Task.Linux.3

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Task3.Part1

1) **How many states could have a process in Linux?**

Running: The process is currently using the CPU and executing its instructions.

Waiting: The process is waiting for an event to occur before it can proceed.

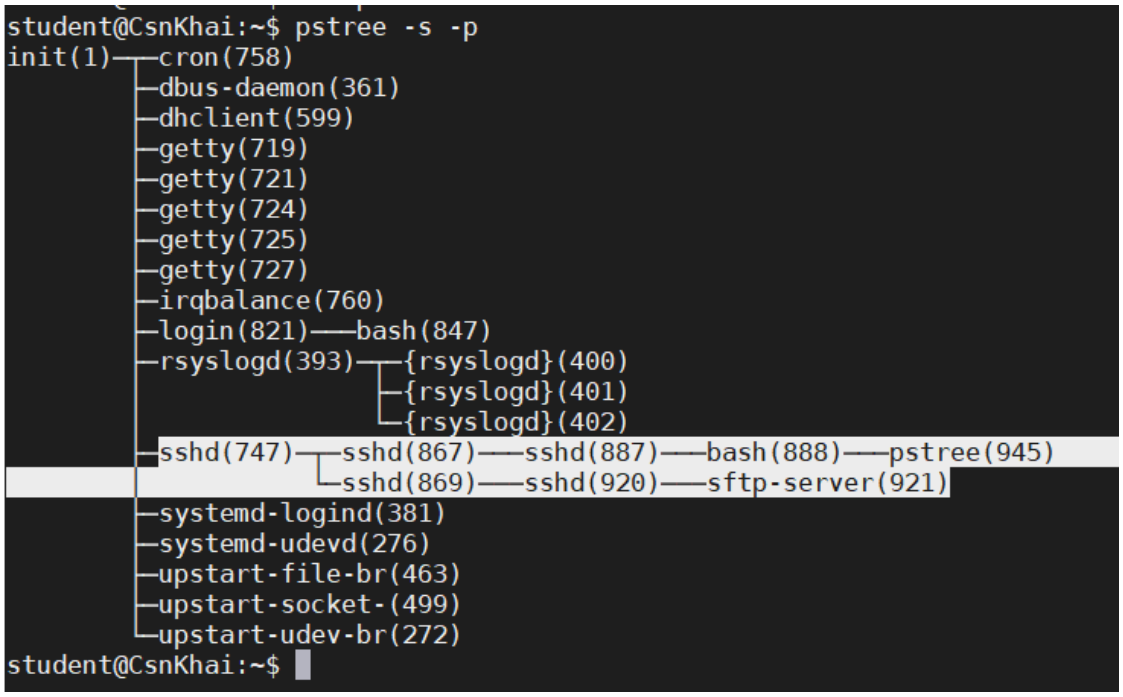
Ready: The process is waiting to be assigned to a CPU. It's ready to execute, but the scheduler has not yet selected it to run.

Terminated: The process has finished executing or has been explicitly terminated by the user or another process.

Stopped: The process has been stopped, usually as a result of receiving a signal.

Zombie: A terminated process that is still listed in the process table. It's waiting for its parent process to collect its exit status.

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



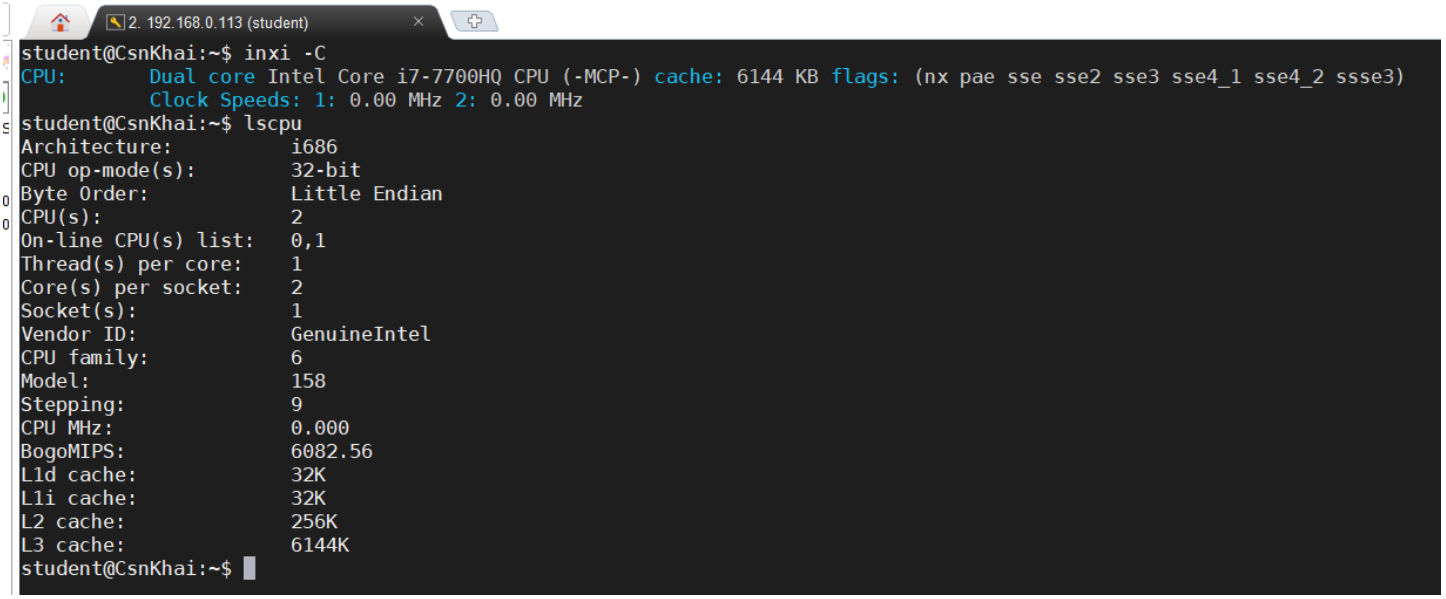
Here we can see that parent process ***sshd(747)*** created 2 separate subprocesses, one for establishing secure shell connection with bash

