Assignment 4 - Process Management & Signal Handling

Part 1: Process Exploration

1. List all running processes using:

○ ps -ef

○ ps aux

2. Identify:

○ PID

○ User

○ CPU usage

○ Memory usage

```
Last login: Sun Jan 18 12:25:01 2026 from 101.0.63.64
ubuntu@ip-172-31-25-177:~$ ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1       0  0 14:51 ?        00:00:01 /sbin/init
root           2       0  0 14:51 ?        00:00:00 [kthreadd]
root           3       2  0 14:51 ?        00:00:00 [pool_workqueue_release]
root           4       2  0 14:51 ?        00:00:00 [kworker/R-rcu_gp]
root           5       2  0 14:51 ?        00:00:00 [kworker/R-sync_wq]
root           6       2  0 14:51 ?        00:00:00 [kworker/R-kvfree_rcu_rec
root           7       2  0 14:51 ?        00:00:00 [kworker/R-slub_flushwq]
root           8       2  0 14:51 ?        00:00:00 [kworker/R-netns]
root           9       2  0 14:51 ?        00:00:00 [kworker/0:0-rcu_gp]
root          10       2  0 14:51 ?        00:00:00 [kworker/0:1-cgroup_destr
root          11       2  0 14:51 ?        00:00:00 [kworker/0:0H-events_high
root          12       2  0 14:51 ?        00:00:00 [kworker/u8:0-flush-259:0
root          13       2  0 14:51 ?        00:00:00 [kworker/R-mm_percpu_wq]
root          14       2  0 14:51 ?        00:00:00 [rcu_tasks_rude_kthread]
root          15       2  0 14:51 ?        00:00:00 [rcu_tasks_trace_kthread]
root          16       2  0 14:51 ?        00:00:00 [ksoftirqd/0]
root          17       2  0 14:51 ?        00:00:00 [rcu_sched]
root          18       2  0 14:51 ?        00:00:00 [rcu_exp_par_gp_kthread_w
root          19       2  0 14:51 ?        00:00:00 [rcu_exp_gp_kthread_worke
root          20       2  0 14:51 ?        00:00:00 [migration/0]
root          21       2  0 14:51 ?        00:00:00 [idle_inject/0]
root          22       2  0 14:51 ?        00:00:00 [cpuhp/0]
root          23       2  0 14:51 ?        00:00:00 [cpuhp/1]
root          24       2  0 14:51 ?        00:00:00 [idle_inject/1]
root          25       2  0 14:51 ?        00:00:00 [migration/1]
root          26       2  0 14:51 ?        00:00:00 [ksoftirqd/1]
root          27       2  0 14:51 ?        00:00:00 [kworker/1:0-events]
root          28       2  0 14:51 ?        00:00:00 [kworker/1:0H-events_high
root          29       2  0 14:51 ?        00:00:00 [kdevtmpfs]
root          30       2  0 14:51 ?        00:00:00 [kworker/R-inet_frag_wq]
root          31       2  0 14:51 ?        00:00:00 [kauditd]
```

```
ubuntu@ip-172-31-25-177:~$ ps aux
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root           1  0.5  1.4  22192 13508 ?        Ss   14:51   0:01 /sbin/init
root           2  0.0  0.0      0     0 ?        S    14:51   0:00 [kthreadd]
root           3  0.0  0.0      0     0 ?        S    14:51   0:00 [pool_workqueue_release]
root           4  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-rcu_gp]
root           5  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-sync_wq]
root           6  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-kvfree_rcu_reclaim]
root           7  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-slub_flushwq]
root           8  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-netns]
root           9  0.0  0.0      0     0 ?        I    14:51   0:00 [kworker/0:0-rcu_gp]
root          10  0.0  0.0      0     0 ?        I    14:51   0:00 [kworker/0:1-cgroup_destroy]
root          11  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/0:0H-events_highpri]
root          12  0.0  0.0      0     0 ?        I    14:51   0:00 [kworker/u8:0-flush-259:0]
root          13  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-mm_percpu_wq]
root          14  0.0  0.0      0     0 ?        I    14:51   0:00 [rcu_tasks_rude_kthread]
root          15  0.0  0.0      0     0 ?        I    14:51   0:00 [rcu_tasks_trace_kthread]
root          16  0.0  0.0      0     0 ?        S    14:51   0:00 [ksoftirqd/0]
root          17  0.0  0.0      0     0 ?        I    14:51   0:00 [rcu_sched]
root          18  0.0  0.0      0     0 ?        S    14:51   0:00 [rcu_exp_par_gp_kthread_worker/0]
root          19  0.0  0.0      0     0 ?        S    14:51   0:00 [rcu_exp_gp_kthread_worker]
root          20  0.0  0.0      0     0 ?        S    14:51   0:00 [migration/0]
root          21  0.5  0.0      0     0 ?        S    14:51   0:00 [idle_inject/0]
root          22  0.0  0.0      0     0 ?        S    14:51   0:00 [cpuhp/0]
root          23  0.0  0.0      0     0 ?        S    14:51   0:00 [cpuhp/1]
root          24  0.0  0.0      0     0 ?        S    14:51   0:00 [idle_inject/1]
root          25  0.0  0.0      0     0 ?        S    14:51   0:00 [migration/1]
root          26  0.0  0.0      0     0 ?        S    14:51   0:00 [ksoftirqd/1]
root          27  0.0  0.0      0     0 ?        I    14:51   0:00 [kworker/1:0-events]
root          28  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/1:0H-events_highpri]
root          29  0.0  0.0      0     0 ?        S    14:51   0:00 [kdevtmpfs]
root          30  0.0  0.0      0     0 ?        I<   14:51   0:00 [kworker/R-inet_frag_wq]
root          31  0.0  0.0      0     0 ?        S    14:51   0:00 [kauditd]
```

