FATIMA JINNAH WOMEN UNIVERSITY

Department of Software Engineering

LAB #07

SUBJECT: CLOUD COMPUTING

SUBMITTED TO: SIR MUHAMMAD SHOAIB

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REGISTRATION NO: 2023-BSE-066

CLASS: BSSE V-B

Environment Variables, PATH, UFW, and SSH Key Authentication

Task#01: Print & filter environment variables

Print all environment variables

Filter specific variables

Task#02: Export DB_* variables temporarily and observe scope

Define (export) variables

Echo the variables

```
umberqasim@2023-bse-066:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
umberqasim@2023-bse-066:~$ echo "$DB_USER"
labuser
umberqasim@2023-bse-066:~$ echo "$DB_PASSWORD"
labpass123
```

Filter only DB_ variables using grep

```
umberqasim@2023-bse-066:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
```

Close and reopen terminal

```
Ubuntu 24.04.3 LTS 2023-bse-066 tty1

2023-bse-066 login: umberqasim
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 Fri Nov  7 05:01:53 AM UTC 2025

  System load:  0.17              Processes:               228
  Usage of /:   21.5% of 47.93GB  Users logged in:         0
  Memory usage: 15%               IPv4 address for ens33: 192.168.254.129
  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.

0 updates can be applied immediately.

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


umberqasim@2023-bse-066:~$ echo "$DB_URL"

umberqasim@2023-bse-066:~$ printenv | grep '^DB_'
```
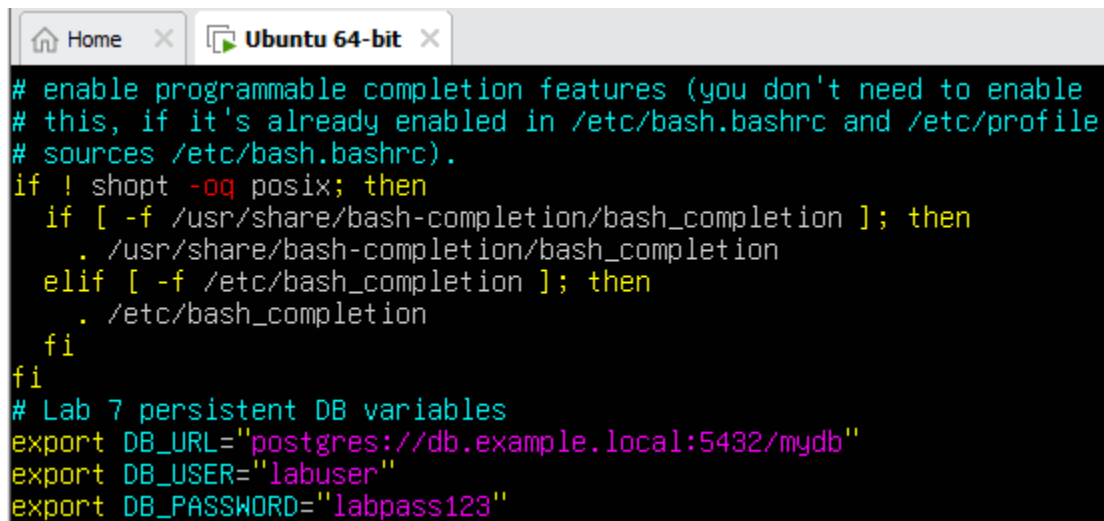
Task#03: Make DB_* variables persistent in ~/.bashrc

Open ~/.bashrc and variables

```
# enable programmable completion features (you don't need to enable
# this, if it's already enabled in /etc/bash.bashrc and /etc/profile
# sources /etc/bash.bashrc).
if ! shopt -oq posix; 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
# Lab 7 persistent DB variables
export DB_URL="postgres://db.example.local:5432/mydb"
export DB_USER="labuser"
export DB_PASSWORD="labpass123"
```

Reload (source) and verify

```
".bashrc" 121L, 3914B written
umberqasim@2023-bse-066:~$ source ~/.bashrc
umberqasim@2023-bse-066:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
umberqasim@2023-bse-066:~$ echo "$DB_USER"
labuser
umberqasim@2023-bse-066:~$ echo "$DB_PASSWORD"
labpass123
umberqasim@2023-bse-066:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
```

