CLOUD COMPUTING

SUBMITTED TO
SIR WAQAS SALEEM

SUBMITTED BY
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BSE V-A

Lab 07

Lab Title

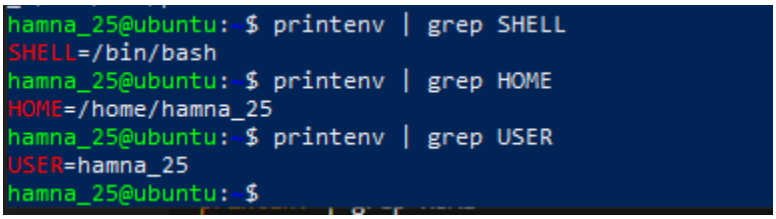
Environment Variables, PATH, UFW, and SSH Key Authentication

Task 1 — Print & filter environment variable

1. Print all environment variables

```
hamna_25@ubuntu:~$ printenv
SHELL=/bin/bash
PWD=/home/hamna_25
LOGNAME=hamna_25
XDG_SESSION_TYPE=tty
HOME=/home/hamna_25
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;01:mi=00:su=37;41:sg=
30;43:ca=00:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:
*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.
gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.zst=01;31:*.tzst=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz
2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace
=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.avif
=01;35:*.jpg=01;35:*.jpeg=01;35:*.mjpg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*
.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35
:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.webp=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01
;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01
;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogv=01;3
5:*.ogx=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;
36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:*~=00;90:*#=00;90:*.bak=00;90:*.
crdownload=00;90:*.dpkg-dist=00;90:*.dpkg-new=00;90:*.dpkg-old=00;90:*.dpkg-tmp=00;90:*.old=00;90:*.orig=00;90:*.part=00
;90:*.rej=00;90:*.rpmnew=00;90:*.rpmorig=00;90:*.rpmsave=00;90:*.swp=00;90:*.tmp=00;90:*.ucf-dist=00;90:*.ucf-new=00;90:
*.ucf-old=00;90:
SSH_CONNECTION=192.168.152.1 49406 192.168.152.135 22
LESSCLOSE=/usr/bin/lesspipe %s %s
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %s
USER=hamna_25
SHLVL=1
XDG_SESSION_ID=3
XDG_RUNTIME_DIR=/run/user/1000
SSH_CLIENT=192.168.152.1 49406 22
XDG_DATA_DIRS=/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
SSH_TTY=/dev/pts/0
_=/usr/bin/printenv
hamna_25@ubuntu:~$
```

2. Filter for SHELL, HOME and USER.



Task 2 — Export DB_* variables temporarily and observe scope

1. Define all DB_* variables (run the three exports one after another). Capture them in one screenshot showing the three export commands and their execution.

```
hamna_25@ubuntu:~$ export DB_URL="postgres://db.example.local:5432/mydb"
hamna_25@ubuntu:~$ export DB_USER="labuser"
hamna_25@ubuntu:~$ export DB_PASSWORD="labpass123"
hamna_25@ubuntu:~$
```

2. Echo the three variables (run the three echo commands together) and capture one screenshot showing their outputs.

```
hamna_25@ubuntu:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
hamna_25@ubuntu:~$ echo "$DB_USER"
labuser
hamna_25@ubuntu:~$ echo "$DB_PASSWORD"
labpass123
hamna_25@ubuntu:~$
```

3. Show all DB_ variables with a single grep command (capture that output).

```
hamna_25@ubuntu:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
hamna_25@ubuntu:~$
```

4. Close the bash session (exit) and reopen a new terminal. Verify variables are gone using echo and grep together.

```
hamna_25@ubuntu:~$ exit
logout
Connection to 192.168.152.135 closed.
PS C:\Users\ABC> ssh hamna_25@192.168.152.135
hamna_25@192.168.152.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)
    hamna_25@ubuntu:~$ echo "$DB_URL"

    hamna_25@ubuntu:~$ printenv | grep '^DB_'
    hamna_25@ubuntu:~$
```

Task 3 — Make DB_ variables persistent in ~/.bashrc*

Open ~/.bashrc in an editor and append the three export lines. Capture the editor showing the three lines added (single screenshot).

