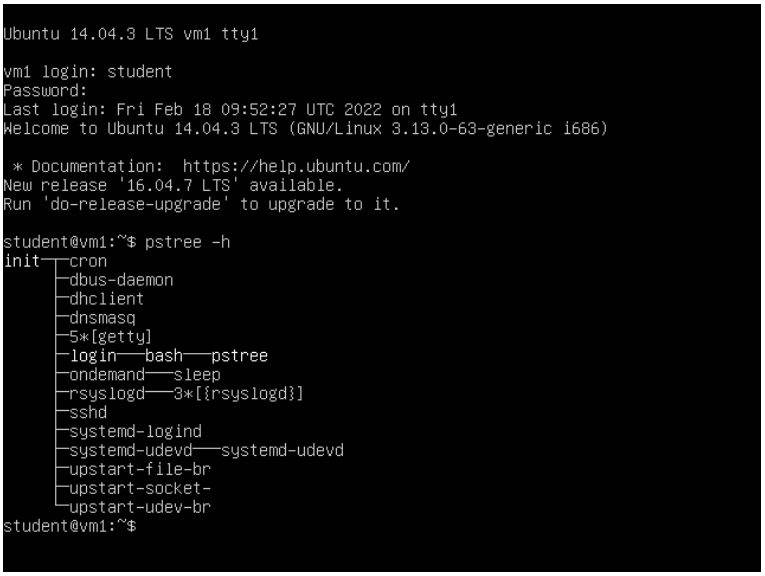
TASK5.3
Part1

1. How many states could has a process in Linux?

one of five Linux process states: running & runnable, interruptable_sleep, uninterruptable_sleep, stopped, and zombie

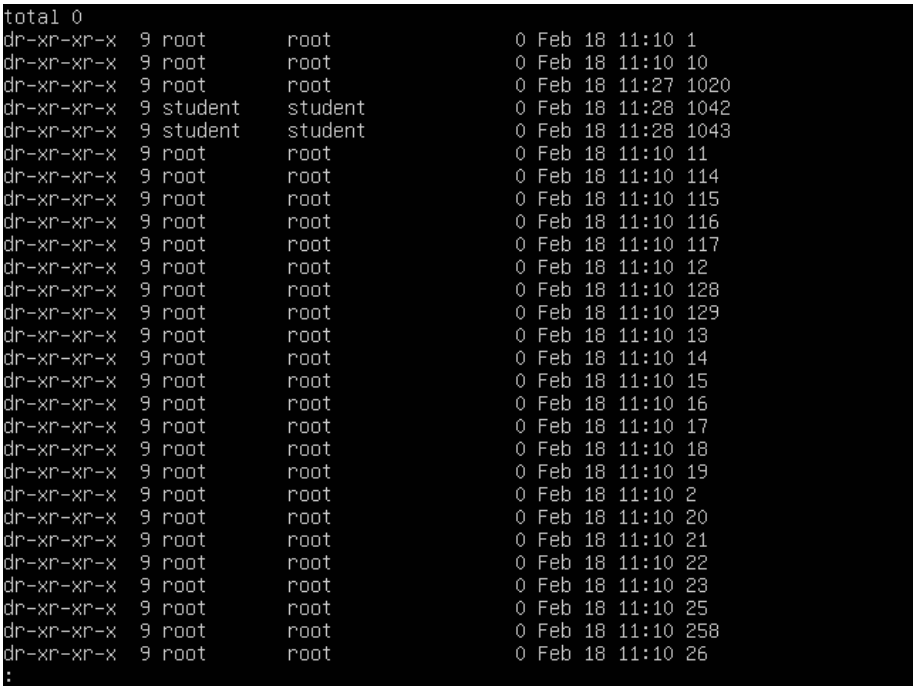
2. Examine the pstree command. Make output (highlight) the chain (ancestors) of the current process.



3. What is a proc file system?

Proc file system (procfs) is virtual file system created on fly when system boots and is dissolved at time of system shut down. It contains useful information about the processes that are currently running, it is regarded as control and information center for kernel.

ls -l /proc | less



4. Print information about the processor (its type, supported technologies, etc.).

less /proc/cpuinfo

```
processor       : 0
vendor_id       : GenuineIntel
cpu family      : 6
model           : 158
model name      : Intel(R) Core(TM) i5-9300H CPU @ 2.40GHz
stepping        : 10
cpu MHz         : 2403.661
cache size      : 8192 KB
physical id     : 0
siblings        : 1
core id         : 0
cpu cores       : 1
apicid          : 0
initial apicid  : 0
fdiv_bug        : no
f00f_bug        : no
coma_bug        : no
fpu             : yes
fpu_exception   : yes
cpuid level     : 22
wp              : yes
flags           : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
pat pse36 clflush mmx fxsr sse sse2 ht nx rdtscp constant_tsc xtopology nonstop_
tsc pni pclmulqdq monitor ssse3 cx16 pcid sse4_1 sse4_2 movbe popcnt aes xsave a
vx rdrand lahf_lm abm 3dnowprefetch fsgsbase avx2 invpcid rdseed
bogomips        : 4807.32
clflush size    : 64
cache_alignment : 64
address sizes   : 39 bits physical, 48 bits virtual
:
```

5. Use the ps command to get information about the process. The information should be as follows: the owner of the process, the arguments with which the process was launched for execution, the group owner of this process, etc.

