



Fatima Jinnah Women University

Opening Portals of Excellence Through Higher Education

CLOUD COMPUTING LAB 7

Environment Variables, PATH, UFW, and SSH Key Authentication

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Task 1 — Print & filter environment variables

task1_printenv_all.png

```
maham123@maham123:~$ printenv
#SHELL=/bin/bash
CREDENTIALS_DIRECTORY=/run/credentials/getty@tty1.service
MEMORY_PRESSURE_WRITE=c29tZSayMDAwMDAgMjAwMDAwMAA=
XDG_SEAT=seat0
PWD=/home/maham123
LOGNAME=maham123
XDG_SESSION_TYPE=tty
SYSTEMD_EXEC_PID=1863
HOME=/home/maham123
LANG=en_US.UTF-8
LS_COLORS=r=0;di=0;34:ln=0;36:mh=0;pi=0;38:so=0;1;35:do=0;1;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:e
x=01;32*:tar=01;31*:tgz=01;31*:arc=01;31*:arj=01;31*:tarz=01;31*:lha=01;31*:lz4=01;31*:lzh=01;31*:lzma=01;31*:lz=01;31*:txz=01;31*:tzo=01;31*:t7z=0
1;31*:zip=01;31*:z=01;31*:dz=01;31*:gz=01;31*:lrz=01;31*:lz=01;31*:lz=01;31*:xz=01;31*:zst=01;31*:tzst=01;31*:bz2=01;31*:bz=01;31*:tbz
2=01;31*:txz=01;31*:deb=01;31*:rpm=01;31*:jar=01;31*:war=01;31*:ear=01;31*:sar=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*:sum=01;31*:dum=01;31*:esd=01;31*:avif=01;35*:jpeg=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*:svga=01;35*:xvg=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*:ogg=01;35*:ogg=01;35*:mp4=01;35*:m4v=01;35*:mp4v=01;35*:vob=01;35*:qt=01;35
*:nuv=01;35*:umv=01;35*:asf=01;35*:rmm=01;35*:rmvb=01;35*:rm=01;35*:flc=01;35*:av1=01;35*:fli=01;35*:gl=01;35*:dl=01;35*:xci=01;35*:xud=01;35*:yuv=
01;35*:cgm=01;35*:emf=01;35*:ogv=01;35*:ogx=01;35*:aac=00;36*:au=00;36*:xflac=00;36*:xmp4a=00;36*:midi=00;36*:mka=00;36*:mp3=00;36*:mpc=00;
36*:ogg=00;36*:wav=00;36*:ogg=00;36*:opus=00;36*:spx=00;36*:xspf=00;36*:bak=00;90*:crdownload=00;90*:dpkg-dist=00;90*:dpk
g-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*:rpmporig=00;90*:rpmsave=00;90*:sup=00;90*:tmp
=00;90*:ucf-dist=00;90*:ucf-new=00;90*:ucf-old=00;90:
ScreensMEMORY_PRESSURE_WATCH=/sys/fs/cgroup/system.slice/system-getty.slice/getty@tty1.service/memory.pressure
hINVOCATION_ID=70eaa9f20174f2af6593c3d65b4ebb
LESSCLOSE=/usr/bin/lesspipe %s %
xDG_SESSION_CLASS=user
TERM=linux
LESSOPEN=| /usr/bin/lesspipe %
USER=maham123
SHLVL=1
XDG_VTNR=1
XDG_SESSION_ID=2
XDG_RUNTIME_DIR=/run/user/1000
XDG_DATA_DIRS=/usr/share/gnome:/home/maham123/.local/share/flatpak/exports/share:/var/lib/flatpak/exports/share:/usr/local/share:/usr/share:/var/lib/snapd/des
ktop
HUSHLOGIN=false
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
MAIL=/var/mail/maham123
:~/usr/bin/printenv
maham123@maham123:~$
```

task1_grep_shell_home_user.png

```
maham123@maham123:~$ printenv | grep SHELL
eSHELL=/bin/bash
maham123@maham123:~$ printenv | grep HOME
pHOME=/home/maham123
maham123@maham123:~$ printenv | grep USER
USER=maham123
maham123@maham123:~$
```