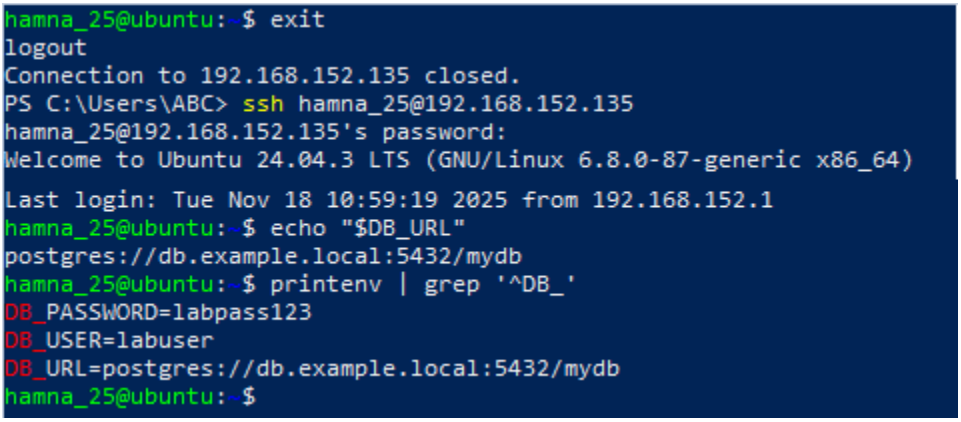
```
# Lab 7 persistent DB variables
 export DB_URL="postgres://db.example.local:5432/mydb"
 export DB_USER="labuser"
 export DB_PASSWORD="labpass123"

-- INSERT --
```

Source ~/.bashrc and then immediately run the three echoes and the grep filter. Capture all commands together in one screenshot.

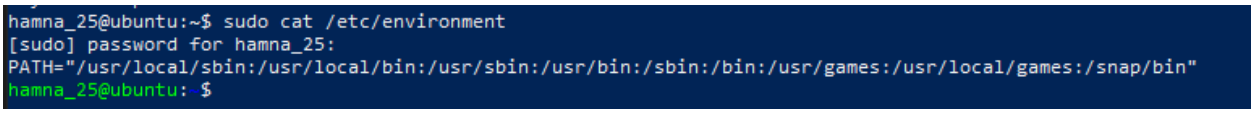
```
hamna_25@ubuntu:~$ source ~/.bashrc
hamna_25@ubuntu:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
hamna_25@ubuntu:~$ echo "$DB_USER"
labuser
hamna_25@ubuntu:~$ echo "$DB_PASSWORD"
labpass123
hamna_25@ubuntu:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
hamna_25@ubuntu:~$
```

Close and reopen terminal. Run echo and grep together to confirm persistence. Capture both in one screenshot.

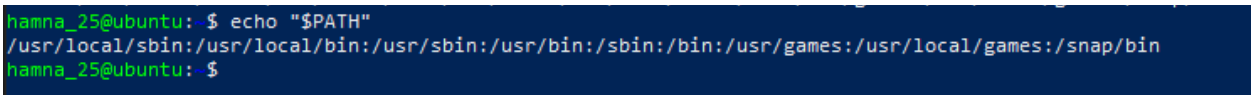


Task 4 — System-wide environment variable, welcome script, and PATH

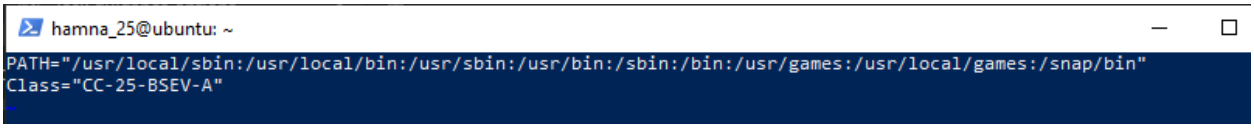
View /etc/environment before editing and save the screenshot.



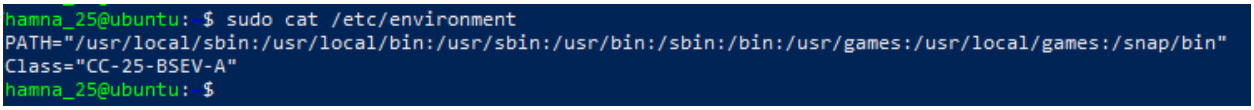
Show the current PATH value.



