

Name: Raorane Sakshi
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CDAC MUMBAI
Module 1: Concepts of Operating System
Assignment 2

Part A

What will the following commands do?

1. `echo "Hello, World!"`
-This command prints "Hello, World!" to the terminal.
2. `name="Productive"`
-This assigns the string "Productive" to the variable 'name'.
3. `touch file.txt`
-This command creates an empty file named 'file.txt'.
4. `ls -a`
-This command lists all files and directories in the current directory including the files name starts with '.'.
5. `rm file.txt`
-This command removes or deletes the file named file.txt.
6. `cp file1.txt file2.txt`
-This command copies the contents of file1.txt to file2.txt. If the file2.txt is not there it'll create a new file named file2.txt'
7. `mv file.txt /path/to/directory/`
-This command moves file.txt to the specified directory /path/to/directory/ if there is already a file present named file1.txt it'll override the present file.
8. `chmod 755 script.sh`
-This command changes the permissions of script.sh to 755, which means the owner can read, write, and execute the file, while the group and others can only read and execute it.
 - i. Owner: Read, write, and execute (7)
 - ii. Group: Read and execute (5)
 - iii. Others: Read and execute (5)
9. `grep "pattern" file.txt`

-This command searches for the string "pattern" within file.txt and prints lines that match the pattern.

10. kill PID

-This command sends a signal to the process with the specified Process ID (PID) to terminate or end that PID.

11. mkdir mydir && cd mydir && touch file.txt && echo "Hello, World!" > file.txt && cat file.txt

-This sequence of commands:

- i. mkdir mydir - Creates a directory called mydir.
- ii. cd mydir - Changes the current directory to mydir.
- iii. touch file.txt - Creates an empty file named file.txt.
- iv. echo "Hello, World!" > file.txt - Writes "Hello, World!" to file.txt.
- v. cat file.txt - Displays the contents of file.txt to the terminal.

12. ls -l | grep ".txt"

-This command lists all files in the current directory in long format (detailed information like permissions, owner, size,date,time etc.) and then filters the output to display only files with .txt in their names.

13. cat file1.txt file2.txt | sort | uniq

-This command concatenates the contents of file1.txt and file2.txt, sorts the combined lines, and then filters out any duplicate lines, displaying only unique lines.

14. ls -l | grep "^d"

-This command lists all files and directories in long format, then filters the output to show only directories that start with "d".

15. grep -r "pattern" /path/to/directory/

-This command searches recursively for the string "pattern" in all files within /path/to/directory/ and its subdirectories.

16. cat file1.txt file2.txt | sort | uniq -d

-This command concatenates the contents of file1.txt and file2.txt, sorts the combined lines, and then displays only duplicate lines i.e. lines that appear more than once.

17. chmod 644 file.txt

-This command changes the permissions of file.txt to 644, meaning the owner can read and write the file, while the group and others can only read it.

- i. Owner: Read and write (6)
- ii. Group: Read only (4)
- iii. Others: Read only (4)

18. `cp -r source_directory destination_directory`
 - This command copies the `source_directory` and all its contents including subdirectories to the `destination_directory`. The `-r` option means recursive, allowing it to copy directories.
19. `find /path/to/search -name "*.txt"`
 - This command searches for files ending with `.txt` within the `/path/to/search` directory and its subdirectories.
20. `chmod u+x file.txt`
 - This command adds execute permissions to the owner of the `file.txt`.
21. `echo $PATH`
 - This command displays the current value of the `PATH` environment variable, which contains a list of directories the shell searches for executable files.

Part B

Identify True or False:

1. `ls` is used to list files and directories in a directory.
 - True
2. `mv` is used to move files and directories.
 - True
3. `cd` is used to copy files and directories.
 - False. `cd` is used to change the directories.
4. `pwd` stands for "print working directory" and displays the current directory.
 - True
5. `grep` is used to search for patterns in files.
 - True
6. `chmod 755 file.txt` gives read, write, and execute permissions to the owner, and read and execute permissions to group and others.
 - True

7. `mkdir -p directory1/directory2` creates nested directories, creating `directory2` inside `directory1` if `directory1` does not exist.

-True

8. `rm -rf file.txt` deletes a file forcefully without confirmation.

-True

Identify the Incorrect Commands:

1. `chmodx` is used to change file permissions.

- `chmod`

2. `cpy` is used to copy files and directories.

- `cp`

3. `mkfile` is used to create a new file.

- `touch` OR `nano`

4. `catx` is used to concatenate files.

- `cat`

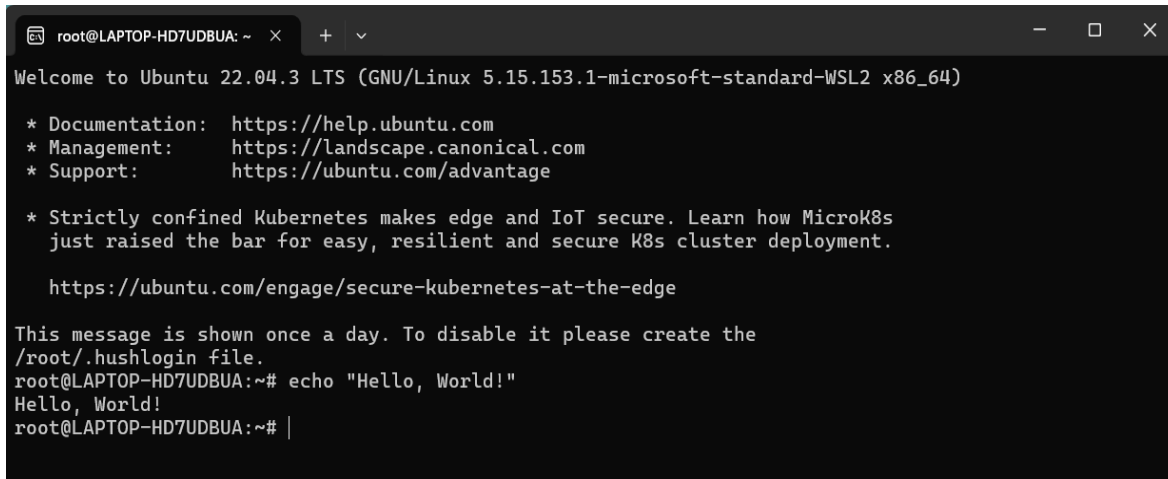
5. `rn` is used to rename files.

- `mv`

Part C

Question 1: Write a shell script that prints "Hello, World!" to the terminal.

- Echo "Hello, World!"



```
root@LAPTOP-HD7UDBUA: ~  
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.153.1-microsoft-standard-WSL2 x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
* 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  
  
This message is shown once a day. To disable it please create the  
/root/.hushlogin file.  
root@LAPTOP-HD7UDBUA:~# echo "Hello, World!"  
Hello, World!  
root@LAPTOP-HD7UDBUA:~# |
```

Question 2: Declare a variable named "name" and assign the value "CDAC Mumbai" to it. Print the value of the variable.