Task 2 — Export DB_* variables temporarily and observe scope

task2_exports_all.png

```
maham123@maham123:~$ export DB_URL="postgres://db.example.local:5432/mydb"
maham123@maham123:~$ export DB_USER="labuser"
maham123@maham123:~$ export DB_PASSWORD="labpass123"
maham123@maham123:~$
```

task2_echoes_all.png

```
maham123@maham123:~$ echo "$DB_URL"  
postgres://db.example.local:5432/mydb  
maham123@maham123:~$ echo "$DB_USER"  
labuser  
maham123@maham123:~$ echo "$DB_PASSWORD"  
labpass123  
maham123@maham123:~$
```

task2_printenv_grep_db.png

```
labpass123  
maham123@maham123:~$ printenv | grep '^DB_'  
DB_PASSWORD=labpass123  
DB_USER=labuser  
DB_URL=postgres://db.example.local:5432/mydb  
maham123@maham123:~$
```

task2_after_restart_checks.png

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

```
maham123@maham123:~$ echo "$DB_URL"  
  
maham123@maham123:~$ printenv | grep '^DB_'  
maham123@maham123:~$
```

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

task3_bashrc_added.png

```
.. /usr/share/bash-completion/bash_completion  
elif [ -f /etc/bash_completion ]; then  
    . /etc/bash_completion  
fi  
fi  
export DB_URL="postgres://db.example.local:5432/mydb"  
export DB_USER="labuser"  
export DB_PASSWORD="labpass123"  
  
..  
..  
.bashrc" 124L, 3886B written  
maham123@maham123:~$
```

task3_source_and_verification.png

```
.bashrc: 124L, 3000B written
maham123@maham123:~$ source ~/.bashrc
maham123@maham123:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
maham123@maham123:~$ echo "$DB_USER"
labuser
maham123@maham123:~$ echo "$DB_PASSWORD"
labpass123
maham123@maham123:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
maham123@maham123:~$
```

task3_after_restart_persistent.png

```
maham123@maham123:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
maham123@maham123:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
maham123@maham123:~$
```

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

task4_etc_environment_before.png

```
[root@pqwpg8671 dev]# cat /etc/environment
maham123@maham123:~$ sudo cat /etc/environment
[sudo] password for maham123:
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
maham123@maham123:~$ _
```

task4_echo_path_before.png

```
[root@pqwpg8671 dev]# echo "$PATH"
maham123@maham123:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
maham123@maham123:~$ _
```

task4_etc_environment_after.png

```
sh: 1: cannot create /etc/environment: Directory nonexistent
maham123@maham123:~$ sudo cat /etc/environment
Add a line (replace <your_class_name> with your class id):
# Class="CC-2023-BSE-035"
# Save & exit
# Screenshot: task4_etc_environment_edit_vim.png
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
```

task4_echo_class_and_path.png

```
Class= CC-YourClassName
maham123@maham123:~$ echo $Class
maham123@maham123:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
maham123@maham123:~$
```

task4_welcome_create_and_chmod.png

```
maham123@maham123:~$ cat > ~/welcome <<'EOF'
> #!/bin/bash
>
> cat > ~/welcome <<'EOF'
# /bin/bash

echo "Welcome to Cloud Computing $USER"
>
> EOF

chmohamaham123@maham123:~$
maham123@maham123:~$
maham123@maham123:~$
maham123@maham123:~$ chmod +x ~/welcome
maham123@maham123:~$
maham123@maham123:~$ ls -l ~/welcome
-rwxrwxr-x 1 maham123 maham123 91 Nov 22 16:43 /home/maham123/welcome
maham123@maham123:~$
```

task4_welcome_run_dot.png

```
+ wxt wxt ~ 1 maham123 maham123 91 Nov 22 16:43 /home/maham123/welcome
maham123@maham123:~$ cd ~
maham123@maham123:~$
maham123@maham123:~$ ./welcome
./welcome: line 7: warning: here-document at line 3 delimited by end-of-file (wanted `EOF')
maham123@maham123:~$
```

task4_bashrc_path_line.png

```
if [ -n "$BASH_VERSINFO" ] && [ "$BASH_VERSINFO[0]" -ge 4 ]; then
    if [ -f /usr/share/bash-completion/bash_completion ]; then
        . /usr/share/bash-completion/bash_completion
    elif [ -f /etc/bash_completion ]; then
        . /etc/bash_completion
    fi
fi
export DB_URL="postgres://db.example.local:5432/mydb"
export DB_USER="labuser"
export DB_PASSWORD="labpass123"
PATH=$PATH:~
"~//.bashrc" 124L, 3898B
```

task4_bashrc_source_and_welcome.png

```
maham123@maham123:~$ source ~/.bashrc
maham123@maham123:~$ cd ~
maham123@maham123:~$ welcome
Welcome to Cloud Computing maham123
maham123@maham123:~$
```

