) { // Task_list에 새로운 원소 추가
	if (Task_list.len == Task_list.size) { // 배열이 꽉 찼다면
		Task_list.size *= 2; // 크기 두배로 늘림
		Task_list.list = (Task_info **)realloc(Task_list.list, Task_list.size * sizeof(Task_info *));
		if (Task_list.list == NULL) { // 메모리 재할당 실패 시
			fprintf(stderr, "realloc error in append_to_task_list₩n");
			endwin();
			exit(1);
		}
	}
	Task_list.list[(Task_list.len)++] = new_info;
	Task_list.is_sorted_by_pid = 0;
	Task_list.is_sorted_by_cpu_and_pid = 0;

	return;
}


Task_info *make_new_task_info(pid_t pid) { // pid에 해당하는 프로세스의 Task_info 생성
	FILE *fp;
	char fname[MAXNAMLEN + 1];
	char tmp[BUFFER_SIZE];
	const char *mode = "r";
	unsigned long stime, utime;
	float mem_total;
	int i;
	struct passwd *result;
	uid_t uid;

	//printf("1111₩n");
	Task_info *new_info = (Task_info *)malloc(sizeof(Task_info));
	if (new_info == NULL) {
		fprintf(stderr, "malloc error in make_new_task_info₩n");
		endwin();
```

```
        exit(1);
}
new_info->pid = pid;

//printf("2222₩n");
/////
// /proc/[pid]/stat에서 필요한 정보들 읽어옴
sprintf(fname, "/proc/%d/stat", pid);
if ((fp = fopen(fname, mode)) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", fname);
        endwin();
        exit(1);
}

for(i = 0; i < 2; ++i)
        fscanf(fp, "%s", tmp);
fscanf(fp, "%s", new_info->s);
for(i = 0; i < 10; ++i)
        fscanf(fp, "%s", tmp);
fscanf(fp, "%lu%lu", &stime, &utime); // stime, utime
new_info->time = stime + utime;
for(i = 0; i < 2; ++i)
        fscanf(fp, "%s", tmp);
fscanf(fp, "%ld%ld", &(new_info->pr), &(new_info->ni)); // pr, ni
fclose(fp);

//printf("3333₩n");
```

```
/////
// /proc/[pid]/loginuid에서 필요한 정보들 읽어옴
sprintf(fname, "/proc/%d/loginuid", pid);
if ((fp = fopen(fname, mode)) == NULL) {
	fprintf(stderr, "fopen error for %s₩n", fname);
	endwin();
	exit(1);
}
fscanf(fp, "%d", &uid); // uid
fclose(fp);

// uid 이용하여 user name 얻어옴
if ((result = getpwuid(uid)) == NULL) {
	strcpy(new_info->user_name, "root");
} else {
	strcpy(new_info->user_name, result->pw_name);
}

//printf("4444₩n");
/////
// /proc/[pid]/status에서 필요한 정보 읽어옴
sprintf(fname, "/proc/%d/status", pid);
if ((fp = fopen(fname, mode)) == NULL) {
	fprintf(stderr, "fopen error for %s₩n", fname);
	endwin();
	exit(1);
}
```

```
fscanf(fp, "%s%s", tmp, new_info->command); // command

fclose(fp);

//printf("5555₩n");
/////
// /proc/[pid]/statm에서 필요한 정보 읽어옴
sprintf(fname, "/proc/%d/statm", pid);
if ((fp = fopen(fname, mode)) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", fname);
        endwin();
        exit(1);
}
fscanf(fp, "%lu%lu%lu", &(new_info->virt), &(new_info->res), &(new_info->shr));
fclose(fp);
new_info->virt *= page_size_in_KiB; // virt
new_info->res *= page_size_in_KiB; // res
new_info->shr *= page_size_in_KiB; // shr

//printf("6666₩n");
/////
// /proc/meminfo에서 필요한 정보 읽어옴
sprintf(fname, "/proc/meminfo");
if ((fp = fopen(fname, mode)) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", fname);
        endwin();
        exit(1);
```

```
	}
	fscanf(fp, "%s%f", tmp, &mem_total);
	fclose(fp);

	new_info->mem = (new_info->res) / mem_total * 100.0;

	return new_info;
}

int compare_by_pid(const void *a, const void *b) { // qsort에 사용
	return (*(Task_info **)a)->pid - (*(Task_info **)b)->pid;
}

int compare_by_cpu_and_pid(const void *_a, const void *_b) { // qsort에 사용
	int a_cpu, b_cpu;
	Task_info **a = (Task_info **)_a;
	Task_info **b = (Task_info **)_b;
	a_cpu = (int)((*a)->cpu * 100);
	b_cpu = (int)((*b)->cpu * 100);

	if (a_cpu == b_cpu) {
		return (*a)->pid - (*b)->pid;
	} else {
		return a_cpu - b_cpu;
	}
}
```

```
void sort_list_by_pid() { // pid 기준으로 정렬
        Task_list.is_sorted_by_pid = 1;
        Task_list.is_sorted_by_cpu_and_pid = 0;

        qsort(Task_list.list, Task_list.len, sizeof(Task_info *), compare_by_pid);
}

void sort_list_by_cpu_and_pid() { // cpu사용량, pid 기준으로 정렬
        Task_list.is_sorted_by_pid = 0;
        Task_list.is_sorted_by_cpu_and_pid = 1;

        qsort(Task_list.list, Task_list.len, sizeof(Task_info *), compare_by_cpu_and_pid);
}

Task_info **find_element(pid_t pid) { // Task_list에서 pid로 검색
        Task_info tmp_info;
        Task_info *key;
        if (!Task_list.is_sorted_by_pid) {
                sort_list_by_pid();
        }

        tmp_info.pid = pid;
        key = &tmp_info;
        return bsearch(&key, Task_list.list, Task_list.len, sizeof(Task_info *), compare_by_pid);
}