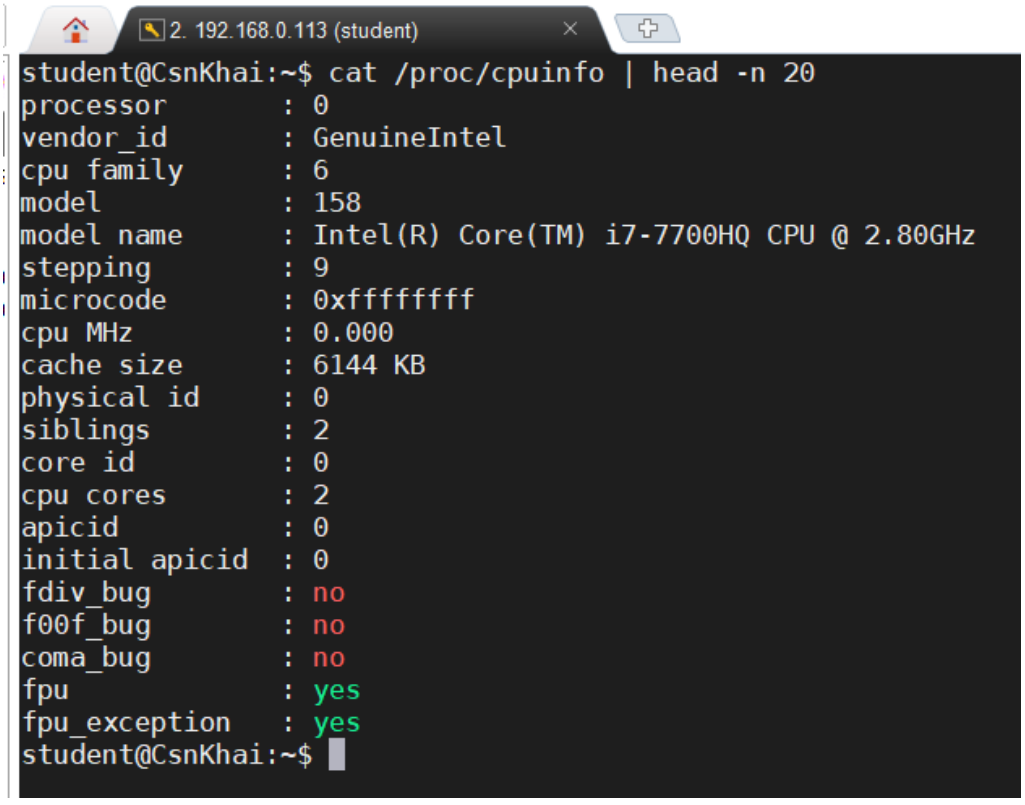
command interpreter and ***pstree*** executed inside, and another to make ***SFTP*** connection.

3) **What is a proc file system?**

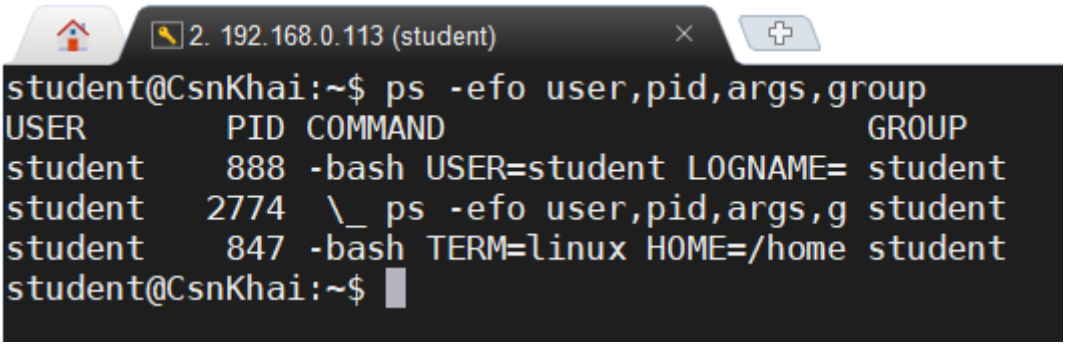
The ***/proc*** file system in Linux is a virtual filesystem that provides an interface to kernel data structures and information about running processes. It's not a regular file system that stores files on disk, it's a way to expose system and process-related information as files and directories in a hierarchical structure.

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





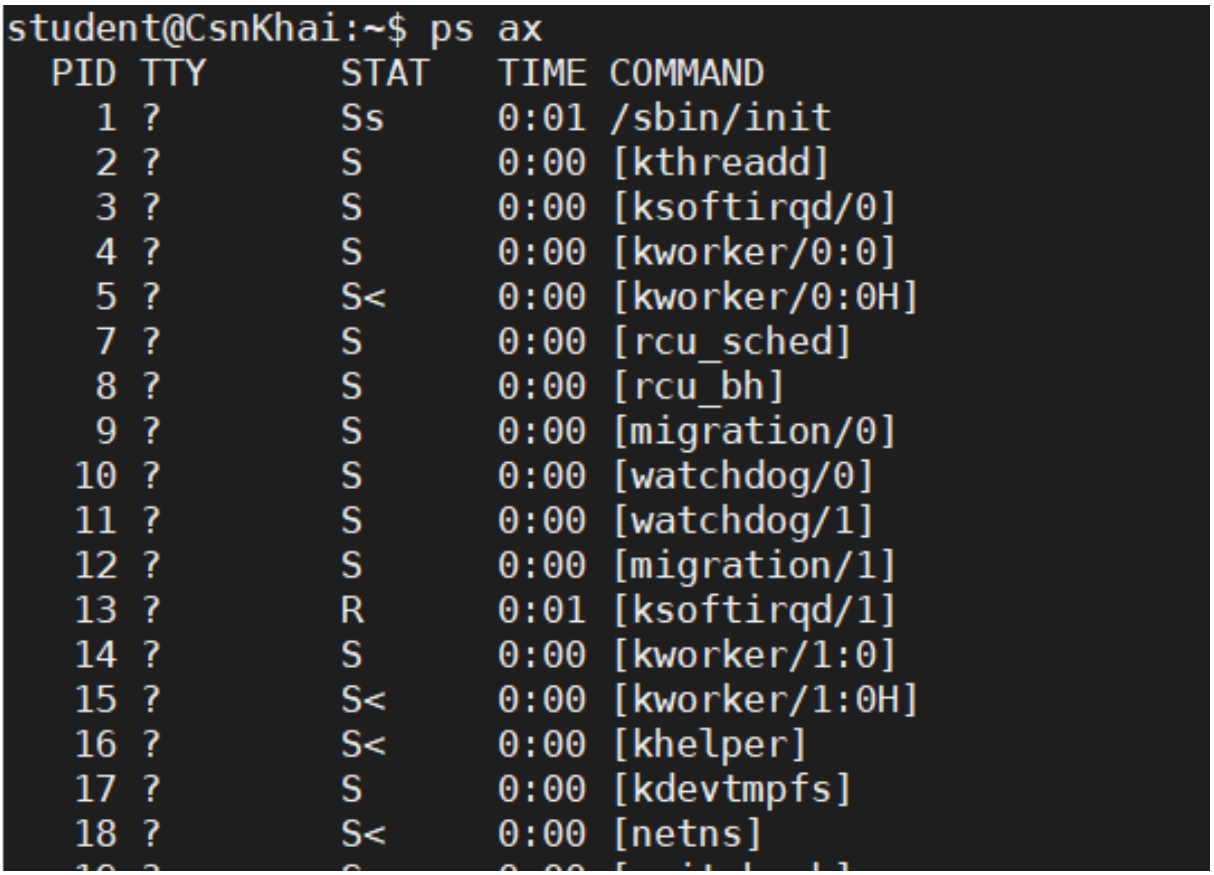
5) **Use the ps command to get information about the process. The information should be as follows: the owner of the process, the arguments with which the process was launched for execution, the group owner of this process, etc.**



6) **How to define kernel processes and user processes?**

Kernel processes highlighted with ***[]***.