Close terminal and reopen

```
umberqasim@2023-bse-066:~$ echo "$DB_URL"
postgres://db.example.local:5432/mydb
umberqasim@2023-bse-066:~$ printenv | grep '^DB_'
DB_PASSWORD=labpass123
DB_USER=labuser
DB_URL=postgres://db.example.local:5432/mydb
```

Task#04: System-wide environment variable, welcome script, and PATH

View /etc/environment (before editing)

```
umberqasim@2023-bse-066:~$ sudo cat /etc/environment
[sudo] password for umberqasim:
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
```

Show current PATH

```
umberqasim@2023-bse-066:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
```
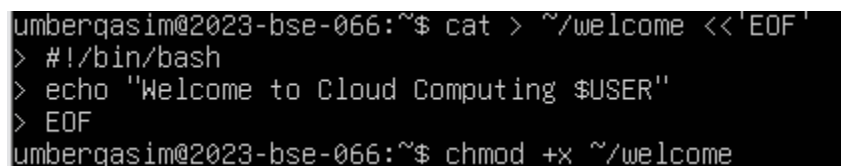
Edit /etc/environment and add Class variable

```
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
Class="CC-BSE-VB"_
```

```
umberqasim@2023-bse-066:~$ sudo cat /etc/environment
PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin"
Class="CC-BSE-VB"
```
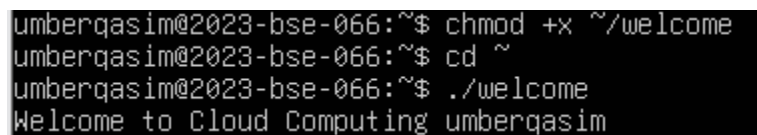
```
umberqasim@2023-bse-066:~$ echo "$Class"
CC-BSE-VB
umberqasim@2023-bse-066:~$ echo "$PATH"
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
```

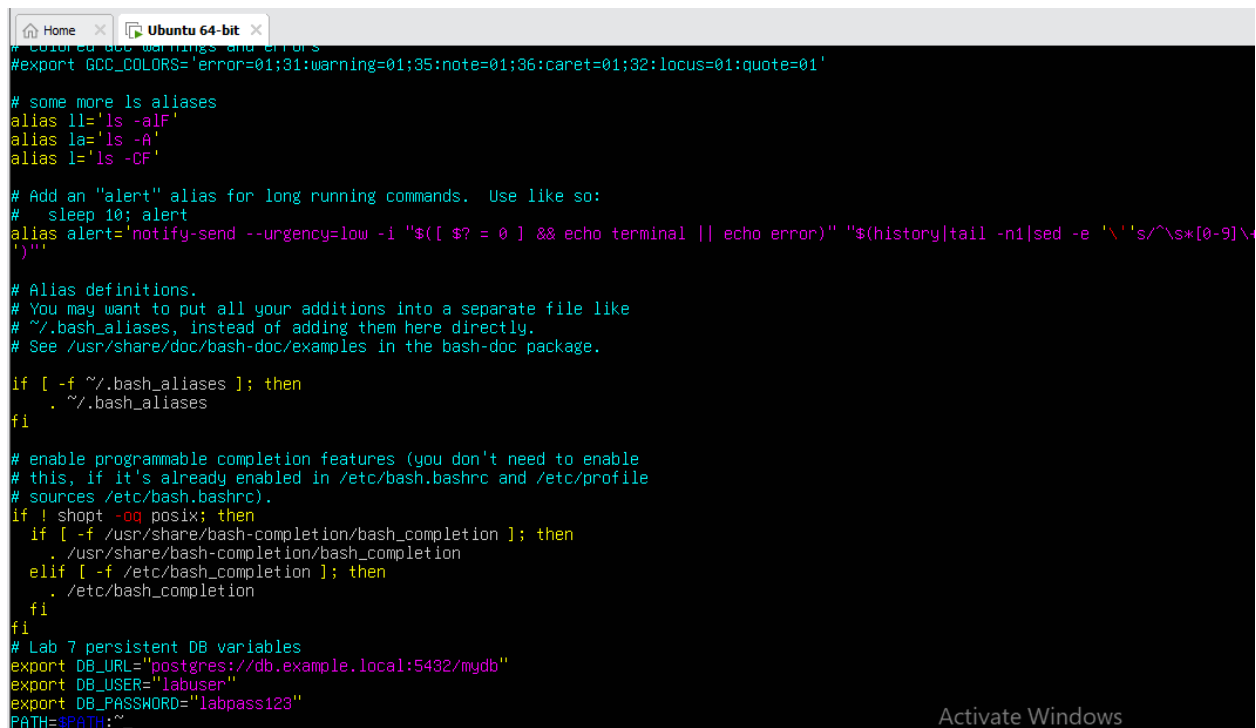## Create ~/welcome script and make it executable

```
umberqasim@2023-bse-066:~$ cat > ~/welcome <<'EOF'
> #!/bin/bash
> echo "Welcome to Cloud Computing $USER"
> EOF
umberqasim@2023-bse-066:~$ chmod +x ~/welcome
```