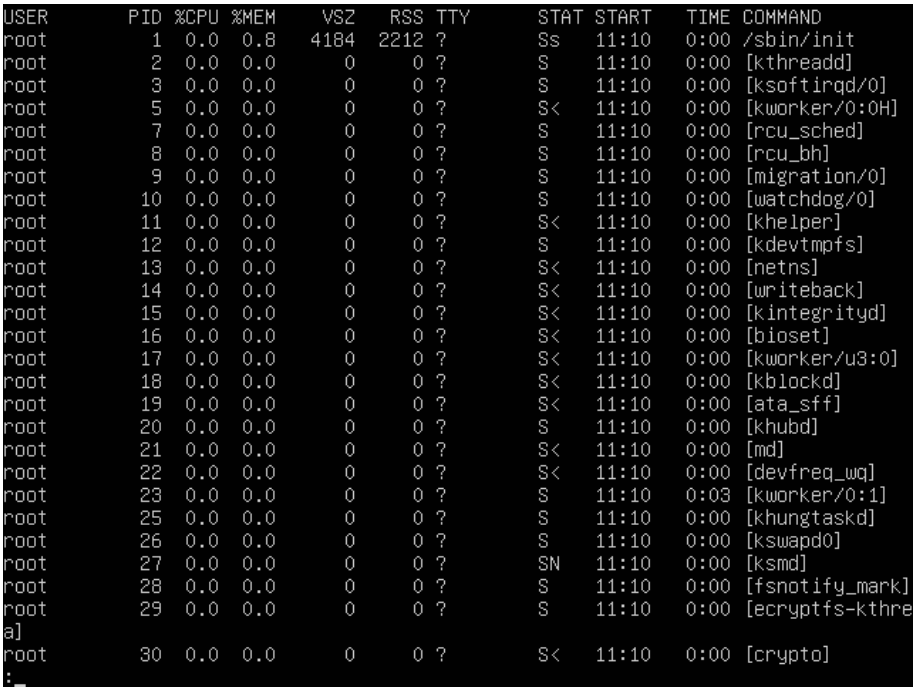
ps o user,args,group | less

```
root     [kpsmoused]                root
root     [kworker/0:2]              root
root     [kworker/u3:1]             root
root     [scsi_eh_2]                root
root     [jbd2/sda1-8]              root
root     [ext4-rsv-conver]          root
root     upstart-udev-bridge --daemo root
root     /lib/systemd/systemd-udevd  root
root     dhclient -1 -v -pf /run/dhc root
message+ dbus-daemon --system --fork messagebus
syslog   rsyslogd                   syslog
root     /lib/systemd/systemd-logind root
root     upstart-socket-bridge --dae root
root     upstart-file-bridge --daemo root
root     /sbin/getty -8 38400 tty4   root
root     /sbin/getty -8 38400 tty5   root
root     /sbin/getty -8 38400 tty2   root
root     /sbin/getty -8 38400 tty3   root
root     /sbin/getty -8 38400 tty6   root
root     /usr/sbin/sshd -D           root
root     cron                        root
dnsmasq  /usr/sbin/dnsmasq -x /var/r dip
root     /bin/login --               student
root     [kauditd]                   root
student  -bash                       student
root     [kworker/u2:2]              root
root     [kworker/u2:0]              root
student  ps -eo user,args,group      student
student  less                        student
(END)
```

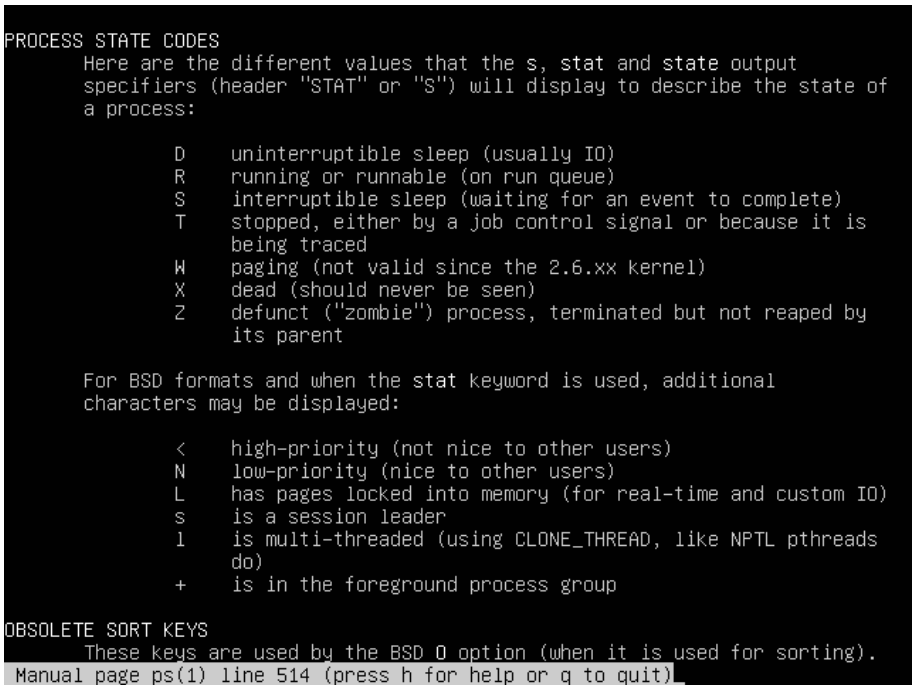
6. How to define kernel processes and user processes?