//void print_list() { // Task_list 내용 출력 - 디버깅용
```

```
//	int i;
//
//	printf("*** Task_info ***₩n");
//	for (i = 0; i < Task_list.len; ++i) {
//		printf("pid: %d, cpu: %.1f₩n", Task_list.list[i]->pid, Task_list.list[i]->cpu);
//		printf("username: %s, pri: %ld, ni: %ld, virt: %lu, res: %lu, shr: %lu, s: %s, mem: %.1f, time: %lu, command: %s₩n", Task_list.list[i]->user_name, Task_list.list[i]->pr, Task_list.list[i]->ni, Task_list.list[i]->virt, Task_list.list[i]->res, Task_list.list[i]->shr, Task_list.list[i]->s, Task_list.list[i]->mem, Task_list.list[i]->time, Task_list.list[i]->command);
//	}
//	printf("₩n");
//
//	return;
//}


// simple task info
void free_simple_task_list() {
	if (Simple_task_list.list != NULL) {
		int i;
		for (i = 0; i < Simple_task_list.len; ++i) {
			if (Simple_task_list.list[i] != NULL) {
				free(Simple_task_list.list[i]);
			}
		}
		free(Simple_task_list.list);

		Simple_task_list.list = NULL;
		Simple_task_list.len = 0;
		Simple_task_list.size = 0;
	}

	return;
}

void init_simple_task_list() { // Simple_task_list 초기화
	free_simple_task_list();
	Simple_task_list.list = (Simple_task_info **)malloc(INIT_LIST_SIZE * sizeof(Simple_task_info *));
	if (Simple_task_list.list == NULL) {
		fprintf(stderr, "malloc error in init_simple_task_list₩n");
		endwin();
		exit(1);
	}
	Simple_task_list.len = 0;
	Simple_task_list.size = INIT_LIST_SIZE;
	Simple_task_list.is_sorted_by_pid = 0;
	Simple_task_list.is_sorted_by_cpu_and_pid = 0;

	return;
}

void append_to_simple_task_list(Simple_task_info *new_info) {
	if (Simple_task_list.len == Simple_task_list.size) { // 배열 꽉찼으면
		Simple_task_list.size *= 2; // 크기 두배로 늘림
		Simple_task_list.list = (Simple_task_info **)realloc(Simple_task_list.list, Simple_task_list.size * sizeof(Simple_task_info *));
		if (Simple_task_list.list == NULL) { // 메모리 할당 실패 시
```

```
                fprintf(stderr, "realloc error in append_to_simple_task_list₩n");
                endwin();
                exit(1);
            }
    }
    Simple_task_list.list[(Simple_task_list.len)++] = new_info;
    Simple_task_list.is_sorted_by_pid = 0;
    Simple_task_list.is_sorted_by_cpu_and_pid = 0;

    return;
}

Simple_task_info *make_new_simple_task_info(pid_t pid) {
    Simple_task_info *new_info = (Simple_task_info *)malloc(sizeof(Simple_task_info));
    if (new_info == NULL) {
        fprintf(stderr, "malloc error in make_new_simple_task_info₩n");
        endwin();
        exit(1);
    }
    new_info->pid = pid;
    new_info->is_updated = 1;

    return new_info;
}

int compare_simple_by_pid(const void *_a, const void *_b) { // qsort에 사용
    //printf("compare start₩n");
    Simple_task_info **a = (Simple_task_info **)_a;
    Simple_task_info **b = (Simple_task_info **)_b;
    //printf("%d - %d₩n", (*a)->pid, (*b)->pid);
    //printf("compare end₩n");
    return (*a)->pid - (*b)->pid;
}

int compare_simple_by_cpu_and_pid(const void *_a, const void *_b) { // qsort에 사용
    int a_cpu, b_cpu;
    Simple_task_info **a = (Simple_task_info **)_a;
    Simple_task_info **b = (Simple_task_info **)_b;
    a_cpu = (int)((*a)->cpu * 100);
    b_cpu = (int)((*b)->cpu * 100);

    if (a_cpu == b_cpu) {
        return (*a)->pid - (*b)->pid;
    } else {
        return b_cpu - a_cpu;
    }
}

void sort_simple_list_by_pid() { // pid 기준으로 정렬
    Simple_task_list.is_sorted_by_pid = 1;
    Simple_task_list.is_sorted_by_cpu_and_pid = 0;

    qsort(Simple_task_list.list, Simple_task_list.len, sizeof(Simple_task_info *), compare_simple_by_pid);
}
```

```
void sort_simple_list_by_cpu_and_pid() { // cpu 사용률과 pid 기준으로 정렬
	Simple_task_list.is_sorted_by_pid = 0;
	Simple_task_list.is_sorted_by_cpu_and_pid = 1;

	qsort(Simple_task_list.list, Simple_task_list.len, sizeof(Simple_task_info *), compare_simple_by_cpu_and_pid);
}

Simple_task_info **find_simple_element(pid_t pid) { // Simple_Task_list에서 pid로 검색
	Simple_task_info tmp_info;
	Simple_task_info *key;
	if (!Simple_task_list.is_sorted_by_pid) {
		sort_simple_list_by_pid();
	}

	tmp_info.pid = pid;
	key = &tmp_info;
	return (Simple_task_info **)bsearch(&key, Simple_task_list.list, Simple_task_list.len, sizeof(Simple_task_info *), compare_simple_by_pid);
}

//void print_simple_list() {
//	int i;
//
//	printf("*** Simple_task_info ***₩n");
//	for (i = 0; i < Simple_task_list.len; ++i) {
//		//if (Simple_task_list.list[i]->cpu > 0)
//			printf("pid: %d, cpu: %.1f, cputime: %lu₩n", Simple_task_list.list[i]->pid, Simple_task_list.list[i]->cpu, Simple_task_list.list[i]->cur_cpu_time - Simple_task_list.list[i]->prev_cpu_time);
//		}
//		printf("₩n");
//
//		return;
//}

