

# Cloud Computing Lab

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BSE-V B

**2023-BSE-046**

LAB 07

## Task 1 — Print & filter environment variables

- task1\_printenv\_all.png

- task1\_grep\_shell\_home\_user.png

```
nayab046@nayab046:~$ printenv | grep SHELL  
SHELL=/bin/bash  
nayab046@nayab046:~$ printenv | grep HOME  
HOME=/home/nayab046  
nayab046@nayab046:~$ printenv | grep USER  
USER=nayab046  
nayab046@nayab046:~$ |
```

## Task 2 — Export DB\_\* variables temporarily and observe scope

- task2 exports all.png

```
nayab046@nayab046:~$ export DB_URL="postgres://db.example.local:5432/mydb"
nayab046@nayab046:~$ export DB_USER="labuser"
nayab046@nayab046:~$ export DB_PASSWORD="labpass123"
nayab046@nayab046:~$ |
```

- task2\_echoes\_all.png

```
nayab046@nayab046:~$ export DB_PASSWORD=labpass123
nayab046@nayab046:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ echo "$DB_USER"
labuser
nayab046@nayab046:~$ echo "$DB_PASSWORD"
labpass123
nayab046@nayab046:~$ |
```

- task2\_printenv\_grep\_db.png

```
nayab046@nayab046:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ |
```

- task2\_after\_restart\_checks.png

```
nayab046@nayab046:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ |
```

## Task 3 — Make DB\_\* variables persistent in ~/.bashrc

- task3\_bashrc\_added.png

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

- task3\_source\_and\_verification.png

```
nayab046@nayab046:~$ source ~/.bashrc
nayab046@nayab046:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ echo "$DB_USER"
labuser
nayab046@nayab046:~$ echo "$DB_PASSWORD"
labpass123
nayab046@nayab046:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ |
```

- task3\_after\_restart\_persistent.png

```
nayab046@nayab046:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
nayab046@nayab046:~$ |
```

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

- task4/etc\_environment\_before.png

```
nayab046@nayab046:~$ sudo cat /etc/environment
[sudo] password for nayab046:
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games
s:/usr/local/games:/snap/bin"
nayab046@nayab046:~$ |
```

- task4\_echo\_path\_before.png

```
nayab046@nayab046:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr
/local/games:/snap/bin
nayab046@nayab046:~$ |
```

- task4/etc\_environment\_edit\_vim.png

```
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games
# add line: Class="CC-BSE-5B"
~
```

- task4/etc\_environment\_after.png

```
nayab046@nayab046:~$ cat /etc/environment
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games
s:/usr/local/games:/snap/bin
class="CC-BSE-5B"
nayab046@nayab046:~$ |
```

- task4\_echo\_class\_and\_path.png

```
nayab046@nayab046:~$ echo $Class
nayab046@nayab046:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr
/local/games:/snap/bin
nayab046@nayab046:~$ |
```

- task4\_welcome\_create\_and\_chmod.png

```
nayab046@nayab046:~$ cat > ~/welcome <<'EOF'
#!/bin/bash
echo "Welcome to Cloud Computing $USER"
EOF
nayab046@nayab046:~$ chmod +x ~/welcome
nayab046@nayab046:~$ |
```

- task4\_welcome\_run\_dot.png

```
nayab046@nayab046:~$ cd ~
nayab046@nayab046:~$ ./welcome
Welcome to Cloud Computing nayab046
nayab046@nayab046:~$ |
```

- task4\_bashrc\_path\_line.png

```
PATH=$PATH:~/Desktop
export PATH
PATH=$PATH:~
~
```

- task4\_bashrc\_source\_and\_welcome.png

```
nayab046@nayab046:~$ source ~/.bashrc
nayab046@nayab046:~$ cd ~
nayab046@nayab046:~$ welcome
```

## Task 5 — Block and allow SSH using ufw

- task5\_ufw\_enable\_and\_status.png

```
nayab046@nayab046:~$ sudo ufw enable
[sudo] password for nayab046:
Firewall is active and enabled on system startup
nayab046@nayab046:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip
nayab046@nayab046:~$ _
```

- task5\_ufw\_deny\_22\_and\_status.png

```
nayab046@nayab046:~$ sudo ufw deny 22/tcp
Rule added
Rule added (v6)
nayab046@nayab046:~$ sudo ufw status numbered
Status: active

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

nayab046@nayab046:~$
```

- task5\_ssh\_attempt\_blocked.png

```
nayab046@nayab046:~$ ssh nayab046@192.168.254.131
nayab046@192.168.254.131's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-71-generic x86_64)

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

System information as of Mon Nov 24 01:42:38 PM UTC 2025

System load: 0.02          Processes:           226
Usage of /: 56.8% of 9.75GB  Users logged in:      1
Memory usage: 15%
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.

74 updates can be applied immediately.
38 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Mon Nov 24 12:52:35 2025 from 192.168.254.1
nayab046@nayab046:~$ _
```