ps aux| less - kernel's processes have [brackets] in command column, user's not

7. Print the list of processes to the terminal. Briefly describe the statuses of the processes. What condition are they in, or can they be arriving in?



```
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.0  0.8   4184  2212 ?        Ss   11:10   0:00 /sbin/init
root         2  0.0  0.0      0     0 ?        S    11:10   0:00 [kthreadd]
root         3  0.0  0.0      0     0 ?        S    11:10   0:00 [ksoftirqd/0]
root         5  0.0  0.0      0     0 ?        S<   11:10   0:00 [kworker/0:0H]
root         7  0.0  0.0      0     0 ?        S    11:10   0:00 [rcu_sched]
root         8  0.0  0.0      0     0 ?        S    11:10   0:00 [rcu_bh]
root         9  0.0  0.0      0     0 ?        S    11:10   0:00 [migration/0]
root        10  0.0  0.0      0     0 ?        S    11:10   0:00 [watchdog/0]
root        11  0.0  0.0      0     0 ?        S<   11:10   0:00 [khelper]
root        12  0.0  0.0      0     0 ?        S    11:10   0:00 [kdevtmpfs]
root        13  0.0  0.0      0     0 ?        S<   11:10   0:00 [netns]
root        14  0.0  0.0      0     0 ?        S<   11:10   0:00 [writeback]
root        15  0.0  0.0      0     0 ?        S<   11:10   0:00 [kintegrityd]
root        16  0.0  0.0      0     0 ?        S<   11:10   0:00 [bioset]
root        17  0.0  0.0      0     0 ?        S<   11:10   0:00 [kworker/u3:0]
root        18  0.0  0.0      0     0 ?        S<   11:10   0:00 [kblockd]
root        19  0.0  0.0      0     0 ?        S<   11:10   0:00 [ata_sff]
root        20  0.0  0.0      0     0 ?        S    11:10   0:00 [khubd]
root        21  0.0  0.0      0     0 ?        S<   11:10   0:00 [md]
root        22  0.0  0.0      0     0 ?        S<   11:10   0:00 [devfreq_wq]
root        23  0.0  0.0      0     0 ?        S    11:10   0:03 [kworker/0:1]
root        25  0.0  0.0      0     0 ?        S    11:10   0:00 [khungtaskd]
root        26  0.0  0.0      0     0 ?        S    11:10   0:00 [kswapd0]
root        27  0.0  0.0      0     0 ?        SN   11:10   0:00 [ksmd]
root        28  0.0  0.0      0     0 ?        S    11:10   0:00 [fsnotify_mark]
root        29  0.0  0.0      0     0 ?        S    11:10   0:00 [ecryptfs-kthre
a]
root        30  0.0  0.0      0     0 ?        S<   11:10   0:00 [crypto]
:
```



```
PROCESS STATE CODES
       Here are the different values that the s, stat and state output
       specifiers (header "STAT" or "S") will display to describe the state of
       a process:

               D    uninterruptible sleep (usually IO)
               R    running or runnable (on run queue)
               S    interruptible sleep (waiting for an event to complete)
               T    stopped, either by a job control signal or because it is
                    being traced
               W    paging (not valid since the 2.6.xx kernel)
               X    dead (should never be seen)
               Z    defunct ("zombie") process, terminated but not reaped by
                    its parent

       For BSD formats and when the stat keyword is used, additional
       characters may be displayed:

               <    high-priority (not nice to other users)
               N    low-priority (nice to other users)
               L    has pages locked into memory (for real-time and custom IO)
               s    is a session leader
               l    is multi-threaded (using CLONE_THREAD, like NPTL pthreads
                    do)
               +    is in the foreground process group

OBSOLETE SORT KEYS
       These keys are used by the BSD O option (when it is used for sorting).
 Manual page ps(1) line 514 (press h for help or q to quit)
```

8. Display only the processes of a specific user.

```
student@vm1:~$ ps u
USER       PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
student    959  0.0  1.2   6668  3116 tty1     S    11:10   0:00 -bash
student   1231  0.0  0.4   5216  1152 tty1     R+   12:22   0:00 ps u
student@vm1:~$ ps
  PID TTY          TIME CMD
  959 tty1     00:00:00 bash
 1232 tty1     00:00:00 ps
student@vm1:~$ _
```

ps -U root (or another specific username)

```
   42 ?        00:00:00 kthrotld
   44 ?        00:00:00 scsi_eh_0
   45 ?        00:00:00 scsi_eh_1
   67 ?        00:00:00 deferwq
   68 ?        00:00:00 charger_manager
  114 ?        00:00:00 kpsmoused
  115 ?        00:00:00 kworker/0:2
  116 ?        00:00:00 kworker/u3:1
  117 ?        00:00:00 scsi_eh_2
  128 ?        00:00:00 jbd2/sda1-8
  129 ?        00:00:00 ext4-rsv-conver
  258 ?        00:00:00 upstart-udev-br
  264 ?        00:00:00 systemd-udevd
  555 ?        00:00:00 dhclient
  647 ?        00:00:00 systemd-logind
  670 ?        00:00:00 upstart-socket-
  679 ?        00:00:00 upstart-file-br
  706 tty4     00:00:00 getty
  708 tty5     00:00:00 getty
  711 tty2     00:00:00 getty
  712 tty3     00:00:00 getty
  714 tty6     00:00:00 getty
  738 ?        00:00:00 sshd
  788 ?        00:00:00 cron
  890 tty1     00:00:00 login
  941 ?        00:00:00 kauditd
 1205 ?        00:00:00 kworker/u2:2
 1206 ?        00:00:00 kworker/u2:0
 1236 ?        00:00:00 kworker/u2:1
student@vm1:~$ ps -U root_
```