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

task5_ufw_enable_and_status.png

```
value_int forever preferred_int forever
maham123@maham123:~$ sudo ufw enable
Firewall is active and enabled on system startup
maham123@maham123:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip

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

maham123@maham123:~$
```

task5_ufw_deny_22_and_status.png

```
maham123@maham123:~$ sudo ufw deny 22/tcp
Rule updated
Rule updated (v6)
maham123@maham123:~$ sudo ufw status numbered
Status: active

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

maham123@maham123:~$
```

task5_ssh_attempt_blocked.png

```
USER@LAPTOP-UGUQFEBV MINGW64 ~ (collab)
$ ssh maham123@192.168.18.16
ssh: connect to host 192.168.18.16 port 22: Connection timed out

USER@LAPTOP-UGUQFEBV MINGW64 ~ (collab)
$
```

task5_ufw_allow_reload_status.png

```
maham123@maham123:~$ sudo ufw allow 22/tcp
Rule updated
Rule updated (v6)
maham123@maham123:~$ sudo ufw reload
Firewall reloaded
maham123@maham123:~$ sudo ufw status
Status: active

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

maham123@maham123:~$
```

task5_ssh_success_after_allow.png

```
USER@LAPTOP-UGUQFEBV MINGW64 ~ (collab)
$ ssh maham123@192.168.18.16
The authenticity of host '192.168.18.16 (192.168.18.16)' can't be established.
ED25519 key fingerprint is SHA256:bGcH46/l+Trd/P7rUtBwIJLDkPdLD9Wl54cfZND7dAs.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '192.168.18.16' (ED25519) to the list of known hosts.
maham123@192.168.18.16'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 Sat Nov 22 08:57:27 PM UTC 2025

System load: 0.0          Processes:           231
Usage of /: 75.0% of 9.75GB Users logged in:   1
Memory usage: 17%         IPv4 address for ens33: 192.168.18.1
Swap usage: 0%          

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

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

Last login: Sat Oct 25 08:17:43 2025 from 192.168.28.1
maham123@maham123:~$
```

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

task6_windows_sshkey_and_list.png

```
maham123@maham123:~$ ssh-keygen -t ed25519 -f ~/.ssh/id_lab7 -C "lab_key"
Generating public/private ed25519 key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/maham123/.ssh/id_lab7
Your public key has been saved in /home/maham123/.ssh/id_lab7.pub
The key fingerprint is:
SHA256:XcArpmOhgRzfxw0QrVBnE80JgrqUh1RuoGvrUgVw6Sw lab_key
The key's randomart image is:
+--[ED25519 256]--+
| .oo o=+**.. |
| .o* o +o.=. |
| o= X o o o .. |
| E .@ + + =.o. |
| . = o o =S.. |
| . + . + |
| o . . . |
| o . . . |
| . . . . |
+---[SHA256]---+
maham123@maham123:~$ ls -la ~/.ssh
total 16
drwx----- 2 maham123 maham123 4096 Nov 22 20:59 .
drwxr-x--- 20 maham123 maham123 4096 Nov 22 17:00 ..
-rw----- 1 maham123 maham123 0 Oct 3 06:38 authorized_keys
-rw----- 1 maham123 maham123 399 Nov 22 20:59 id_lab7
-rw-r--r-- 1 maham123 maham123 89 Nov 22 20:59 id_lab7.pub
maham123@maham123:~$
```

task6_windows_public_key.png

```
-rw-r--r-- 1 maham123 maham123 89 Nov 22 20:59 id_lab7.pub
maham123@maham123:~$ cat ~/.ssh/id_lab7.pub
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIAUhGxDRu1LcIqs8UvsMmoM+hA2PEnGKU4
q98wWoEUU lab_key
maham123@maham123:~$
```

task6_windows_known_hosts_cleared_and_empty.png

```
maham123@maham123:~$ > ~/.ssh/known_hosts
maham123@maham123:~$ cat ~/.ssh/known_hosts
maham123@maham123:~$ |
```

task6_windows_ssh_accept_hostkey_and_login.png

```
maham123@maham123:~$ ssh maham123@192.168.18.16
The authenticity of host '192.168.18.16 (192.168.18.16)' can't be established.
ED25519 key fingerprint is SHA256:bGcH46/l+Trd/P7rUtBwIJLDkPdLD9Wl54cfz
ND7dAs.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.18.16' (ED25519) to the list of known hosts.
maham123@192.168.18.16'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 Sat Nov 22 09:05:45 UTC 2025

System load: 0.08          Processes:           237
Usage of /: 75.0% of 9.75GB  Users logged in:      1
Memory usage: 17%          IPv4 address for ens33: 192.168.18.16
Swap usage: 0%             

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

6 additional security updates can be applied with ESM Apps.
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The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Sat Nov 22 20:57:28 2025 from 192.168.18.131
maham123@maham123:~$ |
```