Run script with ./welcome

```
umberqasim@2023-bse-066:~$ chmod +x ~/welcome
umberqasim@2023-bse-066:~$ cd ~
umberqasim@2023-bse-066:~$ ./welcome
Welcome to Cloud Computing umberqasim
```

Add PATH modification line to ~/.bashrc

```
# colored GCC warnings and errors
#export GCC_COLORS='error=01;31:warning=01;35:note=01;36:caret=01;32:locus=01:quote=01'

# some more ls aliases
alias ll='ls -alF'
alias la='ls -A'
alias l='ls -CF'

# Add an "alert" alias for long running commands.  Use like so:
#   sleep 10; alert
alias alert='notify-send --urgency=low -i "$([ $? = 0 ] && echo terminal || echo error)" "$(history|tail -n1|sed -e '\''s/^\s*[0-9]\+
'\'')"'

# Alias definitions.
# You may want to put all your additions into a separate file like
# ~/.bash_aliases, instead of adding them here directly.
# See /usr/share/doc/bash-doc/examples in the bash-doc package.

if [ -f ~/.bash_aliases ]; then
    . ~/.bash_aliases
fi

# enable programmable completion features (you don't need to enable
# this, if it's already enabled in /etc/bash.bashrc and /etc/profile
# sources /etc/bash.bashrc).
if ! shopt -oq posix; 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
# Lab 7 persistent DB variables
export DB_URL="postgres://db.example.local:5432/mydb"
export DB_USER="labuser"
export DB_PASSWORD="labpass123"
PATH=$PATH:~_
```

Reload and verify you can run welcome directly

```
umberqasim@2023-bse-066:~$ source ~/.bashrc
umberqasim@2023-bse-066:~$ cd ~
umberqasim@2023-bse-066:~$ welcome
Welcome to Cloud Computing umberqasim
```

Task#05: Block and allow SSH using ufw (firewall)

Enable UFW and show status

```
umberqasim@2023-bse-066:~$ sudo ufw enable
[sudo] password for umberqasim:
Firewall is active and enabled on system startup
umberqasim@2023-bse-066:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip
```

Deny SSH (port 22) and check status

```
umberqasim@2023-bse-066:~$ sudo ufw deny 22/tcp
Rule added
Rule added (v6)
umberqasim@2023-bse-066:~$ sudo ufw status numbered
Status: active

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

Attempt SSH from Windows host (should fail)

```
C:\Users\HP>ssh umberqasim@192.168.254.129
ssh: connect to host 192.168.254.129 port 22: Connection timed out
```

Allow SSH back and reload firewall

```
umberqasim@2023-bse-066:~$ sudo ufw allow 22/tcp
Rule updated
Rule updated (v6)
umberqasim@2023-bse-066:~$ sudo ufw reload
Firewall reloaded
umberqasim@2023-bse-066:~$ sudo ufw status
Status: active

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

Attempt SSH again from Windows host (should succeed)

```
C:\Users\HP>ssh umberqasim@192.168.254.129
umberqasim@192.168.254.129'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 10:56:06 AM UTC 2025

  System load:  0.0               Processes:             231
  Usage of /:   21.5% of 47.93GB  Users logged in:       1
  Memory usage: 17%               IPv4 address for ens33: 192.168.254.129
  Swap usage:   0%


Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

12 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: Fri Oct 31 12:56:26 2025 from 192.168.254.1
umberqasim@2023-bse-066:~$
```