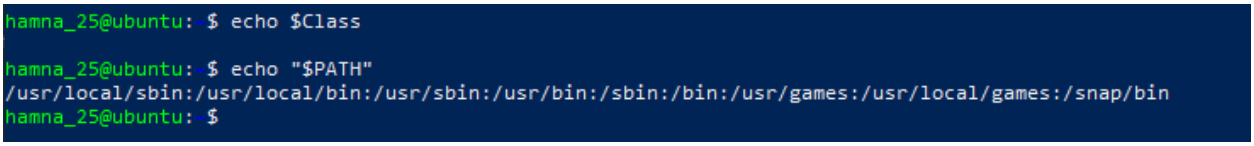
Edit /etc/environment and add the Class variable. Capture the editor showing the added line.



Show the updated file containing the Class line.



After re-login, show the Class variable and PATH in a single screenshot.



Create a welcome script named welcome in your home directory and make it executable. Capture the creation and chmod together.

```
hamna_25@ubuntu:~$ cat > ~/welcome <<'EOF'
> #!/bin/bash
> echo "Welcome to Cloud Computing $USER"
> EOF
hamna_25@ubuntu:~$ chmod +x ~/welcome
hamna_25@ubuntu:~$
```

Execute the script with ./welcome and show the output.

```
hamna_25@ubuntu:~$ cd ~
hamna_25@ubuntu:~$ ./welcome
Welcome to Cloud Computing hamna_25
hamna_25@ubuntu:~$
```

Add your home directory to PATH inside ~/.bashrc. Capture only the editor view showing the PATH line.

```
PATH=$PATH:~
:wq
```

Apply the PATH update and run welcome directly. Capture source + welcome output together.

```
hamna_25@ubuntu:~$ source ~/.bashrc
hamna_25@ubuntu:~$ cd ~
hamna_25@ubuntu:~$ welcome
Welcome to Cloud Computing hamna_25
hamna_25@ubuntu:~$
```

Task 5 – Block and allow SSH using ufw (firewall)

1. Enable ufw and show status (group both commands in one screenshot if you run them together).

```
hamna_25@ubuntu:~$ sudo ufw enable
[sudo] password for hamna_25:
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
hamna_25@ubuntu:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), deny (routed)
New profiles: skip

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW IN    Anywhere
22/tcp (v6)                ALLOW IN    Anywhere (v6)

hamna_25@ubuntu:~$
```

Deny TCP port 22 and show status (run deny and status numbered together and capture in one screenshot). Use short form as requested.

```
hamna_25@ubuntu:~$ sudo ufw deny 22/tcp
Rule updated
Rule updated (v6)
hamna_25@ubuntu:~$ sudo ufw status numbered
Status: active

     To                         Action      From
     --                         ------      ----
[ 1] 22/tcp                     DENY IN     Anywhere
[ 2] 22/tcp (v6)                DENY IN     Anywhere (v6)

hamna_25@ubuntu:~$
```

From Windows host attempt to SSH (expected to fail) — capture the host-side SSH attempt in one screenshot:

```
hamna_25@ubuntu:~$ ssh hamna_25@192.168.152.135
The authenticity of host '192.168.152.135 (192.168.152.135)' can't be established.
ED25519 key fingerprint is SHA256:SmwV641vqFARVkU+D30pyc/pvxlYhlcWblCxNX0Pcag.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.152.135' (ED25519) to the list of known hosts.
hamna_25@192.168.152.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)
```

Allow SSH back and reload, then show status (group allow, reload, status in one screenshot if run together). Use short form as requested.

```
hamna_25@ubuntu:~$ sudo ufw allow 22/tcp
[sudo] password for hamna_25:
Rule updated
Rule updated (v6)
hamna_25@ubuntu:~$ sudo ufw reload
Firewall reloaded
hamna_25@ubuntu:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)

hamna_25@ubuntu:~$
```

From Windows host attempt SSH again (should succeed) — capture successful login in one screenshot:

```
hamna_25@ubuntu:~$ ssh hamna_25@192.168.152.135
hamna_25@192.168.152.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Nov 18 12:53:23 PM UTC 2025

  System load:  0.47               Processes:               245
  Usage of /:   63.0% of 22.53GB   Users logged in:         1
  Memory usage: 12%                IPv4 address for ens33: 192.168.152.135
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

8 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

6 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm


Last login: Tue Nov 18 12:48:57 2025 from 192.168.152.135
hamna_25@ubuntu:~$
```