//////////////////////////////////////////////////////////////

unsigned int print_start_index; // 출력 시작할 Task_list의 인덱스
void increase_print_start_index() { // print_start_index 증가시킴
		if (print_start_index >= Simple_task_list.len - 1) { // 맨 마지막 원소이면
				print_start_index = Simple_task_list.len - 1; // 증가시키지 않음
		} else {
				++print_start_index;
		}

		return;
}

void decrease_print_start_index() { // print_start_index 감소시킴
		if (print_start_index <= 0) { // 맨 앞 원소이면
				print_start_index = 0; // 감소시키지 않음
		} else {
				--print_start_index;
		}
```

```
        return;
}

void update_time() {
        prev_time = cur_time;
        cur_time = get_current_time();
        //printf("prev_time = %lu, current_time = %lu₩n", prev_time, cur_time);

        return;
}

unsigned long get_current_time() { // 현재시간 밀리초단위로 리턴
        struct timespec ts;

        if (clock_gettime(CLOCK_REALTIME, &ts) == -1) {
                fprintf(stderr, "clock_gettime error₩n");
                endwin();
                exit(1);
        }

        return (NANOS * ts.tv_sec + ts.tv_nsec) / (NANOS / MILLIS);
}

void update_cpu_time() {
        FILE *fp;
        const char *fname = "/proc/stat";
```

```
	const char *mode = "r";
	char tmp[BUFFER_SIZE];
	unsigned long user, nice, system, idle, lowait, irq, softirq, steal, guest, guest_nice;

	// /proc/stat에서 원하는 정보 읽어온다
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}

	fscanf(fp, "%s%lu%lu%lu%lu%lu%lu%lu%lu%lu%lu", tmp, &user, &nice, &system, &idle, &lowait, &irq, &softirq, &steal, &guest, &guest_nice);
	fclose(fp);

	// 이전 cpu time 갱신
	prev_cpu_nonidle = cur_cpu_nonidle;
	prev_cpu_idle = cur_cpu_idle;
	prev_cpu_time = cur_cpu_time;
	//cur_cpu_time = user + nice + system + idle + lowait + irq + softirq + steal + guest + guest_nice;

	// 새로운 cpu time 갱신
	cur_cpu_nonidle = user + nice + system + irq + softirq + steal;
	cur_cpu_idle = idle + lowait;
	cur_cpu_time = cur_cpu_nonidle + cur_cpu_idle;

	return;
```

```
}

void update_task_status(int max_count) {
	int i;
	int target_index;

	init_task_list(); // Task_list 초기화하여 기존에 있던 정보들 다 지운다
	for(i = 0, target_index = print_start_index; i < max_count && print_start_index + i < Simple_task_list.len; ++i) { // 화면에 출력할 만큼만 Task_info를 생성한다
		pid_t target_pid;

		target_index = print_start_index + i;
		target_pid = Simple_task_list.list[target_index]->pid; // Simple_task_list에서 Task_info 생성할 프로세스의 pid 가져온다

		Task_info *new_info = make_new_task_info(target_pid); // 새로운 Task_info 생성
		new_info->cpu = Simple_task_list.list[target_index]->cpu;
		append_to_task_list(new_info); // 배열에 추가
	}
	//print_list();
}

void update_simple_task_status() {
	struct dirent *dentry;
	struct stat statbuf;
	char filename[MAXNAMLEN + 1];
	DIR *dirp;
	int i;
```

```
for (i = 0; i < Simple_task_list.len; ++i) {
    Simple_task_list.list[i]->prev_cpu_time = Simple_task_list.list[i]->cur_cpu_time;
    Simple_task_list.list[i]->cur_cpu_time = 0;
    Simple_task_list.list[i]->is_updated = 0;
}

if ((dirp = opendir("/proc")) == NULL) {
    fprintf(stderr, "opendir error for /proc₩n");
    endwin();
    exit(1);
}

//printf("1111₩n");

while ((dentry = readdir(dirp)) != NULL) { // /proc 디렉토리 내의 모든 파일을 확인한다
    //printf("2222₩n");
    pid_t pid;
    if (dentry->d_ino == 0)
        continue;

    memcpy(filename, dentry->d_name, MAXNAMLEN);
    if ((pid = atoi(filename))) { // 파일명이 숫자일때
        FILE *fp;
        unsigned long stime, utime;
        char proc_stat_filename[MAXNAMLEN + 1];
        char tmp[BUFFER_SIZE];
```

```
int is_new_info = 0;
int i;
//printf("2.5222₩n");
Simple_task_info *task_info ;
Simple_task_info **task_info_p = find_simple_element(pid); // 해당 pid의 정보가 이미 존재하는지 확인한다
//printf("3333₩n");
if (task_info_p == NULL) { // 해당 pid의 정보가 없다면
        is_new_info = 1;
        task_info = make_new_simple_task_info(pid); // 새로 생성
} else {
        task_info = *task_info_p;
}

//printf("4444₩n");
// /proc/[pid]/stat에서 필요한 정보를 읽어온다
sprintf(proc_stat_filename, "/proc/%d/stat", pid);
if ((fp = fopen(proc_stat_filename, "r")) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", proc_stat_filename);
        endwin();
        exit(1);
}

for (i = 0; i < 2; ++i)
        fscanf(fp, "%s", tmp);
fscanf(fp, "%s", task_info->s); // status
for (i = 0; i < 10; ++i)
```

```
				fscanf(fp, "%s", tmp);
			fscanf(fp, "%lu%lu", &utime, &stime); // utime, stime
			fclose(fp);

			//printf("5555₩n");
			task_info->cur_cpu_time = utime + stime;
			task_info->cpu = ((float)(task_info->cur_cpu_time - task_info->prev_cpu_time) / (sysconf(_SC_CLK_TCK) * (cur_time - prev_time))) * 100.0 * MILLIS; // cpu 사용량 계산
			if (task_info->cpu > 100.0) {
				task_info->cpu = 100.0;
			}
			task_info->is_updated = 1;