Part 2: Background Jobs

1. Start a long-running command: sleep 1000 &

2. View running background jobs.

3. Bring the job to foreground and send it back to background.

```
ubuntu@ip-172-31-25-177:~$ sleep 1000 &
[1] 1093
ubuntu@ip-172-31-25-177:~$ jobs
[1]+  Running                 sleep 1000 &
ubuntu@ip-172-31-25-177:~$ fg %1
sleep 1000
^Z
[1]+  Stopped                 sleep 1000
ubuntu@ip-172-31-25-177:~$ bg %1
[1]+ sleep 1000 &
ubuntu@ip-172-31-25-177:~$ jobs
[1]+  Running                 sleep 1000 &
```

Part 3: Process Termination & Signals

1. Gracefully stop the sleep process using:

○ SIGTERM

2. Verify if the process still exists.

3. Forcefully terminate it using:

○ SIGKILL

```
ubuntu@ip-172-31-25-177:~$ kill -15 1093
ubuntu@ip-172-31-25-177:~$ ps -p 1093
    PID TTY             TIME CMD
[1]+  Terminated            sleep 1000
ubuntu@ip-172-31-25-177:~$ kill -9 1093
-bash: kill: (1093) - No such process
ubuntu@ip-172-31-25-177:~$
```

4. Explain the difference between:

○ **kill -15 -** terminates the process rightaway (force kill or immediate kill)

○ **kill -9 –** graceful termination, terminates and allows to save data till what work is done.

Part 4: Real-Time Monitoring

1. Use top to:

○ Identify top CPU-consuming processes (-p)

 ○ Sort by memory usage (-m)

2. Observe changes in real time.

```
ubuntu@ip-172-31-25-177:~$ top
top - 15:07:24 up 15 min,  1 user,  load average: 0.00, 0.00, 0.00
Tasks: 107 total,   1 running, 106 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem :    914.2 total,     79.0 free,    696.5 used,    295.9 buff/cache
MiB Swap:      0.0 total,      0.0 free,      0.0 used.    217.7 avail Mem

    PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
    744 mysql     20   0 1786400 394172  37096 S   0.7  42.1   0:07.38 mysqld
      1 root      20   0   22192  13508   9636 S   0.0   1.4   0:01.11 systemd
      2 root      20   0       0      0      0 S   0.0   0.0   0:00.00 kthreadd
      3 root      20   0       0      0      0 S   0.0   0.0   0:00.00 pool_workqueue_release
      4 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-rcu_gp
      5 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-sync_wq
      6 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-kvfree_rcu_reclaim
      7 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-slub_flushwq
      8 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-netns
     11 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/0:0H-events_highpri
     13 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-mm_percpu_wq
     14 root      20   0       0      0      0 I   0.0   0.0   0:00.00 rcu_tasks_rude_kthread
     15 root      20   0       0      0      0 I   0.0   0.0   0:00.00 rcu_tasks_trace_kthread
     16 root      20   0       0      0      0 S   0.0   0.0   0:00.01 ksoftirqd/0
     17 root      20   0       0      0      0 I   0.0   0.0   0:00.09 rcu_sched
     18 root      20   0       0      0      0 S   0.0   0.0   0:00.00 rcu_exp_par_gp_kthread_worker/0
     19 root      20   0       0      0      0 S   0.0   0.0   0:00.00 rcu_exp_gp_kthread_worker
     20 root      rt   0       0      0      0 S   0.0   0.0   0:00.00 migration/0
     21 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/0
     22 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/0
     23 root      20   0       0      0      0 S   0.0   0.0   0:00.00 cpuhp/1
     24 root     -51   0       0      0      0 S   0.0   0.0   0:00.00 idle_inject/1
     25 root      rt   0       0      0      0 S   0.0   0.0   0:00.06 migration/1
     26 root      20   0       0      0      0 S   0.0   0.0   0:00.02 ksoftirqd/1
     28 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/1:0H-events_highpri
     29 root      20   0       0      0      0 S   0.0   0.0   0:00.00 kdevtmpfs
     30 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-inet_frag_wq
     31 root      20   0       0      0      0 S   0.0   0.0   0:00.00 kauditd
     32 root      20   0       0      0      0 S   0.0   0.0   0:00.00 khungtaskd
     34 root      20   0       0      0      0 S   0.0   0.0   0:00.00 oom_reaper
     35 root      20   0       0      0      0 I   0.0   0.0   0:00.09 kworker/u8:2-events_power_efficient
     36 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/R-writeback
     37 root      20   0       0      0      0 S   0.0   0.0   0:00.02 kcompactd0
     38 root      25   5       0      0      0 S   0.0   0.0   0:00.00 ksmd
     39 root      39  19       0      0      0 S   0.0   0.0   0:00.00 khugepaged
```