Nano text_test.sh

name="CDAC Mumbai"

echo \$name

Chmod +x text_test.sh

./text_test.sh



The image consists of two terminal window screenshots. The top screenshot shows the nano text editor editing a file named 'text_test.sh'. The file contains three lines of code: 'name="CDAC Mumbai"', 'echo \$name', and a blank line. The bottom screenshot shows a terminal session where the user runs 'nano text_test.sh', then './text_test.sh', which outputs 'CDAC Mumbai' to the terminal.

```
root@LAPTOP-HD7UDBUA: ~  
GNU nano 6.2 text_test.sh  
name="CDAC Mumbai"  
echo $name  
  
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location   M-U Undo      M-A Set Mark  
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^/_ Go To Line M-E Redo      M-6 Copy
```

```
root@LAPTOP-HD7UDBUA: ~  
root@LAPTOP-HD7UDBUA:~# nano text_test.sh  
root@LAPTOP-HD7UDBUA:~# ./text_test.sh  
CDAC Mumbai  
root@LAPTOP-HD7UDBUA:~#
```

Question 3: Write a shell script that takes a number as input from the user and prints it.

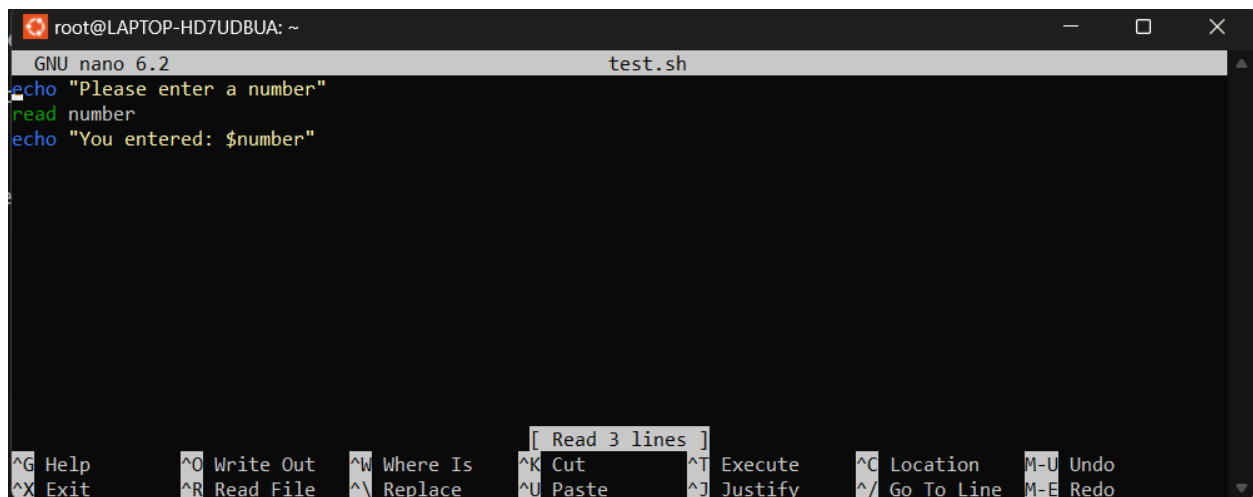
Nano test.sh

echo "Please enter a number"

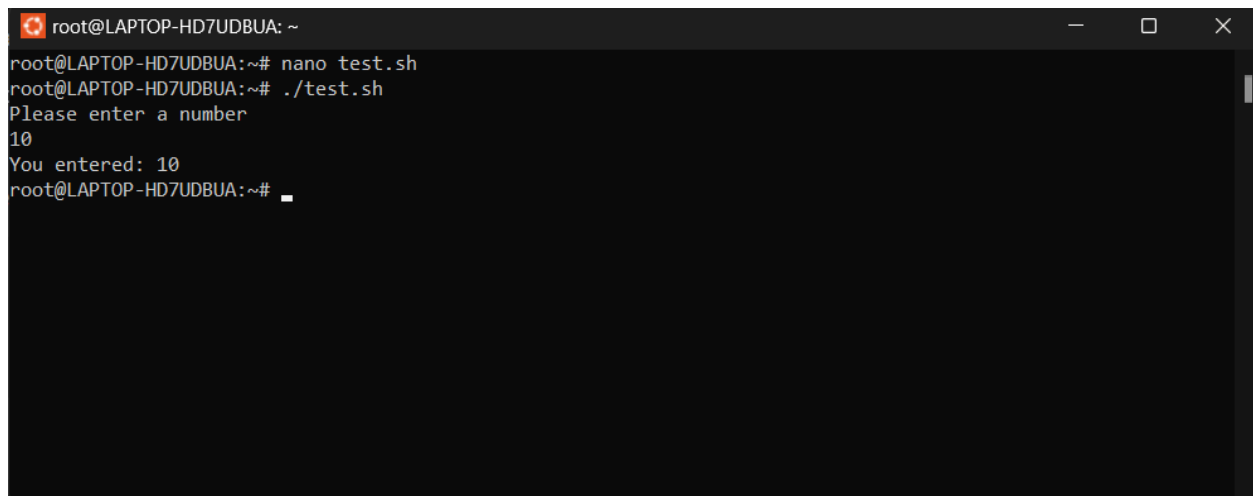
read number

Echo "You entered \$number"

./test.sh



```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test.sh
echo "Please enter a number"
read number
echo "You entered: $number"
```



```
root@LAPTOP-HD7UDBUA: ~# nano test.sh
root@LAPTOP-HD7UDBUA: ~# ./test.sh
Please enter a number
10
You entered: 10
root@LAPTOP-HD7UDBUA: ~#
```

Question 4: Write a shell script that performs addition of two numbers (e.g., 5 and 3) and prints the result.