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?**



The first letter of the value under the ***STAT*** column indicates the state that the process is in.

R: Running or Runnable;

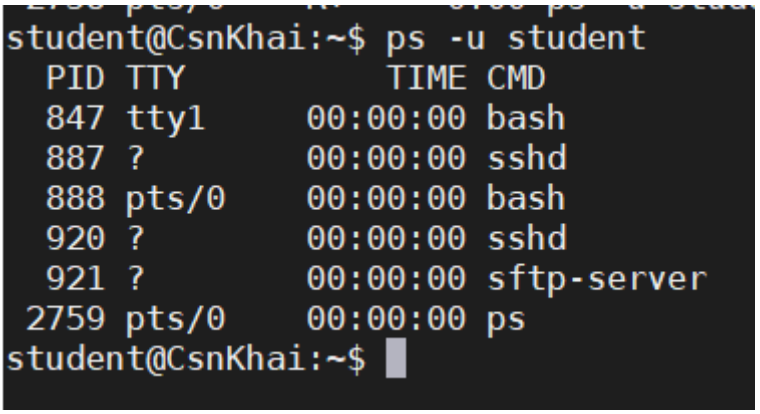
S: Interruptible Sleep;

D: Uninterruptible Sleep;

T: Stopped;

Z: Zombie.

8) **Display only the processes of a specific user.**



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

ps aux or ***-ef:*** displays a detailed list of all running processes for all users.

--sort: sorts processes by some column (***%cpu***, ***%mem***, etc).

ps -eo: allows you to specify the columns you want to display.

--forest: displays a hierarchical tree view of processes, showing parent-child relationships between processes.

ps -C: lists all instances of the specified process.

etc…

10) **What information does the top command display?**

Detailed process information and usage of system resources (CPU, Memory, etc.).

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

```
student@CsnKhai:~$ top -u student
```

2. 192.168.0.113 (student)

```
top - 12:41:24 up  2:55,  2 users,  load average: 0.00, 0.01, 0.05
Tasks:  74 total,   1 running,  73 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
KiB Mem:   2064204 total,   316104 used,  1748100 free,    27876 buffers
KiB Swap:        0 total,        0 used,        0 free.   229364 cached Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  847 student   20   0    6660   3028   1676 S   0.0  0.1   0:00.01 bash
  887 student   20   0   11192   2592   1732 S   0.0  0.1   0:00.47 sshd
  888 student   20   0    6680   3160   1776 S   0.0  0.2   0:00.04 bash
  920 student   20   0   11192   1704    952 S   0.0  0.1   0:00.00 sshd
  921 student   20   0    2460    820    692 S   0.0  0.0   0:00.00 sftp-server
 2919 student   20   0    5424   1364   1008 R   0.0  0.1   0:00.00 top
```

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

Sorting by columns:

M (sort by mem usage)

2. 192.168.0.113 (student)

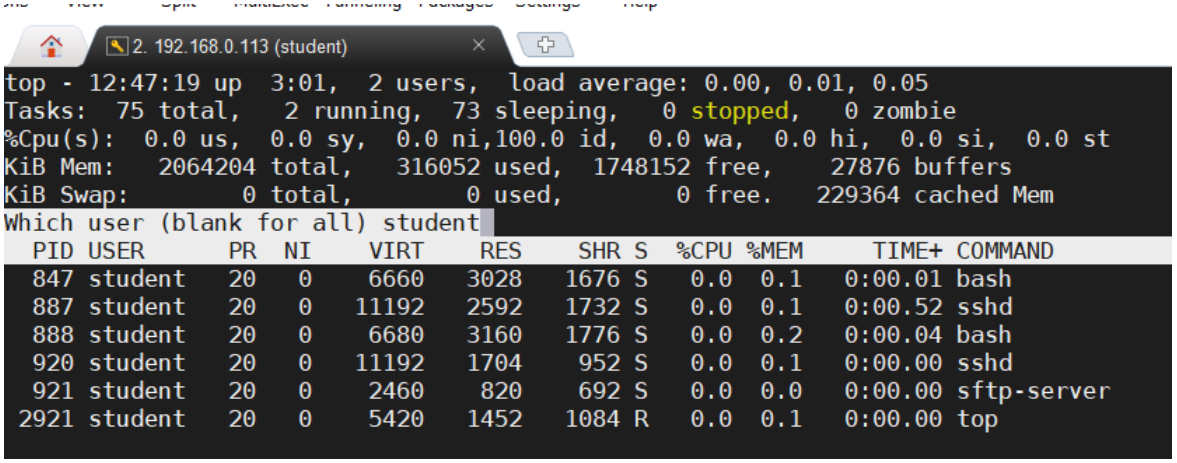
```
top - 12:45:15 up  2:59,  2 users,  load average: 0.00, 0.01, 0.05
Tasks:  74 total,   2 running,  72 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni, 97.0 id,  0.0 wa,  0.0 hi,  3.0 si,  0.0 st
KiB Mem:   2064204 total,   316140 used,  1748064 free,    27876 buffers
KiB Swap:        0 total,        0 used,        0 free.   229364 cached Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
  867 root      20   0   11192   3812   3040 S   0.0  0.2   0:00.03 sshd
  869 root      20   0   11192   3576   2828 S   0.0  0.2   0:00.02 sshd
  888 student   20   0    6680   3160   1776 S   0.0  0.2   0:00.04 bash
  847 student   20   0    6660   3028   1676 S   0.0  0.1   0:00.01 bash
  887 student   20   0   11192   2592   1732 S   0.0  0.1   0:00.49 sshd
  747 root      20   0    7796   2492   1996 S   0.0  0.1   0:00.03 sshd
  599 root      20   0    5512   2344    624 S   0.0  0.1   0:00.00 dhclient
```

P (sort by CPU usage)

2. 192.168.0.113 (student)