9. What utilities can be used to analyze existing running tasks (by analyzing the help for the ps command)?

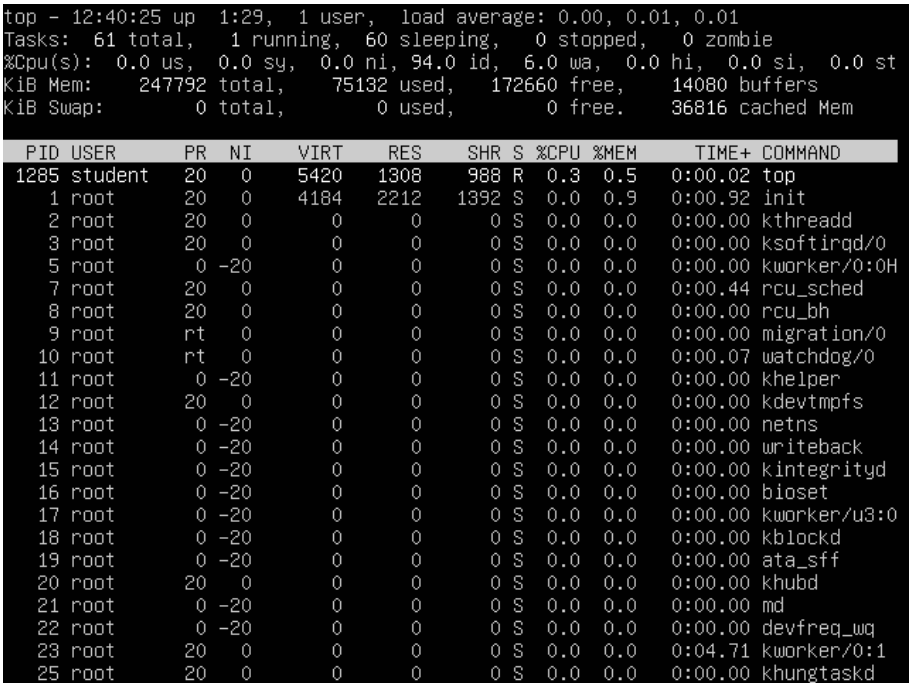
using different flags with ps

```
Usage:
 ps [options]

Basic options:
 -A, -e               all processes
 -a                   all with tty, except session leaders
  a                   all with tty, including other users
 -d                   all except session leaders
 -N, --deselect       negate selection
  r                   only running processes
  T                   all processes on this terminal
  x                   processes without controlling ttys

Selection by list:
 -C <command>         command name
 -G, --Group <gid>    real group id or name
 -g, --group <group>  session or effective group name
 -p, --pid <pid>      process id
     --ppid <pid>     select by parent process id
 -s, --sid <session>  session id
 -t, t, --tty <tty>   terminal
 -u, U, --user <uid>  effective user id or name
 -U, --User <uid>     real user id or name

  selection <arguments> take either:
    comma-separated list e.g. '-u root,nobody' or
    blank-separated list e.g. '-p 123 4567'

:_
```

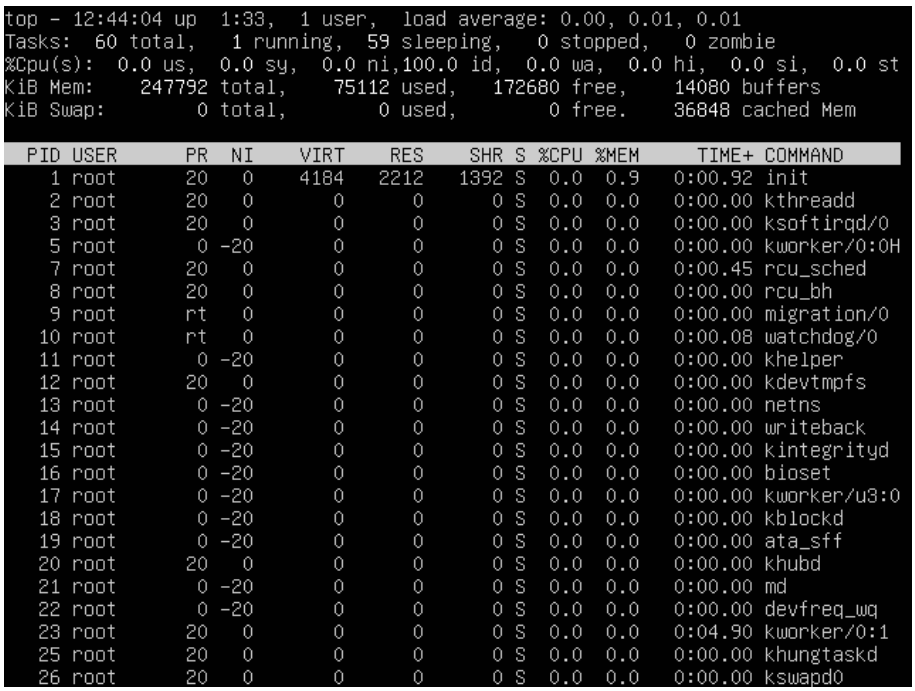
```
     --headers        repeat header lines, one per page
     --no-headers     do not print header at all
     --cols, --columns, --width <num>
                      set screen width
     --rows, --lines <num>
                      set screen height

Show threads:
  H                   as if they where processes
 -L                   possibly with LWP and NLWP columns
 -m, m                after processes
 -T                   possibly with SPID column

Miscellaneous options:
 -c                   show scheduling class with -l option
  c                   show true command name
  e                   show the environment after command
  k,    --sort        specify sort order as: [+|-]key[,[+|-]key[,...]]
  L                   list format specifiers
  n                   display numeric uid and wchan
  S,    --cumulative  include some dead child process data
 -y                   do not show flags, show rss (only with -l)
 -V, V, --version     display version information and exit
 -w, w                unlimited output width

        --help <simple|list|output|threads|misc|all>
                      display help and exit

For more details see ps(1).
(END)
```

