CLOUD COMPUTING
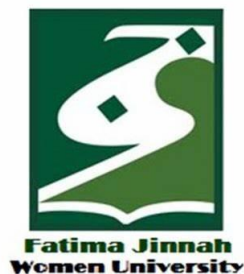
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BSE V-A

Lab 6

Lab Title

Linux Users, Groups, Permissions, Pipes, and Bash Scripting

Task 1
Switch to root with su – and back to a normal user
Set a root password

```
hamna_25@ubuntu:~$ sudo passwd root
[sudo] password for hamna_25:
New password:
Retype new password:
passwd: password updated successfully
hamna_25@ubuntu:~$
```

Entered a temporary root password for this lab.
Switch to the root user and verify:

```
hamna_25@ubuntu:~$ su -
Password:
root@ubuntu:~# whoami
root
root@ubuntu:~# id
uid=0(root) gid=0(root) groups=0(root)
root@ubuntu:~#
```

Switch back to the normal user and verify:

```
root@ubuntu:~# exit
logout
hamna_25@ubuntu:~$ whoami
hamna_25
hamna_25@ubuntu:~$
```

Task 2
Create user *tom* and verify in passwd/group/shadow
Create a new user tom (interactive command that sets a password and creates a home directory):
Password:tom123

```
hamna_25@ubuntu:~$ sudo adduser tom
info: Adding user `tom' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `tom' (1002) ...
info: Adding new user `tom' (1002) with group `tom (1002)' ...
info: Creating home directory `/home/tom' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for tom
Enter the new value, or press ENTER for the default
        Full Name []: Tom Lab6
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] Y
info: Adding new user `tom' to supplemental / extra groups `users' ...
info: Adding user `tom' to group `users' ...
hamna_25@ubuntu:~$
```

Verify user tom in the /etc/passwd file

```
hamna_25@ubuntu:~$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
```

.

Verify user tom in the /etc/group file:

```
hamna_25@ubuntu:~$ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog,hamna_25
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
dialout:x:20:
fax:x:21:
voice:x:22:
cdrom:x:24:hamna_25
floppy:x:25:
tape:x:26:
sudo:x:27:hamna_25
audio:x:29:pulse
dip:x:30:hamna_25
www-data:x:33:
colord:x:120:
lpadmin:x:121:
pulse:x:122:
pulse-access:x:123:
xrdp:x:124:
docker:x:988:hamna_25
tom:x:1002:
hamna_25@ubuntu:~$
```

Verify user tom in the /etc/shadow file:

```
hamna_25@ubuntu:~$ sudo cat /etc/shadow
root:$y$j9T$ombppfBzAwgoFPSncKlq7.$ZuF/Xf9jnqUFgKfEZLmXcbVFtiB5HFfQEM5y7HExWC0:20399:0:99999:7:::
daemon:*:20305:0:99999:7:::
bin:*:20305:0:99999:7:::
sys:*:20305:0:99999:7:::
sync:*:20305:0:99999:7:::
games:*:20305:0:99999:7:::
man:*:20305:0:99999:7:::
lp:*:20305:0:99999:7:::
mail:*:20305:0:99999:7:::
news:*:20305:0:99999:7:::
uucp:*:20305:0:99999:7:::
proxy:*:20305:0:99999:7:::
www-data:*:20305:0:99999:7:::
backup:*:20305:0:99999:7:::
list:*:20305:0:99999:7:::
irc:*:20305:0:99999:7:::
apt:*:20305:0:99999:7:::
saned:!:20394::::::
colord:!:20394::::::
cups-pk-helper:!:20394::::::
pulse:!:20394::::::
cups-browsed:!:20394::::::
xrdp:!:20394::::::
tom:$y$j9T$YiOKYlfTFl7gd0WTMXX8v1$nkThzi1.s3fb4AihKnmqPqrfD7qg.bRNiA5RjXbs49B:20399:0:99999:7:::
hamna_25@ubuntu:~$
```

Task 3
Create groups; change tom's primary and secondary groups
Create the required groups and verify:

```
hamna_25@ubuntu: $ sudo groupadd developer
hamna_25@ubuntu: $ sudo groupadd devops
hamna_25@ubuntu: $ sudo groupadd designer
hamna_25@ubuntu: $ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog,hamna_25
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
dialout:x:20:
fax:x:21:
voice:x:22:
cdrom:x:24:hamna_25
```

Change tom's primary group to designer and verify:

```
hamna_25@ubuntu:~$ sudo usermod -g designer tom
hamna_25@ubuntu:~$ id tom
uid=1002(tom) gid=1005(designer) groups=1005(designer),100(users)
hamna_25@ubuntu:~$
```

Add secondary groups developer and devops to tom and verify:

```
hamna_25@ubuntu:~$ sudo usermod -aG developer,devops tom
hamna_25@ubuntu:~$ id tom
uid=1002(tom) gid=1005(designer) groups=1005(designer),100(users),1003(developer),1004(devops)
hamna_25@ubuntu:~$ groups tom
tom : designer users developer devops
hamna_25@ubuntu:~$
```

Replace secondary groups so only tom (user's own group) remains and verify:

```
hamna_25@ubuntu:~$ sudo usermod G tom tom
Usage: usermod [options] LOGIN

Options:
  -a, --append                  append the user to the supplemental GROUPS
                                mentioned by the -G option without removing
                                the user from other groups
  -b, --badname                 allow bad names
  -c, --comment COMMENT         new value of the GECOS field
  -d, --home HOME_DIR           new home directory for the user account
  -e, --expiredate EXPIRE_DATE  set account expiration date to EXPIRE_DATE
  -f, --inactive INACTIVE       set password inactive after expiration
                                to INACTIVE
  -g, --gid GROUP               force use GROUP as new primary group
  -G, --groups GROUPS           new list of supplementary GROUPS
  -h, --help                    display this help message and exit
  -l, --login NEW_LOGIN         new value of the login name
  -L, --lock                    lock the user account
  -m, --move-home               move contents of the home directory to the
                                new location (use only with -d)
hamna_25@ubuntu:~$ id tom
uid=1002(tom) gid=1005(designer) groups=1005(designer),100(users),1003(developer),1004(devops)
hamna_25@ubuntu:~$ groups tom
tom : designer users developer devops
hamna_25@ubuntu:~$
```

Task 4
Create/Delete Users (Jerry, Scooby) and Groups (jolly, anime)

```
hamna_25@ubuntu:~$ sudo adduser jerry
info: Adding user `jerry' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `jerry' (1007) ...
info: Adding new user `jerry' (1007) with group `jerry (1007)' ...
info: Creating home directory `/home/jerry' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for jerry
Enter the new value, or press ENTER for the default
        Full Name []: Jerry Lab6
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] Y
info: Adding new user `jerry' to supplemental / extra groups `users' ...
info: Adding user `jerry' to group `users' ...
hamna_25@ubuntu:~$ sudo useradd Scooby
hamna_25@ubuntu:~$
```

Attempt to log in as Scooby before setting a password (expected failure):

```
hamna_25@ubuntu:~$ su - Scooby
Password:
su: Authentication failure
```

Set a password for Scooby:

```
hamna_25@ubuntu:~$ sudo passwd Scooby
New password:
Retype new password:
passwd: password updated successfully
hamna_25@ubuntu:~$
```

Log in again as Scooby (observe missing home directory warning):

```
hamna_25@ubuntu:~$ su - Scooby
Password:
su: warning: cannot change directory to /home/Scooby: No such file or directory
$
```

Verify Scooby's home directory and /etc/passwd entry

```
$ exit
hamna_25@ubuntu:~$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
xrdp:x:119:124::/run/xrdp:/usr/sbin/nologin
tom:x:1002:1005:Tom Lab6,,,:/home/tom:/bin/bash
Scooby:x:1003:1006::/home/Scooby:/bin/sh
hamna_25@ubuntu:~$ ls -ld /home/Scooby
ls: cannot access '/home/Scooby': No such file or directory
hamna_25@ubuntu:~$
```

Manually create Scooby's home directory and set ownership/permissions:

```
hamna_25@ubuntu:~$ sudo mkdir -p /home/Scooby
hamna_25@ubuntu:~$ sudo chown Scooby:Scooby /home/Scooby
hamna_25@ubuntu:~$ sudo chmod 750 /home/Scooby
hamna_25@ubuntu:~$ ls -ld /home/Scooby
```

Log in as Scooby again to confirm correct home directory access:

```
hamna_25@ubuntu:~$ su - Scooby
Password:
$ pwd
/home/Scooby
$ ls -la
total 8
drwxr-x--- 2 Scooby Scooby 4096 Nov  7 16:01 .
drwxr-xr-x 6 root   root   4096 Nov  7 16:01 ..
$
```

Verify users in /etc/passwd and check Scooby's shell:

```
$ exit
hamna_25@ubuntu: $ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
xrdp:x:119:124::/run/xrdp:/usr/sbin/nologin
tom:x:1002:1005:Tom Lab6,,,:/home/tom:/bin/bash
Scooby:x:1003:1006::/home/Scooby:/bin/sh
hamna_25@ubuntu: $
```

Change Scooby's shell from /bin/sh to /bin/bash and verify:

```
hamna_25@ubuntu:~$ sudo usermod -s /bin/bash Scooby
hamna_25@ubuntu:~$ su - Scooby
Password:
Scooby@ubuntu:~$
```

Create groups jolly and anime:

```
Scooby@ubuntu:~$ exit
logout
hamna_25@ubuntu: $ sudo addgroup jolly
info: Selecting GID from range 1000 to 59999 ...
info: Adding group `jolly' (GID 1007) ...
hamna_25@ubuntu: $ sudo groupadd anime
hamna_25@ubuntu: $
```

Verify groups in /etc/group:

```
hamna_25@ubuntu: $ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog,hamna_25
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
dialout:x:20:
fax:x:21:
voice:x:22:
cdrom:x:24:hamna_25
xrdp:x:124:
docker:x:988:hamna_25
tom:x:1002:
developer:x:1003:tom
devops:x:1004:tom
designer:x:1005:
Scooby:x:1006:
jolly:x:1007:
anime:x:1008:
hamna_25@ubuntu: $
```