			//printf("6666₩n");
			if (is_new_info) {
				//printf("add new simple info₩n");
				append_to_simple_task_list(task_info);
			}
			//printf("7777₩n");
		} else {
			continue;
		}
	}
	// 종료된 프로세스 Simple_task_list에서 제거하는 작업
	for (i = 0; i < Simple_task_list.len; ++i) {
		if (Simple_task_list.list[i]->is_updated == 0) { // 종료된 프로세스
			free(Simple_task_list.list[i]);
```

```
            if (i < --(Simple_task_list.len)) {
                Simple_task_list.list[i] = Simple_task_list.list[Simple_task_list.len];
            }
            Simple_task_list.list[Simple_task_list.len] = NULL;
            Simple_task_list.is_sorted_by_pid = 0;
            Simple_task_list.is_sorted_by_cpu_and_pid = 0;
        }
    }

    sort_simple_list_by_cpu_and_pid();
    //printf("8888₩n");
    return;
}

void print_process_infos(int row, int col) { // 여러 프로세스의 정보들을 출력
    int i;
    char task_info_string[1024];

    sprintf(task_info_string, "₩n%6s %-8s%3s %3s %7s %7s %7s %s %5s %4s %9s %s", "PID", "USER", "PR", "NI", "VIRT", "RES", "SHR", "S", "%CPU", "%MEM", "TIME+", "COMMAND");
    //printf("%s₩n", task_info_string);
    addnstr(task_info_string, col);
    for (i = 0; i < Task_list.len; ++i) {
        print_process_info(i, col);
    }

    return;
```

```
}


void print_process_info(int index, int col) { // 프로세스 하나의 정보 출력
        Task_info *t;
        char task_info_string[1024];
        char pr_string[10];
        char *time_string;

        t = Task_list.list[index];
        if (t->pr == -100) {
                sprintf(pr_string, "rt");
        } else {
                sprintf(pr_string, "%ld", t->pr);
        }
        time_string = convert_time_format(t->time);
        sprintf(task_info_string, "₩n%6d %-8s%3s %3ld %7lu %7lu %7lu %s %5.1f %4.1f %9s %s", t->pid, t->user_name,
pr_string, t->ni, t->virt, t->res, t->shr, t->s, t->cpu, t->mem, time_string, t->command);

        //printf("%s₩n", task_info_string);
        addnstr(task_info_string, col);
        free(time_string);

        return;
}


char *convert_time_format(unsigned long time){
        char *time_string;
        unsigned long tmp_seconds = time / sysconf(_SC_CLK_TCK);
        unsigned long minutes = tmp_seconds / 60;
        float seconds = (time - minutes * 60.0 * sysconf(_SC_CLK_TCK)) / sysconf(_SC_CLK_TCK);
        time_string = (char *)malloc(16 * sizeof(char));

        sprintf(time_string, "%lu:%05.2f", minutes, seconds);
        return time_string;
}
```

pps.c

```
#include <ncurses.h>
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <unistd.h>
#include <string.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <sys/sysmacros.h>
#include <dirent.h>
#include <pwd.h>
#include <time.h>

#define INIT_LIST_SIZE 1024
#define BUFFER_SIZE 128

unsigned long uptime;

const int NANOS = 1000000000;
const int MILLIS = 1000;

typedef struct _Task_info { // 프로세스 정보 담는 구조체
	char user[10]; // 8글자 이상이면 7번째 문자까지만 표시하고 뒤에 +
	pid_t pid;
	uid_t euid;
	float cpu;
	float mem;

	unsigned long vsz;

	unsigned long rss;

	char tty[20];

	char stat[10];

	char start[10];

	char time[10];

	char default_time[10]; // 아무 옵션 없는 pps명령어에 사용할 시간 format

	char command[128];


//	int is_background_process;

//	int is_terminal_process;

} Task_info;


struct _task_list { // Task_info 배열 관리 구조체

	Task_info **list;

	int len;

	int size;

} Task_list;


void update_uptime(); // uptime 갱신

void print_list(); // 프로세스 정보들 출력

void sort_list_by_pid(); // pid 기준으로 Task_list 정렬하는 함수

int compare_by_pid(const void *a, const void *b); // qsrot에 사용

Task_info *make_new_task_info(pid_t pid); // 새로운 Task_info 생성하는 함수

void append_to_task_list(Task_info* new_info); // Task_list에 원소 추가하는 함수

void init_task_list();
void free_task_list();
char *convert_time_format(unsigned long time); // a, u, x 옵션으로 출력할때 시간 포맷으로 변환하는 함수
char *convert_start_time(unsigned long long time); // 프로세스 시작된 시간 포맷으로 변환하는 함수
char *convert_default_time_format(unsigned long time); // 옵션없이 실행됐을 때 시간 포맷으로 변환하는 함수
void update_task_status(); // Task_list 갱신하는 함수
unsigned long get_current_time(); // 현재시간 밀리초단위로 구해서 리턴하는 함수
void print_u_format(Task_info *t); // u옵션 출력 양식으로 프로세스 정보 하나 출력
void print_a_x_format(Task_info *t); // a, x 옵션 출력 양식으로 프로세스 정보 하나 출력
void print_selected_options();   // 어느 옵션이 주어졌나 출력 (디버깅용)
void print_default_format(Task_info *t);// 아무 옵션 없을 때 양식으로 프로세스 정보 하나 출력

typedef struct _Device_info { // /dev에 있는 파일들 검사해서 여기에 저장해둔다
	char name[MAXNAMLEN + 1];
	unsigned int major_nr;
	unsigned int minor_nr;
} Device_info;

struct _Device_list {
	Device_info **list;
	int len;
	int size;
} Device_list;

void get_devices(); // /dev 디렉토리 확인해서 저장하는 함수
void free_device_list();
void init_device_list();
void append_to_device_list(Device_info* new_info);// 새 원소 추가 함수
void print_device_list();
void get_cur_usr_name(); // 이 프로세스 실행한 유저 이름 구하는 함수

void init_screen();
void check_options(int argc, char *argv[]);

int option_a = 0;
int option_u = 0;
int option_x = 0;