10. What information does top command display?

The top program provides a dynamic real-time view of a running system. It can display system summary information as well as a list of processes or threads currently being managed by the Linux kernel. The types of system summary information shown and the types, order and size of information displayed for processes are all user configurable and that configuration can be made persistent across restarts

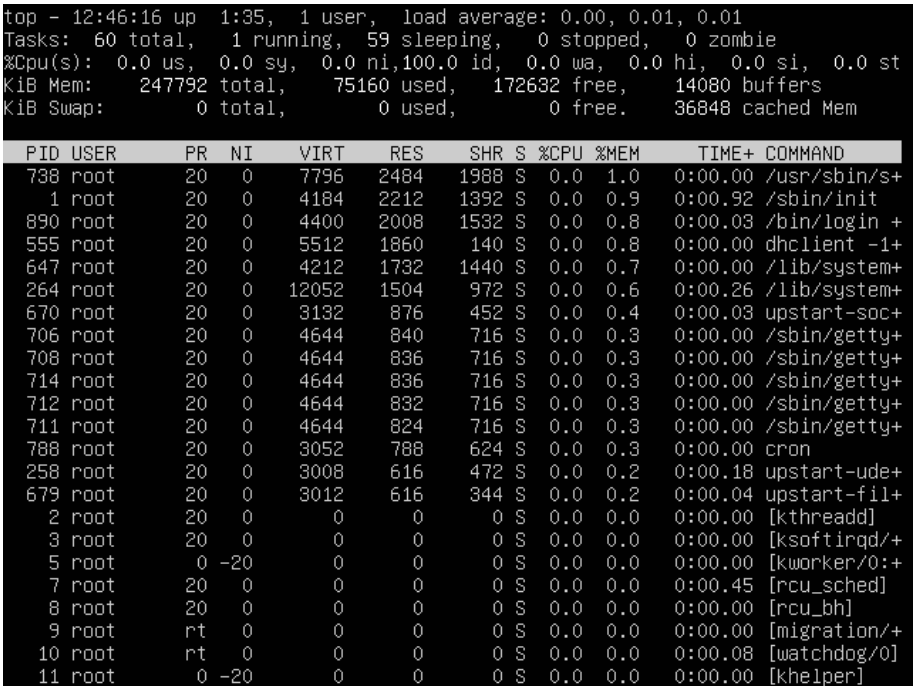


11. Display the processes of the specific user using the top command.

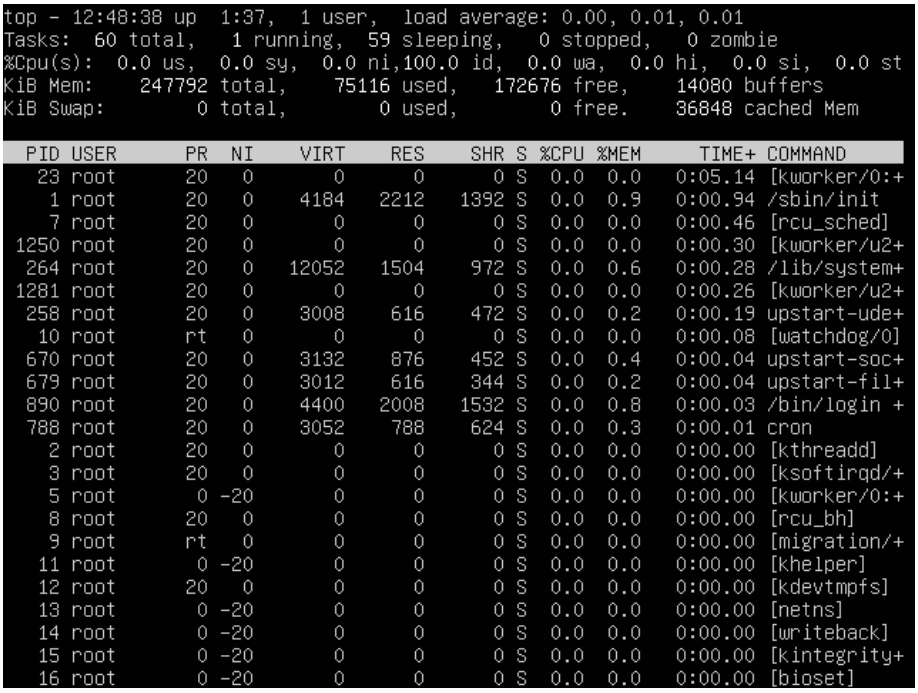


12. What interactive commands can be used to control the top command? Give a couple of examples.

shift+m – sort by memory usage
c – shows absolute path of the command



13. Sort the contents of the processes window using various parameters (for example, the amount of processor time taken up, etc.)