Delete the groups and users:

task4_delete_groups

```
hamna_25@ubuntu: $ sudo delgroup jolly
info: Removing group `jolly' ...
hamna_25@ubuntu: $ sudo groupdel anime
hamna_25@ubuntu: $ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog,hamna_25
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
```

```
pulse:x:122:
pulse-access:x:123:
xrdp:x:124:
docker:x:988:hamna_25
tom:x:1002:
developer:x:1003:tom
devops:x:1004:tom
designer:x:1005:
Scooby:x:1006:
```

task4_delete_users

```
hamna_25@ubuntu: $ sudo deluser --remove-home jerry
info: Looking for files to backup/remove ...
info: Removing files ...
info: Removing crontab ...
info: Removing user `jerry' ...
hamna_25@ubuntu: $ sudo deluser -r Scooby
Option r is ambiguous (remove-all-files, remove-home)
deluser [--system] [--remove-home] [--remove-all-files] [--backup]
        [--backup-to dir] [--backup-suffix str] [--conf file]
        [--quiet] [--verbose] [--debug] user

  remove a normal user from the system

deluser --group [--system] [--only-if-empty] [--conf file] [--quiet]
        [--verbose] [--debug] group
delgroup [--system] [--only-if-empty] [--conf file] [--quiet]
        [--verbose] [--debug] group
  remove a group from the system

deluser [--conf file] [--quiet] [--verbose] [--debug] user group
  remove the user from a group
hamna_25@ubuntu: $ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
```

```
cups-browsed:x:118:121::/nonexistent:/usr/sbin/nologin
xrdp:x:119:124::/run/xrdp:/usr/sbin/nologin
tom:x:1002:1005:Tom Lab6,,,:/home/tom:/bin/bash
Scooby:x:1003:1006::/home/Scooby:/bin/bash
hamna_25@ubuntu:~$
```

Task 5
 Create User "Student"; Create Files; Set Owner/Group; Identify File Types
Create a new user Student:

```
hamna_25@ubuntu:~$ sudo adduser student
info: Adding user `student' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `student' (1007) ...
info: Adding new user `student' (1007) with group `student (1007)' ...
info: Creating home directory `/home/student' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for student
Enter the new value, or press ENTER for the default
        Full Name []: Student Lab6
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] Y
info: Adding new user `student' to supplemental / extra groups `users' ...
info: Adding user `student' to group `users' ...
hamna_25@ubuntu:~$
```

Switch to Student and create files and directories:

```
hamna_25@ubuntu:~$ su - student
Password:
student@ubuntu:~$ touch file1
student@ubuntu:~$ mkdir -p dir1
student@ubuntu:~$ touch dir1/file2
student@ubuntu:~$ ls -l
total 4
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rw-rw-r-- 1 student student    0 Nov  7 16:35 file1
student@ubuntu:~$
```

Change the owner of file1 to tom and verify:

```
student@ubuntu:~$ exit
logout
hamna_25@ubuntu:~$ sudo chown tom /home/student/file1
[sudo] password for hamna_25:
hamna_25@ubuntu:~$ sudo ls -l /home/student/file1
-rw-rw-r-- 1 tom student 0 Nov  7 16:35 /home/student/file1
hamna_25@ubuntu:~$
```

Change the group of file1 to devops and verify:

```
hamna_25@ubuntu:~$ sudo chgrp devops /home/student/file1
hamna_25@ubuntu:~$ sudo ls -l /home/student/file1
-rw-rw-r-- 1 tom devops 0 Nov  7 16:35 /home/student/file1
hamna_25@ubuntu:~$
```

Identify files, directories, and special files:

```
hamna_25@ubuntu:~$ su - student
Password:
student@ubuntu:~$ ls -l
total 4
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rw-rw-r-- 1 tom     devops    0 Nov  7 16:35 file1
student@ubuntu:~$ ls -l dir1
total 0
-rw-rw-r-- 1 student student 0 Nov  7 16:35 file2
student@ubuntu:~$ ls -ls -l /dev/null
0 crw-rw-rw- 1 root root 1, 3 Nov  7 15:09 /dev/null
student@ubuntu:~$ file file1 dir1 /dev/null
file1:      empty
dir1:       directory
/dev/null: character special (1/3)
student@ubuntu:~$
```

Exit from Student account:

```
student@ubuntu:~$ exit
logout
hamna_25@ubuntu:~$
```

Task 6:
Change Permissions Using Symbolic Mode
Ensure the Student user and target file exist:

```
hamna_25@ubuntu:~$ su - student
Password:
student@ubuntu:~$ cd ~
student@ubuntu:~$ ls -l file1
-rw-rw-r-- 1 tom devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Remove all permissions from file1:

```
hamna_25@ubuntu:~$ sudo chown student /home/student/file1
hamna_25@ubuntu:~$ su - student
Password:
student@ubuntu:~$ chmod -rwx file1
student@ubuntu:~$ ls -l file1
---------- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Add read permission to all users:

```
student@ubuntu:~$ chmod +r file1
student@ubuntu:~$ ls -l file1
-r--r--r-- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Add execute permission to the user (owner):

```
student@ubuntu:~$ chmod u+x file1
student@ubuntu:~$ ls -l file1
-r-xr--r-- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Add write permission to both user and group:

```
student@ubuntu:~$ chmod ug+w file1
student@ubuntu:~$ ls -l file1
-rwxrw-r-- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Remove all permissions explicitly from user, group, and others:

```
student@ubuntu: $ chmod ugo-rwx file1
student@ubuntu: $ ls -l file1
---------- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu: $
```

Task 7
Change Permissions Using "Set" Symbolic Form (u= g= o=)
Ensure you are logged in as Student and confirm the file exists:

```
student@ubuntu: $ su - student
Password:
student@ubuntu: $ cd ~
student@ubuntu: $ ls -l file1
---------- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu: $
```

Set all permissions (read, write, execute) for user, group, and others:

```
student@ubuntu: $ chmod u=rwx,g=rwx,o=rwx file1
student@ubuntu: $ ls -l file1
-rwxrwxrwx 1 student devops 0 Nov  7 16:35 file1
student@ubuntu: $
```

Remove execute permission from group and others:

```
student@ubuntu:~$ chmod g=rw,o=rw file1
student@ubuntu:~$ ls -l file1
-rwxrw-rw- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Remove all permissions from user, group, and others:

```
student@ubuntu:~$ chmod u=,g=,o= file1
student@ubuntu:~$ ls -l file1
---------- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Task 8
 Change Permissions Using Numeric (Octal) Mode
Ensure you are logged in as Student and the file exists:

```
hamna_25@ubuntu:~$ su - student
Password:
student@ubuntu:~$ cd ~
student@ubuntu:~$ ls -l file1
---------- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Set permissions to 777 (rwx for user, group, and others):

```
student@ubuntu:~$ chmod 777 file1
student@ubuntu:~$ ls -l file1
-rwxrwxrwx 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Set permissions to 700 (rwx for user only):

```
student@ubuntu: $ chmod 700 file1
student@ubuntu: $ ls -l file1
-rwx------ 1 student devops 0 Nov  7 16:35 file1
student@ubuntu: $
```

Set permissions to 744 (rwx for user, read for group and others):

```
student@ubuntu:~$ chmod 744 file1
student@ubuntu:~$ ls -l file1
-rwxr--r-- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Set permissions to 640 (rw for user, r for group, none for others):

```
student@ubuntu: $ chmod 640 file1
student@ubuntu: $ ls -l file1
-rw-r----- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu: $
```

Set permissions to 664 (rw for user and group, read for others):

```
student@ubuntu:~$ chmod 644 file1
student@ubuntu:~$ ls -l file1
-rw-r--r-- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Set permissions to 775 (rwx for user and group, read/execute for others):

```
student@ubuntu:~$ chmod 775 file1
student@ubuntu:~$ ls -l file1
-rwxrwxr-x 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Set permissions to 750 (rwx for user, read/execute for group, none for others):

```
student@ubuntu:~$ chmod 750 file1
student@ubuntu:~$ ls -l file1
-rwxr-x--- 1 student devops 0 Nov  7 16:35 file1
student@ubuntu:~$
```

Task 9
Practice Pipes, Pagers, Grep, and Redirects with /var/log/syslog
View /var/log/syslog using less (with pipe):

```
2025-11-02T11:13:27.032242+00:00 ubuntu systemd-modules-load[465]: Inserted module 'msr'
2025-11-02T11:13:27.038944+00:00 ubuntu systemd-modules-load[465]: Inserted module 'dm_multipath'
2025-11-02T11:13:27.039009+00:00 ubuntu systemd[1]: Finished systemd-random-seed.service - Load/Save OS Random Seed.
2025-11-02T11:13:27.039020+00:00 ubuntu lvm[454]:    1 logical volume(s) in volume group "ubuntu-vg" monitored
2025-11-02T11:13:27.039030+00:00 ubuntu systemd[1]: Starting systemd-journal-flush.service - Flush Journal to Persistent
 Storage...
2025-11-02T11:13:27.039039+00:00 ubuntu systemd[1]: Finished lvm2-monitor.service - Monitoring of LVM2 mirrors, snapshot
s etc. using dmeventd or progress polling.
2025-11-02T11:13:27.039085+00:00 ubuntu multipathd[485]: multipathd v0.9.4: start up
2025-11-02T11:13:27.039095+00:00 ubuntu multipathd[485]: reconfigure: setting up paths and maps
2025-11-02T11:13:27.039835+00:00 ubuntu multipathd[485]: sda: failed to get udev uid: No data available
2025-11-02T11:13:27.039857+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev-early.service - Create Static De
vice Nodes in /dev gracefully.
2025-11-02T11:13:27.039867+00:00 ubuntu systemd[1]: systemd-sysusers.service - Create System Users was skipped because n
o trigger condition checks were met.
2025-11-02T11:13:27.039874+00:00 ubuntu systemd[1]: Starting systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev...
2025-11-02T11:13:27.039880+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev.
2025-11-02T11:13:27.039887+00:00 ubuntu systemd[1]: Starting systemd-udevd.service - Rule-based Manager for Device Event
s and Files...
2025-11-02T11:13:27.042002+00:00 ubuntu kernel: Linux version 6.8.0-87-generic (buildd@lcy02-amd64-034) (x86_64-linux-gn
u-gcc-13 (Ubuntu 13.3.0-6ubuntu2~24.04) 13.3.0, GNU ld (GNU Binutils for Ubuntu) 2.42) #88-Ubuntu SMP PREEMPT_DYNAMIC Sa
t Oct 11 09:28:41 UTC 2025 (Ubuntu 6.8.0-87.88-generic 6.8.12)
2025-11-02T11:13:27.042139+00:00 ubuntu kernel: Command line: BOOT_IMAGE=/vmlinuz-6.8.0-87-generic root=/dev/mapper/ubun
tu--vg-ubuntu--lv ro
2025-11-02T11:13:27.042149+00:00 ubuntu kernel: KERNEL supported cpus:
2025-11-02T11:13:27.042150+00:00 ubuntu kernel:    Intel GenuineIntel
2025-11-02T11:13:27.042151+00:00 ubuntu kernel:    AMD AuthenticAMD
2025-11-02T11:13:27.042152+00:00 ubuntu kernel:    Hygon HygonGenuine
2025-11-02T11:13:27.042153+00:00 ubuntu kernel:    Centaur CentaurHauls
:
```