int page_size_in_KiB;
char cur_usr_name[BUFFER_SIZE];
uid_t euid;
unsigned int cp_major; // 현재 프로세스의 tty major number
unsigned int cp_minor; // 현재 프로세스의 tty minor number
char *tty;
int x, y;
char print_buf[1024];


int main(int argc, char *argv[]) {
	int opt;

	tty = ttyname(2);
	if (!strncmp(tty, "/dev/", 5)) {
		tty += 5;
	}
```

```
        //printf("%s₩n", tty);

        init_screen();
        getmaxyx(stdscr, y, x); // 화면 크기만 알아내고 바로 종료
        endwin();

        page_size_in_KiB = getpagesize() / 1024; // KiB 단위의 페이지 크기 계산
        check_options(argc, argv); // 옵션 확인
        //print_selected_options();

        euid = geteuid();
        get_cur_usr_name(); // 이 프로세스 실행한 유저 이름 가져온다
        update_uptime(); // uptime 구해서 저장
        init_device_list(); // Device_list 초기화
        get_devices(); // /dev 에서 device 목록 가져와 저장
        //print_device_list();
        init_task_list(); // Task_list 초기화
        update_task_status(); // 프로세스 정보들 가져옴

        print_list();

        free_device_list();
        free_task_list();

        return 0;
}
```

```
void init_screen() {
    initscr();

    return;
}

void check_options(int argc, char *argv[]) {
    int i, j;

    for (i = 1; i < argc; ++i) {
        int arg_len = strlen(argv[i]);
        for (j = 0; j < arg_len; ++j) {
            char arg_chr = argv[i][j];
            switch(arg_chr) {
                case 'a':
                    option_a = 1;
                    break;
                case 'u':
                    option_u = 1;
                    break;
                case 'x':
                    option_x = 1;
                    break;
                default:
                    fprintf(stderr, "error: unsupported option₩n");
                    endwin();
                    exit(1);
```

```
					}
			}
	}

	return;
}

void print_selected_options() { // 디버깅용 함수

	printf("selected options: ");
	if (option_a) {
		printf("a");
	}

	if (option_u) {
		printf("u");
	}

	if (option_x) {
		printf("x");
	}
	printf("₩n");

	return;
}

//////////////////////////////////////////////// task_info
```

```
void free_task_list() {
	if (Task_list.list != NULL) {
		int i;
		for (i = 0; i < Task_list.len; ++i) {
			if (Task_list.list[i] != NULL) {
				free(Task_list.list[i]);
			}
		}
		free(Task_list.list);

		Task_list.list = NULL;
		Task_list.len = 0;
		Task_list.size = 0;
	}

	return;
}

void init_task_list() {
	free_task_list();
	Task_list.list = (Task_info **)malloc(INIT_LIST_SIZE * sizeof(Task_info));
	if (Task_list.list == NULL) {
		fprintf(stderr, "malloc error in init_task_list₩n");
		endwin();
		exit(1);
	}
	Task_list.len = 0;
```

```
    Task_list.size = INIT_LIST_SIZE;

    return;
}

void append_to_task_list(Task_info* new_info) {
    if (Task_list.len == Task_list.size) { // 배열 꽉찼다면
        Task_list.size *= 2; //배열 사이즈 2배로 늘림
        Task_list.list = (Task_info **)realloc(Task_list.list, Task_list.size * sizeof(Task_info *));
        if (Task_list.list == NULL) { // 재할당 실패시
            fprintf(stderr, "realloc error in append_to_task_list₩n");
            endwin();
            exit(1);
        }
    }
    Task_list.list[(Task_list.len)++] = new_info; // 새로운 원소 추가

    return;
}

Task_info *make_new_task_info(pid_t pid) {
    FILE *fp;
    char fname[MAXNAMLEN + 1];
    char tmp[BUFFER_SIZE];
    const char *mode = "r";
    float mem_total;
    int i;
```

```
struct passwd *result;
uid_t uid;
pid_t session, pgrp, tpgid;
long ni, num_thread, VmLck;
unsigned long stime, utime;
unsigned long long starttime;
unsigned long user, nice, system, idle, lowait, irq, softirq, steal, guest, guest_nice;
unsigned long cur_cpu_nonidle, cur_cpu_idle, cur_cpu_time;
char *time_string, *default_time_string;
dev_t tty_nr;
unsigned int major_nr, minor_nr;
char tmp_command[MAXNAMLEN + 1];

//printf("1111₩n");
Task_info *new_info = (Task_info *)malloc(sizeof(Task_info));
if (new_info == NULL) {
	fprintf(stderr, "malloc error in make_new_task_info₩n");
	endwin();
	exit(1);
}
new_info->pid = pid; // pid

//printf("2222₩n");
/////
// /proc/[pid]/stat에서 필요한 정보 가져온다
sprintf(fname, "/proc/%d/stat", pid);
if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}

	for(i = 0; i < 2; ++i)
		fscanf(fp, "%s", tmp);
	fscanf(fp, "%s", new_info->stat); // status
	fscanf(fp, "%s", tmp);
	fscanf(fp, "%d", &pgrp); // pgrp
	fscanf(fp, "%d", &session); // sid
	fscanf(fp, "%ld", &tty_nr); // tty_nr
	major_nr = major(tty_nr); // major 번호
	minor_nr = minor(tty_nr); // minor 번호

	int tty_find_flag = 0;
	for(i = 0; i < Device_list.len; ++i) { // 만들어둔 디바이스 리스트에서 일치하는 디바이스를 찾는다
		if (Device_list.list[i]->major_nr == major_nr) {
			if (Device_list.list[i]->minor_nr == minor_nr) {
				tty_find_flag = 1;
				strncpy(new_info->tty, Device_list.list[i]->name, 18);
				new_info->tty[19] = '₩0';
			}
		}
		//printf("ma: %d ,mi: %d, ma2: %d, mi2: %d₩n", Device_list.list[i]->major_nr, Device_list.list[i]->minor_nr,
major_nr, minor_nr);
	}
```