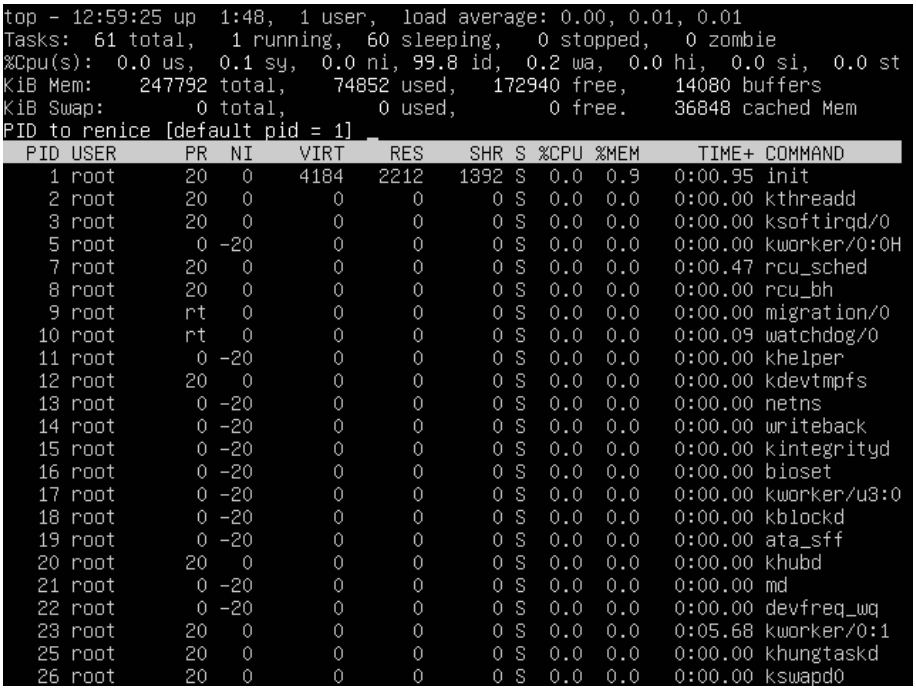
14. Concept of priority, what commands are used to set priority?

When you only have one or a limited number of CPUs, you need to decide how to share those limited CPU resources among several competing processes. This is generally done by selecting one process for execution and letting it run for a short period (called a timeslice), or until it needs to wait for some event, such as IO to complete. To ensure that important processes don't get starved out by CPU hogs, the selection is done based on a scheduling priority.