View /var/log/syslog using more (with pipe):

      sudo cat /var/log/syslog | more

```
2025-11-02T11:13:27.032242+00:00 ubuntu systemd-modules-load[465]: Inserted module 'msr'
2025-11-02T11:13:27.038944+00:00 ubuntu systemd-modules-load[465]: Inserted module 'dm_multipath'
2025-11-02T11:13:27.039009+00:00 ubuntu systemd[1]: Finished systemd-random-seed.service - Load/Save OS Random Seed.
2025-11-02T11:13:27.039020+00:00 ubuntu lvm[454]:    1 logical volume(s) in volume group "ubuntu-vg" monitored
2025-11-02T11:13:27.039030+00:00 ubuntu systemd[1]: Starting systemd-journal-flush.service - Flush Journal to Persistent
 Storage...
2025-11-02T11:13:27.039039+00:00 ubuntu systemd[1]: Finished lvm2-monitor.service - Monitoring of LVM2 mirrors, snapshot
s etc. using dmeventd or progress polling.
2025-11-02T11:13:27.039085+00:00 ubuntu multipathd[485]: multipathd v0.9.4: start up
2025-11-02T11:13:27.039095+00:00 ubuntu multipathd[485]: reconfigure: setting up paths and maps
2025-11-02T11:13:27.039835+00:00 ubuntu multipathd[485]: sda: failed to get udev uid: No data available
2025-11-02T11:13:27.039857+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev-early.service - Create Static De
vice Nodes in /dev gracefully.
2025-11-02T11:13:27.039867+00:00 ubuntu systemd[1]: systemd-sysusers.service - Create System Users was skipped because n
o trigger condition checks were met.
2025-11-02T11:13:27.039874+00:00 ubuntu systemd[1]: Starting systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev...
2025-11-02T11:13:27.039880+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev.
2025-11-02T11:13:27.039887+00:00 ubuntu systemd[1]: Starting systemd-udevd.service - Rule-based Manager for Device Event
s and Files...
2025-11-02T11:13:27.042002+00:00 ubuntu kernel: Linux version 6.8.0-87-generic (buildd@lcy02-amd64-034) (x86_64-linux-gn
u-gcc-13 (Ubuntu 13.3.0-6ubuntu2~24.04) 13.3.0, GNU ld (GNU Binutils for Ubuntu) 2.42) #88-Ubuntu SMP PREEMPT_DYNAMIC Sa
t Oct 11 09:28:41 UTC 2025 (Ubuntu 6.8.0-87.88-generic 6.8.12)
2025-11-02T11:13:27.042139+00:00 ubuntu kernel: Command line: BOOT_IMAGE=/vmlinuz-6.8.0-87-generic root=/dev/mapper/ubun
tu--vg-ubuntu--lv ro
2025-11-02T11:13:27.042149+00:00 ubuntu kernel: KERNEL supported cpus:
2025-11-02T11:13:27.042150+00:00 ubuntu kernel:    Intel GenuineIntel
2025-11-02T11:13:27.042151+00:00 ubuntu kernel:    AMD AuthenticAMD
2025-11-02T11:13:27.042152+00:00 ubuntu kernel:    Hygon HygonGenuine
2025-11-02T11:13:27.042153+00:00 ubuntu kernel:    Centaur CentaurHauls
:
```

Search for log entries containing "fail" or "error":

    sudo grep -E 'fail|error' /var/log/syslog | head

```
hamna_25@ubuntu: $ sudo grep -E 'fail|error' /var/log/syslog | head
2025-11-02T11:13:27.039835+00:00 ubuntu multipathd[485]: sda: failed to get udev uid: No data available
2025-11-02T11:13:27.043067+00:00 ubuntu multipath: sda: failed to get sysfs uid: No such file or directory
2025-11-02T11:13:27.043079+00:00 ubuntu multipath: sda: failed to get sgio uid: No such file or directory
2025-11-02T11:13:27.043089+00:00 ubuntu multipathd[485]: sda: failed to get udev uid: No data available
2025-11-02T11:13:27.043098+00:00 ubuntu multipathd[485]: sda: failed to get path uid
2025-11-02T11:13:27.043106+00:00 ubuntu multipathd[485]: uevent trigger error
2025-11-02T11:13:27.047189+00:00 ubuntu systemd[1]: apport-autoreport.path - Process error reports when automatic report
ing is enabled (file watch) was skipped because of an unmet condition check (ConditionPathExists=/var/lib/apport/autorep
ort).
2025-11-02T11:13:27.047212+00:00 ubuntu systemd[1]: apport-autoreport.timer - Process error reports when automatic repor
ting is enabled (timer based) was skipped because of an unmet condition check (ConditionPathExists=/var/lib/apport/autor
eport).
2025-11-02T11:13:27.052133+00:00 ubuntu systemd[1]: Started update-notifier-download.timer - Download data for packages
that failed at package install time.
2025-11-02T11:13:27.052720+00:00 ubuntu kernel: ACPI: _OSC evaluation for CPUs failed, trying _PDC
hamna_25@ubuntu: $
```

Redirect search results to a new file (overwrite mode):

```
hamna_25@ubuntu:~$ sudo grep -i systemd /var/log/syslog > ~/syslog_systemd.txt
grep: /var/log/syslog: binary file matches
hamna_25@ubuntu:~$
```

Append additional search results to the same file:

```
hamna_25@ubuntu: $ sudo grep -i network /var/log/syslog >> ~/syslog_systemd.txt
grep: /var/log/syslog: binary file matches
hamna_25@ubuntu: $ cat ~/syslog_systemd.txt
2025-11-02T11:13:27.032242+00:00 ubuntu systemd-modules-load[465]: Inserted module 'msr'
2025-11-02T11:13:27.038944+00:00 ubuntu systemd-modules-load[465]: Inserted module 'dm_multipath'
2025-11-02T11:13:27.039009+00:00 ubuntu systemd[1]: Finished systemd-random-seed.service - Load/Save OS Random Seed.
2025-11-02T11:13:27.039030+00:00 ubuntu systemd[1]: Starting systemd-journal-flush.service - Flush Journal to Persistent
 Storage...
2025-11-02T11:13:27.039039+00:00 ubuntu systemd[1]: Finished lvm2-monitor.service - Monitoring of LVM2 mirrors, snapshot
s etc. using dmeventd or progress polling.
2025-11-02T11:13:27.039857+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev-early.service - Create Static De
vice Nodes in /dev gracefully.
2025-11-02T11:13:27.039867+00:00 ubuntu systemd[1]: systemd-sysusers.service - Create System Users was skipped because n
o trigger condition checks were met.
2025-11-02T11:13:27.039874+00:00 ubuntu systemd[1]: Starting systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev...
2025-11-02T11:13:27.039880+00:00 ubuntu systemd[1]: Finished systemd-tmpfiles-setup-dev.service - Create Static Device N
odes in /dev.
2025-11-02T11:13:27.039887+00:00 ubuntu systemd[1]: Starting systemd-udevd.service - Rule-based Manager for Device Event
s and Files...
2025-11-02T11:13:27.040056+00:00 ubuntu systemd[1]: Finished systemd-sysctl.service - Apply Kernel Variables.
2025-11-02T11:13:27.042786+00:00 ubuntu systemd-udevd[516]: Using default interface naming scheme 'v255'.
2025-11-02T11:13:27.042813+00:00 ubuntu systemd[1]: Started multipathd.service - Device-Mapper Multipath Device Controll
er.
```

(Alternative) Use journalctl to explore logs:

    sudo journalctl | less

```
Nov 03 12:37:29 ubuntu kernel: Linux version 6.8.0-87-generic (buildd@lcy02-amd64-034) (x86_64-linux-gnu-gcc-13 (Ubuntu
13.3.0-6ubuntu2~24.04) 13.3.0, GNU ld (GNU Binutils for Ubuntu) 2.42) #88-Ubuntu SMP PREEMPT_DYNAMIC Sat Oct 11 09:28:41
 UTC 2025 (Ubuntu 6.8.0-87.88-generic 6.8.12)
Nov 03 12:37:29 ubuntu kernel: Command line: BOOT_IMAGE=/vmlinuz-6.8.0-87-generic root=/dev/mapper/ubuntu--vg-ubuntu--lv
 ro
Nov 03 12:37:29 ubuntu kernel: KERNEL supported cpus:
Nov 03 12:37:29 ubuntu kernel:   Intel GenuineIntel
Nov 03 12:37:29 ubuntu kernel:   AMD AuthenticAMD
Nov 03 12:37:29 ubuntu kernel:   Hygon HygonGenuine
Nov 03 12:37:29 ubuntu kernel:   Centaur CentaurHauls
Nov 03 12:37:29 ubuntu kernel:   zhaoxin   Shanghai
Nov 03 12:37:29 ubuntu kernel: Disabled fast string operations
Nov 03 12:37:29 ubuntu kernel: BIOS-provided physical RAM map:
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x0000000000000000-0x000000000009e7ff] usable
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x000000000009e800-0x000000000009ffff] reserved
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000000dc000-0x00000000000fffff] reserved
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x0000000000100000-0x00000000bfecffff] usable
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000bfed0000-0x00000000bfefefff] ACPI data
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000bfeff000-0x00000000bfefffff] ACPI NVS
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000bff00000-0x00000000bfffffff] usable
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000f0000000-0x00000000f7ffffff] reserved
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000fec00000-0x00000000fec0ffff] reserved
Nov 03 12:37:29 ubuntu kernel: BIOS-e820: [mem 0x00000000fee00000-0x00000000fee00fff] reserved
:
hamna_25@ubuntu: $ sudo journalctl -u systemd | grep -i error > ~/journal_errors.txt
hamna_25@ubuntu: $
```

Viewed and filtered logs directly from systemd journal as an alternative to /var/log/syslog.

