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S.No.	Name of the Experiment	Date	Page No.	Marks Awarded	Remarks

OS RECORD

WEEK-1

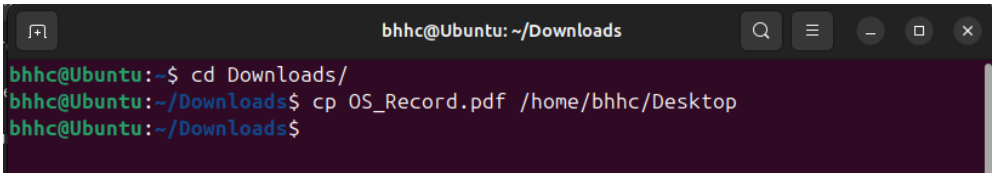
AIM: Understanding and practical exposure towards Basic Linux commands.

1. pwd

- **Definition**: Displays the full, absolute path of the current working directory, starting from the root (`/`).
- **Syntax**: `pwd`
- **Command**: `pwd`
- **Output**:

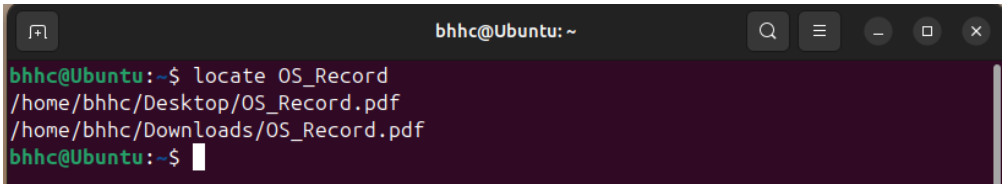
2. cp

- **Definition**: Copies files or directories from one location to another. Can also copy multiple files to a directory.
- **Syntax**: `cp [options] source destination`
- **Command**: `cp OS_Record.pdf /home/Desktop`
- **Output**:



3. locate

- **Definition**: Searches for files and directories by name using an indexed database, making it faster than other search commands.
- **Syntax**: `locate [pattern]`
- **Command**: `locate OS_Record`
- **Output**:

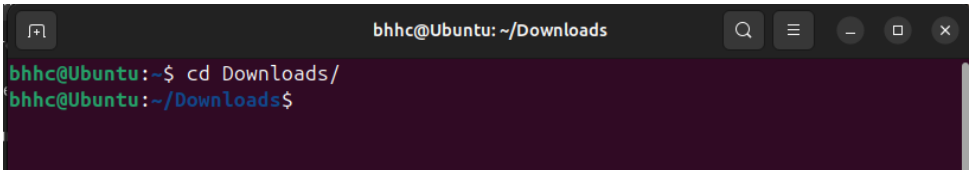


4. kill

- **Definition**: Terminates a process by sending it a signal, typically used to stop unresponsive programs.
- **Syntax**: `kill [signal] PID`
- **Command**: `kill -l`
- **Output**:

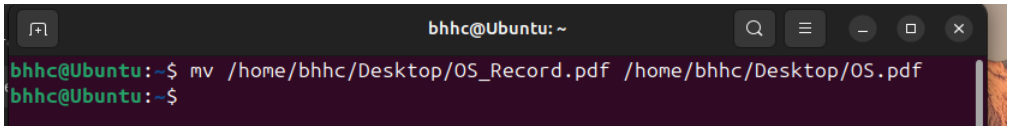
5. cd

- **Definition**: Changes the current working directory to the specified directory. Can navigate using relative or absolute paths.
- **Syntax**: `cd [directory]`
- **Command**: `cd Downloads/`
- **Output**:



6. mv

- **Definition**: Moves or renames files and directories. Can transfer files between directories or update their names.
- **Syntax**: `mv [source] [destination]`
- **Command**: `mv /home/bhhc/Desktop/OS_Record.pdf /home/bhhc/Desktop/OS.pdf`
- **Output**:



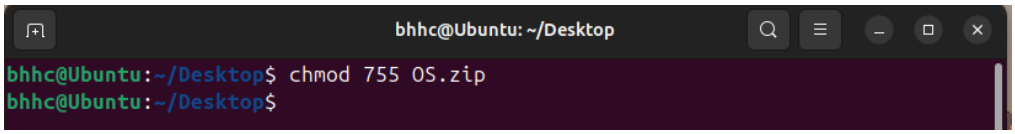
7. find

- **Definition**: Searches for files and directories based on conditions like name, size, or permissions, and performs actions on them if specified.
- **Syntax**: `find [path] [options] [expression]`
- **Command**: `find /home -name "*.pdf"`

- **Output**:

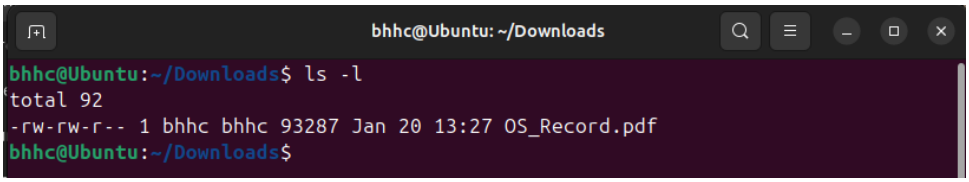
8. chmod

- **Definition**: Modifies the read, write, and execute permissions of a file or directory for the user, group, and others.
- **Syntax**: `chmod [permissions] [file]`
- **Command**: `chmod 755 script.sh`
- **Output**:



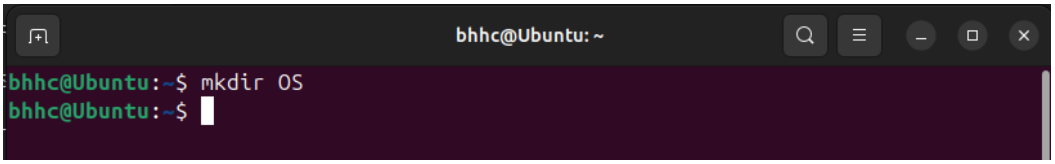
9. ls

- **Definition**: Lists the files and directories in the current or specified directory, with options to show hidden files or detailed metadata.
- **Syntax**: `ls [options] [path]`
- **Command**: `ls -l`
- **Output**:



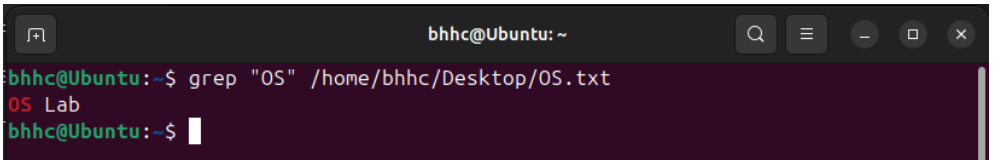
10. mkdir

- **Definition**: Creates a new directory. Can also create parent directories if they do not exist.
- **Syntax**: `mkdir [options] directory`
- **Command**: `mkdir OS`
- **Output**:



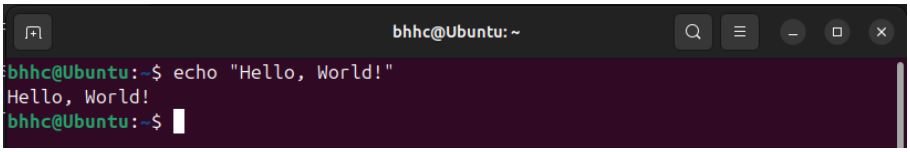
11. grep

- **Definition**: Searches for a specific text pattern in files or output streams and highlights matching lines.
- **Syntax**: `grep [options] pattern [file]`
- **Command**: `grep "OS" mv /home/bhhc/Desktop/OS.pdf`
- **Output**:



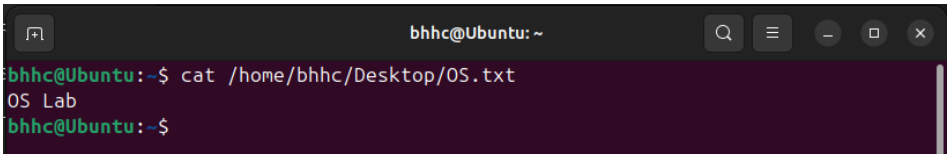
12. echo

- **Definition**: Displays a string or variable value to the terminal. Commonly used in scripts.
- **Syntax**: `echo [string]`
- **Command**: `echo "Hello, World!"`
- **Output**