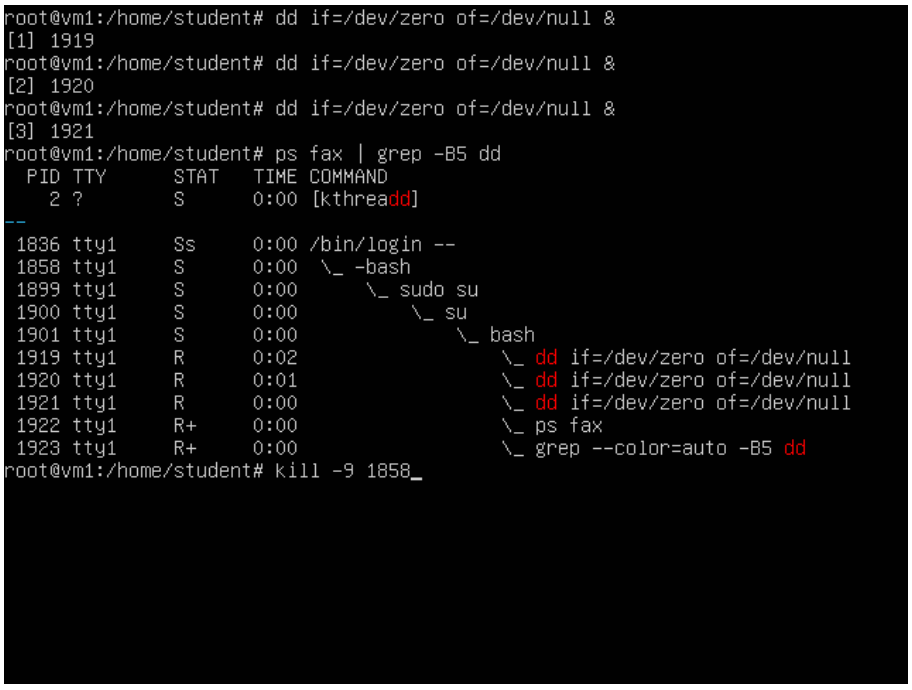
nice/renice commands

15. Can I change the priority of a process using the top command? If so, how?

Top → press 'r' → enter pid of proccess → enter renice value

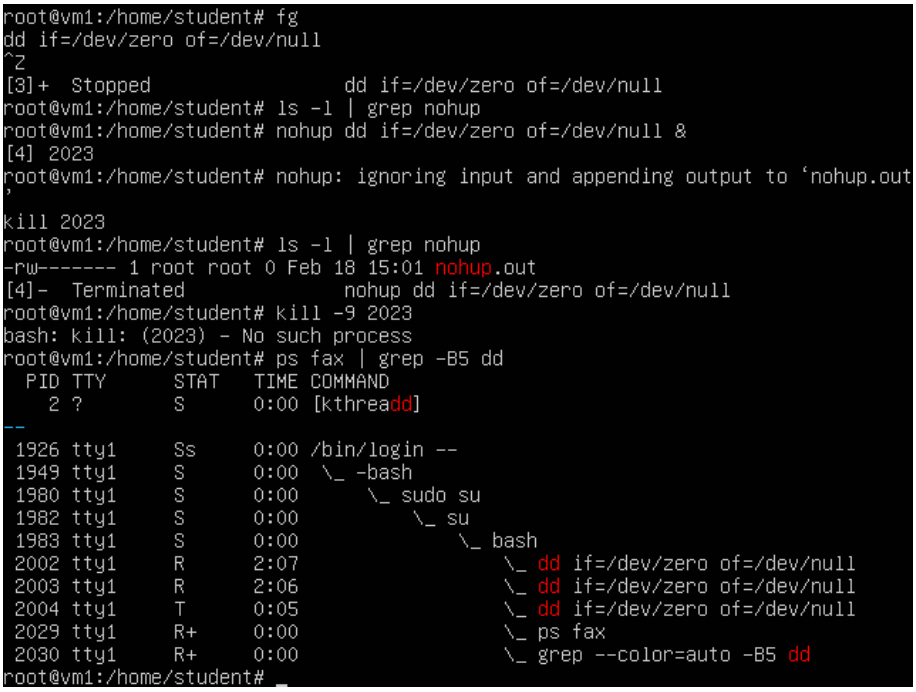


16. Examine the kill command. How to send with the kill command process control signal? Give an example of commonly used signals.



17. Commands jobs, fg, bg, nohup. What are they for? Use the sleep, yes command to demonstrate the process control mechanism with fg, bg.

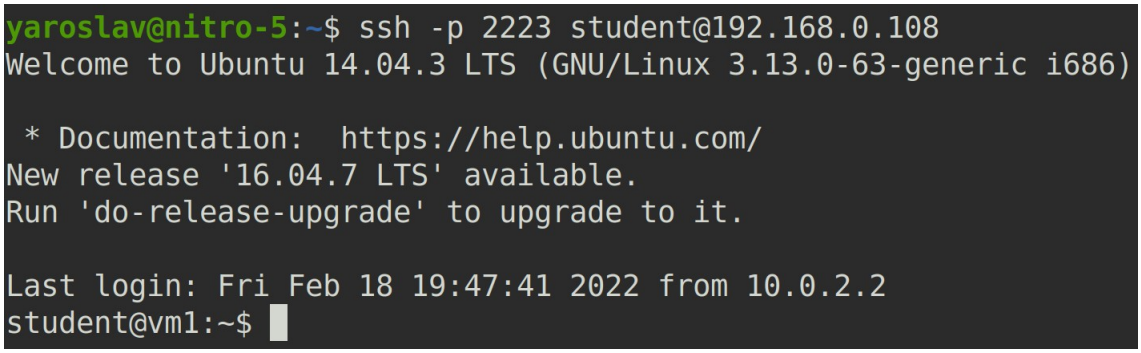
jobs – see the list of tasks started in command line
fg – return to running task
bg – return to stopped task



Part2

1. Check the implementability of the most frequently used OPENSSH commands in the MS Windows operating system. (Description of the expected result of the commands + screenshots: command – result should be presented)

ssh – OpenSSH client (remote login program)
ssh-keygen – authentication key generation, managemeAuthentication key generation, management, and conversionnt, and conversion



2. Implement basic SSH settings to increase the security of the client-server connection (at least

PermitRootLoogin no
AllowUsers student

```
# Use these options to restrict which interfaces/protocols sshd will bind to
#ListenAddress ::
#ListenAddress 0.0.0.0
Protocol 2
# HostKeys for protocol version 2
HostKey /etc/ssh/ssh_host_rsa_key
HostKey /etc/ssh/ssh_host_dsa_key
HostKey /etc/ssh/ssh_host_ecdsa_key
HostKey /etc/ssh/ssh_host_ed25519_key
#Privilege Separation is turned on for security
UsePrivilegeSeparation yes

# Lifetime and size of ephemeral version 1 server key
KeyRegenerationInterval 3600
ServerKeyBits 1024

# Logging
SyslogFacility AUTH
LogLevel INFO

# Authentication:
LoginGraceTime 120
PermitRootLogin no
StrictModes yes
AllowUsers student

RSAAuthentication yes
PubkeyAuthentication yes
#AuthorizedKeysFile     %h/.ssh/authorized_keys
:
```