Task 10
Bash Script: setup.sh (Variables, Command Substitution, File/Dir Checks, Permissions)
Add Bash Shebang

```
>_ student@ubuntu: ~
#!/bin/bash
~
~
```

```
student@ubuntu: $ vim setup.sh
student@ubuntu: $ chmod +x setup.sh
student@ubuntu: $ ./setup.sh
student@ubuntu: $ vim setup.sh
student@ubuntu: $
```

Define and Display a Variable

```
>_ student@ubuntu: ~
#!/bin/bash
#Define and show var1
var1="Hello from Lab 6"
echo "var1: $var1"

~
~
~
```

```
student@ubuntu:~$ ./setup.sh
var1: Hello from Lab 6
student@ubuntu:~$
```

Command Substitution: Save and Display ls -l

```bash
#!/bin/bash
#Define and show var1
var1="Hello from Lab 6"
echo "var1: $var1"
# Save ls -l to variable and display
allFiles="$(ls -l)"
echo "allFiles (ls -l):"
echo "$allFiles"
~
```

```
student@ubuntu:~$ student@ubuntu:~$ vim setup.sh
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh
var1: Hello from Lab 6
allFiles (ls -l):
total 8
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rwxr-x--- 1 student devops     0 Nov  7 16:35 file1
-rwxrwxr-x 1 student student  176 Nov  7 19:18 setup.sh
student@ubuntu:~$
```

Directory Check and Creation

```bash
if [ -d "dir1" ]; then
        echo "Directory dir1 exists."
   else
          echo "Directory dir1 does not exist. Creating..."
            mkdir -p "dir1"
              echo "Directory dir1 created."
fi
-- INSERT --
```

```
student@ubuntu:~$ vim setup.sh
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh
var1: Hello from Lab 6
allFiles (ls -l):
total 8
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rwxr-x--- 1 student devops     0 Nov  7 16:35 file1
-rwxrwxr-x 1 student student  374 Nov  7 19:21 setup.sh
./setup.sh: line 9: rectory: command not found
Directory dir1 exists.
student@ubuntu:~$
```

File Check and Creation

```bash
# File check
 if [ -f "dir1/file2" ]; then
    echo "file2 already exists."
    else
      echo "file2 does not exist. Creating..."
        touch "dir1/file2"
          chmod a-rwx "dir1/file2"
            echo "file2 created."
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh
var1: Hello from Lab 6
allFiles (ls -l):
total 8
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rwxr-x--- 1 student devops     0 Nov  7 16:35 file1
-rwxrwxr-x 1 student student  610 Nov  7 19:25 setup.sh
./setup.sh: line 9: rectory: command not found
Directory dir1 exists.
file2 already exists.
student@ubuntu:~$
```

Permission Check and Adjustment

```
# Permission checks for dir1/file2 (user permissions)
f="dir1/file2"
if [ ! -r "$f" ]; then
  echo "Read permission missing; granting to user..."
    chmod u+r "$f"
    fi

    if [ ! -w "$f" ]; then
      echo "Write permission missing; granting to user..."
        chmod u+w "$f"
        fi

        if [ ! -x "$f" ]; then
          echo "Execute permission missing; granting to user..."
            chmod u+x "$f"
            fi

            echo "Final permissions for $f:"

            ls -l "$f"
```

```
student@ubuntu:~$ ./setup.sh
var1: Hello from Lab 6
allFiles (ls -l):
total 8
drwxrwxr-x 2 student student 4096 Nov  7 16:35 dir1
-rwxr-x--- 1 student devops     0 Nov  7 16:35 file1
-rwxrwxr-x 1 student student 1196 Nov  7 19:29 setup.sh
./setup.sh: line 9: rectory: command not found
Directory dir1 exists.
file2 already exists.
Execute permission missing; granting to user...
Final permissions for dir1/file2:
-rwxrw-r-- 1 student student 0 Nov  7 16:35 dir1/file2
student@ubuntu:~$
```

Task 11
Script setup.sh – Argument Comparisons and String Checks
Shebang, Variable Setup

```
 student@ubuntu: ~
#!/bin/bash
num=$1
str=$2

~
~
~
student@ubuntu:~$ chmod +x setup.sh
student@ubuntu:~$ ./setup.sh 10 student
student@ubuntu:~$
```

Numeric Equal (-eq)

```
 student@ubuntu: ~
#!/bin/bash
num=$1
str=$2
if [ "$num" -eq 10 ]; then
        echo "$num is equal to 10 (-eq)."
  else
          echo "$num is NOT equal to 10 (-eq)."
fi
~
```

```
student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
student@ubuntu:~$ ./setup.sh 7 Student
7 is NOT equal to 10 (-eq).
student@ubuntu:~$
```

Numeric Not Equal (-ne)

```
fi
if [ "$num" -ne 10 ]; then
        echo "$num is not equal to 10 (-ne)."
  else
            echo "$num is equal to 10 (-ne false)."
fi
~
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 7 Student
7 is NOT equal to 10 (-eq).
7 is not equal to 10 (-ne).
student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
student@ubuntu:~$
```

Greater Than (-gt)

```
fi
if [ "$num" -gt 10 ]; then
        echo "$num is greater than 10 (-gt)."
  else
            echo "$num is NOT greater than 10 (-gt)."
fi
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 12 Student
12 is NOT equal to 10 (-eq).
12 is not equal to 10 (-ne).
12 is greater than 10 (-gt).
student@ubuntu:~$ ./setup.sh 9 Student
9 is NOT equal to 10 (-eq).
9 is not equal to 10 (-ne).
9 is NOT greater than 10 (-gt).
student@ubuntu:~$
```

Less Than (-lt)

```
fi
if [ "$num" -lt 10 ]; then
        echo "$num is less than 10 (-lt)."
  else
            echo "$num is NOT less than 10 (-lt)."
fi
-- INSERT --
```

```
student@ubuntu:~$ ./setup.sh 5 Student
5 is NOT equal to 10 (-eq).
5 is not equal to 10 (-ne).
5 is NOT greater than 10 (-gt).
5 is less than 10 (-lt).
student@ubuntu:~$ ./setup.sh 11 Student
11 is NOT equal to 10 (-eq).
11 is not equal to 10 (-ne).
11 is greater than 10 (-gt).
11 is NOT less than 10 (-lt).
student@ubuntu:~$
```

Greater Than or Equal (-ge)

```
fi
if [ "$num" -ge 10 ]; then
        echo "$num is greater than or equal to 10 (-ge)."
  else
            echo "$num is NOT greater than or equal to 10 (-ge)."
fi
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
student@ubuntu:~$ ./setup.sh 8 Student
8 is NOT equal to 10 (-eq).
8 is not equal to 10 (-ne).
8 is NOT greater than 10 (-gt).
8 is less than 10 (-lt).
8 is NOT greater than or equal to 10 (-ge).
student@ubuntu:~$
```

Less Than or Equal (-le)

```
fi
if [ "$num" -le 10 ]; then
        echo "$num is less than or equal to 10 (-le)."
  else
            echo "$num is NOT less than or equal to 10 (-le)."
fi
-- INSERT --
```

```
student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
student@ubuntu:~$ ./setup.sh 12 Student
12 is NOT equal to 10 (-eq).
12 is not equal to 10 (-ne).
12 is greater than 10 (-gt).
12 is NOT less than 10 (-lt).
12 is greater than or equal to 10 (-ge).
12 is NOT less than or equal to 10 (-le).
student@ubuntu:~$
```

String Equality (=)

```
fi
if [ "$str" = "Student" ]; then
        echo "Second argument equals 'Student' ( = )."
  else
            echo "Second argument does NOT equal 'Student' ( = )."
fi
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument equals 'Student' ( = ).
student@ubuntu:~$ ./setup.sh 10 Test
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument does NOT equal 'Student' ( = ).
student@ubuntu:~$
```

String Inequality (!=)

```
fi
if [ "$str" != "Student" ]; then
        echo "Second argument is not equal to 'Student' ( != )."
  else
           echo "Second argument equals 'Student' ( != false)."
fi
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 10 Test
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument does NOT equal 'Student' ( = ).
Second argument is not equal to 'Student' ( != ).
student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument equals 'Student' ( = ).
Second argument equals 'Student' ( != false).
student@ubuntu:~$
```

String Zero-Length (-z)

```
fi
if [ -z "$str" ]; then
        echo "Second argument is empty (zero-length)."
  else
           echo "Second argument is not empty."
fi
-- INSERT --
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh 10
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument does NOT equal 'Student' ( = ).
Second argument is not equal to 'Student' ( != ).
Second argument is empty (zero-length).
student@ubuntu:~$ ./setup.sh 10 Student
10 is equal to 10 (-eq).
10 is equal to 10 (-ne false).
10 is NOT greater than 10 (-gt).
10 is NOT less than 10 (-lt).
10 is greater than or equal to 10 (-ge).
10 is less than or equal to 10 (-le).
Second argument equals 'Student' ( = ).
Second argument equals 'Student' ( != false).
Second argument is not empty.
student@ubuntu:~$
```

Task 12
Script setup.sh – Print All Arguments with a For Loop
Goal:
Shebang and Comment

```
student@ubuntu: ~

#!/bin/bash
# Script to demonstrate printing all user-entered arguments using $*
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh
student@ubuntu:~$
```

Append the For Loop Using $*

```
echo "Printing all arguments using \$*:"
for arg in $*; do
        echo "Argument: $arg"
done
```

```
student@ubuntu:~$ chmod +x setup.sh
student@ubuntu:~$ ./setup.sh one "two words" three
Printing all arguments using $*:
Argument: one
Argument: two
Argument: words
Argument: three
student@ubuntu:~$
```