Nano test4.sh

num1=5

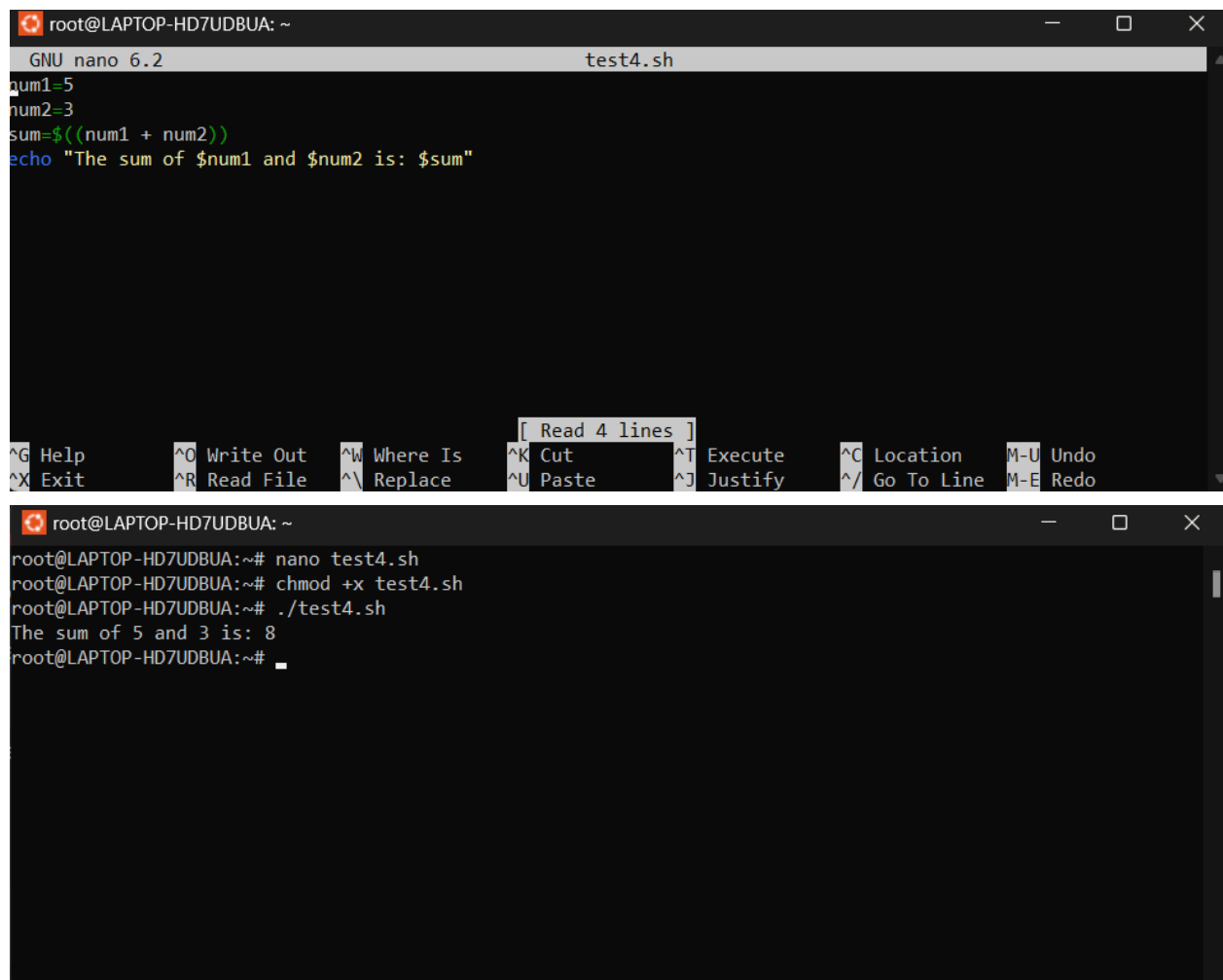
num2=3

sum=\$((num1 + num2))

Echo "The sum of \$num1 and \$num2 is: \$sum"

Chmod +x test4.sh

./test4.sh



The image consists of two terminal window screenshots. The top screenshot shows the nano text editor editing a file named test4.sh. The script content is as follows:

```
num1=5
num2=3
sum=$((num1 + num2))
echo "The sum of $num1 and $num2 is: $sum"
```

The bottom screenshot shows the execution of the script in a terminal. The commands entered and their outputs are:

```
root@LAPTOP-HD7UDBUA:~# nano test4.sh
root@LAPTOP-HD7UDBUA:~# chmod +x test4.sh
root@LAPTOP-HD7UDBUA:~# ./test4.sh
The sum of 5 and 3 is: 8
root@LAPTOP-HD7UDBUA:~#
```


Question 5: Write a shell script that takes a number as input and prints "Even" if it is even, otherwise prints "Odd".

```
nano test5.sh
```

```
echo "Please enter a number "
```

```
read number
```

```
if((number % 2 == 0)); then
```

```
    echo "Even"
```

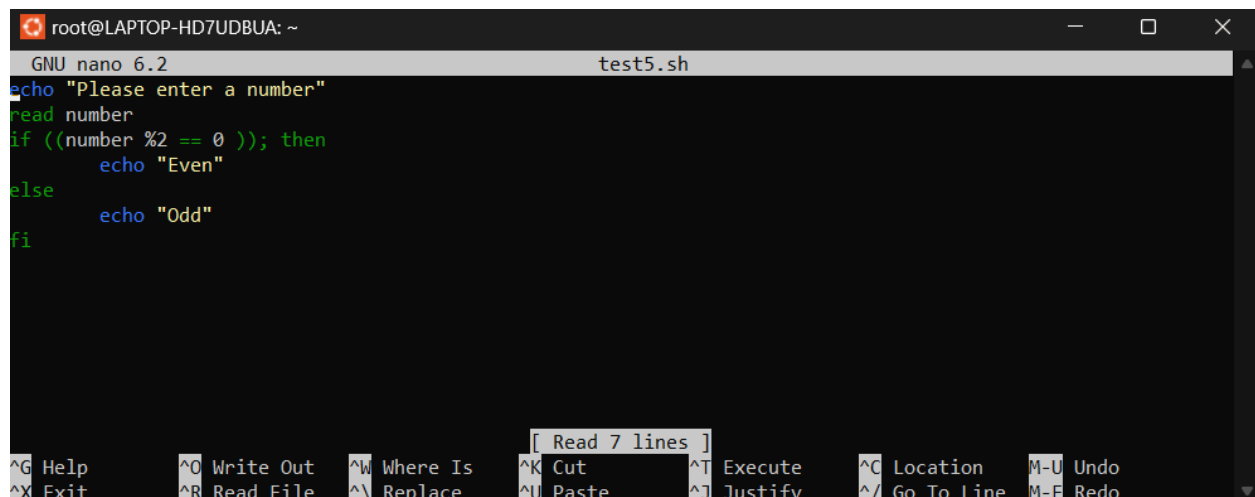
```
else
```

```
    Echo "Odd"
```

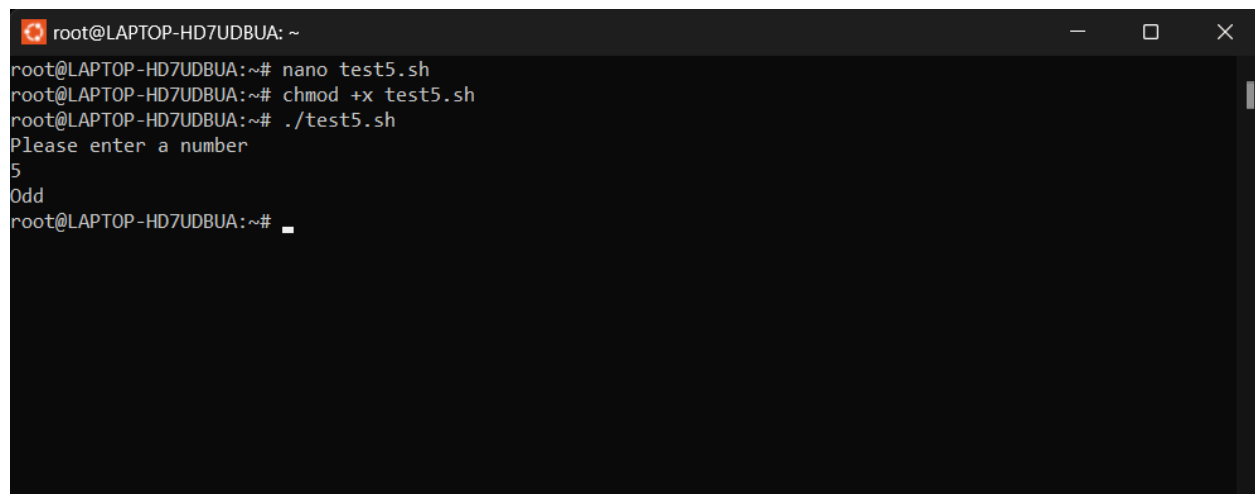
```
fi
```

```
chmod +x test5.sh
```

```
./test5.sh
```



```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test5.sh
echo "Please enter a number"
read number
if ((number % 2 == 0 )); then
    echo "Even"
else
    echo "Odd"
fi
```



```
root@LAPTOP-HD7UDBUA: ~# nano test5.sh
root@LAPTOP-HD7UDBUA:~# chmod +x test5.sh
root@LAPTOP-HD7UDBUA:~# ./test5.sh
Please enter a number
5
Odd
root@LAPTOP-HD7UDBUA:~#
```