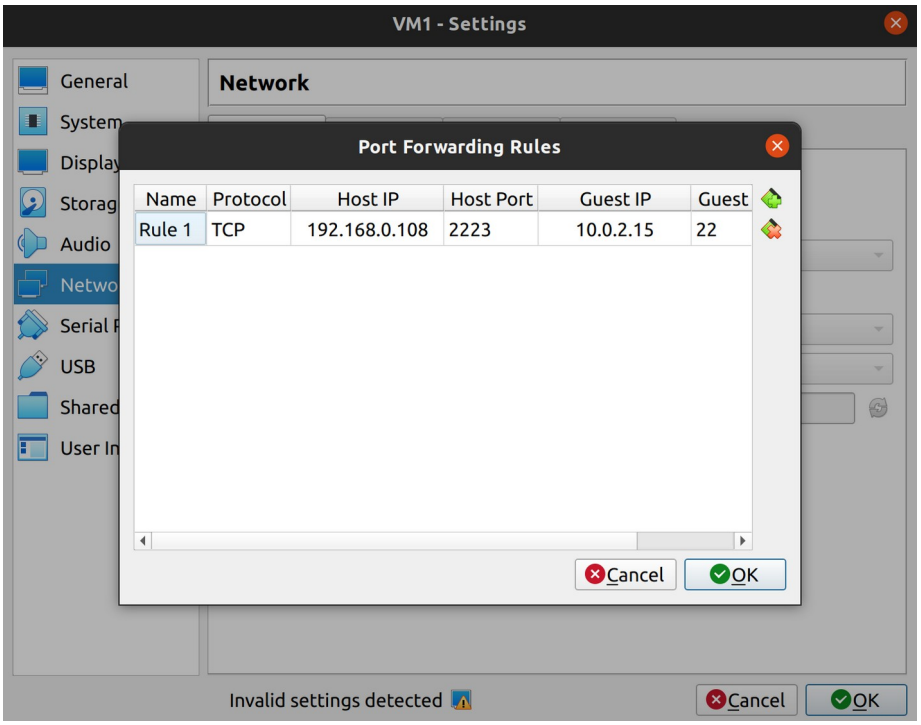
PasswordAuthentication no

```
  GNU nano 2.2.6          File: /etc/ssh/sshd_config                  Modified

# similar for protocol version 2
HostbasedAuthentication no
# Uncomment if you don't trust ~/.ssh/known_hosts for RhostsRSAAuthentication
#IgnoreUserKnownHosts yes

# To enable empty passwords, change to yes (NOT RECOMMENDED)
PermitEmptyPasswords no

# Change to yes to enable challenge-response passwords (beware issues with
# some PAM modules and threads)
ChallengeResponseAuthentication no

# Change to no to disable tunnelled clear text passwords
PasswordAuthentication no

# Kerberos options
#KerberosAuthentication no
#KerberosGetAFSToken no
#KerberosOrLocalPasswd yes
#KerberosTicketCleanup yes

# GSSAPI options
#GSSAPIAuthentication no
#GSSAPICleanupCredentials yes


^G Get Help  ^O WriteOut  ^R Read File ^Y Prev Page ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is  ^V Next Page ^U UnCut Text^T To Spell
```

3. List the options for choosing keys for encryption in SSH. Implement 3 of them.

```
student@vm1:~$ ssh-keygen -t ecdsa -b 384
Generating public/private ecdsa key pair.
Enter file in which to save the key (/home/student/.ssh/id_ecdsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/student/.ssh/id_ecdsa.
Your public key has been saved in /home/student/.ssh/id_ecdsa.pub.
The key fingerprint is:
63:0e:1f:a3:c7:d4:34:c6:a0:b0:51:6f:6c:11:89:db student@vm1
The key's randomart image is:
+--[ECDSA  384]---+
|    o...+o       |
|     +.+.+       |
|    . .o= =      |
|      .oE+ .     |
|      . S .      |
|       O +       |
|      . =        |
|       .         |
|                 |
+-----------------+
student@vm1:~$ ssh-keygen -t ed25519
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/student/.ssh/id_ed25519):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
```

4. Implement port forwarding for the SSH client from the host machine to the guest Linux virtual machine behind NAT.



5*. Intercept (capture) traffic (tcpdump, wireshark) while authorizing the remote client on the server using ssh, telnet, rlogin. Analyze the result.

```
15:53:18.815145 IP 10.0.2.15.10324 > 10.0.2.3.domain: 62458+ PTR? 3.2.0.10.in-ad
dr.arpa. (39)
15:53:18.873155 IP 10.0.2.3.domain > 10.0.2.15.10324: 62458 NXDomain 0/0/0 (39)
15:53:21.313993 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [P.], seq 2222:2370, ac
k 2120, win 65535, length 148
15:53:21.332052 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2120:2148, ac
k 2370, win 37960, length 28
15:53:21.332638 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2148, win 6553
5, length 0
15:53:21.332893 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [P.], seq 2370:2482, ac
k 2148, win 65535, length 112
15:53:21.369214 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2148:2192, ac
k 2482, win 37960, length 44
15:53:21.369326 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2192, win 6553
5, length 0
15:53:21.369542 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [P.], seq 2482:3578, ac
k 2192, win 65535, length 1096
15:53:21.369933 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2192:2300, ac
k 3578, win 40880, length 108
15:53:21.370262 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2300:2576, ac
k 3578, win 40880, length 276
15:53:21.370414 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2300, win 6553
5, length 0
15:53:21.370434 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2576, win 6553
5, length 0
15:53:21.404075 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2576:2644, ac
k 3578, win 40880, length 68
15:53:21.404511 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2644, win 6553
5, length 0
```

```
k 2120, win 65535, length 148
15:53:21.332052 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2120:2148, ac
k 2370, win 37960, length 28
15:53:21.332638 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2148, win 6553
5, length 0
15:53:21.332893 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [P.], seq 2370:2482, ac
k 2148, win 65535, length 112
15:53:21.369214 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2148:2192, ac
k 2482, win 37960, length 44
15:53:21.369326 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2192, win 6553
5, length 0
15:53:21.369542 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [P.], seq 2482:3578, ac
k 2192, win 65535, length 1096
15:53:21.369933 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2192:2300, ac
k 3578, win 40880, length 108
15:53:21.370262 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2300:2576, ac
k 3578, win 40880, length 276
15:53:21.370414 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2300, win 6553
5, length 0
15:53:21.370434 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2576, win 6553
5, length 0
15:53:21.404075 IP 10.0.2.15.ssh > 10.0.2.2.33002: Flags [P.], seq 2576:2644, ac
k 3578, win 40880, length 68
15:53:21.404511 IP 10.0.2.2.33002 > 10.0.2.15.ssh: Flags [.], ack 2644, win 6553
5, length 0
^C
48 packets captured
48 packets received by filter
0 packets dropped by kernel
student@vm1:~$ _
```