Task#06: Configure SSH key-based login from Windows host

Generate SSH key pair (ed25519)

```
HP@DESKTOP-BGNOK42 MINGW64 ~
$ ssh-keygen -t ed25519 -f ~/.ssh/id_lab7 -C "lab_key"
Generating public/private ed25519 key pair.
Enter passphrase for "/c/Users/HP/.ssh/id_lab7" (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /c/Users/HP/.ssh/id_lab7
Your public key has been saved in /c/Users/HP/.ssh/id_lab7.pub
The key fingerprint is:
SHA256:MyuxSAMrnCOAK1ZimMI8mo/nVjj7v/e6p3gTEEryaRo lab_key
The key's randomart image is:
+--[ED25519 256]--+
|=+ .             |
|*=+ . .          |
|*oo+ o .         |
|B Eo= .          |
|.*.*o ..S         |
|..B..o o.+        |
| o +. o ..       |
|  +    o+ .      |
| . ...+++B.      |
+----[SHA256]-----+

HP@DESKTOP-BGNOK42 MINGW64 ~
$ ls -la ~/.ssh
total 36
drwxr-xr-x 1 HP 197121    0 Nov 18 16:02 ./
drwxr-xr-x 1 HP 197121    0 Nov 18 15:13 ../
-rw-r--r-- 1 HP 197121  419 Oct  2 19:17 id_ed25519
-rw-r--r-- 1 HP 197121  109 Oct  2 19:17 id_ed25519.pub
-rw-r--r-- 1 HP 197121  399 Nov 18 16:02 id_lab7
-rw-r--r-- 1 HP 197121   89 Nov 18 16:02 id_lab7.pub
-rw-r--r-- 1 HP 197121 1677 Oct 17 10:05 known_hosts
-rw-r--r-- 1 HP 197121  926 Oct 17 09:53 known_hosts.old
```

Show the public key content

```
HP@DESKTOP-BGNOK42 MINGW64 ~
$ cat ~/.ssh/id_lab7.pub
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIPDTe1PUltfKZCQ9bKV7aV/CWo85qHLh+uLN6NrV45x5 lab_key
```

Clear known_hosts file

```
HP@DESKTOP-BGNOK42 MINGW64 ~
$ > ~/.ssh/known_hosts

HP@DESKTOP-BGNOK42 MINGW64 ~
$ cat ~/.ssh/known_hosts
```

First SSH connection to server

```
C:\Users\HP>ssh umberqasim@192.168.254.129
The authenticity of host '192.168.254.129 (192.168.254.129)' can't be established.
ED25519 key fingerprint is SHA256:xg+BSY3OGzKSPNQ7YrAyVnMJRNLHZ1IBHEi6NCeTyAk.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.254.129' (ED25519) to the list of known hosts.
umberqasim@192.168.254.129'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 11:10:34 AM UTC 2025

  System load:  0.4                Processes:             231
  Usage of /:   21.5% of 47.93GB   Users logged in:       1
  Memory usage: 17%                IPv4 address for ens33: 192.168.254.129
  Swap usage:   0%


Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

12 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: Tue Nov 18 10:56:07 2025 from 192.168.254.1
umberqasim@2023-bse-066:~$
```