- task5\_ufw\_allow\_reload\_status.png

```
nayab046@nayab046:~$ sudo ufw allow 22/tcp
[sudo] password for nayab046:
Rule updated
Rule updated (v6)
nayab046@nayab046:~$ sudo ufw reload
Firewall reloaded
nayab046@nayab046:~$ sudo ufw status
Status: active

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

nayab046@nayab046:~$ _
```

- task5\_ssh\_success\_after\_allow.png

```
nayab046@nayab046:~$ ssh nayab046@192.168.254.131
nayab046@192.168.254.131's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-71-generic x86_64)

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

System information as of Mon Nov 24 01:46:40 UTC 2025

System load: 0.0          Processes:           232
Usage of /: 56.9% of 9.75GB  Users logged in:     1
Memory usage: 16%          IPv4 address for ens33: 192.168.254.131
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.

74 updates can be applied immediately.
38 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Mon Nov 24 13:42:39 2025 from 192.168.254.131
nayab046@nayab046:~$
```

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

- task6\_windows\_sshkey\_and\_list.png

```

Enter same passphrase again:
Your identification has been saved in C:\Users\ Laptop\. ssh\ id_lab7
Your public key has been saved in C:\Users\ Laptop\. ssh\ id_lab7.pub
The key fingerprint is:
SHA256:ch1DY033WkaOrDurLd1MZ8NH09wlUOKVim382X9dJEY lab_key
The key's randomart image is:
+--[ED25519 256]--+
| oo.ooo.|
| . ... oE.|
| .o+.o o+|
| .oo* + *|
| S . + 0 *|
| o + % +|
| . = * o+|
| ..+ + +|
| .o++ .|
+---[SHA256]-----+
C:\Users\ Laptop>ls -la ~/ . ssh
'ls' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\ Laptop>dir %USERPROFILE%\. ssh
Volume in drive C has no label.
Volume Serial Number is ACD8-A7BE

Directory of C:\Users\ Laptop\ . ssh

11/07/2025 10:14 AM <DIR> .
11/07/2025 10:14 AM <DIR> ..
09/27/2025 02:07 PM 419 id_ed25519
09/27/2025 02:07 PM 110 id_ed25519. pub
11/07/2025 10:14 AM 399 id_lab7
11/07/2025 10:14 AM 90 id_lab7. pub
10/24/2025 09:33 AM 1,674 known_hosts
10/24/2025 09:33 AM 925 known_hosts.old
6 File(s) 3,617 bytes
2 Dir(s) 6,718,468,096 bytes free

```

- task6\_windows\_public\_key.png

```

C:\Users\ Laptop>type %USERPROFILE%\. ssh\ id_lab7. pub
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIG/sAAc1jNtpG8Q9t5IU/ToadwALXwViz2VUJ0cRgQZ3 lab_key

C:\Users\ Laptop>

```

- task6\_windows\_known\_hosts\_cleared\_and\_empty.png

```

C:\Users\ Laptop>echo "" > %USERPROFILE%\. ssh\ known_hosts
C:\Users\ Laptop>type %USERPROFILE%\. ssh\ known_hosts
"
```

- task6\_windows\_ssh\_accept\_hostkey\_and\_login.png

```

ED25519 key fingerprint is SHA256:rrrwoC97Xj50JGMociBh4uffKm0pGj/sTKCaf6Q0cDE.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.135' (ED25519) to the list of known hosts.
safa@192.168.56.135's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-86-generic x86_64)

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

```

- task6\_windows\_known\_hosts\_after\_connect.png

```

%USERPROFILE%\. ssh\ known_hosts
25519 AAAAC3NzaC1lZDI1NTE5AAAAI098/sdUvbD3Lix/7JMyHDSnVtc16RbFs+yBHE/Vuhv
a AAAB3NzaC1yc2EAAAQABAAABgQCzTff68yYlhSlvbFeEbT35F3QKQlwTTmJpxgn1kVfdV4pxctJpjtrXjh7eh7mmzx7r4zoTbb4uysRdu+EHn1Z5Asrg5Lm803159uDwUNp3ngiw6AwkIDC5Fyt
uqjBkFd+gBs0pLxE65HptrRya/1l5Nk5pG+Cxequ0dfy0Axwd2TeE6KjCj1djgnjS3ee1afTr/pvjlNxWSX19ZyE0Keg/eYluTx3c5CfUPQK10joEf+Thn5F4jGohvle9b9usX5f0qqb000EG64Lmh0bJ
ierCgPce2v4qp7eybFDmzTfgmIHbMRY8ZWm8KtTEn+ht1Y8bEnk/Nmv06KQApstxg4FpuuAOx8EwUsOxc5p9Zkb5HePuHT0jTY+F8BgUKS0IKS2KKjvJupM=
sha2-nistp256 AAAAE2VjZHNhLXNoYTItbm1zdHAyNTYAAAIBm1zdHAyNTYAAABBBDHoxthjh9AGB4+jlZangShyNQdgG1TwCTqt2tNLYLcc7GMelPlEx8kmPnibeTQEfufyRsFuGDPRQhGjpvaaU=