Question 6: Write a shell script that uses a for loop to print numbers from 1 to 5.

```
nano test6.sh
```

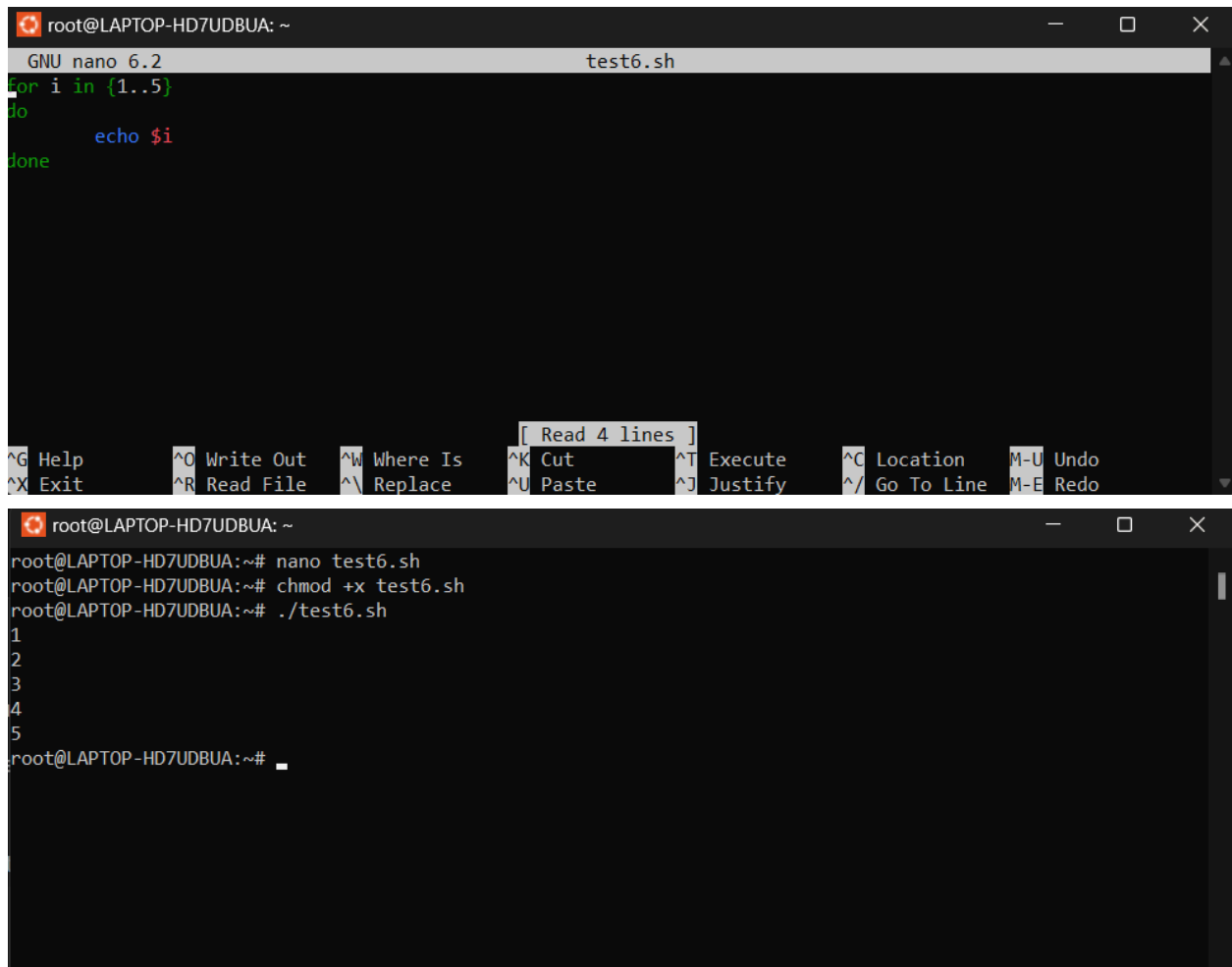
```
for i in {1..5}
```

```
do
```

```
    echo $i
```

```
done
```

```
./test6.sh
```



The image consists of two screenshots of a terminal window. The top screenshot shows the nano text editor editing a file named test6.sh. The script content is: for i in {1..5}, do, echo \$i, done. The bottom screenshot shows the terminal after running the script. It displays the commands: nano test6.sh, chmod +x test6.sh, and ./test6.sh, followed by the output: 1, 2, 3, 4, 5.

```
root@LAPTOP-HD7UDBUA: ~  
GNU nano 6.2 test6.sh  
for i in {1..5}  
do  
    echo $i  
done  
[ Read 4 lines ]  
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location   M-U Undo  
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^_ Go To Line  M-E Redo  
root@LAPTOP-HD7UDBUA: ~  
root@LAPTOP-HD7UDBUA:~# nano test6.sh  
root@LAPTOP-HD7UDBUA:~# chmod +x test6.sh  
root@LAPTOP-HD7UDBUA:~# ./test6.sh  
1  
2  
3  
4  
5  
root@LAPTOP-HD7UDBUA:~#
```

Question 7: Write a shell script that uses a while loop to print numbers from 1 to 5.

```
nano test7.sh
```

```
i=1
```

```
while[ $i -le 5 ]
```