Task 13:
Script setup.sh – While Loop Summation and Functions
Shebang Line

```
student@ubuntu: ~

#!/bin/bash
```

```
student@ubuntu:~$ student@ubuntu:~$ chmod +x setup.sh
student@ubuntu:~$ ./setup.sh
student@ubuntu:~$
```

Interactive While Loop Summation

```
# While-loop summation (interactive)
sum=0
while true; do
  read -p "Enter a number (or 'q' to quit): " input
    if [ "$input" = "q" ]; then
       break
         fi
            sum=$((sum + input))
             echo "Total Score: $sum"
             done
             echo "Final total: $sum"
```

```
student@ubuntu:~$ student@ubuntu:~$ ./setup.sh
Enter a number (or 'q' to quit): 5
Total Score: 5
Enter a number (or 'q' to quit): 7
Total Score: 12
Enter a number (or 'q' to quit): q
Final total: 12
student@ubuntu:~$
```

Function sum_two() (Interactive Loop Inside a Function)

```
sum_two()
{
     sum=0
     while true; do
            read -p "Enter a number (or 'q' to quit): " input
            if [ "$input" = "q" ]; then
             break
            fi

            sum=$((sum+input))
             echo "Total Score: $sum"
      done
      echo "Function final total: $sum"

}

#Demonstrate the function
echo "Now calling sum_two function:"
sum_two
```

```
student@ubuntu:~$ ./setup.sh
Now calling sum_two function:
Enter a number (or 'q' to quit): 3
Total Score: 3
Enter a number (or 'q' to quit): 4
Total Score: 7
Enter a number (or 'q' to quit): q
Function final total: 7
student@ubuntu:~$
```

Function sum_args() (Two Arguments Summation)

```
#Function that sums two arguments and returns the result
sum_args()
{
        a=$1
        b=$2
        return $((a+b))


}
#Demonstrate sum_args function
echo "Now demonstrating sum_Args function:"
sum_args 3 4
result=$?
echo "sum_args(3,4) returned: $result"
```

```
student@ubuntu:~$ ./setup.sh
Now calling sum_two function:
Enter a number (or 'q' to quit): q
Function final total: 0
Now demonstrating sum_Args function:
sum_args(3,4) returned: 7
student@ubuntu:~$
```

Task 14

Codespaces GUI: Fork Repo, Start GUI, Connect via VNC, Stop GUI

1. **Fork the repository to your GitHub account**
   - Open the repo URL in your browser.
     https://github.com/WaqasSaleem97/UbuntuMachine
   - Click **Fork** (top-right) and fork to your account.
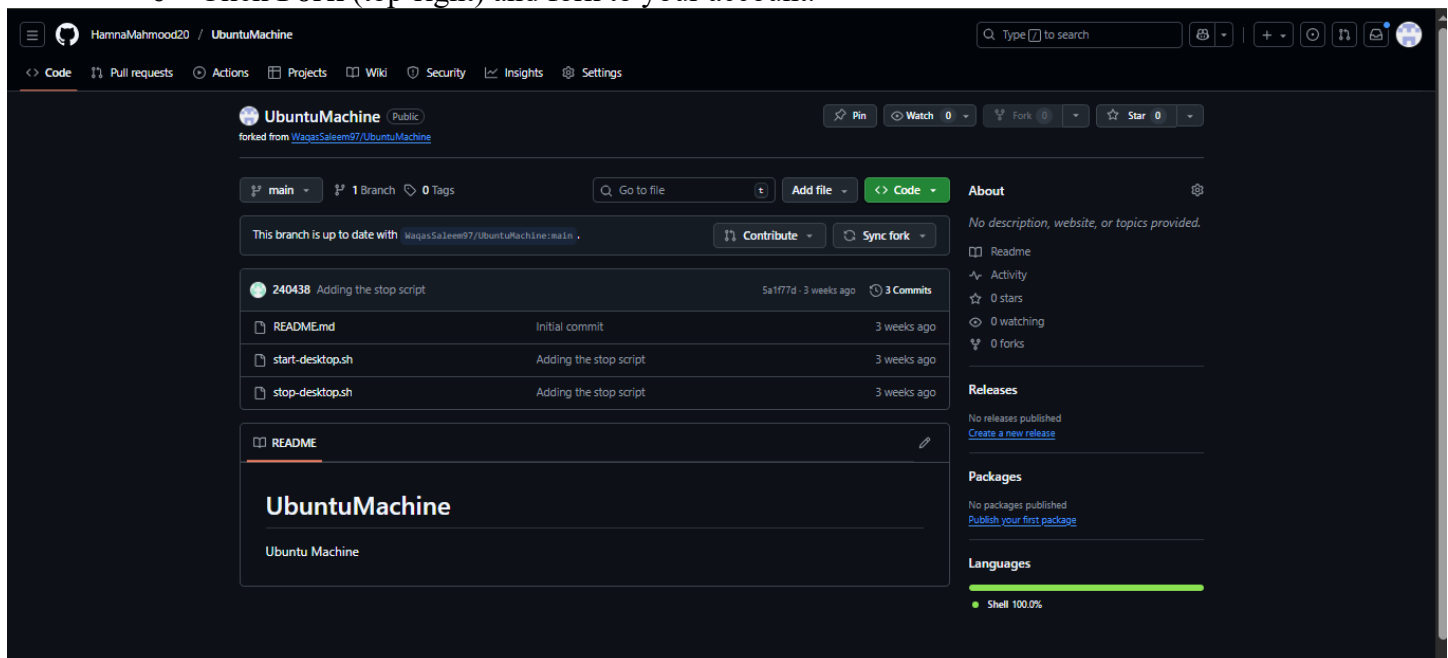
2. **Open a Codespace on your fork**
   - Click **Code → Open with Codespaces → Create codespace**.
   - Wait for Codespace initialization.
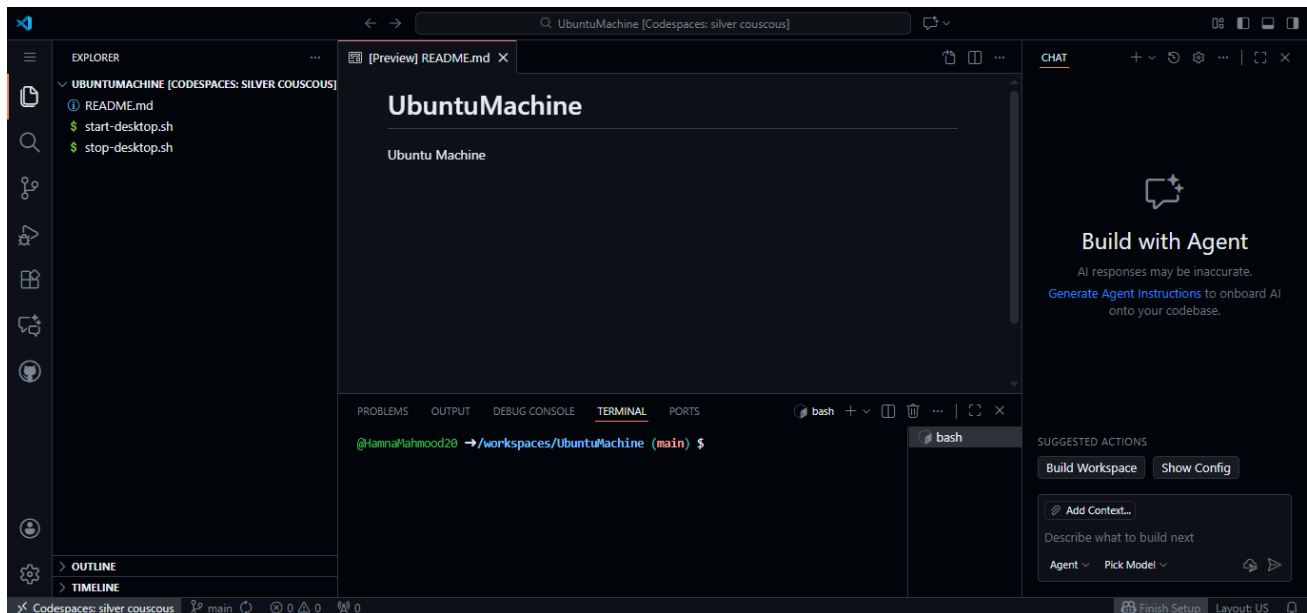
3. **Verify start/stop scripts exist and are executable**
   ls -l start-desktop.sh stop-desktop.sh

4. **Run the start script to launch the GUI**
   ./start-desktop.sh
   - o Capture terminal output showing successful start.

5. **Verify forwarded ports in Codespaces (Ports view)**
   - o Open **Ports panel** and confirm port **6080** is forwarded.

6. **Connect to the VNC HTML page**
   - o Open the forwarded port 6080 in the browser or Codespaces preview.