Task 6 — Configure SSH key-based login from Windows host

Generate ed25519 key pair (if needed) and show the generated files in one screenshot (run ssh-keygen and then list ~/.ssh):

```
hamna_25@ubuntu:~$ ssh-keygen -t ed25519 -f ~/.ssh/id_lab7 -C "lab_key"
a ~/.ssh
Generating public/private ed25519 key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/hamna_25/.ssh/id_lab7
Your public key has been saved in /home/hamna_25/.ssh/id_lab7.pub
The key fingerprint is:
SHA256:G33aBzX1AsrB2O8N+7lygLgEN5hw77F5c4mY0waiUzA lab_key
The key's randomart image is:
+--[ED25519 256]--+
|         +. .    .|
|    E . ..oo . ..|
|     = +  o.  + .|
|      * *.  o. o |
|     o =S@.+o=   |
|    o   XoB+*..  |
|     . ..=.o.o.. |
|        .   ..+  |
|             o.. |
+----[SHA256]-----+
hamna_25@ubuntu:~$ ls -la ~/.ssh
total 28
drwx------  2 hamna_25 hamna_25 4096 Nov 18 12:57 .
drwxr-x--- 29 hamna_25 hamna_25 4096 Nov 18 11:35 ..
-rw-------  1 hamna_25 hamna_25    1 Sep 28 19:14 authorized_keys
-rw-------  1 hamna_25 hamna_25  399 Nov 18 12:57 id_lab7
-rw-r--r--  1 hamna_25 hamna_25   89 Nov 18 12:57 id_lab7.pub
-rw-------  1 hamna_25 hamna_25  978 Nov 18 12:48 known_hosts
-rw-r--r--  1 hamna_25 hamna_25  142 Nov 18 12:48 known_hosts.old
hamna_25@ubuntu:~$
```

Show the public key content (single screenshot):

```
hamna_25@ubuntu:~$ cat ~/.ssh/id_lab7.pub
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIHAFdnZxTbQIPT/BBgsw80YffOpy2s7UCEcXT36GqDwq lab_key
hamna_25@ubuntu:~$
```

Clear the known_hosts file content and verify it is empty (single screenshot):

```
hamna_25@ubuntu:~$ echo $null > $env:USERPROFILE\.ssh\known_hosts
hamna_25@ubuntu:~$ type $env:USERPROFILE\.ssh\known_hosts
:USERPROFILE.sshknown_hosts is /home/hamna_25/:USERPROFILE.sshknown_hosts
hamna_25@ubuntu:~$
```

Connect to Ubuntu Server (Initial Connection)

```
hamna_25@ubuntu:~$ ssh hamna_25@192.168.152.135
hamna_25@192.168.152.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Nov 18 01:19:26 PM UTC 2025

  System load:  0.02               Processes:             250
  Usage of /:   63.0% of 22.53GB   Users logged in:       1
  Memory usage: 12%                IPv4 address for ens33: 192.168.152.135
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

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Last login: Tue Nov 18 13:16:16 2025 from 192.168.152.1
hamna_25@ubuntu:~$
```

Verify known_hosts Updated

```
hamna_25@ubuntu:~$ type $env:USERPROFILE\.ssh\known_hosts
:USERPROFILE.sshknown_hosts is /home/hamna_25/:USERPROFILE.sshknown_hosts
hamna_25@ubuntu:~$
```

B: Ubuntu Server (Server-Side)

```
hamna_25@ubuntu:~$ mkdir -p ~/.ssh
hamna_25@ubuntu:~$ chmod 700 ~/.ssh
hamna_25@ubuntu:~$ > ~/.ssh/authorized_keys
hamna_25@ubuntu:~$
```

Append Public Key and Set Permissions

```
hamna_25@ubuntu:~$ echo "ssh-ed25519 AAAA...yourpublickey... lab_key" >> ~/.ssh/authorized_keys
hamna_25@ubuntu:~$ chmod 600 ~/.ssh/authorized_keys
hamna_25@ubuntu:~$ cat ~/.ssh/authorized_keys
ssh-ed25519 AAAA...yourpublickey... lab_key
hamna_25@ubuntu:~$
```