```

- task6\_server\_clear\_authorized\_keys.png

```
nayab046@nayab046:~$ mkdir -p ~/.ssh  
nayab046@nayab046:~$ chmod 700 ~/.ssh  
nayab046@nayab046:~$ > ~/.ssh/authorized_keys  
nayab046@nayab046:~$ _
```

- task6\_ssh\_with\_identity\_file.png

```
nayab046@nayab046:~$ echo "ssh-ed25519 AAAA... yourpublickey ... comment" >>  
~/.ssh/authorized_keys  
nayab046@nayab046:~$ chmod 600 ~/.ssh/authorized_keys  
nayab046@nayab046:~$ cat ~/.ssh/authorized_keys  
ssh-ed25519 AAAA... yourpublickey ... comment  
nayab046@nayab046:~$ _
```

- task6\_ssh\_passwordless\_login.png

```
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-86-generic x86_64)

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

System information as of Fri Nov  7 05:36:54 AM UTC 2025

 System load:  0.0          Processes:           230
 Usage of /:   88.2% of 9.75GB   Users logged in:      1
 Memory usage: 8%
 Swap usage:  0%
=> / is using 88.2% of 9.75GB

Expanded Security Maintenance for Applications is not enabled.
```

- task6\_ssh\_with\_identity\_file.png

```
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-86-generic x86_64)

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

# **Exam Evaluation Questions**

# **Q1: Quick Environment Audit**

EE\_q1\_env\_all.png

EE\_q1\_env\_filters.png

```
nayab046@nayab046:~$ echo "PATH: $PATH"
PATH: /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/usr/games:/usr/local/games:/snap/bin
nayab046@nayab046:~$ echo "LANG: $LANG"
LANG: en_US.UTF-8
nayab046@nayab046:~$ echo "PWD: $PWD"
PWD: /home/nayab046
nayab046@nayab046:~$ |
```

## **Q2: Short-lived Student Info**

EE\_q2\_exports.png

```
nayab046@nayab046:~$ export STUDENT_NAME="Nayab"
nayab046@nayab046:~$ export STUDENT_ROLL_NUMBER="2023-BSE-046"
nayab046@nayab046:~$ export STUDENT_SEMESTER="BSE-5B"
```

EE q2 echoes.png

```
nayab046@nayab046:~$ echo "Name: $STUDENT_NAME, Roll: $STUDENT_ROLL_NUMBER, SEMESTER: $STUDENT_SEMESTER"
Name: Nayab, Roll: 2023-BSE-046, SEMESTER: BSE-5B
```

EE\_q2\_printenv\_grep.png

```
nayab046@nayab046:~$ printenv | grep '^STUDENT_'
STUDENT_ROLL_SEMESTER=BSE-5B
STUDENT_NAME=Nayab
STUDENT_SEMESTER=BSE-5B
STUDENT_ROLL_NUMBER=2023-BSE-046
nayab046@nayab046:~$ |
```

EE\_q2\_after\_restart.png

```
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-86-generic x86_64)

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

System information as of Fri Nov  7 05:55:39 AM UTC 2025

System load: 0.0          Processes:      229
Usage of /: 88.2% of 9.75GB Users logged in: 1
Memory usage: 8%          IPv4 address for ens3: 192.168.56.
Swap usage: 0%
=> / is using 88.2% of 9.75GB

Expanded Security Maintenance for Applications is not enabled.

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

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

## Q3: Make It Sticky (Persistence Check for Student Info)

EE\_q3\_after\_source.png

```
nayab046@nayab046:~$ printenv | grep '^STUDENT_'
STUDENT_ROLL_SEMESTER=BSE-5B
STUDENT_NAME=Nayab
STUDENT_SEMESTER=BSE-5B
STUDENT_ROLL_NUMBER=2023-BSE-046
nayab046@nayab046:~$ |
```

EE\_q3\_after\_restart.png

```
nayab046@nayab046:~$ printenv | grep '^STUDENT_'
STUDENT_ROLL_SEMESTER=BSE-5B
STUDENT_NAME=Nayab
STUDENT_SEMESTER=BSE-5B
STUDENT_ROLL_NUMBER=2023-BSE-046
```

## Q4: Firewall Rules: Block and Restore Ping (ICMP)

EE\_q5\_ufw\_enable\_status.png

```
nayab046@nayab046:~$ sudo ufw enable
[sudo] password for nayab046:
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
nayab046@nayab046:~$ sudo ufw status
Status: active

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

nayab046@nayab046:~$
```

EE\_q5\_ufw\_deny\_ping\_status.png

```
nayab046@nayab046:~$ sudo ufw reload
[sudo] password for nayab046:
Firewall reloaded
nayab046@nayab046:~$ sudo ufw status numbered
Status: active

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

nayab046@nayab046:~$ |
```

EE\_q5\_ping\_blocked.png

```
[root@nayab046 ~]# ping 192.168.1.100  
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

EE\_q5\_ufw\_allow\_ping\_status.png

```
nayab046@nayab046:~$ sudo ufw status  
Status: active  
  
To                         Action      From  
--                         ----      ----  
22/tcp                      ALLOW      Anywhere  
22/tcp (v6)                 ALLOW      Anywhere (v6)
```