   - o Click vnc.html.
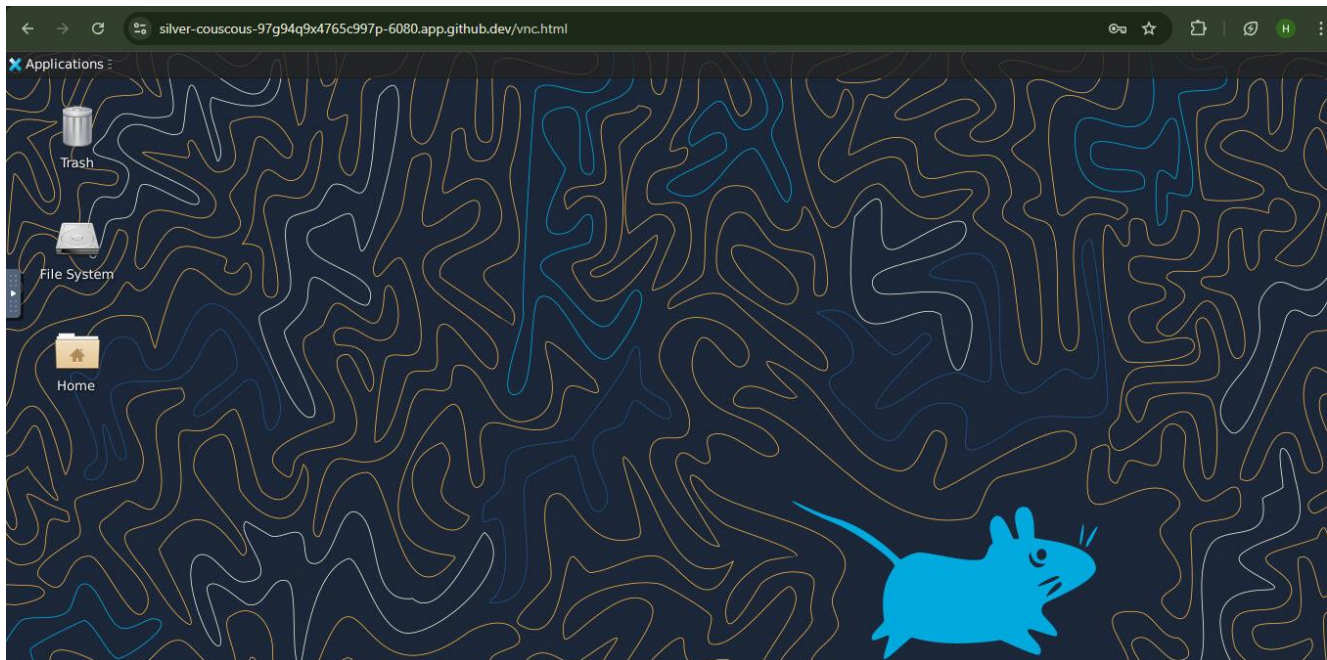
o Enter password: codespace (do **not** show typed password).
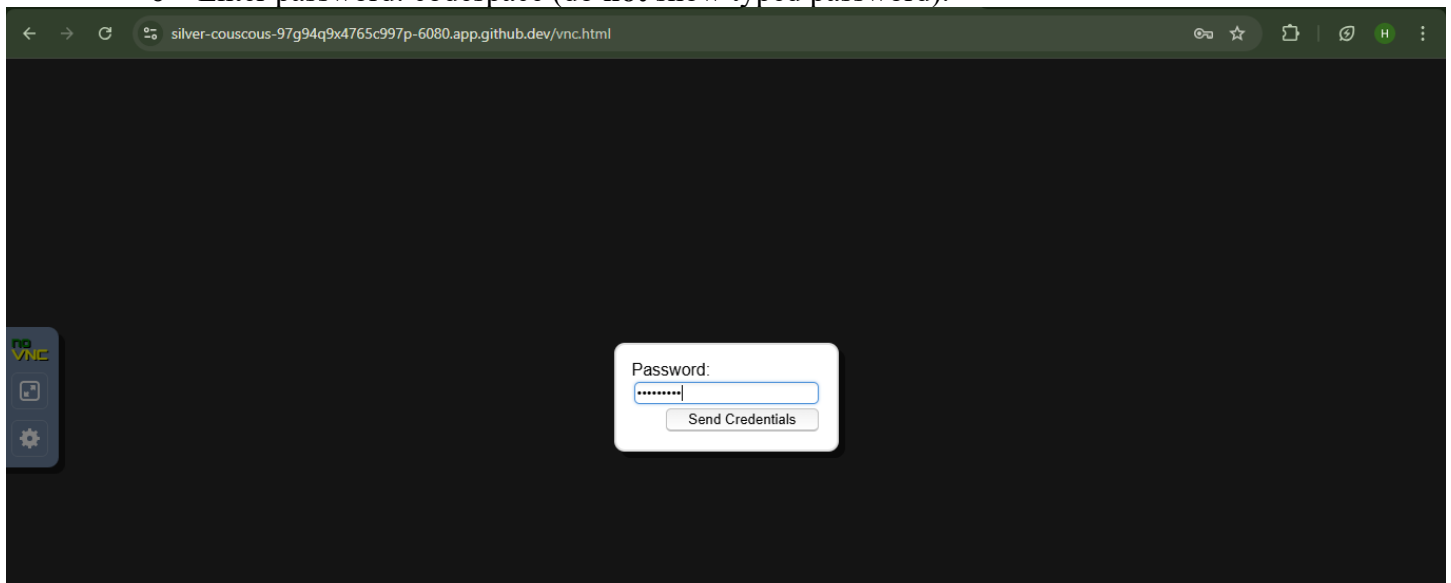
7. **Stop the GUI**
   ./stop-desktop.sh
   - o Capture terminal output showing GUI stop/cleanup.


```
[*] Stopping virtual X server (Xvfb)...
[✓] All services stopped.
xfsettingsd: Another instance took over. Leaving...

(Thunar:23797): thunar-WARNING **: 20:20:52.574: Name 'org.xfce.FileManager' lost on the me
ssage dbus.

(Thunar:23797): thunar-WARNING **: 20:20:52.574: Name 'org.freedesktop.FileManager1' lost o
n the message dbus.

** (xfce4-power-manager:23823): WARNING **: 20:20:52.585: Error: The connection is closed

** (xfce4-power-manager:23823): WARNING **: 20:20:52.585: Error: The connection is closed

○ @HamnaMahmood20 →/workspaces/UbuntuMachine (main) $
```

Exam Evaluation Questions

Group Management and Membership

Scenario: Create groups and manage a user's primary and supplementary group memberships.

1. **Create groups** g1, g2, and g3


```
hamna_25@ubuntu:~$ sudo groupadd g1
[sudo] password for hamna_25:
hamna_25@ubuntu:~$ sudo groupadd g2
hamna_25@ubuntu:~$ sudo groupadd g3
hamna_25@ubuntu:~$
```

2. **Change examuser's primary group and add supplementary groups**
   - o Primary: g3
   - o Supplementary: g1, g2


```
hamna_25@ubuntu:~$ sudo useradd -m examuser
hamna_25@ubuntu:~$ sudo passwd examuser
New password:
Retype new password:
passwd: password updated successfully
hamna_25@ubuntu:~$ sudo usermod -g g3 examuser
hamna_25@ubuntu:~$ sudo usermod -aG g1,g2 examuser
```

3. **Verify group changes**

o Show id examuser and relevant /etc/group lines

```
hamna_25@ubuntu:~$ id examuser
uid=1008(examuser) gid=1010(g3) groups=1010(g3),1008(g1),1009(g2)
hamna_25@ubuntu:~$ grep -E "g1|g2|g3" /etc/group
g1:x:1008:examuser
g2:x:1009:examuser
g3:x:1010:
hamna_25@ubuntu:~$
```

1. Ownership and Permission Tasks

Scenario: Demonstrate ownership changes and apply symbolic and numeric permission changes.

1. **Create file and change ownership**

```
hamna_25@ubuntu:~$ mkdir -p workspace
hamna_25@ubuntu:~$ touch workspace/secret.txt
hamna_25@ubuntu:~$ sudo chown examuser workspace/secret.txt
hamna_25@ubuntu:~$ sudo chgrp g1 workspace/secret.txt
hamna_25@ubuntu:~$ ls -l workspace/secret.txt
-rw-rw-r-- 1 examuser g1 0 Nov 17 12:41 workspace/secret.txt
hamna_25@ubuntu:~$
```

2. **Remove group/other permissions**
   - o Symbolic: chmod go-rwx workspace/secret.txt
   - o Numeric: chmod 700 workspace/secret.txt

```
hamna_25@ubuntu:~$ sudo chmod go-rwx workspace/secret.txt
```

3. **Show final permissions**

```
hamna_25@ubuntu:~$ ls -l workspace/secret.txt
-rw------- 1 examuser g1 0 Nov 17 12:41 workspace/secret.txt
hamna_25@ubuntu:~$
```

3. Pipes, Grep, and Redirection Practice

Scenario: Filter system logs and save results using redirection and piping.