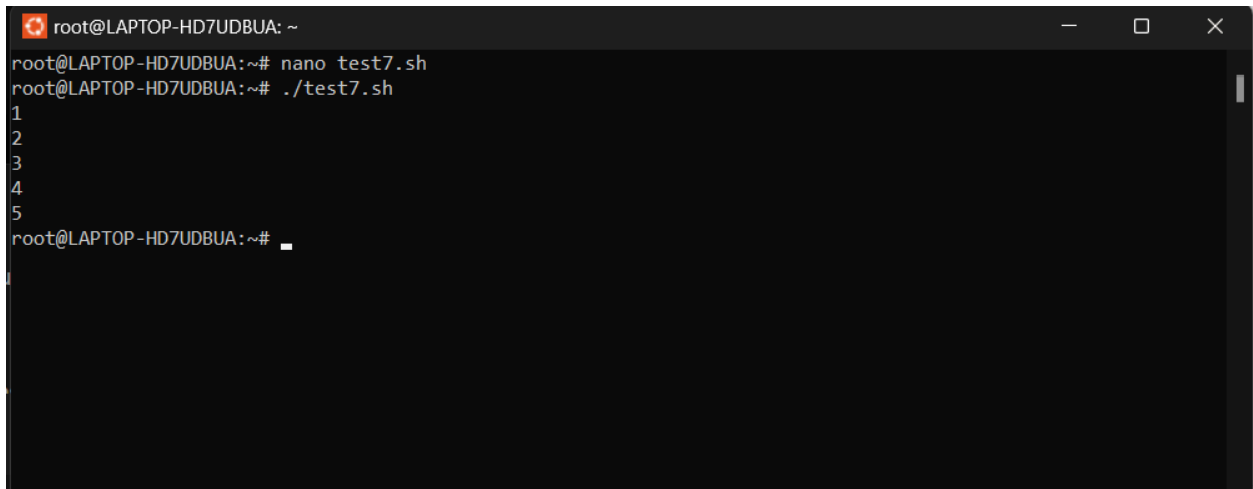
```
do
```

```
    echo $i
```

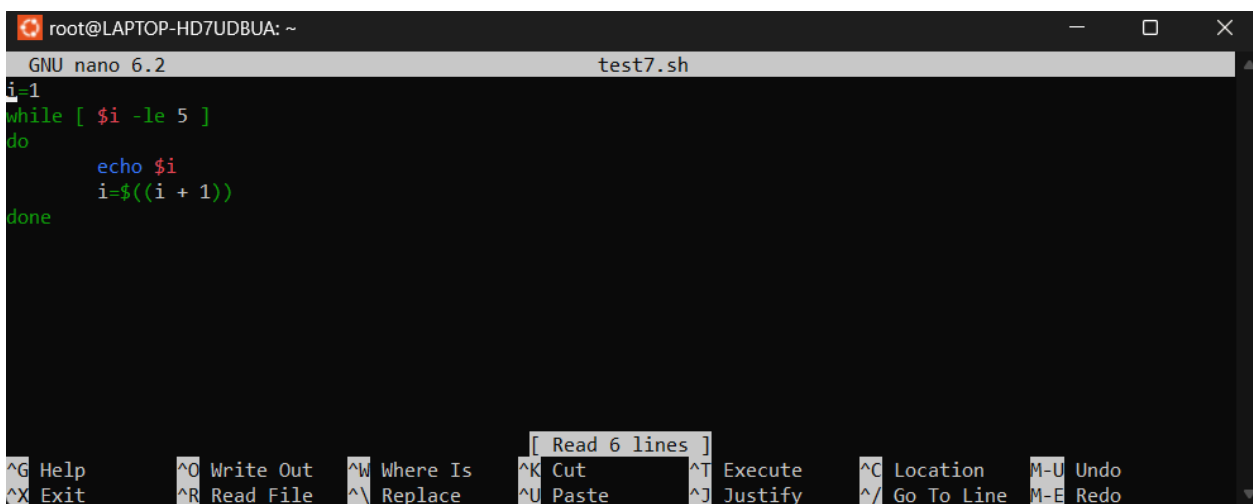
```
    i=$((i + 1))
```

```
done
```

```
./test7.sh
```



A terminal window titled 'root@LAPTOP-HD7UDBUA: ~' showing the execution of the script. The prompt is 'root@LAPTOP-HD7UDBUA:~# nano test7.sh'. The next prompt is 'root@LAPTOP-HD7UDBUA:~# ./test7.sh'. The output of the script is the numbers 1 through 5, each on a new line. The prompt then returns to 'root@LAPTOP-HD7UDBUA:~# '.



A terminal window titled 'root@LAPTOP-HD7UDBUA: ~' showing the contents of the 'test7.sh' file in the nano editor. The editor title bar says 'GNU nano 6.2 test7.sh'. The script content is displayed with syntax highlighting: 'i=1' (blue), 'while [\$i -le 5]' (green), 'do' (green), ' echo \$i' (blue), ' i=\$((i + 1))' (blue), and 'done' (green). At the bottom, a menu bar shows various shortcuts: '^G Help', '^X Exit', '^O Write Out', '^R Read File', '^W Where Is', '^_ Replace', '^K Cut', '^U Paste', '^T Execute', '^J Justify', '^C Location', '^_ Go To Line', 'M-U Undo', and 'M-E Redo'. A status bar at the bottom indicates '[Read 6 lines]'.

Question 8: Write a shell script that checks if a file named "file.txt" exists in the current directory. If it does, print "File exists", otherwise, print "File does not exist".

nano test8.sh

```
if [ -f "file.txt" ]; then
```

```
    echo "File exists"
```

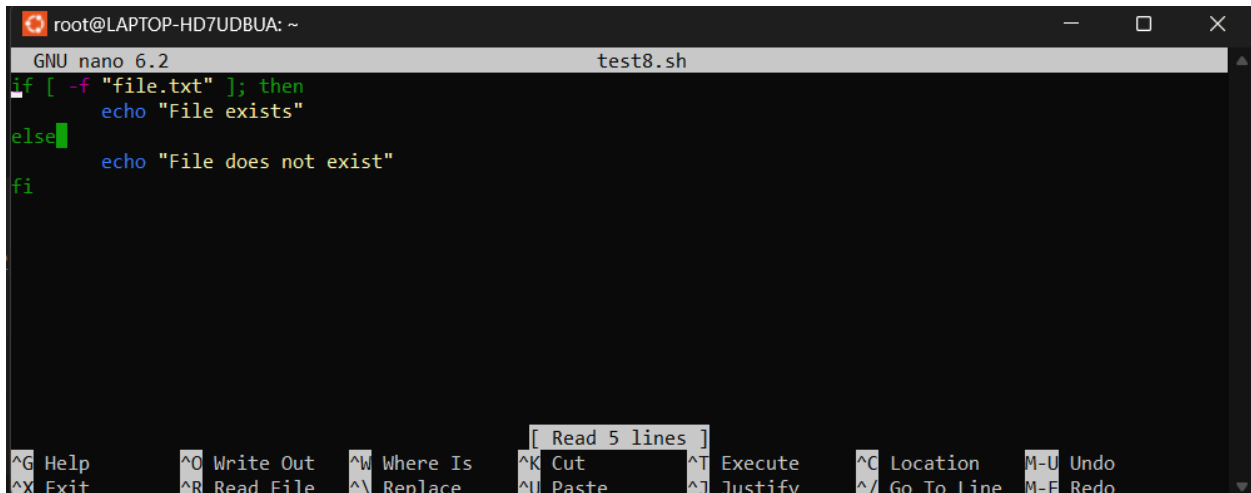
```
else
```

```
    echo "File does not exist"
```

