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CDAC MUMBAI

Concepts of Operating System

Assignment 2

Part A

What will the following commands do?

- **echo "Hello, World!" -** Prints "Hello, World!" to the terminal.
- **name="Productive" -** Assigns the value "Productive" to the variable name.
- **touch file.txt -** Creates an empty file named file.txt (or updates the timestamp if it exists).
- **ls -a -** Lists all files and directories, including hidden ones.
- **rm file.txt -** Deletes file.txt.
- **cp file1.txt file2.txt -** Copies file1.txt to file2.txt**.**
- **mv file.txt /path/to/directory/ -** Moves file.txt to the specified directory.
- **chmod 755 script.sh -** Changes permissions of script.sh to be readable and executable by everyone, but only writable by the owner.
- **grep "pattern" file.txt -** Searches for "pattern" in file.txt.
- **kill PID -** Terminates the process with the specified PID.
- **mkdir mydir && cd mydir && touch file.txt && echo "Hello, World!" > file.txt && cat file.txt -** Creates a directory mydir, navigates into it, creates file.txt, writes "Hello, World!" into it, and displays the content.
- **ls -l | grep ".txt" -** Lists details of files and directories, filtering to show only .txt files.
- **cat file1.txt file2.txt | sort | uniq -** Combines contents of both files, sorts them, and removes duplicate lines.

- **ls -l | grep "^d" -** Lists details of directories only.
- **grep -r "pattern" /path/to/directory/ -** Recursively searches for "pattern" in all files under the specified directory.
- **cat file1.txt file2.txt | sort | uniq –d -** Lists only duplicate lines found in both files.
- **chmod 644 file.txt -** Sets permissions so the owner can read/write, while others can only read.
- **cp -r source_directory destination_directory -** Recursively copies a directory and its contents.
- **find /path/to/search -name "*.txt" -** Finds all .txt files under the specified path.
- **chmod u+x file.txt** - Gives the owner execution permission for file.txt.
- **echo $PATH -** Displays the system's PATH environment variable.

Part B

Identify True or False:

ls is used to list files and directories in a directory. - **True**

mv is used to move (or rename) files and directories. - **True**

cd is used to change the current directory, not copy files. - **False** (cp is used for copying files and directories.)

pwd stands for "print working directory" and displays the current directory path. - **True**

grep is used to search for patterns in files. – **True**

mkdir -p directory1/directory2 creates nested directories, including directory1 if it does not exist, and then directory2 inside it. – **True**

rm -rf file.txt deletes the file forcefully without confirmation. - **True**

(The -r is for recursive deletion (mainly for directories), and -f forces the deletion without prompts.)

mkdir -p directory1/directory2 creates nested directories. If directory1 does not exist, it will be created along with directory2. - **True**

Identify the Incorrect Commands:

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

Incorrect - chmodx is not a valid command. The correct command for changing file permissions is **chmod**.

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

Incorrect - cpy is not a valid command. The correct command for copying files and directories is **cp.**

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

Incorrect - mkfile is not typically used in Linux to create a new file. The common way is to use **touch or redirection (>)** to create an empty file.

4. **catx** is used to concatenate files.

Incorrect - catx is not a valid command. The correct command for concatenating and displaying file contents is **cat.**

5. **rn** is used to rename files.

Incorrect - rn is not a valid command. The correct command for renaming files is mv.

Part C

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

cdac@LAPTOP-0IP9GGLJ:~$ pwd

/home/cdac

cdac@LAPTOP-0IP9GGLJ:~$ ls

LinuxAssignment

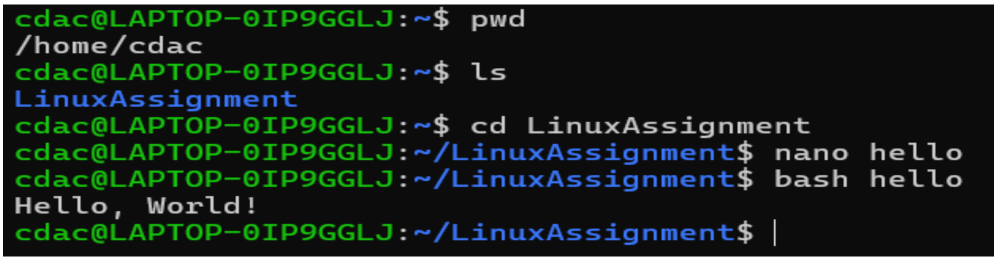
cdac@LAPTOP-0IP9GGLJ:~$ cd LinuxAssignment

cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano hello

cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash hello

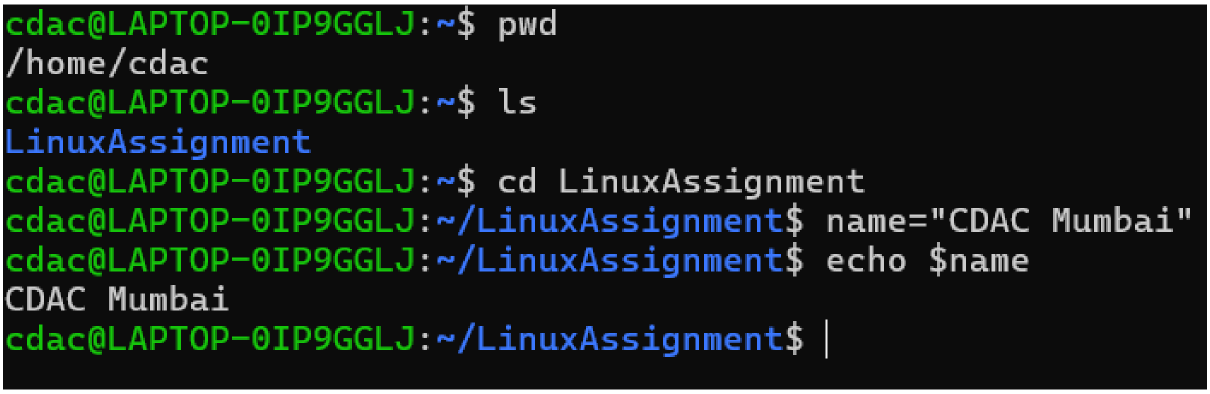
Hello, World!

cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$



```
cdac@LAPTOP-0IP9GGLJ:~$ pwd
/home/cdac
cdac@LAPTOP-0IP9GGLJ:~$ ls
LinuxAssignment
cdac@LAPTOP-0IP9GGLJ:~$ cd LinuxAssignment
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano hello
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash hello
Hello, World!
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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



```
cdac@LAPTOP-0IP9GGLJ:~$ pwd
/home/cdac
cdac@LAPTOP-0IP9GGLJ:~$ ls
LinuxAssignment
cdac@LAPTOP-0IP9GGLJ:~$ cd LinuxAssignment
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ name="CDAC Mumbai"
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ echo $name
CDAC Mumbai
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano print
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat print
echo "Enter a number"
read number
echo "You Entered: $number"
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash print
Enter a number
12
You Entered: 12
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ |
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano addition2no
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat addition2no
num1=5
num2=3
sum=$((num1 + num2))
echo "Addition of $num1 and $num2 is: $sum"
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash addition2no
Addition of 5 and 3 is: 8
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ |
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano EvenOdd
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat EvenOdd
echo "Enter a number:"
read n
if [ $((n % 2)) -eq 0 ]; then
        echo "Even"
else
        echo "Odd"
fi
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash EvenOdd
Enter a number:
2
Even
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash EvenOdd
Enter a number:
3
Odd
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ |
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano printno
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat printno
for i in {1..5}
do
   echo $i
done
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash printno
1
2
3
4
5
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano whileprintno
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat whileprintno
i=1
while [ $i -le 5 ]
do
   echo $i
   i=$((i + 1))
done
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash whileprintno
1
2
3
4
5
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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".

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano filecheck
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat filecheck
if [ -e file.txt ]; then
    echo "File exists"
else
   echo "File does not exists"
fi
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash filecheck
File does not exists
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano graterno
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat graterno
echo "Enter a number"
read number
if [ $number -gt 10 ]; then
     echo "The number is greater than 10"
else
     echo "The number is no greater than 10"
fi
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash graterno
Enter a number
77
The number is greater than 10
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash graterno
Enter a number
5
The number is no greater than 10
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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.

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano multiplicationtable
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat multiplicationtable
for i in {1..5}
do
         for j in {1..5}
         do
               result=`expr $i \* $j`
               echo -n "$result        "
        done
        echo
done
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash multiplicationtable
1       2       3       4       5
2       4       6       8       10
3       6       9       12       15
4       8       12       16       20
5       10       15       20       25
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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.

```
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ nano posinegi
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ cat posinegi
while true
do
   echo "Enter a number:"
   read number
   if [ $number -lt 0 ]; then
       break
   fi
   echo "The square of $number is: $((number * number))"
done

cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$ bash posinegi
Enter a number:
34
The square of 34 is: 1156
Enter a number:
68
The square of 68 is: 4624
Enter a number:
-34
cdac@LAPTOP-0IP9GGLJ:~/LinuxAssignment$
```

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.

Step 1: Compute Completion Time (CT)

FCFS executes processes in the order they arrive.

1. **P1** starts at time **0** and finishes at 0+5=50 + 5 = 5.
2. **P2** starts at time **5** and finishes at 5+3=85 + 3 = 8.
3. **P3** starts at time **8** and finishes at 8+6=148 + 6 = 14.