```
if (!tty_find_flag) {// 일치하는 걸 찾지 못했을 때
		strcpy(new_info->tty, "?");
}


fscanf(fp, "%d", &tpgid);
for(i = 0; i < 5; ++i)
		fscanf(fp, "%s", tmp);
fscanf(fp, "%lu%lu", &utime, &stime); // time
time_string = convert_time_format(stime + utime); // a, u, x 옵션일 때 출력할 시간 문자열
default_time_string = convert_default_time_format(stime + utime); // 아무 옵션 없을 때 출력할 시간 문자열
strcpy(new_info->time, time_string);
strcpy(new_info->default_time, default_time_string);
free(time_string);
free(default_time_string);
for(i = 0; i < 3; ++i)
		fscanf(fp, "%s", tmp);
fscanf(fp, "%ld", &ni); // ni
fscanf(fp, "%ld", &num_thread); // num_thread
fscanf(fp, "%s", tmp);
fscanf(fp, "%llu", &starttime); // starttime
fclose(fp);


//printf("3333₩n");
/////
// /proc/[pid]/loginuid에서 필요한 정보 가져온다
sprintf(fname, "/proc/%d/loginuid", pid);
if ((fp = fopen(fname, mode)) == NULL) {
    fprintf(stderr, "fopen error for %s₩n", fname);
    endwin();
    exit(1);
}
fscanf(fp, "%d", &uid);
fclose(fp);

if ((result = getpwuid(uid)) == NULL) { // 위에서 가져온 uid 이용해 username 알아낸다
    strcpy(new_info->user, "root");
} else {
    if (strlen(result->pw_name) > 7) {
        strncpy(new_info->user, result->pw_name, 7);
        new_info->user[7] = '+';
        new_info->user[8] = '₩0';
    } else {
        strcpy(new_info->user, result->pw_name);
    }
} // USER

//printf("4444₩n");
/////
// /proc/[pid]/status에서 필요한 정보 가져온다
sprintf(fname, "/proc/%d/status", pid);
if ((fp = fopen(fname, mode)) == NULL) {
    fprintf(stderr, "fopen error for %s₩n", fname);
    endwin();
    exit(1);
```

```
}
fscanf(fp, "%s%s", tmp, tmp_command); // COMMAND
tmp_command[15] = '₩0';
sprintf(new_info->command, "[%s]", tmp_command);
strcpy(tmp_command, "");
for (i = 0; i < 8; ++i)
        fgets(tmp, BUFFER_SIZE, fp);
fscanf(fp, "%s%s%d%s%s", tmp, tmp, &(new_info->euid), tmp, tmp); // euid
for (i = 0; i < 10; ++i)
        fgets(tmp, BUFFER_SIZE, fp);
fscanf(fp, "%s%ld", tmp, &VmLck); // VmLck
if (strcmp(tmp, "VmLck:")) { // /proc/[pid]/status에 VmLck 정보가 없는경우
        VmLck = 0;
}

fclose(fp);

//printf("5555₩n");
/////
// /proc/[pid]/statm에서 필요한 정보 가져온다
sprintf(fname, "/proc/%d/statm", pid);
if ((fp = fopen(fname, mode)) == NULL) {
        fprintf(stderr, "fopen error for %s₩n", fname);
        endwin();
        exit(1);
}
fscanf(fp, "%lu%lu", &(new_info->vsz), &(new_info->rss));
```

```
	fclose(fp);
	new_info->vsz *= page_size_in_KiB; // virt
	new_info->rss *= page_size_in_KiB; // rss

	// cmdline
	// /proc/[pid]/cmdline에서 필요한 정보 가져온다
	sprintf(fname, "/proc/%d/cmdline", pid);
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}
	fgets(tmp_command, 1024, fp); // mem
	fclose(fp);
	if (strcmp(tmp_command, "")) { // cmdline에서 아무것도 가져오지 못한 경우에는 status에서 읽은 command로 대체한다
		strcpy(new_info->command, tmp_command);
	}

	//printf("6666₩n");
	/////
	// /proc/meminfo에서 필요한 정보 가져온다
	sprintf(fname, "/proc/meminfo");
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
```

```
}
fscanf(fp, "%s%f", tmp, &mem_total); // mem
fclose(fp);

new_info->mem = (new_info->rss) / mem_total * 100.0;

// status 상세 정보 추가
if (ni > 0) {
	strcat(new_info->stat, "N");
} else if (ni < 0) {
	strcat(new_info->stat, "<");
}

if (VmLck > 0) {
	strcat(new_info->stat, "L");
}

if (pid == session) {
	strcat(new_info->stat, "s");
}

if (num_thread > 1) {
	strcat(new_info->stat, "l");
}

if (pgrp == tpgid) {
	strcat(new_info->stat, "+");
	}

	// cpu 계산
	sprintf(fname, "/proc/stat");
	if ((fp = fopen(fname, mode)) == NULL) {
		fprintf(stderr, "fopen error for %s₩n", fname);
		endwin();
		exit(1);
	}
	fscanf(fp, "%s%lu%lu%lu%lu%lu%lu%lu%lu%lu%lu", tmp, &user, &nice, &system, &idle, &lowait, &irq, &softirq, &steal, &guest, &guest_nice);
	fclose(fp);
	cur_cpu_nonidle = user + nice + system + irq + softirq + steal;
	cur_cpu_idle = idle + lowait;
	cur_cpu_time = cur_cpu_nonidle + cur_cpu_idle;
	new_info->cpu = ((float)(stime + utime) / (uptime * sysconf(_SC_CLK_TCK) - starttime)) * 100.0;

	// start 계산
	time_string = convert_start_time(starttime);
	strcpy(new_info->start, time_string);
	free(time_string);


	return new_info;
}

int compare_by_pid(const void *a, const void *b) {
	return (*(Task_info **)a)->pid - (*(Task_info **)b)->pid;