Verify known_hosts updated

```
HP@DESKTOP-BGNOK42 MINGW64 ~
$ cat ~/.ssh/known_hosts
192.168.254.129 ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIBP2ocEmAvrxUm99gOXROWjrUF+VjrQqcWIVvZiqApdl
192.168.254.129 ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABgQCcfPU07xN3K7NNRCn9/vC/DrglFa4yhSyOR8XdvPDj1e/OU2FrCJHlch26JM3COoySn68o4+Cs6cgMoo+LZWeYemlNTcPIlWBMuJKUMoYyUc5E+QMaQtraE8CA7kTo7klYUjCvSDEw
MfAS8eVdgjlXyEKlOpK8AScQlWnFOhwaN16jQra135gRLOwCbS2et2ZyHZXowEPK6b/I+3Ufl/EBlMQom2q5gzlL/+8btf5FuhK5GGyn6L/Jh4Aev79+DFW335y1LbkyIfVXBz12cOUPrNNzXHtToulZ8CnVa82rnM8JM1geL/IiAvXZLCRlcAVV3AZBWik3
K//xDnjWHVJmv2DEvzg/us/CQnMK7MlTNpPbbi8YninFhFR3bVTHpzm+mhjBh6bG9VjWDfhv7WFHqIrxCQylhiROOsjv2o9JH6PsXlj1Ww6Nhgu5RB3UPc9dn2K9qKqEvI/C53kSUnpMvVdmpnjwAqo/jvxXuPIJKOizqrGZ5sJk8XKY+PiEsZs=
192.168.254.129 ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAABBNoUrTDtRxCvrE8R/p5qQjOFwpilnYRIkowFRi9CXZMvEyJ/5UxdpjeqUsuheb2+xG4Fp4ROnweaqYRrvb/+H6E=
```

Prepare ~/.ssh directory & clear authorized_keys

```
umberqasim@2023-bse-066:~$ > ~/.ssh/authorized_keys
umberqasim@2023-bse-066:~$ mkdir -p ~/.ssh
umberqasim@2023-bse-066:~$ chmod 700 ~/.ssh
umberqasim@2023-bse-066:~$ > ~/.ssh/authorized_keys
```

Add public key & set permissions

```
umberqasim@2023-bse-066:~$ echo "ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIPDTe1PUltfKZCQ9bKV7aV/CWo85qHLh+uLN6NrV45x5 lab_key" >> ~/.ssh/authorized
umberqasim@2023-bse-066:~$ chmod 600 ~/.ssh/authorized_keys
umberqasim@2023-bse-066:~$ cat ~/.ssh/authorized_keys
ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIPDTe1PUltfKZCQ9bKV7aV/CWo85qHLh+uLN6NrV45x5 lab_key
```

Test SSH Key-Based Login from Windows host (passwordless)

```
C:\Users\HP>ssh -i ~/.ssh/id_lab7 umberqasim@192.168.254.129
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 12:12:30 PM UTC 2025

  System load:  0.0                Processes:              230
  Usage of /:   21.5% of 47.93GB   Users logged in:        1
  Memory usage: 17%                IPv4 address for ens33: 192.168.254.129
  Swap usage:   0%


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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: Tue Nov 18 12:10:41 2025 from 192.168.254.1
umberqasim@2023-bse-066:~$
```

Exam Evaluation Questions

I.   Quick Environment Audit

Display environment variables

```
XDG_SESSION_TYPE=tty
SYSTEMD_EXEC_PID=2212
DB_USER=labuser
HOME=/home/umberqasim
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
x=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:*.
1;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:
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:*.cp
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:*.gi
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=
:*.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=
*.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:*
01;35:*.cgm=01;35:*.emf=01;35:*.ogv=01;35:*.ogx=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp
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
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:*.rpmorig=00;90:*.rpmsave=00;90:
=00;90:*.ucf-dist=00;90:*.ucf-new=00;90:*.ucf-old=00;90:
MEMORY_PRESSURE_WATCH=/sys/fs/cgroup/system.slice/system-getty.slice/getty@tty1.service/memory.pressure
INVOCATION_ID=ff6b934393a74cffa6e99ec7d26be5e3
LESSCLOSE=/usr/bin/lesspipe %s %s
XDG_SESSION_CLASS=user
TERM=linux
LESSOPEN=| /usr/bin/lesspipe %s
USER=umberqasim
SHLVL=1
XDG_VTNR=1
DB_URL=postgres://db.example.local:5432/mydb
XDG_SESSION_ID=16
XDG_RUNTIME_DIR=/run/user/1000
XDG_DATA_DIRS=/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
HUSHLOGIN=FALSE
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/home/umberqasim
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
MAIL=/var/mail/umberqasim
Class=CC-BSE-VB
OLDPWD=/home/umberqasim
_=/usr/bin/printenv
```

Showing values for PATH, LANG, and PWD

```
umberqasim@2023-bse-066:~$ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/home/umberqasim
umberqasim@2023-bse-066:~$ echo $LANG
en_US.UTF-8
umberqasim@2023-bse-066:~$ echo $PWD
/home/umberqasim
```