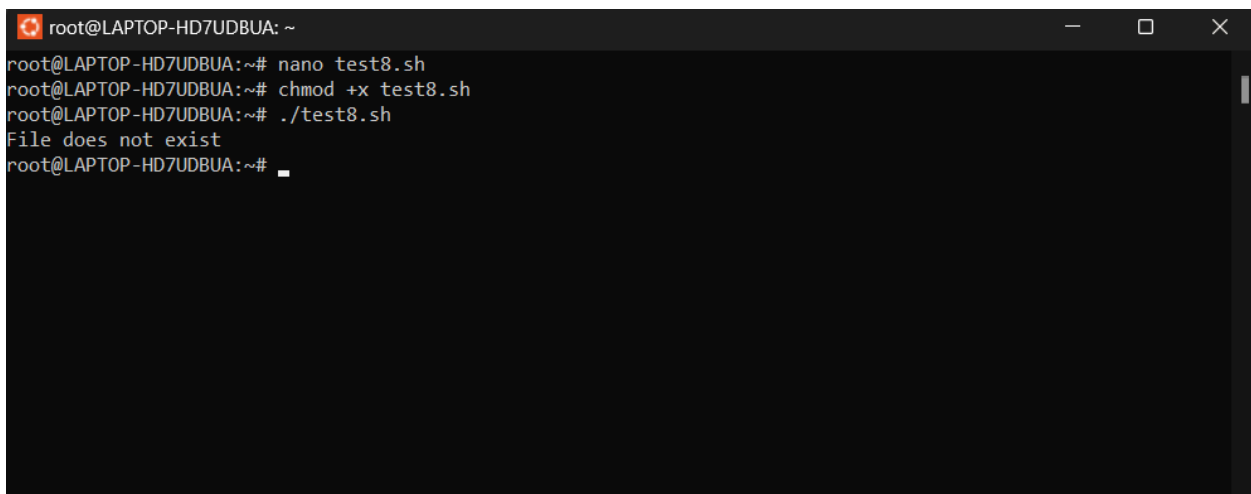
```
fi
```

chmod +x test.sh

./test8.sh



```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test8.sh
if [ -f "file.txt" ]; then
    echo "File exists"
else
    echo "File does not exist"
fi
[ Read 5 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location  M-U Undo
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line M-E Redo
```



```
root@LAPTOP-HD7UDBUA: ~
root@LAPTOP-HD7UDBUA:~# nano test8.sh
root@LAPTOP-HD7UDBUA:~# chmod +x test8.sh
root@LAPTOP-HD7UDBUA:~# ./test8.sh
File does not exist
root@LAPTOP-HD7UDBUA:~#
```

Question 9: Write a shell script that uses the if statement to check if a number is greater than 10 and prints a message accordingly.

```
nano test9.sh
```

```
echo "Please enter a number"
```

```
read number
```

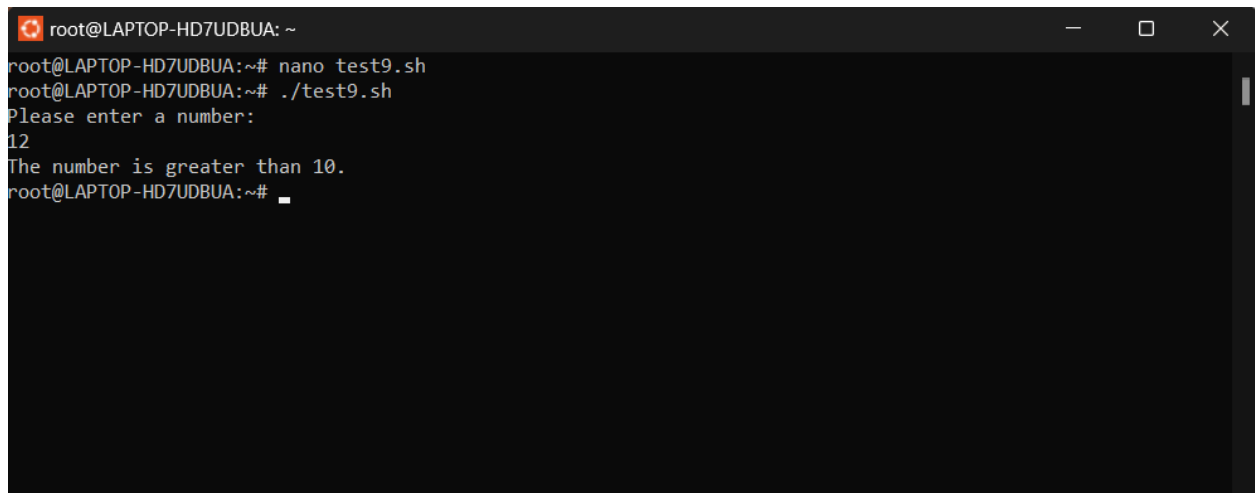
```
if [ "$number" -gt 10 ]; then
```

```
    echo "The number is greater than 10."
```

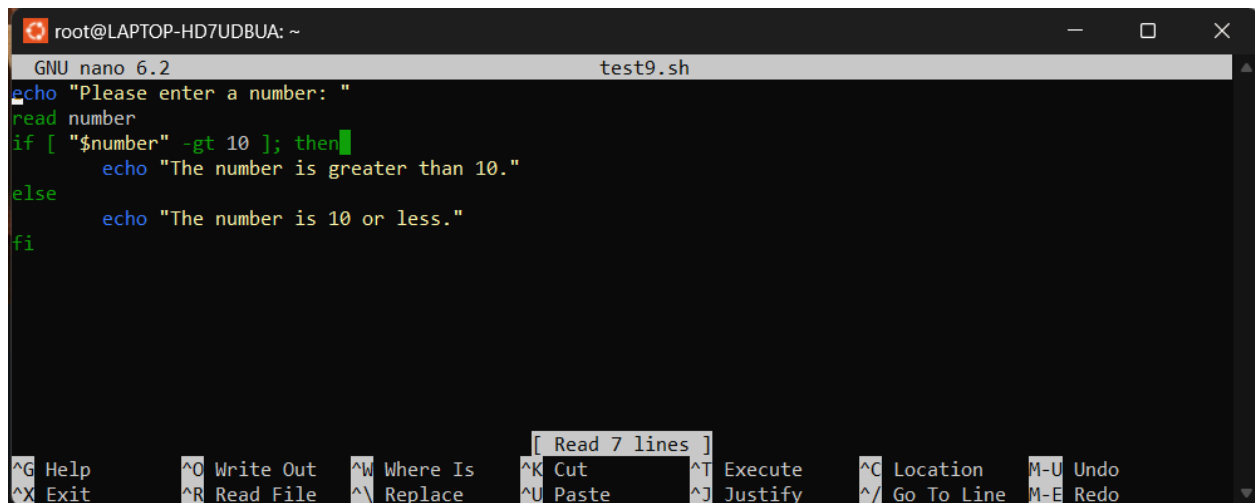
```
else
```

```
    echo "The number is 10 or less."
```

```
fi
```



```
root@LAPTOP-HD7UDBUA: ~
root@LAPTOP-HD7UDBUA:~# nano test9.sh
root@LAPTOP-HD7UDBUA:~# ./test9.sh
Please enter a number:
12
The number is greater than 10.
root@LAPTOP-HD7UDBUA:~#
```