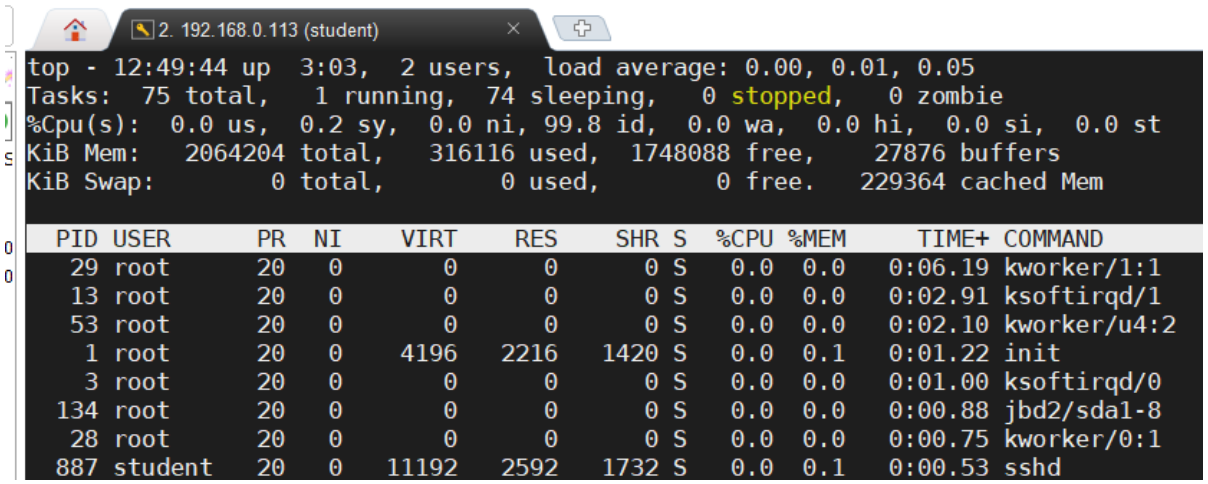
```
top - 12:46:14 up  3:00,  2 users,  load average: 0.00, 0.01, 0.05
Tasks:  74 total,   2 running,  72 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.0 us,  0.2 sy,  0.0 ni, 99.8 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:   2064204 total,   316076 used,  1748128 free,    27876 buffers
KiB Swap:        0 total,        0 used,        0 free.   229364 cached Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
   28 root      20   0       0      0      0 S   0.5  0.0   0:00.74 kworker/0:1
    1 root      20   0    4196   2216   1420 S   0.0  0.1   0:01.22 init
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.04 kthreadd
    3 root      20   0       0      0      0 S   0.0  0.0   0:00.99 ksoftirqd/0
    4 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kworker/0:0
```

Filtering by user:

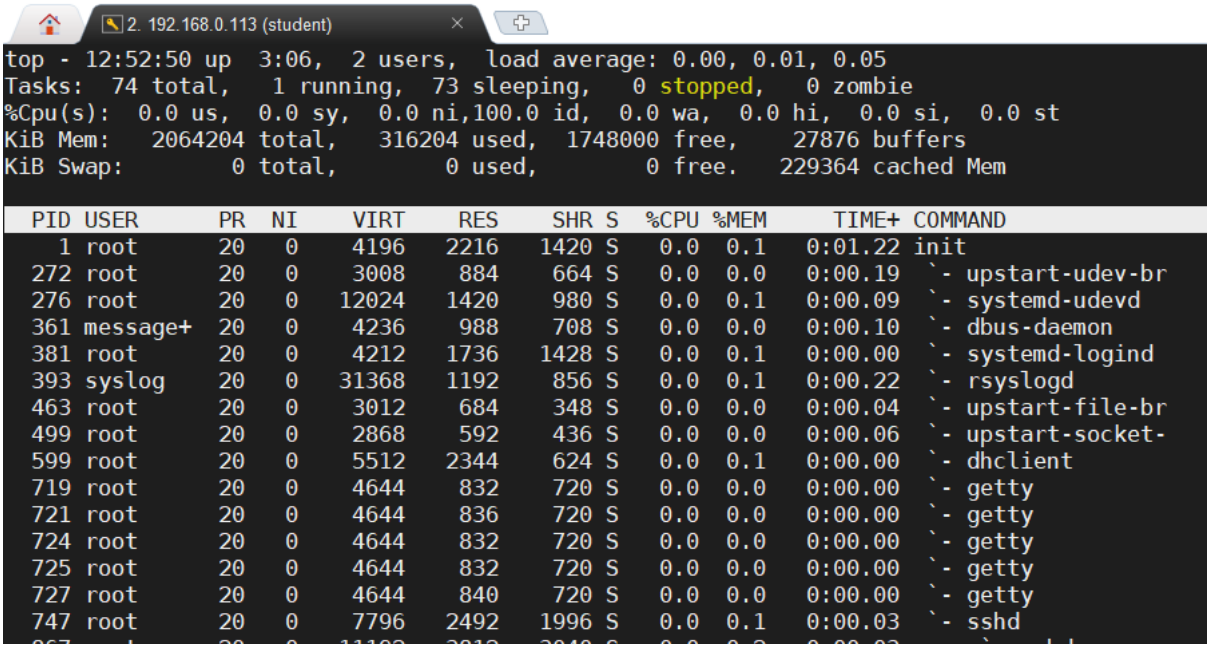


13) **Sort the contents of the processes window using various parameters (for example, the amount of processor time taken up, etc.)**

Sorting by process execution time (***T***):



Sorting by virtual memory usage (***V***):



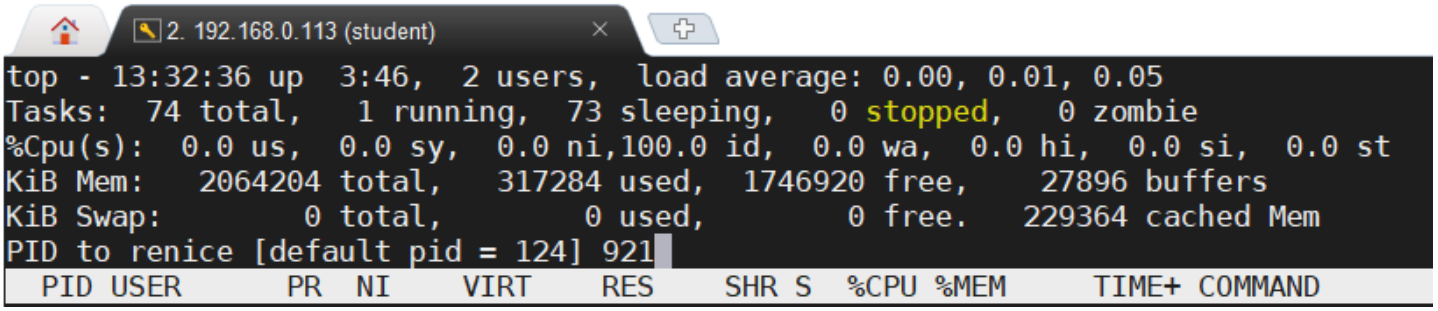
14) **Concept of priority, what commands are used to set priority?**

The concept of priority determines the order in which the kernel schedules processes to run on the CPU. A higher priority value typically results in a process being scheduled more frequently and receiving ***more CPU time***, while a lower priority value means the process is scheduled less frequently and may have ***less CPU time*** allocated.