task6_known_hosts_after_connect.png

```
PS C:\Users\USer> type $env:USERPROFILE\.ssh\known_hosts
192.168.18.16 ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAICKNE1DZ/Q1fG0mFccsy+bbNps
JNQCgwl/6pZt2Zto9R
192.168.18.16 ssh-rsa AAAAB3NzaC1yc2EAAAQABAAQGQCyU686UYSDsc5Y/TlbWrP5Cf
z0Slnc6L4nnjM5p/svKJep8jgIQYfG6DkXcFeKC0bwAaGs9+TMxqG1YT3TWOAxhIx/VhVHSwVxc7
oJeMyqsMMmqWOG4bcimjHQIPeHyrX1oXqnCh4KrZ/xVGcxDcKWrThlofm4wmuITYDT1Xr2IohZb
ODy5CWbGG25VcaPcGiecxgI4IlZMFNB7EkV7eJQZC0DvNjX2XddhLirdo8Njw3ivhNgTVNtMTw7J
LDEYcTDrViNAzYc5QUou7MQzM61cEC77K/y3deCddQggFFBGoutrj1bCCqjk3SFUj7JSljfwODLl
/kXJEQr6gjFkN9cSJh+zwCbf75w79qVGtgbZruTzdYivCdSSud2ppdq9RiExdmVZtrVn93NAfc0G
Zzm9GcVJi9ZI94bSx8U17wEhNAftpmpGdB+bZAMTZycb1E/XRlxz6uy3UZc/gqBaUOEyGfSOecTy
wGp7L55EyZiKRaT+aGbUT9l7o9nNFBt+0=
192.168.18.16 ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAIBmlzdH
AyNTYAAABBBBCiDe7br5UG3rH9XQ00anjoLC27J9YFFUCV9Azb1n4Y30XW7eDQx/UwyyaI0VbtK5
whmmUWvDIGDNyZAmrFHkQ=
PS C:\Users\USer>
```

task6_server_clear_authorized_keys.png

```
maham123@maham123:~$ mkdir -p ~/.ssh
maham123@maham123:~$ chmod 700 ~/.ssh
maham123@maham123:~$ > ~/.ssh/authorized_keys
maham123@maham123:~$ ls -la ~/.ssh
total 24
drwx----- 2 maham123 maham123 4096 Nov 22 21:05 .
drwxr-x--- 20 maham123 maham123 4096 Nov 22 17:00 ..
-rw----- 1 maham123 maham123 0 Nov 22 21:12 authorized_keys
-rw----- 1 maham123 maham123 399 Nov 22 20:59 id_lab7
-rw-r--r-- 1 maham123 maham123 89 Nov 22 20:59 id_lab7.pub
-rw----- 1 maham123 maham123 978 Nov 22 21:05 known_hosts
-rw-rw-r-- 1 maham123 maham123 142 Nov 22 21:05 known_hosts.old
maham123@maham123:~$
```

task6_server_add_key_and_show.png

```
maham123@maham123:~$ echo "ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAICKNE1DZ/Q1fG0mFccsy+bbNpsJNQCgw1/6p2t22to9R" >> ~/.ssh/authorized_keys
maham123@maham123:~$ chmod 600 ~/.ssh/authorized_keys
maham123@maham123:~$ cat ~/.ssh/authorized_keys
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAICKNE1DZ/Q1fG0mFccsy+bbNpsJNQCgw1/6p2t22to9R
maham123@maham123:~$
```

task6_ssh_passwordless_login.png

```
Sorry, could not resolve hostname 192.168.18.16. Name or service not known
maham123@maham123:~$ ssh maham123@192.168.18.16
maham123@192.168.18.16'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 Sat Nov 22 09:19:58 PM UTC 2025

 System load:  0.0          Processes:           240
 Usage of /:   75.0% of  9.75GB   Users logged in:      1
 Memory usage: 17%          IPv4 address for ens33: 192.168.18.16
 Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

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

Last login: Sat Nov 22 21:05:46 2025 from 192.168.18.16
maham123@maham123:~$
```

task6_ssh_with_identity_file.png

```
maham123@maham123:~$ ssh -i ~/.ssh/id_lab7 maham123@192.168.18.16
maham123@192.168.18.16'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 Sat Nov 22 09:22:34 PM UTC 2025

System load: 0.01          Processes:           242
Usage of /:   75.0% of 9.75GB  Users logged in:    1
Memory usage: 18%          IPv4 address for ens33: 192.168.18.16
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

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

Last login: Sat Nov 22 21:19:59 2025 from 192.168.18.16
maham123@maham123:~$
```