}



void sort_list_by_pid() {

	qsort(Task_list.list, Task_list.len, sizeof(Task_info *), compare_by_pid);

}



void print_list() { // 프로세스 정보들을 출력한다

	int i;

	char ts[1024];



	// 각 항목 이름 출력

	if (option_u) {

		sprintf(ts, "%-8s%5s%5s%5s %7s %6s %-7s %-4s%6s%8s %s", "USER", "PID", "%CPU", "%MEM", "VSZ", 
"RSS", "TTY", "STAT", "START", "TIME", "COMMAND");

		strncpy(print_buf, ts, x);

		print_buf[x] = '₩0';

		printf("%s", print_buf);

	} else if (option_a || option_x) {

		sprintf(ts, "%5s %-7s %-4s%8s %s", "PID", "TTY", "STAT", "TIME", "COMMAND");

		strncpy(print_buf, ts, x);

		print_buf[x] = '₩0';

		printf("%s", print_buf);



	} else {

		sprintf(ts, "%5s %-7s %8s %s", "PID", "TTY", "TIME", "CMD");

		strncpy(print_buf, ts, x);
```

```
    print_buf[x] = '₩0';

    printf("%s", print_buf);

}


// 프로세스 정보들 출력

for (i = 0; i < Task_list.len; ++i) {

    if(option_a && !option_x) {

        if (strcmp(Task_list.list[i]->tty, "?")) {

            if (option_u) {

                print_u_format(Task_list.list[i]);

            } else {

                print_a_x_format(Task_list.list[i]);

            }

        }

    } else if (!option_a && option_x) {

        if (!strcmp(Task_list.list[i]->user, cur_usr_name)) {

            if (option_u) {

                print_u_format(Task_list.list[i]);

            } else {

                print_a_x_format(Task_list.list[i]);

            }

        }

    } else if (option_a && option_x) {

        if (option_u) {

            print_u_format(Task_list.list[i]);

        } else {

            print_a_x_format(Task_list.list[i]);
            }
        } else {
            if (option_u) {
                if (strcmp(Task_list.list[i]->tty, "?")) {
                    if (!strcmp(Task_list.list[i]->user, cur_usr_name)) {
                        print_u_format(Task_list.list[i]);
                    }
                }

            } else {
                if (Task_list.list[i]->euid == euid) {
                    if (!strcmp(tty, Task_list.list[i]->tty)) {
                        print_default_format(Task_list.list[i]);
                    }
                }
            }
        }
    }
    printf("₩n");

    return;
}

char *convert_time_format(unsigned long time){
    char *time_string;
    unsigned long tmp_seconds = time / sysconf(_SC_CLK_TCK);
    unsigned long minutes = tmp_seconds / 60;
```

```
	int seconds = (time - minutes * 60 * sysconf(_SC_CLK_TCK)) / sysconf(_SC_CLK_TCK);
	time_string = (char *)malloc(16 * sizeof(char));

	sprintf(time_string, "%lu:%02d", minutes, seconds);
	return time_string;
}


char *convert_start_time(unsigned long long starttime){
	time_t cur_time = time(NULL);
	time_t running_time;
	time_t start_time;
	char *time_string;
	char *start_time_str;

	running_time = (time_t)(uptime - (starttime / sysconf(_SC_CLK_TCK)));
//	printf("runningtime : %ld₩n", running_time);
//	printf("uptime : %ld₩n", uptime);
//	printf("start time:%ld₩n", starttime / sysconf(_SC_CLK_TCK));

	start_time = cur_time - running_time;
	start_time_str = ctime(&start_time);
	time_string = (char *)malloc(16 * sizeof(char));
	strncpy(time_string, start_time_str + 11, 5);
	time_string[5] = '₩0';

	return time_string;
}
```

```
char *convert_default_time_format(unsigned long time) {
        char *time_string;
        unsigned long tmp_seconds = time / sysconf(_SC_CLK_TCK);
        unsigned long minutes = tmp_seconds / 60;
        unsigned long hours = minutes / 60;
        minutes -= hours * 60;
        int seconds = (time - minutes * 60 * sysconf(_SC_CLK_TCK)) / sysconf(_SC_CLK_TCK);
        time_string = (char *)malloc(16 * sizeof(char));

        sprintf(time_string, "%02lu:%02lu:%02d", hours, minutes, seconds);
        return time_string;
}

void update_uptime() {
        FILE *fp;
        const char* fname = "/proc/uptime";
        const char* mode = "r";
        float fuptime;

        if ((fp = fopen(fname, mode)) == NULL) {
                fprintf(stderr, "fopen error for %s₩n", fname);
                endwin();
                exit(1);
        }
        fscanf(fp, "%f", &fuptime);
        uptime = (unsigned long)fuptime;
```

```
	return;
}


void update_task_status() {
	struct dirent *dentry;
	struct stat statbuf;
	char filename[MAXNAMLEN + 1];
	DIR *dirp;
	int i;

	if ((dirp = opendir("/proc")) == NULL) {
		fprintf(stderr, "opendir error for /proc₩n");
		endwin();
		exit(1);
	}

	//printf("1111₩n");

	while ((dentry = readdir(dirp)) != NULL) { // /proc 내의 모든 파일 확인
		//printf("2222₩n");
		pid_t pid;
		if (dentry->d_ino == 0)
			continue;

		memcpy(filename, dentry->d_name, MAXNAMLEN);
		if ((pid = atoi(filename))) { // 파일 이름이 숫자라면
}