Test Passwordless Login from Windows

```
PS C:\Users\ABC> ssh hamna_25@192.168.152.135
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Nov 18 04:30:45 PM UTC 2025

  System load:  0.0                Processes:             251
  Usage of /:   63.0% of 22.53GB   Users logged in:       1
  Memory usage: 13%                IPv4 address for ens33: 192.168.152
.135
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how M
icroK8s
   just raised the bar for easy, resilient and secure K8s cluster depl
oyment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

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Last login: Tue Nov 18 16:20:30 2025 from 192.168.152.1
hamna_25@ubuntu:~$
```

Test Explicit Identity Usage

```
hamna_25@ubuntu:~$ ssh -i $env:USERPROFILE\.ssh\id_ed25519.pub hamna_25@192.168.152.135
Warning: Identity file :USERPROFILE.sshid_ed25519.pub not accessible: No such file or directory.
hamna_25@192.168.152.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-87-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Nov 18 04:33:25 PM UTC 2025

  System load:  0.06               Processes:             255
  Usage of /:   63.0% of 22.53GB   Users logged in:       1
  Memory usage: 13%                IPv4 address for ens33: 192.168.152.135
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

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Last login: Tue Nov 18 16:30:46 2025 from 192.168.152.1
hamna_25@ubuntu:~$
```

Exam evaluation questions

Q1: Quick Environment Audit

Show all environment variables

```
hamna_25@ubuntu:~$ printenv
SHELL=/bin/bash
DB_PASSWORD=labpass123
PWD=/home/hamna_25
LOGNAME=hamna_25
XDG_SESSION_TYPE=tty
DB_USER=labuser
HOME=/home/hamna_25
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;01:mi=00:su=37;41:sg=
30;43:ca=00:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:
*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.
gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.zst=01;31:*.tzst=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz
2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace
=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.avif
=01;35:*.jpg=01;35:*.jpeg=01;35:*.mjpg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*
.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35
:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.webp=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01
;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01
;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogv=01;3
5:*.ogx=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;
36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:*~=00;90:*#=00;90:*.bak=00;90:*.
crdownload=00;90:*.dpkg-dist=00;90:*.dpkg-new=00;90:*.dpkg-old=00;90:*.dpkg-tmp=00;90:*.old=00;90:*.orig=00;90:*.part=00
;90:*.rej=00;90:*.rpmnew=00;90:*.rpmorig=00;90:*.rpmsave=00;90:*.swp=00;90:*.tmp=00;90:*.ucf-dist=00;90:*.ucf-new=00;90:
*.ucf-old=00;90:
SSH_CONNECTION=192.168.152.1 55014 192.168.152.135 22
LESSCLOSE=/usr/bin/lesspipe %s %s
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %s
USER=hamna_25
SHLVL=1
DB_URL=postgres://db.example.local:5432/mydb
XDG_SESSION_ID=3
XDG_RUNTIME_DIR=/run/user/1000
SSH_CLIENT=192.168.152.1 55014 22
XDG_DATA_DIRS=/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/home/hamna_25
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
SSH_TTY=/dev/pts/0
Class=CC-25-BSEV-A
_=/usr/bin/printenv
hamna_25@ubuntu:~$
```

Show PATH, LANG, and PWD (three commands, together on screen)

```
hamna_25@ubuntu:~$ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/home/hamna_25
hamna_25@ubuntu:~$ echo $LANG
en_US.UTF-8
hamna_25@ubuntu:~$ echo $PWD
/home/hamna_25
hamna_25@ubuntu:~$
```

Q2: Short-lived Student Info

```
hamna_25@ubuntu:~$ export STUDENT_NAME="Hamna"
hamna_25@ubuntu:~$ export STUDENT_ROLL_NUMBER="25"
hamna_25@ubuntu:~$ export STUDENT_SEMESTER="5"
hamna_25@ubuntu:~$
```

Print them using echo

```
hamna_25@ubuntu:~$ echo $STUDENT_NAME
Hamna
hamna_25@ubuntu:~$ echo $STUDENT_ROLL_NUMBER
25
hamna_25@ubuntu:~$ echo $STUDENT_SEMESTER
5
hamna_25@ubuntu:~$
```