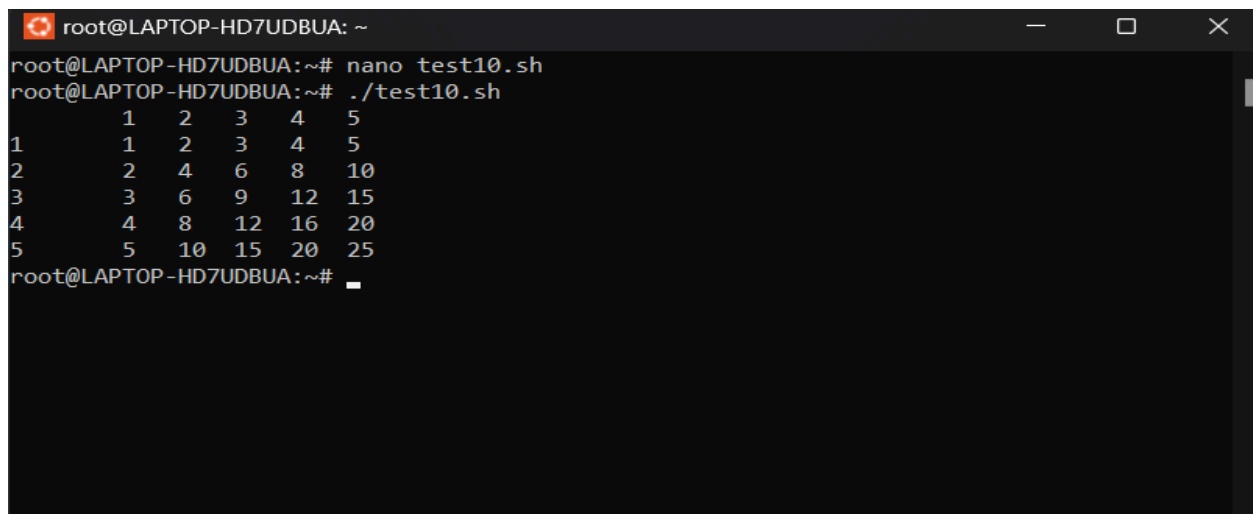
```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test9.sh
echo "Please enter a number: "
read number
if [ "$number" -gt 10 ]; then
    echo "The number is greater than 10."
else
    echo "The number is 10 or less."
fi
```

[Read 7 lines]

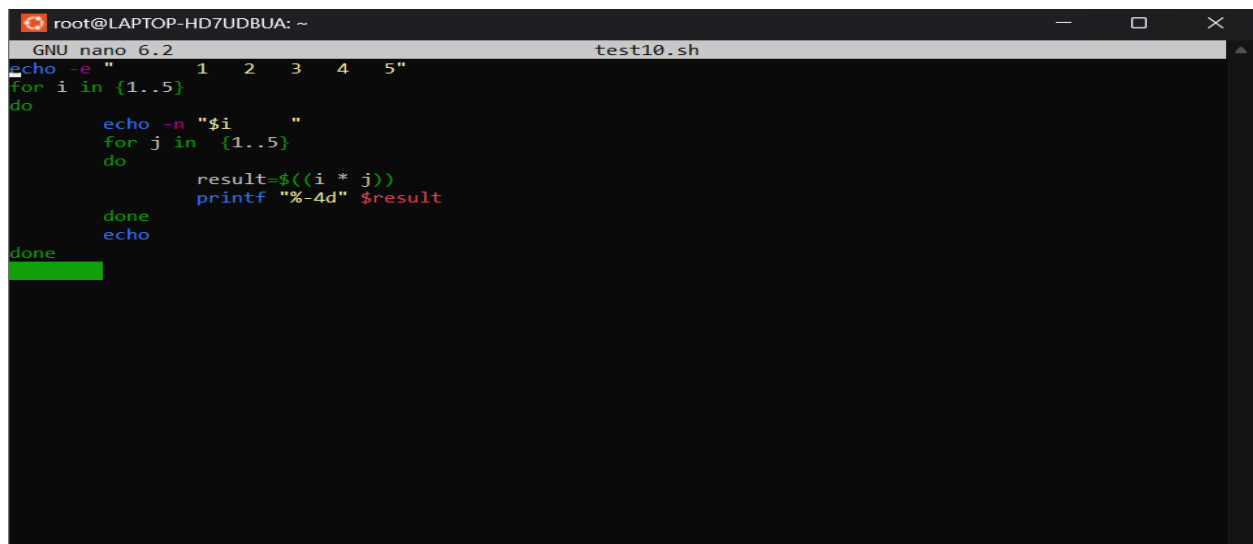
^G Help	^O Write Out	^W Where Is	^K Cut	^T Execute	^C Location	M-U Undo
^X Exit	^R Read File	^_ Replace	^U Paste	^J Justify	^_ Go To Line	M-E Redo

Question 10: Write a shell script that uses nested for loops to print a multiplication table for numbers from 1 to 5. The output should be formatted nicely, with each row representing a number and each column representing the multiplication result for that number.

```
echo -e " 1\t2\t3\t4\t5"
for i in {1..5}
do
    echo -n "$i "
    for j in {1..5}
    do
        result=$((i * j))
        printf "%-4d" $result
    done
    echo
done
```



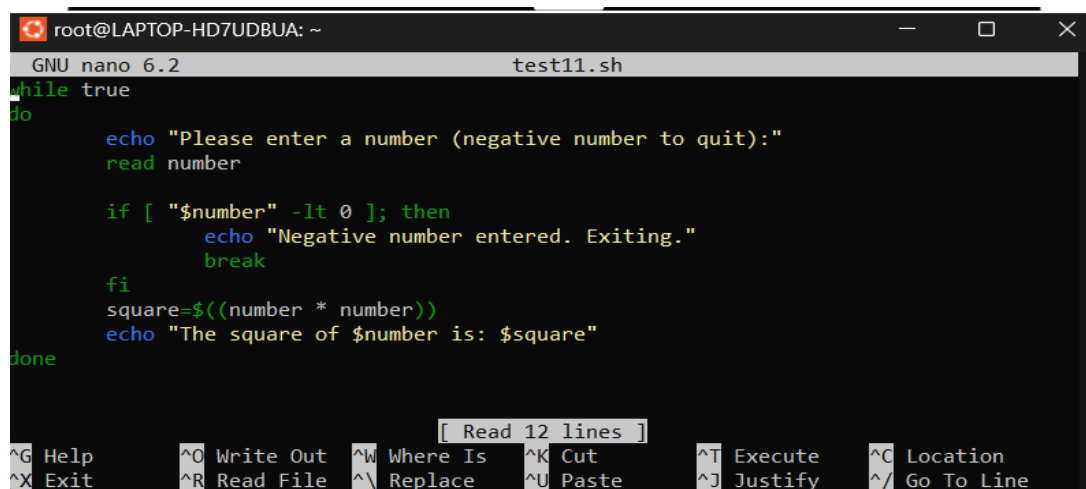
```
root@LAPTOP-HD7UDBUA: ~
root@LAPTOP-HD7UDBUA:~# nano test10.sh
root@LAPTOP-HD7UDBUA:~# ./test10.sh
 1  2  3  4  5
1  1  2  3  4  5
2  2  4  6  8 10
3  3  6  9 12 15
4  4  8 12 16 20
5  5 10 15 20 25
root@LAPTOP-HD7UDBUA:~#
```



```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test10.sh
echo -e " 1  2  3  4  5"
for i in {1..5}
do
    echo -n "$i "
    for j in {1..5}
    do
        result=$((i * j))
        printf "%-4d" $result
    done
    echo
done
```

Question 11: Write a shell script that uses a while loop to read numbers from the user until the user enters a negative number. For each positive number entered, print its square. Use the break statement to exit the loop when a negative number is entered.