Process	Arrival Time	Burst Time	Completion Time (CT)
P1	0	5	5
P2	1	3	8
P3	2	6	14

Step 2: Compute Turnaround Time (TAT)

TAT=CT−AT

Process	Arrival Time	Completion Time	Turnaround Time (TAT)
P1	0	5	5−0=55 - 0 = 5
P2	1	8	8−1=78 - 1 = 7
P3	2	14	14−2=1214 - 2 = 12

Step 3: Compute Waiting Time (WT)

WT=TAT−BT

Process	Turnaround Time (TAT)	Burst Time	Waiting Time (WT)
P1	5	5	5−5=05 - 5 = 0
P2	7	3	7−3=47 - 3 = 4
P3	12	6	12−6=612 - 6 = 6

Step 4: Compute Average Waiting Time (AWT)

0+4+6/3 = 3.33

Average Waiting Time (AWT) = 3.33 ms

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.

Step 1: Arrange Processes Based on Arrival Time

SJF selects the process with the shortest burst time that has arrived at any given time.

Step 2: Compute Completion Time (CT)

- P1 starts at 0 and finishes at 0+3=30 + 3 = 3.
- P3 has the shortest burst time (1) among available processes (P2, P3, P4) at time 3, so it starts at 3 and finishes at 3+1=43 + 1 = 4.
- P4 has the next shortest burst time (4), so it starts at 4 and finishes at 4+4=84 + 4 = 8.
- P2 is the only process left, so it starts at 8 and finishes at 8+5=138 + 5 = 13.

Process	Arrival Time	Burst Time	Completion Time (CT)
P1	0	3	3

Process	Arrival Time	Burst Time	Completion Time (CT)
P3	2	1	4
P4	3	4	8
P2	1	5	13

Step 3: Compute Turnaround Time (TAT)

TAT=CT−ATTAT = CT - AT

Process	Arrival Time	Completion Time	Turnaround Time (TAT)
P1	0	3	3−0=33 - 0 = 3
P3	2	4	4−2=24 - 2 = 2
P4	3	8	8−3=58 - 3 = 5
P2	1	13	13−1=1213 - 1 = 12

Step 4: Compute Average Turnaround Time (ATAT)

$\frac{3+2+5+12}{4} = 5.5$

Average Turnaround Time (ATAT) = 5.5 ms

3. Consider the following processes with arrival times, burst times, and priorities (lower number

indicates higher priority):

| Process | Arrival Time | Burst Time | Priority |

|---------|--------------|------------|----------|

| P1 | 0 | 6 | 3 |

| P2 | 1 | 4 | 1 |

| P3 | 2 | 7 | 4 |

| P4 | 3 | 2 | 2 |

Calculate the average waiting time using Priority Scheduling.

Step 1: Execution Order Based on Priority

- At time 0, P1 is the only available process, so it starts first.
- At time 6, P2 (priority 1) arrives and has the highest priority, so it runs next.
- At time 10, P4 (priority 2) is the next highest priority, so it runs next.
- At time 12, P3 (priority 4) runs last.

Execution Order	**Process**	**Arrival Time**	**Burst Time**	**Priority**
1st	P1	0	6	3
2nd	P2	1	4	1
3rd	P4	3	2	2
4th	P3	2	7	4

Step 2: Compute Completion Time (CT)

- P1 starts at 0 and finishes at 0+6=60 + 6 = 6.
- P2 starts at 6 and finishes at 6+4=106 + 4 = 10.
- P4 starts at 10 and finishes at 10+2=1210 + 2 = 12.
- P3 starts at 12 and finishes at 12+7=1912 + 7 = 19.

Process	**Arrival Time**	**Burst Time**	**Completion Time (CT)**
P1	0	6	6
P2	1	4	10
P4	3	2	12
P3	2	7	19

Step 3: Compute Turnaround Time (TAT)

TAT=CT−AT

Process	**Arrival Time**	**Completion Time**	**Turnaround Time (TAT)**
P1	0	6	6−0=66 - 0 = 6
P2	1	10	10−1=910 - 1 = 9
P4	3	12	12−3=912 - 3 = 9

Process	Arrival Time	Completion Time	Turnaround Time (TAT)
P3	2	19	19−2=1719 - 2 = 17

Step 4: Compute Waiting Time (WT)

WT=TAT−BT

Process	Turnaround Time (TAT)	Burst Time	Waiting Time (WT)
P1	6	6	6−6=06 - 6 = 0
P2	9	4	9−4=59 - 4 = 5
P4	9	2	9−2=79 - 2 = 7
P3	17	7	17−7=1017 - 7 = 10

Step 5: Compute Average Waiting Time (AWT)

$$\frac{0+5+7+10}{4} = 5.5$$

Average Waiting Time (AWT) = 5.5 ms

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 the fork() system call is used in a program, it creates a child process that is a copy of the parent process. This means that all variables, including x, are duplicated in the child process.

Step-by-step analysis:

1. Before calling fork(), the parent process has a variable x initialized to 5.
2. The fork() call creates a child process, which gets its own copy of x with an initial value of 5. (x = 5)
3. Both the parent and child processes then increment their respective copies of x by 1.
   - In the parent process: x becomes 6.
   - In the child process: x also becomes 6.

Since the two processes have separate memory spaces after the fork(), changes made to x in one process do not affect the other.

Final Values:

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

Each process modifies its own independent copy of x, so both end up with the value 6.