To set the priority of the process commands ***nice***, ***renice*** and ***top/htop*** can be used.

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

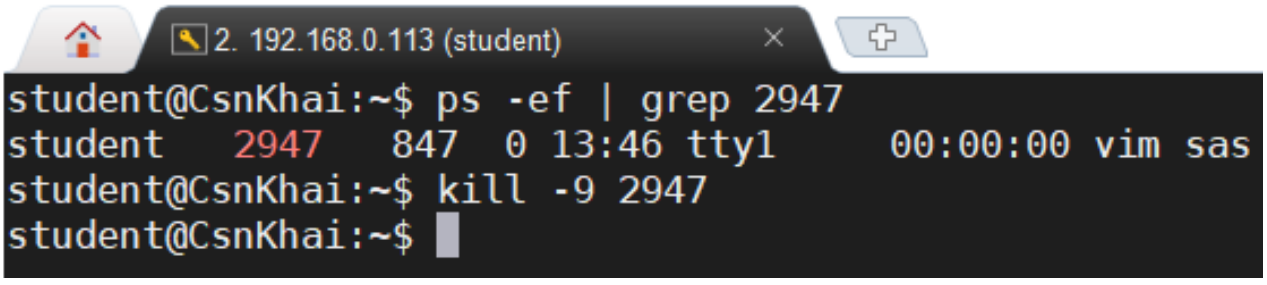
Yes, by pressing ***r*** key, entering ***PID*** and ***niceness***:

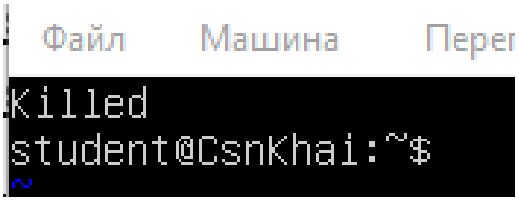


16) **Examine the kill command. How to send with the kill command process control signal? Give an example of commonly used signals.**

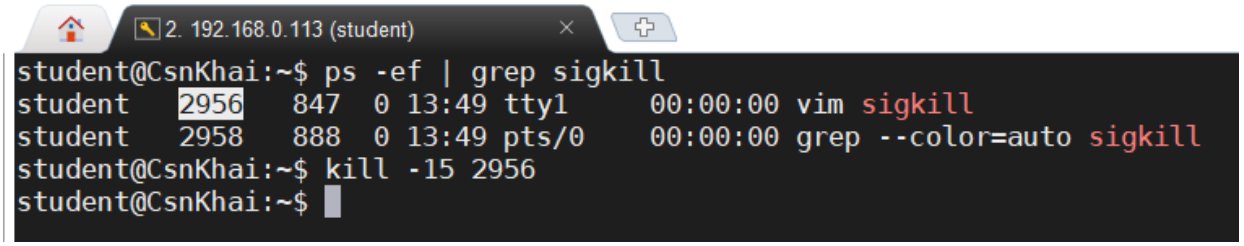
Some commonly used signals are:

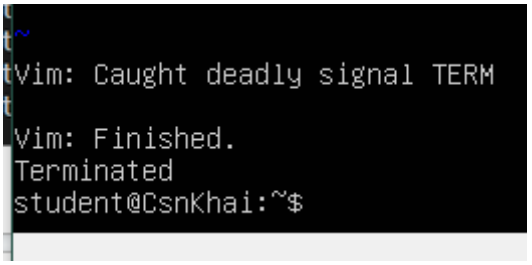
SIGKILL (9) to immediately terminate a process:





SIGTERM (15) to ask a process to exit:





Also, there are ***SIGSTOP (19)***, ***SIGINT (2)***, ***SIGHUP (1)***, etc.

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

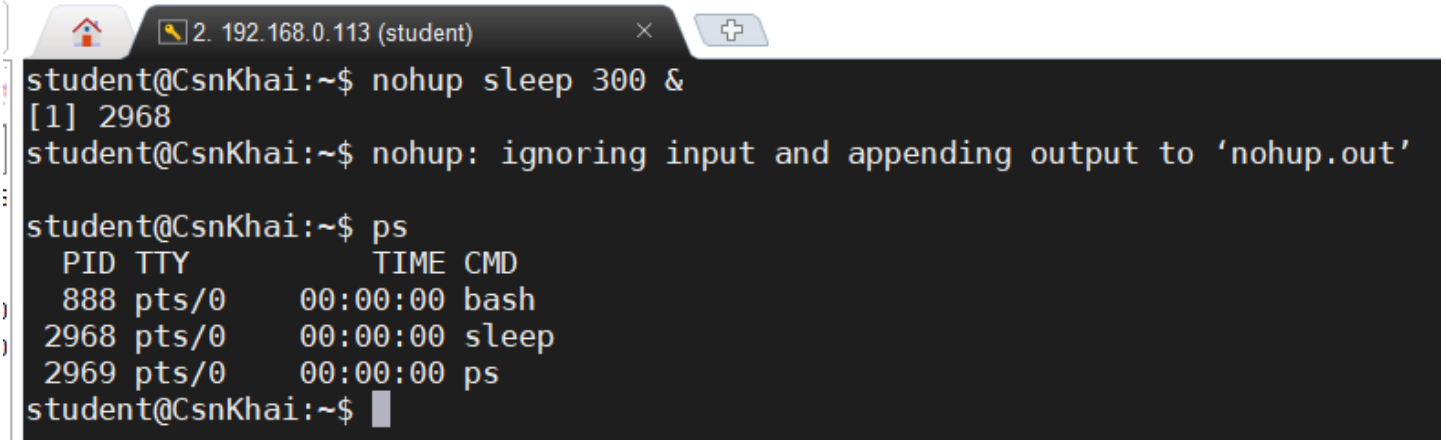
jobs: displays a list of currently running jobs (background processes) associated with the current shell session.

fg: is used to bring a background job into the foreground. It resumes a suspended or backgrounded job and makes it the active process in the terminal.

bg: is used to move a suspended job to the background, allowing it to continue running while freeing up the terminal for other commands.

nohup: is used to run a command in the background and ignore the SIGHUP signal. This allows a process to continue running even after you close the terminal session.