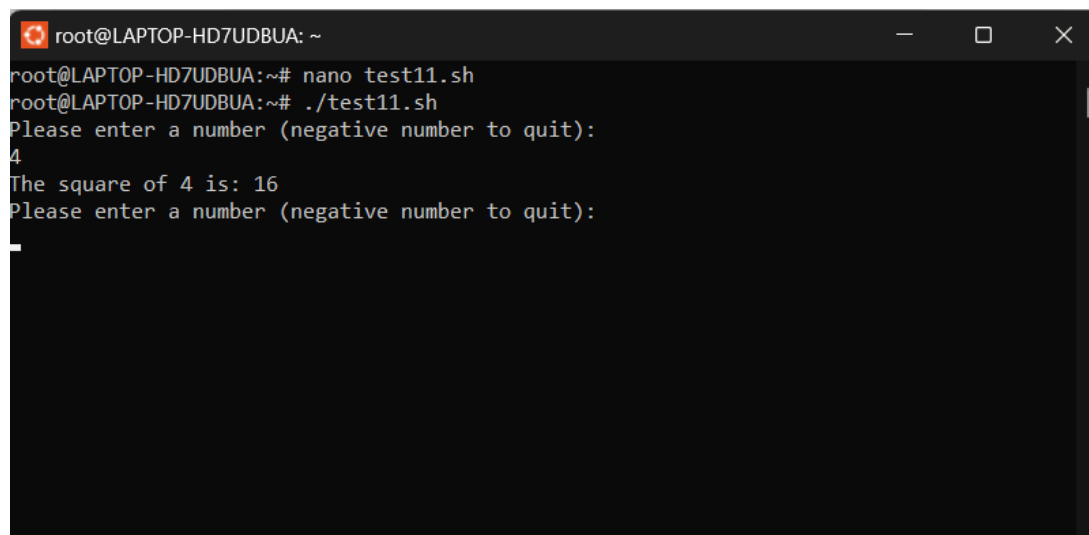
```
while true
do
    echo "Please enter a number (negative number to quit):"
    if [ "$number" -lt 0 ]; then
        echo "Negative number entered. Exiting."
        break
    fi
    square=$((number * number))
    echo "The square of $number is: $square"
done
```



```
root@LAPTOP-HD7UDBUA: ~
GNU nano 6.2 test11.sh
while true
do
    echo "Please enter a number (negative number to quit):"
    read number

    if [ "$number" -lt 0 ]; then
        echo "Negative number entered. Exiting."
        break
    fi
    square=$((number * number))
    echo "The square of $number is: $square"
done

[ Read 12 lines ]
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^_ Go To Line
```



```
root@LAPTOP-HD7UDBUA: ~
root@LAPTOP-HD7UDBUA:~# nano test11.sh
root@LAPTOP-HD7UDBUA:~# ./test11.sh
Please enter a number (negative number to quit):
4
The square of 4 is: 16
Please enter a number (negative number to quit):
```

Part E

1. Consider the following processes with arrival times and burst times:

Process	Arrival Time	Burst Time
P1	0	5
P2	1	3
P3	2	6

Calculate the average waiting time using First-Come, First-Served (FCFS) scheduling.

Process	Arrival Time	Burst Time	Waiting Time	TAT	CT
P1	0	5	0	5-0=5	5
P2	1	3	5-1=4	8-1=7	8
P3	2	6	8-2=6	14-2=12	14

GANTT CHART			
P1	P2	P3	
0	5	8	14

Average Waiting Time = $0 + 4 + 6 / 3$
Average Waiting Time = 3.3

2. Consider the following processes with arrival times and burst times:

Process	Arrival Time	Burst Time
P1	0	3
P2	1	5
P3	2	1
P4	3	4

Calculate the average turnaround time using Shortest Job First (SJF) scheduling

SJF					
Process	Arrival Time	Burst Time	CT	WT	TAT
P1	0	3	3	0	3
P2	1	5	13	7	12
P3	2	1	4	1	2
P4	3	4	8	1	5
GANTT CHART					
P1	P3	P4	P2		
0	3	4	8	13	
Average TAT = $(3 + 12 + 2 + 5) / 4$					
Average TAT = 5.5					

Process	Arrival Time	Burst Time	Priority
P1	0	6	3
P2	1	4	1
P3	2	7	4
P4	3	2	2

Process	Arrival Time	Burst Time	Priority	CT	WT	TAT
P1	0	6	3	6	0	6
P2	1	4	1	10	5	9
P3	2	7	4	19	10	17
P4	3	2	2	12	7	9

GANTT CHART				
P1	P2	P4	P3	
0	6	10	12	19

Average Waiting Time = $(0 + 5 + 10 + 7) / 4$

Average Waiting Time = 5.5

4. Consider the following processes with arrival times and burst times, and the time quantum for Round Robin scheduling is 2 units:

Process	Arrival Time	Burst Time
P1	0	4
P2	1	5
P3	2	2
P4	3	3

Calculate the average turnaround time using Round Robin scheduling.

Round Robin								
	Process	Arrival Time	Burst Time	CT	WT	TAT		
	P1	0	4	10	$6-0=6$	10		
	P2	1	5	16	$(2+6+2)-1=10$	15		
	P3	2	2	6	$(4)-2=2$	4		
	P4	3	3	14	$(6+4)-3=8$	11		
GANTT CHART								
	P1	P2	P3	P4	P1	P2	P4	P2
0		2	4	6	8	10	12	14
								16
	Average TAT = $6 + 9 + 2 + 7 / 4$							
	Average TAT = 6.5							

5. Consider a program that uses the fork() system call to create a child process. Initially, the parent process has a variable x with a value of 5. After forking, both the parent and child processes increment the value of x by 1. What will be the final values of x in the parent and child processes after the fork() call?

When a process calls fork() it creates a new child process that is a duplicate of the parent process. This includes the state of all variables, including the variable x. However, the parent and child processes have separate memory spaces, meaning they do not share the same memory for the variable x. Instead, each process has its own copy of x.

Here's how the execution proceeds:

- Before Fork:
 - The parent process has a variable x with a value of 5.
- After Fork:
 - The child process is created with a copy of the parent process's memory, so the child also has a variable x with a value of 5.
 - Now there are two independent processes: the parent and the child.
- Incrementing x:
 - Both the parent and the child increment their own copy of x by 1.
 - In the parent process, x becomes 6.

- In the **child process**, `x` also becomes `6`.

Final Values:

- **Parent process:** `x = 6`
- **Child process:** `x = 6`

Thus, after the `fork()` call and the increment operation, the value of `x` will be `6` in both the parent and child processes.