1. **Grep for "error" or "fail" and show first 20 lines**

grep -E 'error|fail' /var/log/syslog | head -n 20

```
hamna_25@ubuntu:~$ grep -Ei "error|fail" /var/log/syslog | head -20
2025-11-16T19:09:49.935283+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:49.933896699Z" level=info msg="skip loading plugin \"io.container
d.snapshotter.v1.aufs\"..." error="aufs is not supported (modprobe aufs failed: exit status 1 \"modprobe: FATAL: Module aufs not found in director
y /lib/modules/6.8.0-87-generic\\n\"): skip plugin" type=io.containerd.snapshotter.v1
2025-11-16T19:09:49.985356+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:49.985173600Z" level=info msg="skip loading plugin \"io.container
d.snapshotter.v1.blockfile\"..." error="no scratch file generator: skip plugin" type=io.containerd.snapshotter.v1
2025-11-16T19:09:49.986545+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:49.986456092Z" level=info msg="skip loading plugin \"io.container
d.snapshotter.v1.btrfs\"..." error="path /var/lib/containerd/io.containerd.snapshotter.v1.btrfs (ext4) must be a btrfs filesystem to be used with
the btrfs snapshotter: skip plugin" type=io.containerd.snapshotter.v1
2025-11-16T19:09:49.987503+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:49.986736450Z" level=info msg="skip loading plugin \"io.container
d.snapshotter.v1.devmapper\"..." error="devmapper not configured: skip plugin" type=io.containerd.snapshotter.v1
2025-11-16T19:09:50.004871+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:50.0044090787Z" level=info msg="skip loading plugin \"io.container
d.snapshotter.v1.zfs\"..." error="path /var/lib/containerd/io.containerd.snapshotter.v1.zfs must be a zfs filesystem to be used with the zfs snaps
hotter: skip plugin" type=io.containerd.snapshotter.v1
2025-11-16T19:09:50.096247+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:50.094773616Z" level=info msg="skip loading plugin \"io.container
d.tracing.processor.v1.otlp\"..." error="skip plugin: tracing endpoint not configured" type=io.containerd.tracing.processor.v1
2025-11-16T19:09:50.096342+00:00 ubuntu containerd[1374]: time="2025-11-16T19:09:50.0948237292Z" level=info msg="skip loading plugin \"io.container
d.internal.v1.tracing\"..." error="skip plugin: tracing endpoint not configured" type=io.containerd.internal.v1
2025-11-16T19:09:51.306736+00:00 ubuntu multipath: sda: failed to get sysfs uid: No such file or directory
2025-11-16T19:09:51.307124+00:00 ubuntu multipath: sda: failed to get sgio uid: No such file or directory
2025-11-16T19:09:51.352332+00:00 ubuntu multipathd[479]: sda: failed to get sysfs uid: No such file or directory
2025-11-16T19:09:51.352417+00:00 ubuntu multipathd[479]: sda: failed to get sgio uid: No such file or directory
2025-11-16T19:09:51.352516+00:00 ubuntu multipathd[479]: sda: failed to get path uid
2025-11-16T19:09:51.352692+00:00 ubuntu multipathd[479]: uevent trigger error
2025-11-16T19:10:02.131250+00:00 ubuntu multipathd[479]: sda: failed to get sysfs uid: No such file or directory
2025-11-16T19:10:02.131700+00:00 ubuntu multipathd[479]: sda: failed to get sgio uid: No such file or directory
2025-11-16T19:10:02.132750+00:00 ubuntu multipathd[479]: sda: check_path() failed, removing
2025-11-16T19:10:02.347185+00:00 ubuntu dockerd[1480]: time="2025-11-16T19:10:02.324322526Z" level=info msg="CDI directory does not exist, skippin
g: failed to monitor for changes: no such file or directory" dir=/var/run/cdi
2025-11-16T19:10:02.347320+00:00 ubuntu dockerd[1480]: time="2025-11-16T19:10:02.324467945Z" level=info msg="CDI directory does not exist, skippin
g: failed to monitor for changes: no such file or directory" dir=/etc/cdi
2025-11-16T19:14:31.102131+00:00 ubuntu systemd[1]: Starting update-notifier-download.service - Download data for packages that failed at package
install time...
```
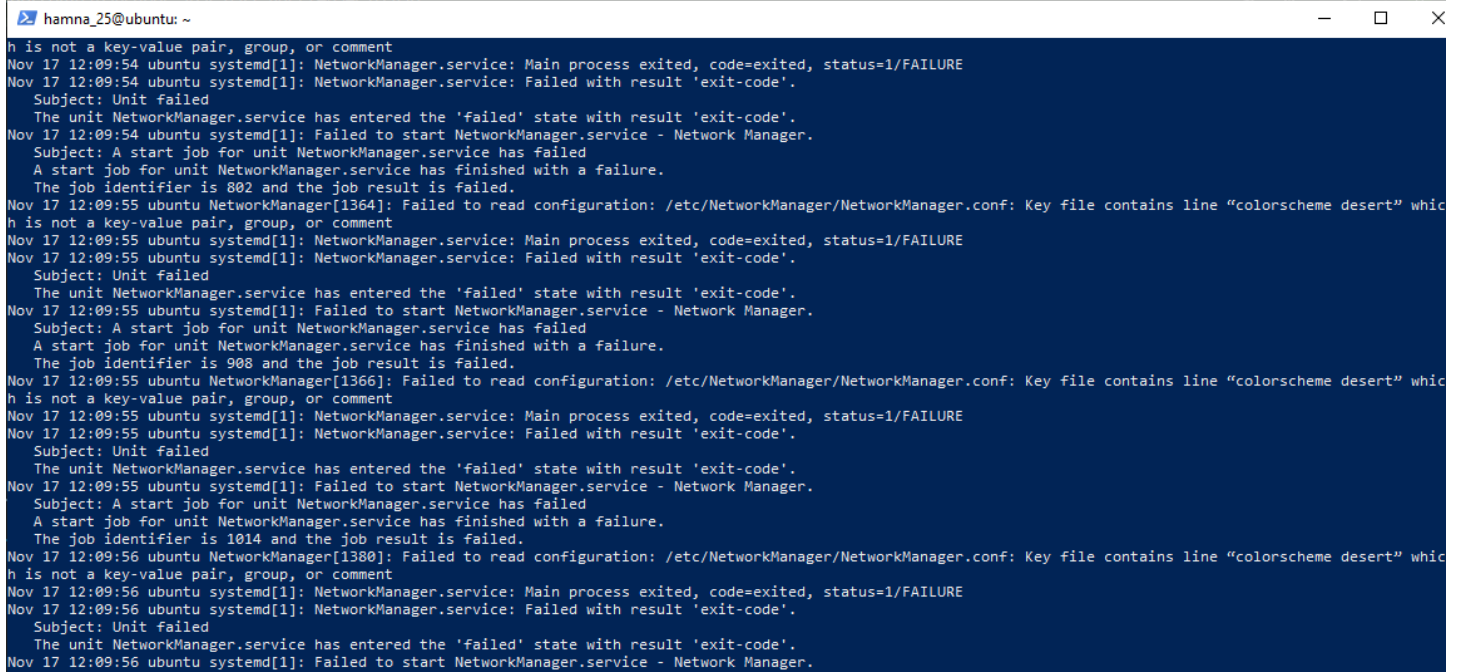
2. **Save filtered results to a file**

grep -E 'error|fail' /var/log/syslog > ~/logs/errors.txt
grep -E 'warning|fail' /var/log/syslog >> ~/logs/errors.txt

```
hamna_25@ubuntu:~$ mkdir -p ~/logs
hamna_25@ubuntu:~$ sudo journalctl -xe | grep -Ei "error|fail" > ~/logs/errors.txt
hamna_25@ubuntu:~$ sudo journalctl -xe | grep -Ei "error|fail" >> ~/logs/errors.txt
hamna_25@ubuntu:~$
```

3. **View the saved file using a pager**
   less ~/logs/errors.txt

```
hamna_25@ubuntu: ~                                                          —  □  ×

h is not a key-value pair, group, or comment
Nov 17 12:09:54 ubuntu systemd[1]: NetworkManager.service: Main process exited, code=exited, status=1/FAILURE
Nov 17 12:09:54 ubuntu systemd[1]: NetworkManager.service: Failed with result 'exit-code'.
  Subject: Unit failed
  The unit NetworkManager.service has entered the 'failed' state with result 'exit-code'.
Nov 17 12:09:54 ubuntu systemd[1]: Failed to start NetworkManager.service - Network Manager.
  Subject: A start job for unit NetworkManager.service has failed
  A start job for unit NetworkManager.service has finished with a failure.
  The job identifier is 802 and the job result is failed.
Nov 17 12:09:55 ubuntu NetworkManager[1364]: Failed to read configuration: /etc/NetworkManager/NetworkManager.conf: Key file contains line "colorscheme desert" whic
h is not a key-value pair, group, or comment
Nov 17 12:09:55 ubuntu systemd[1]: NetworkManager.service: Main process exited, code=exited, status=1/FAILURE
Nov 17 12:09:55 ubuntu systemd[1]: NetworkManager.service: Failed with result 'exit-code'.
  Subject: Unit failed
  The unit NetworkManager.service has entered the 'failed' state with result 'exit-code'.
Nov 17 12:09:55 ubuntu systemd[1]: Failed to start NetworkManager.service - Network Manager.
  Subject: A start job for unit NetworkManager.service has failed
  A start job for unit NetworkManager.service has finished with a failure.
  The job identifier is 908 and the job result is failed.
Nov 17 12:09:55 ubuntu NetworkManager[1366]: Failed to read configuration: /etc/NetworkManager/NetworkManager.conf: Key file contains line "colorscheme desert" whic
h is not a key-value pair, group, or comment
Nov 17 12:09:55 ubuntu systemd[1]: NetworkManager.service: Main process exited, code=exited, status=1/FAILURE
Nov 17 12:09:55 ubuntu systemd[1]: NetworkManager.service: Failed with result 'exit-code'.
  Subject: Unit failed
  The unit NetworkManager.service has entered the 'failed' state with result 'exit-code'.
Nov 17 12:09:55 ubuntu systemd[1]: Failed to start NetworkManager.service - Network Manager.
  Subject: A start job for unit NetworkManager.service has failed
  A start job for unit NetworkManager.service has finished with a failure.
  The job identifier is 1014 and the job result is failed.
Nov 17 12:09:56 ubuntu NetworkManager[1380]: Failed to read configuration: /etc/NetworkManager/NetworkManager.conf: Key file contains line "colorscheme desert" whic
h is not a key-value pair, group, or comment
Nov 17 12:09:56 ubuntu systemd[1]: NetworkManager.service: Main process exited, code=exited, status=1/FAILURE
Nov 17 12:09:56 ubuntu systemd[1]: NetworkManager.service: Failed with result 'exit-code'.
  Subject: Unit failed
  The unit NetworkManager.service has entered the 'failed' state with result 'exit-code'.
Nov 17 12:09:56 ubuntu systemd[1]: Failed to start NetworkManager.service - Network Manager.
```
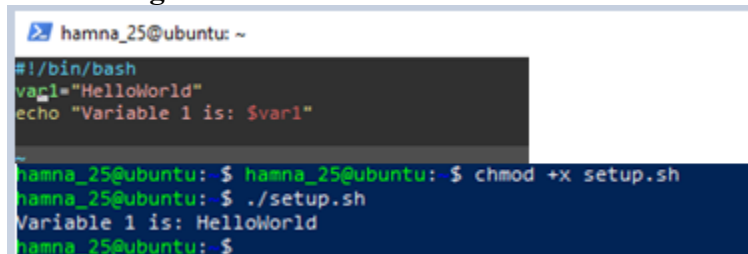
4. Script: Variables, Command Substitution, File & Dir Checks

Scenario: Build and run a script incrementally demonstrating variables, command substitution, and filesystem checks.