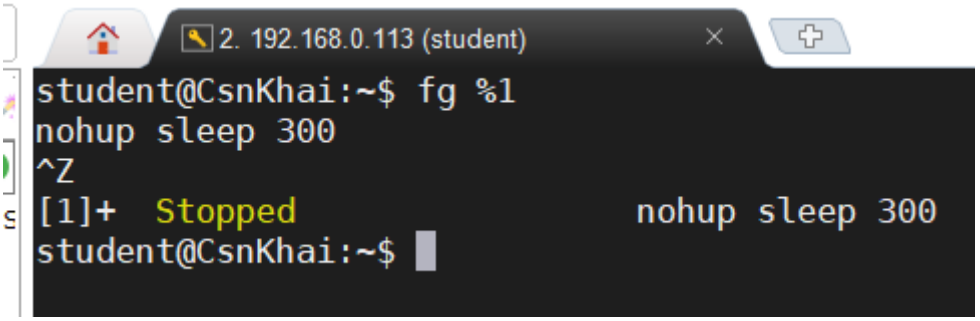
Let's run a ***sleep*** command in the background:



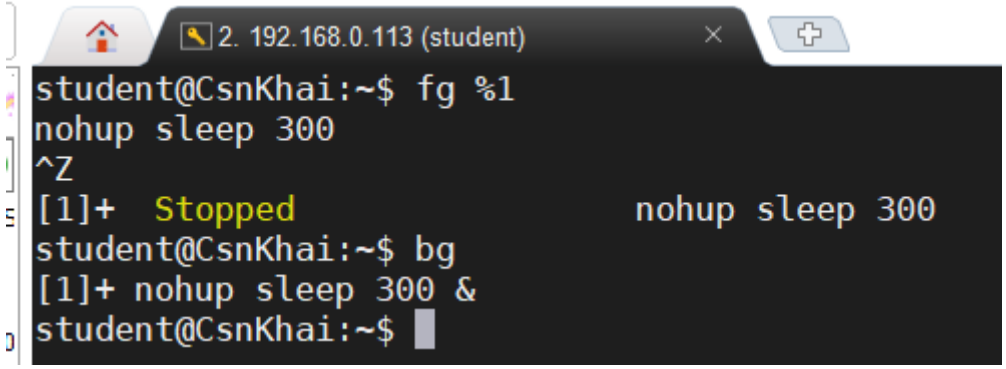
See the ***jobs***:

```
student@CsnKhai:~$ jobs
[1]+  Running                 nohup sleep 300 &
student@CsnKhai:~$
```

Move it to the foreground with ***fg*** and suspend it with ***ctrl+Z***:



And moving it back to the background with ***bg***:



Task3.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).**

Standard ***ssh*** connection to VM using CMD:

```
C:\Users\Win10>ssh student@192.168.0.113
The authenticity of host '192.168.0.113 (192.168.0.113)' can't be established.
ECDSA key fingerprint is SHA256:yp8INOs6pk/gVv7G84N/cRT3KsgxLPiH81jZ/cRpz0o.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.0.113' (ECDSA) to the list of known hosts.
student@192.168.0.113's password:
Welcome to Ubuntu 14.04.3 LTS (GNU/Linux 3.13.0-63-generic i686)

 * Documentation:  https://help.ubuntu.com/
Last login: Fri Aug 18 09:46:31 2023 from 192.168.0.108
student@CsnKhai:~$
```

Generating ***key pair***:

```
C:\Windows\system32>ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (C:\Users\Win10/.ssh/id_rsa): C:\Users\Win10\Desktop\id_rsa
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in C:\Users\Win10\Desktop\id_rsa.
Your public key has been saved in C:\Users\Win10\Desktop\id_rsa.pub.
The key fingerprint is:
SHA256:M5mleNM3Mc9Cx/lr4Uo9jP2huvv7xS8jA7PMdyxKOTY win10@DESKTOP-JT48RV1
The key's randomart image is:
+---[RSA 3072]----+
|                 |
|             . . |
|          . + +  |
|       . * . * . |
|      . S . + o..|
|       . +oo o*.o|
|         oE+ + Xo|
|         o+o* O *|
|          .*=Xo+o|
+----[SHA256]-----+
```

Trying to transfer ***key pair*** to VM (only manual transfer is possible):

```
C:\Windows\system32>ssh-copy-id student@192.168.0.113
'ssh-copy-id' is not recognized as an internal or external command,
operable program or batch file.

C:\Windows\system32>
```

2) **<u>Implement basic SSH settings to increase the security of the client-server connection.</u>**

Establishing authentication without password (***from host WSL***):

```
max@DESKTOP-JT48RV1:~$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/max/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/max/.ssh/id_rsa
Your public key has been saved in /home/max/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:94Xy3xLf22beo/1CPjMoLacSlJeF4utb35751T25+qI max@DESKTOP-JT48RV1
The key's randomart image is:
+---[RSA 3072]----+
|            .    |
|         . . .   |
|        . o o    |
|         + o  .  |
|        .Soo . . |
|         o. + .o +|
|        . ...o+ ==|
|         o.o.++O=@|
|         .o.Eo+@/@|
+----[SHA256]-----+
max@DESKTOP-JT48RV1:~$
```

```
max@DESKTOP-JT48RV1: ~
max@DESKTOP-JT48RV1:~$ ssh-copy-id student@192.168.0.113
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/max/.ssh/id_rsa.pub"
The authenticity of host '192.168.0.113 (192.168.0.113)' can't be established.
ECDSA key fingerprint is SHA256:yp8INOs6pk/gVv7G84N/cRT3KsgxLPiH81jZ/cRpz0o.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
student@192.168.0.113's password:

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'student@192.168.0.113'"
and check to make sure that only the key(s) you wanted were added.

max@DESKTOP-JT48RV1:~$
```

```
max@DESKTOP-JT48RV1:~$ ssh student@192.168.0.113
Welcome to Ubuntu 14.04.3 LTS (GNU/Linux 3.13.0-63-generic i686)

 * Documentation:  https://help.ubuntu.com/
Last login: Fri Aug 18 17:35:49 2023
student@CsnKhai:~$ w
 17:47:21 up 12 min,  2 users,  load average: 0.00, 0.01, 0.03
USER     TTY      FROM             LOGIN@   IDLE   JCPU   PCPU WHAT
student  tty1                      17:35   11:33   0.02s  0.00s -bash
student  pts/0    192.168.0.108    17:47    1.00s  0.01s  0.00s w
student@CsnKhai:~$
```

Disabling root authentication:

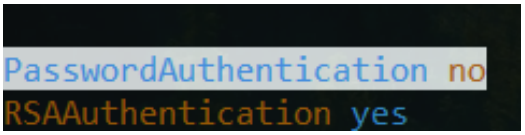
```
# Authentication:
LoginGraceTime 120
PermitRootLogin no
StrictModes yes
```

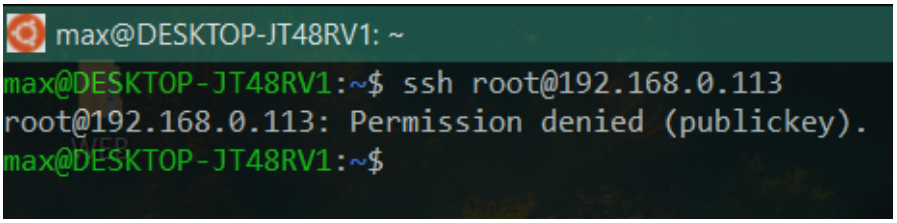
```
# Authentication:
LoginGraceTime 120
PermitRootLogin no
StrictModes yes
AllowUsers student
```

```
student@CsnKhai:~$ sudo service ssh restart
ssh stop/waiting
ssh start/running, process 990
student@CsnKhai:~$ sudo service ssh status
ssh start/running, process 990
student@CsnKhai:~$
```