            Task_info *new_info;

            new_info = make_new_task_info(pid); // 해당 파일 이름으로 새로운 Task_info 만든다
            append_to_task_list(new_info); // Task_list에 새로운 원소 추가
        } else {
            continue;
        }
    }

    sort_list_by_pid();
    //printf("8888₩n");
    return;
}

unsigned long get_current_time() {
    struct timespec ts;

    if (clock_gettime(CLOCK_REALTIME, &ts) == -1) {
        fprintf(stderr, "clock_gettime error₩n");
        endwin();
        exit(1);
    }

    return (NANOS * ts.tv_sec + ts.tv_nsec) / (NANOS / MILLIS);
}

void print_u_format(Task_info *t) {
	char ts[1024];
	sprintf(ts, "₩n%-8s%5d%5.1f%5.1f %7lu %6lu %-7s %-4s%6s%8s %s", t->user, t->pid, t->cpu, t->mem, t->vsz, t->rss, t->tty, t->stat, t->start, t->time, t->command);
	strncpy(print_buf, ts, x);
	print_buf[x] = '₩0';
	printf("%s", print_buf);

	return;
}

void print_a_x_format(Task_info *t) {
	char ts[1024];
	sprintf(ts, "₩n%5d %-7s %-4s%8s %s", t->pid, t->tty, t->stat, t->time, t->command);
	strncpy(print_buf, ts, x);
	print_buf[x] = '₩0';
	printf("%s", print_buf);

	return;
}

void print_default_format(Task_info *t) {
	char ts[1024];
	sprintf(ts, "₩n%5d %-7s %8s %s", t->pid, t->tty, t->default_time, t->command);
	strncpy(print_buf, ts, x);
	print_buf[x] = '₩0';
	printf("%s", print_buf);
	return;
}


void get_devices() { // /dev에 있는 디바이스 파일들 확인해서 저장한다
	struct dirent *dentry;
	struct stat statbuf;
	char filename[MAXNAMLEN + 128];
	DIR *dirp;
	int i;

	if ((dirp = opendir("/dev")) == NULL) {
		fprintf(stderr, "opendir error for /dev₩n");
		endwin();
		exit(1);
	}

	//printf("1111₩n");

	while ((dentry = readdir(dirp)) != NULL) {
		if (dentry->d_ino == 0)
			continue;

		if (!strcmp(dentry->d_name, ".") || !strcmp(dentry->d_name, ".."))
			continue;



		sprintf(filename, "/dev/%s", dentry->d_name);
```

```
        //printf("%s₩n", filename);
        if (stat(filename, &statbuf) == -1) {
            fprintf(stderr, "stat error for %s₩n", filename);
            break;
        }

        if (S_ISDIR(statbuf.st_mode) || S_ISLNK(statbuf.st_mode))
            continue;

        if (S_ISCHR(statbuf.st_mode) || S_ISBLK(statbuf.st_mode)) { // 해당 파일의 major, minor number 저장한다
            Device_info *new_info = (Device_info *)malloc(sizeof(Device_info));
            strcpy(new_info->name, filename + 5);
            new_info->major_nr = major(statbuf.st_rdev);
            new_info->minor_nr = minor(statbuf.st_rdev);

            append_to_device_list(new_info);
        }
    }

    closedir(dirp);

    // opendir /dev/pts
    if ((dirp = opendir("/dev/pts")) == NULL) { // /dev/pts 디렉토리는 따로 확인한다
        fprintf(stderr, "opendir error for /dev/pts₩n");
        endwin();
        exit(1);
    }
```

```
//printf("1111₩n");
while ((dentry = readdir(dirp)) != NULL) {
        //printf("2222₩n");
        pid_t pid;
        if (dentry->d_ino == 0)
                continue;

        if (!strcmp(dentry->d_name, ".") || !strcmp(dentry->d_name, ".."))
                continue;



        sprintf(filename, "/dev/pts/%s", dentry->d_name);
        if (stat(filename, &statbuf) == -1) {
                fprintf(stderr, "stat error for %s₩n", filename);
                break;
        }

        if (S_ISDIR(statbuf.st_mode) || S_ISLNK(statbuf.st_mode))
                continue;

        if (S_ISCHR(statbuf.st_mode) || S_ISBLK(statbuf.st_mode)) {
                Device_info *new_info = (Device_info *)malloc(sizeof(Device_info));
                strcpy(new_info->name, filename + 5);
                new_info->major_nr = major(statbuf.st_rdev);
                new_info->minor_nr = minor(statbuf.st_rdev);
                append_to_device_list(new_info);
            }
        }

        closedir(dirp);

        return;
}

void free_device_list() {
        if (Device_list.list != NULL) {
                int i;
                for (i = 0; i < Device_list.len; ++i) {
                        if (Device_list.list[i] != NULL) {
                                free(Device_list.list[i]);
                        }
                }
                free(Device_list.list);

                Device_list.list = NULL;
                Device_list.len = 0;
                Device_list.size = 0;
        }

        return;
}
```

```
void init_device_list() {
	free_device_list();
	Device_list.list = (Device_info **)malloc(INIT_LIST_SIZE * sizeof(Device_info));
	if (Device_list.list == NULL) {
		fprintf(stderr, "malloc error in init_device_list₩n");
		endwin();
		exit(1);
	}
	Device_list.len = 0;
	Device_list.size = INIT_LIST_SIZE;

	return;
}

void append_to_device_list(Device_info* new_info) {
	if (Device_list.len == Device_list.size) { // 배열 꽉찼으면
		Device_list.size *= 2; // 사이즈 두배로 늘림
		Device_list.list = (Device_info **)realloc(Device_list.list, Device_list.size * sizeof(Device_info *)); // 재할당
		if (Device_list.list == NULL) { // 재할당 실패시
			fprintf(stderr, "realloc error in append_to_device_list₩n");
			endwin();
			exit(1);
		}
	}
	Device_list.list[(Device_list.len)++] = new_info;

	return;
}

void print_device_list() {
        int i;

        for (i = 0; i < Device_list.len; ++i) {
                printf("%s, ma: %d, mi: %d₩n", Device_list.list[i]->name, Device_list.list[i]->major_nr, Device_list.list[i]->minor_nr);
        }

        return;
}

void get_cur_usr_name() {
        struct passwd *pwd;

        if ((pwd = getpwuid(getuid())) == NULL) {
                fprintf(stderr, "getpwuid error₩n");
                endwin();
                exit(1);
        }
        strcpy(cur_usr_name, pwd->pw_name);

        return;
}
```