II.   Short-lived Student Info

Set three variables (STUDENT_NAME, STUDENT_ROLL_NUMBER, STUDENT_SEMESTER) using export

```
umberqasim@2023-bse-066:~$ export STUDENT_NAME="Umber Qasim"
umberqasim@2023-bse-066:~$ export STUDENT_ROLL_NUMBER="2023-BSE-066"
umberqasim@2023-bse-066:~$ export STUDENT_SEMESTER="BSE - VB"
```

Print the three values with echo (grouped)

```
umberqasim@2023-bse-066:~$ echo "Name: $STUDENT_NAME"
Name: Umber Qasim
umberqasim@2023-bse-066:~$ echo "Roll No: $STUDENT_ROLL_NUMBER"
Roll No: 2023-BSE-066
umberqasim@2023-bse-066:~$ echo "Semester: $STUDENT_SEMESTER"
Semester: BSE - VB
```

Single printenv|grep command to list any STUDENT_ variable

```
umberqasim@2023-bse-066:~$ printenv | grep STUDENT_
STUDENT_NAME=Umber Qasim
STUDENT_SEMESTER=BSE - VB
STUDENT_ROLL_NUMBER=2023-BSE-066
```

Open a fresh terminal, and show that the STUDENT_ variables are not set (use echo and printenv|grep together)

```
umberqasim@2023-bse-066:~$ echo "Name: $STUDENT_NAME"
Name:
umberqasim@2023-bse-066:~$ printenv | grep STUDENT_
umberqasim@2023-bse-066:~$
```

III. Make It Sticky (Persistence Check for Student Info)

Edit the ~/.bashrc file

```
export STUDENT_NAME="Umber Qasim"
export STUDENT_ROLL_NUMBER="2023-BSE-066"
export STUDENT_SEMESTER="BSE - VB"
```

Reload Config and Verify

```
umberqasim@2023-bse-066:~$ source ~/.bashrc
umberqasim@2023-bse-066:~$ printenv | grep STUDENT_
STUDENT_NAME=Umber Qasim
STUDENT_SEMESTER=BSE - VB
STUDENT_ROLL_NUMBER=2023-BSE-066
```

Persistence Demonstration

```
umberqasim@2023-bse-066:~$ printenv | grep STUDENT_
STUDENT_NAME=Umber Qasim
STUDENT_SEMESTER=BSE - VB
STUDENT_ROLL_NUMBER=2023-BSE-066
umberqasim@2023-bse-066:~$ echo "Name: $STUDENT_NAME"
Name: Umber Qasim
```

IV. Firewall Rules: Block and Restore Ping (ICMP)

UFW Enable and Status Check

```
umberqasim@2023-bse-066:~$ sudo ufw enable
[sudo] password for umberqasim:
Firewall is active and enabled on system startup
umberqasim@2023-bse-066:~$ sudo ufw status
Status: active

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

Ping (ICMP) Block:

```
umberqasim@2023-bse-066:~$ echo 1 | sudo tee /proc/sys/net/ipv4/icmp_echo_ignore_all
[sudo] password for umberqasim:
1
```

Ping the server while the rule is active and capture the blocked/failing:

```
Select Command Prompt - ping  192.168.254.129

Microsoft Windows [Version 10.0.19045.6466]
(c) Microsoft Corporation. All rights reserved.

C:\Users\HP>ping 192.168.254.129

Pinging 192.168.254.129 with 32 bytes of data:
Request timed out.
```

Re-allow ping (ICMP):

```
umberqasim@2023-bse-066:~$ echo 0 | sudo tee /proc/sys/net/ipv4/icmp_echo_ignore_all
0
```

Capture the allow/reload:

```
Command Prompt

Microsoft Windows [Version 10.0.19045.6466]
(c) Microsoft Corporation. All rights reserved.

C:\Users\HP>ping 192.168.254.129

Pinging 192.168.254.129 with 32 bytes of data:
Reply from 192.168.254.129: bytes=32 time=1ms TTL=64
Reply from 192.168.254.129: bytes=32 time<1ms TTL=64
Reply from 192.168.254.129: bytes=32 time<1ms TTL=64
Reply from 192.168.254.129: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.254.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```