1. **Create setup.sh with shebang and variable var1**

```
hamna_25@ubuntu: ~

#!/bin/bash
var1="HelloWorld"
echo "Variable 1 is: $var1"

~
hamna_25@ubuntu: $ hamna_25@ubuntu: $ chmod +x setup.sh
hamna_25@ubuntu: $ ./setup.sh
Variable 1 is: HelloWorld
hamna_25@ubuntu: $
```

2. **Append command substitution storing ls -l output**

```
allfiles="$(ls-1)"
echo "All files in this directory:"
echo "$allfiles"
```

```
hamna_25@ubuntu:~$ hamna_25@ubuntu:~$ ./setup.sh
Variable 1 is: HelloWorld
All files in this directory:
total 411856
-rw-rw-r-- 1 hamna_25 hamna_25        308 Oct 24 05:13 answers.md
-rw-rw-r-- 1 hamna_25 hamna_25        413 Nov  2 11:19 apt_update_vs_upgarde.md
-rw-rw-r-- 1 hamna_25 hamna_25        404 Nov  2 11:23 apt_update_vs_upgrade.md
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Desktop
-rw-rw-r-- 1 hamna_25 hamna_25 421490404 Oct 30 11:38 docker-desktop-amd64.deb
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Documents
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  6 19:19 Downloads
-rw-rw-r-- 1 hamna_25 hamna_25        740 Oct 30 15:52 filesystem_report.md
drwxrwxr-x 6 hamna_25 hamna_25       4096 Oct 30 15:58 ForensicWorkspace
drwxrwxr-x 6 hamna_25 hamna_25       4096 Oct 30 16:06 ForensicWorkspace_Backup
-rw-rw-r-- 1 hamna_25 hamna_25          0 Nov  7 18:58 journal_errors.txt
drwxrwxr-x 3 hamna_25 hamna_25       4096 Oct 24 05:25 lab4
drwxrwxr-x 2 hamna_25 hamna_25       4096 Nov  3 19:46 Lab5
drwxrwxr-x 2 hamna_25 hamna_25       4096 Nov 17 12:52 logs
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Music
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Pictures
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Public
drwxrwxr-x 2 hamna_25 hamna_25       4096 Oct 30 15:57 Reports,Backups}
-rwxrwxr-x 1 hamna_25 hamna_25        132 Nov 17 13:06 setup.sh
drwx------ 5 hamna_25 hamna_25       4096 Nov  3 18:52 snap
-rw-rw-r-- 1 hamna_25 hamna_25     151856 Nov  7 18:55 syslog_systemd.txt
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Templates
drwxrwxr-t 2 hamna_25 hamna_25       4096 Nov  2 13:39 thinclient_drives
drwxr-xr-x 2 hamna_25 hamna_25       4096 Nov  2 13:39 Videos
drwxrwxr-x 2 hamna_25 hamna_25       4096 Nov 17 12:41 workspace
hamna_25@ubuntu:~$
```

3. **Append directory/file checks for dir1 and dir1/file2**

```
if [ ! -d "dir1" ]; then
        mkdir -p dir1
fi
if [ ! -f "dir1/file2" ]; then
        touch dir1/file2
        chmod 644 dir1/file2
fi
ls -l dir1 dir1/file2
```

```
dir1 not found. Creating it...
file2 not found inside dir1. Creating it...
Final permissions:
drwxrwxr-x 2 hamna_25 hamna_25 4096 Nov 17 13:09 dir1
-rw-rw-r-- 1 hamna_25 hamna_25 0 Nov 17 13:09 dir1/file2
```

5. Script: Comparisons and String Tests

Scenario: Incrementally add numeric and string comparison tests and show both true/false cases.

1. **Overwrite setup.sh to set num=$1 and str=$2; add -eq test**
   Q5_eq_examples

```bash
#!/bin/bash

num=$1
str=$2

echo "Number is: $num"
echo "String is: $str"

 EQ test
if [ "$num" -eq 10 ]; then
     echo "num is equal to 10 (TRUE)"
     else
          echo "num is NOT equal to 10 (FALSE)"
          fi
```

```
hamna_25@ubuntu:~$ ./setup.sh 10 hi
Number is: 10
String is: hi
num is equal to 10 (TRUE)
hamna_25@ubuntu:~$
hamna_25@ubuntu:~$ ./setup.sh 5 hi
Number is: 5
String is: hi
num is NOT equal to 10 (FALSE)
hamna_25@ubuntu:~$
```

2. **Append numeric tests: -ne, -gt, -lt, -ge, -l**

```bash
# NE test
if [ "$num" -ne 10 ]; then
     echo "num is NOT equal to 10 (TRUE for -ne)"
     else
          echo "num is equal to 10 (FALSE for -ne)"
          fi

          # GT test
          if [ "$num" -gt 5 ]; then
               echo "num is greater than 5 (TRUE)"
               else
                    echo "num is NOT greater than 5 (FALSE)"
                    fi

                    # LT test
                    if [ "$num" -lt 20 ]; then
                         echo "num is less than 20 (TRUE)"
                         else
                              echo "num is NOT less than 20 (FALSE)"
                              fi

                              # GE test
                              if [ "$num" -ge 5 ]; then
                                   echo "num is greater or equal to 5 (TRUE)"
                                   else
                                        echo "num is less than 5 (FALSE)"
                                        fi

                                        # LE test
                                        if [ "$num" -le 20 ]; then
                                             echo "num is less or equal to 20 (TRUE)"
                                             else
                                                  echo "num is greater than 20 (FALSE)"
                                                  fi
```

```
hamna_25@ubuntu:~$ ./setup.sh 3 hi
Number is: 3
String is: hi
num is NOT equal to 10 (FALSE)
num is NOT equal to 10 (TRUE for -ne)
num is NOT greater than 5 (FALSE)
num is less than 20 (TRUE)
num is less than 5 (FALSE)
num is less or equal to 20 (TRUE)
hamna_25@ubuntu: $
```

```
hamna_25@ubuntu: $ ./setup.sh 12 hi
Number is: 12
String is: hi
num is NOT equal to 10 (FALSE)
num is NOT equal to 10 (TRUE for -ne)
num is greater than 5 (TRUE)
num is less than 20 (TRUE)
num is greater or equal to 5 (TRUE)
num is less or equal to 20 (TRUE)
```

3. **Append string tests: equality (=), inequality (!=), zero-length (-z)**

```
# String equality test
if [ "$str" = "hello" ]; then
    echo "String equals 'hello' (TRUE)"
else
    echo "String does NOT equal 'hello' (FALSE)"
    fi

# String inequality test
if [ "$str" != "hello" ]; then
    echo "String is NOT 'hello' (TRUE)"
else
    echo "String IS 'hello' (FALSE)"
    fi

# Zero length test
if [ -z "$str" ]; then
    echo "String is EMPTY (TRUE)"
else
    echo "String is NOT empty (FALSE)"
    fi
```

```
hamna_25@ubuntu: $ ./setup.sh 10 hello
Number is: 10
String is: hello
num is equal to 10 (TRUE)
num is equal to 10 (FALSE for -ne)
num is greater than 5 (TRUE)
num is less than 20 (TRUE)
num is greater or equal to 5 (TRUE)
num is less or equal to 20 (TRUE)
String equals 'hello' (TRUE)
String IS 'hello' (FALSE)
String is NOT empty (FALSE)
hamna_25@ubuntu: $ ./setup.sh 10 world
Number is: 10
String is: world
num is equal to 10 (TRUE)
num is equal to 10 (FALSE for -ne)
num is greater than 5 (TRUE)
num is less than 20 (TRUE)
num is greater or equal to 5 (TRUE)
num is less or equal to 20 (TRUE)
String does NOT equal 'hello' (FALSE)
String is NOT 'hello' (TRUE)
String is NOT empty (FALSE)
hamna_25@ubuntu: $ ./setup.sh 10 ""
Number is: 10
String is:
num is equal to 10 (TRUE)
num is equal to 10 (FALSE for -ne)
num is greater than 5 (TRUE)
num is less than 20 (TRUE)
num is greater or equal to 5 (TRUE)
num is less or equal to 20 (TRUE)
String does NOT equal 'hello' (FALSE)
String is NOT 'hello' (TRUE)
String is EMPTY (TRUE)
hamna_25@ubuntu: $
```

6. Script: For Loop and Argument Handling

Scenario: Print all provided arguments and demonstrate correct handling of quoted multi-word arguments.

1. **Create/overwrite setup.sh and print each argument using a for loop**

```
hamna_25@ubuntu: ~

#!/bin/bash
echo "Printing all arguments:"

for arg in "$@"
do
    echo "$arg"
    done

hamna_25@ubuntu:~$ vim setup.sh
hamna_25@ubuntu:~$ hamna_25@ubuntu:~$ chmod +x setup.sh
hamna_25@ubuntu:~$
```

2. **Run script with single and quoted multi-word arguments**

```
hamna_25@ubuntu:~$ ./setup.sh apple banana cherry
Printing all arguments:
apple
banana
cherry
hamna_25@ubuntu:~$ ./setup.sh "red apple" "big banana" cat
Printing all arguments:
red apple
big banana
cat
hamna_25@ubuntu:~$ ./setup.sh "hello world" test "multi word argument" 99
Printing all arguments:
hello world
test
multi word argument
99
hamna_25@ubuntu:~$
```

7. Script: While Loop Summation and Functions

Scenario: Implement an interactive summation function and a function returning a numeric result.

Interactive while-loop that accumulates numbers until q

📷 Q7_while_session.png

```
hamna_25@ubuntu: ~                                           —    □    ×

#!/bin/bash
total=0
echo "Enter numbers to add to the total. Type 'q' to quit."

while true; do
    read -p "Enter a number (or 'q' to quit): " input

            if [[ $input == "q" ]]; then
                    break
                        elif [[ $input =~ ^-?[0-9]+$ ]]; then
                                total=$((total + input))
                                    echo "Running total: $total"
                                        else
                                            echo "Invalid input, please enter a number or 'q' to qu
it."
                                                fi
                                                done

                                                echo "Final total: $total"
```

```
hamna_25@ubuntu: $ chmod +x setup.sh
hamna_25@ubuntu: $ ./setup.sh
Enter numbers to add to the total. Type 'q' to quit.
Enter a number (or 'q' to quit): 5
Running total: 5
Enter a number (or 'q' to quit): 10
Running total: 15
Enter a number (or 'q' to quit): -3
Running total: 12
Enter a number (or 'q' to quit): q
Final total: 12
hamna_25@ubuntu: $
```

Function that sums two numeric arguments and demonstrates capturing the result

```bash
#!/bin/bash
# Function to sum two numbers
add_numbers() {
    local a=$1
        local b=$2
            echo $((a + b))
            }

            # Demonstration
            num1=10
            num2=25
            result=$(add_numbers $num1 $num2)
            echo "The sum of $num1 and $num2 is $result"
```

```
hamna_25@ubuntu: $ chmod +x setup.sh
hamna_25@ubuntu: $ ./setup.sh
The sum of 10 and 25 is 35
hamna_25@ubuntu: $
```