*Show all STUDENT_ using grep**

```
hamna_25@ubuntu:~$ printenv | grep STUDENT_
STUDENT_NAME=Hamna
STUDENT_SEMESTER=5
STUDENT_ROLL_NUMBER=25
hamna_25@ubuntu:~$
```

Open NEW terminal → variables should be gone

```
hamna_25@ubuntu:~$ echo $STUDENT_NAME
Hamna
hamna_25@ubuntu:~$ printenv | grep STUDENT_
STUDENT_NAME=Hamna
STUDENT_SEMESTER=5
STUDENT_ROLL_NUMBER=25
hamna_25@ubuntu:~$
```

Q3: Make It Sticky (Persistent Environment Variables)

Edit bashrc and add exports at bottom

```
export STUDENT_NAME="Hamna"
export STUDENT_ROLL_NUMBER="25"
export STUDENT_SEMESTER="5"


^G Help          ^O Write Out     ^W Where Is      ^K Cut
^X Exit          ^R Read File     ^\ Replace       ^U Paste
```

```
hamna_25@ubuntu:~$ source ~/.bashrc
hamna_25@ubuntu:~$ echo $STUDENT_NAME
Hamna
hamna_25@ubuntu:~$ printenv | grep '^STUDENT_'
STUDENT_NAME=Hamna
STUDENT_SEMESTER=5
STUDENT_ROLL_NUMBER=25
hamna_25@ubuntu:~$
```

Close terminal → Open NEW terminal

```
Last login: Wed Nov 19 12:27:15 2025 from 192.168.152.1
hamna_25@ubuntu:~$ echo $STUDENT_NAME
Hamna
hamna_25@ubuntu:~$ printenv | grep '^STUDENT_'
STUDENT_NAME=Hamna
STUDENT_SEMESTER=5
STUDENT_ROLL_NUMBER=25
hamna_25@ubuntu:~$
```

Q4: Firewall (ufw) Rules — Block/Restore ICMP Ping

```
hamna_25@ubuntu:~$ sudo ufw enable
[sudo] password for hamna_25:
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
hamna_25@ubuntu:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)

hamna_25@ubuntu:~$
```

Block ICMP ping

Since ICMP protocol doesn't work directly on Ubuntu we need to go inside the nano file to edit /etc/ufw/before.rules, which is a file UFW reads before applying rules, and changed the echo-request rule from **ACCEPT** to **DROP** to block ping.

```
hamna_25@ubuntu:~$ sudo nano /etc/ufw/before.rules
-A ufw-before-input -p icmp --icmp-type echo-request -j DROP
hamna_25@ubuntu:~$ sudo ufw reload
Firewall reloaded
hamna_25@ubuntu:~$ sudo ufw status numbered
Status: active

     To                         Action      From
     --                         ------      ----
[ 1] 22/tcp                     ALLOW IN    Anywhere
[ 2] 22/tcp (v6)                ALLOW IN    Anywhere (v6)

hamna_25@ubuntu:~$
```

Test ping from Windows (should fail)

```
C:\Users\ABC>ping 192.168.152.135

Pinging 192.168.152.135 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.152.135:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\ABC>
```

Re-allow ping (undo the change)

```
hamna_25@ubuntu: ~
 GNU nano 7.2                                        /etc/ufw/before.rules *
-A ufw-before-input -p icmp --icmp-type echo-request -j ACCEPT
```

```
hamna_25@ubuntu:~$ sudo ufw reload
Firewall reloaded
hamna_25@ubuntu:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)

hamna_25@ubuntu:~$
```

Test ping (should succeed)

```
C:\Users\ABC>ping 192.168.152.135

Pinging 192.168.152.135 with 32 bytes of data:
Reply from 192.168.152.135: bytes=32 time<1ms TTL=64
Reply from 192.168.152.135: bytes=32 time<1ms TTL=64
Reply from 192.168.152.135: bytes=32 time<1ms TTL=64
Reply from 192.168.152.135: bytes=32 time=1ms TTL=64

Ping statistics for 192.168.152.135:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\Users\ABC>
```

Ping succeeded now because we changed the rule in /etc/ufw/before.rules back from DROP to ACCEPT, allowing ICMP echo-request packets again.
After reloading UFW, the firewall stopped blocking ping, so the server responded normally to ping requests.