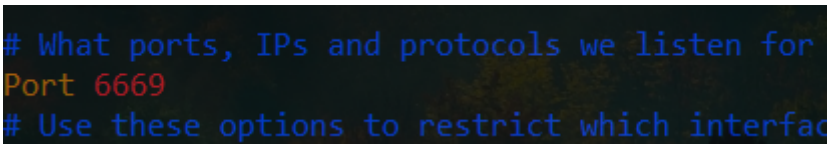
```
student@CsnKhai: ~
max@DESKTOP-JT48RV1:~$ ssh root@192.168.0.113
root@192.168.0.113's password:
Permission denied, please try again.
root@192.168.0.113's password:
Permission denied, please try again.
root@192.168.0.113's password:
root@192.168.0.113: Permission denied (publickey,password).
```

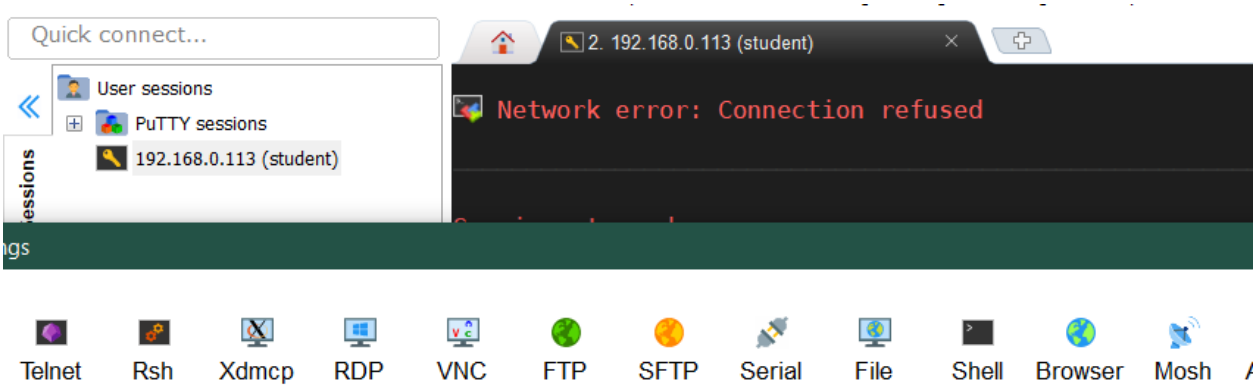
Disabling password based auth:

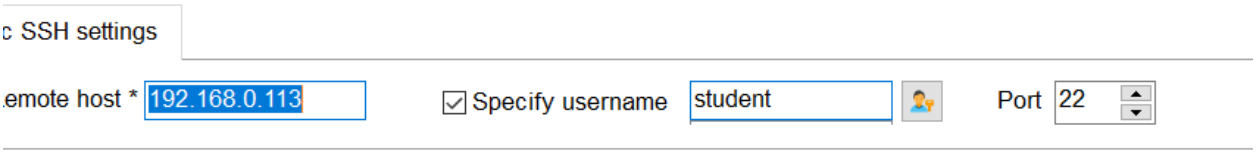


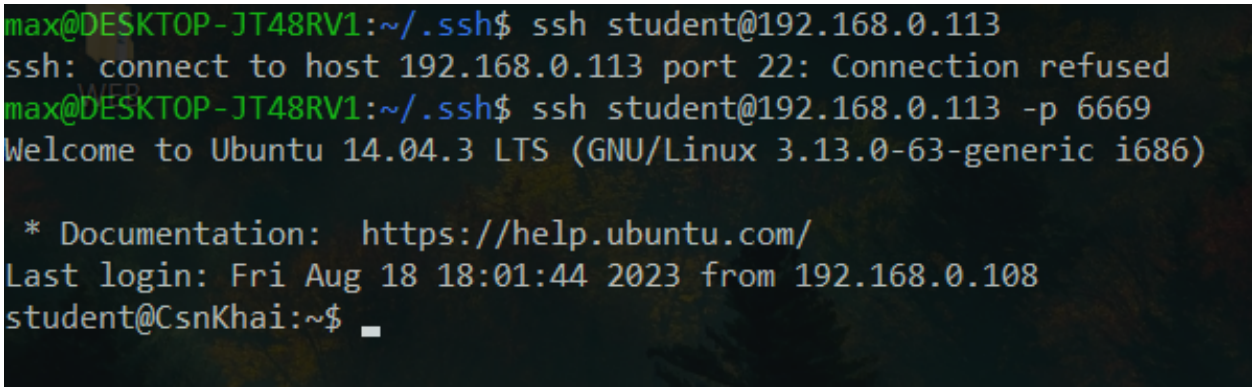


Changing ***ssh port*** from ***22*** to ***6669***:





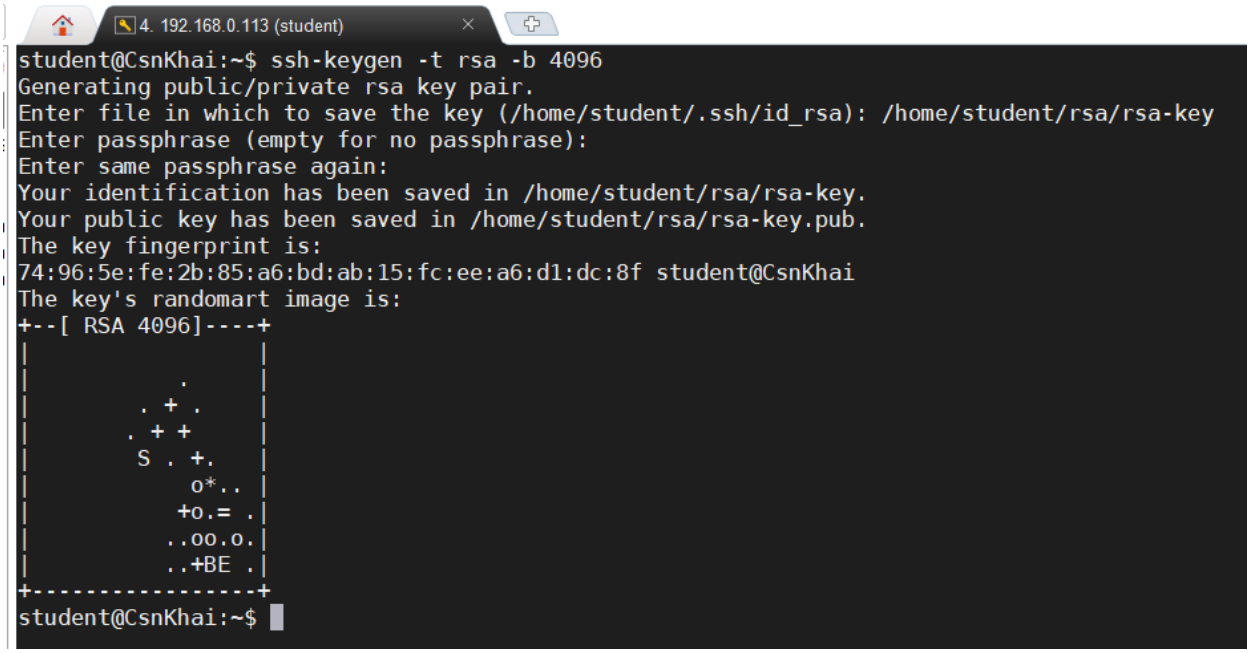




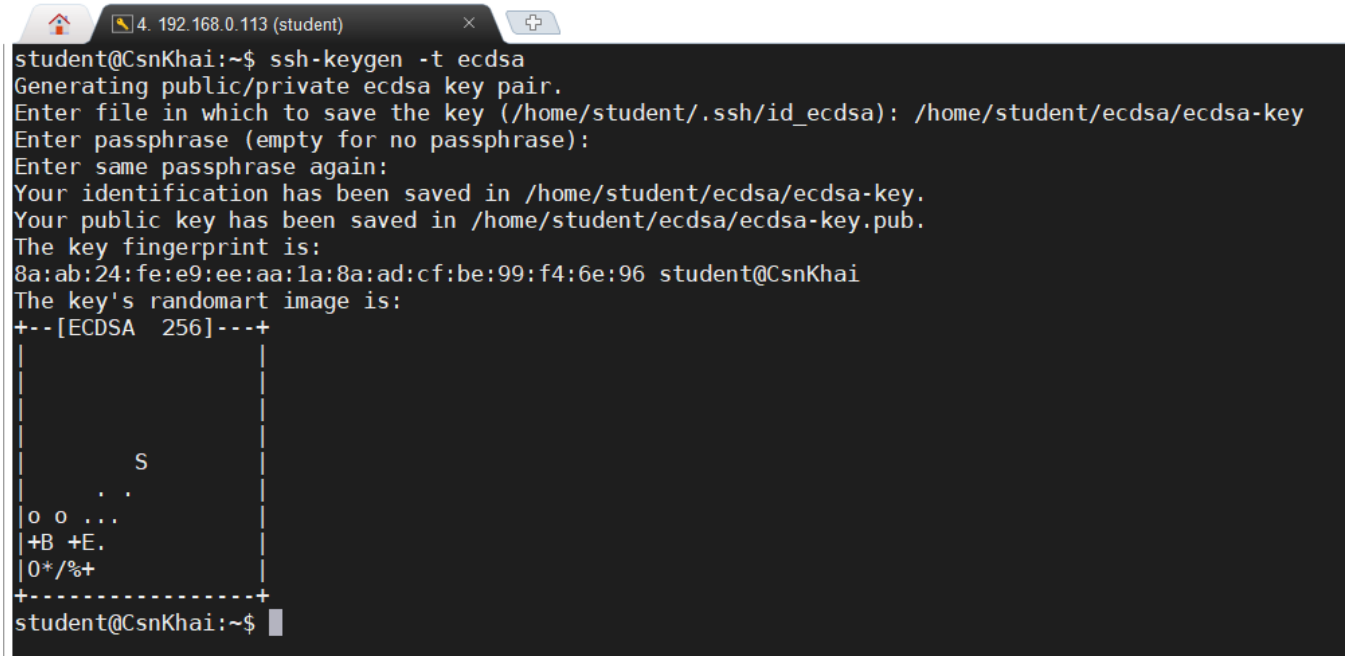
3) **List the options for choosing keys for encryption in SSH. Implement 3 of them.**

There are many cryptographic algorithms used for encryption of ssh connections. Here are three of them:

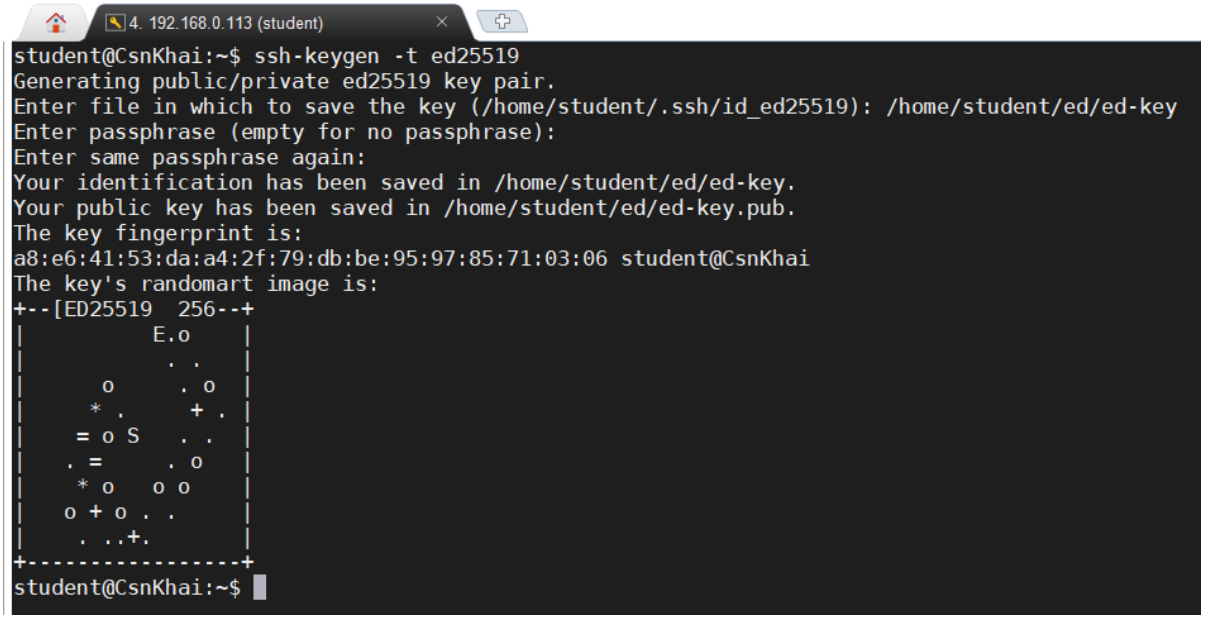
- ***RSA:*** one of the most widely used encryption algorithms for SSH key pairs. It's known for its security and versatility:



- ***ECDSA:*** Elliptic Curve Digital Signature Algorithm, another option for generating SSH key pairs. It uses elliptic curve cryptography and provides a good balance between security and key size:



- ***ED25519:***



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