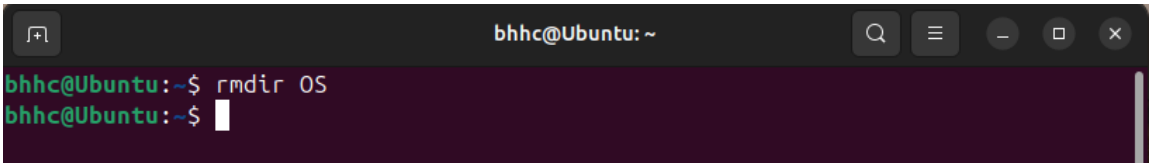
13. cat

- **Definition**: Displays the content of a file, combines multiple files, or creates new files.
- **Syntax**: `cat [file]`
- **Command**: `cat /home/bhhc/Desktop/OS.pdf`
- **Output**:



14. rmdir

- **Definition**: Deletes empty directories. Will not work if the directory contains files or subdirectories.
- **Syntax**: `rmdir [directory]`
- **Command**: `rmdir OS`
- **Output**:

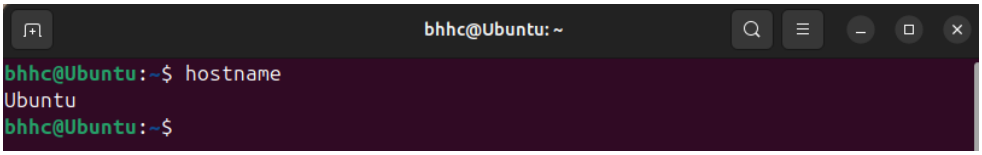


15. man

- **Definition**: Displays the manual page for a command, detailing its purpose, options, and examples.
- **Syntax**: `man [command]`
- **Command**: `man ls`
- **Output**:

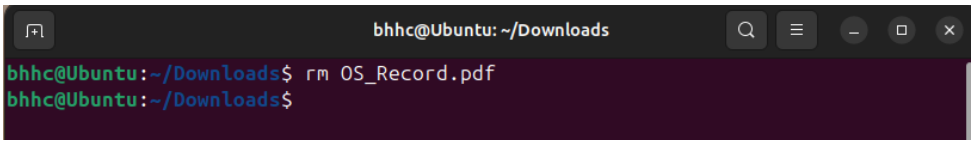
16. hostname

- **Definition**: Displays or sets the hostname of the system, used for network identification.
- **Syntax**: `hostname`
- **Command**: `hostname`
- **Output**:



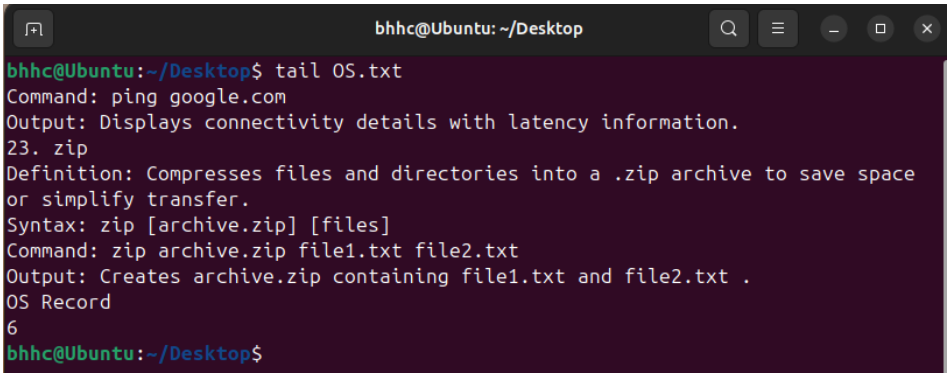
17. rm

- **Definition**: Deletes files and directories. With options, can recursively remove directories and their contents.
- **Syntax**: `rm [options] file`
- **Command**: `rm OS_Record.txt`
- **Output**:



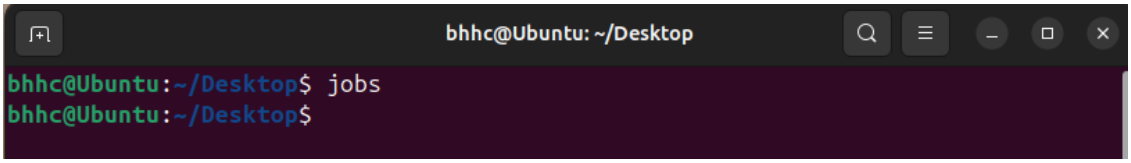
18. tail

- **Definition**: Displays the last few lines of a file, commonly used to monitor logs.
- **Syntax**: `tail [options] [file]`
- **Command**: `tail OS.txt`
- **Output**:



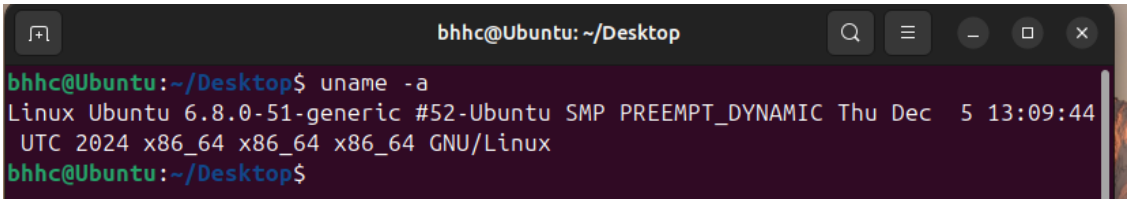
19. jobs

- **Definition**: Lists all active or suspended background jobs in the current shell session.
- **Syntax**: `jobs`
- **Command**: `jobs`
- **Output**:



20. uname

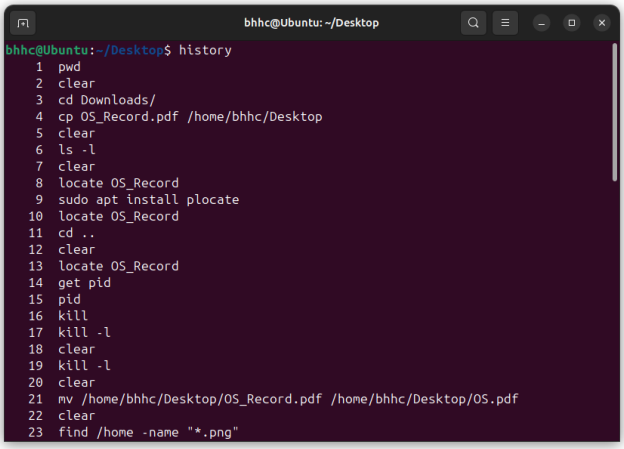
- **Definition**: Provides basic information about the system, such as the kernel name and version.
- **Syntax**: `uname [options]`
- **Command**: `uname -a`
- **Output**:



21. history

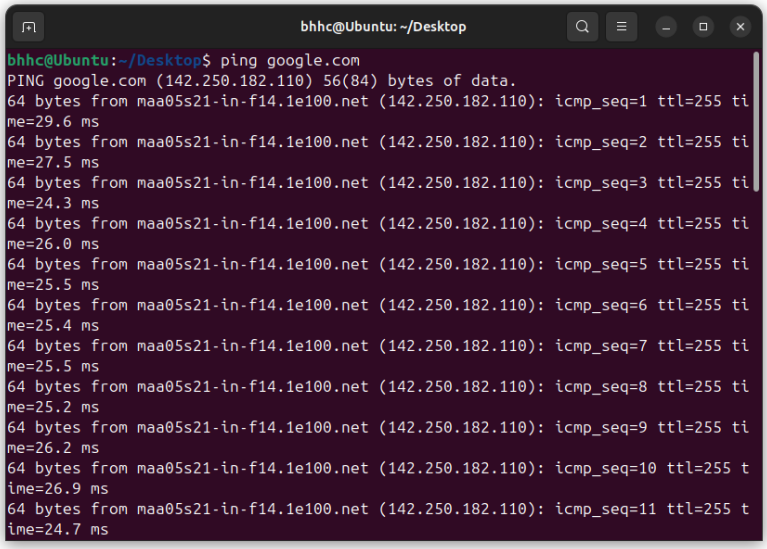
- **Definition**: Displays a list of previously executed commands in the terminal session.
- **Syntax**: `history`

- **Command**: `history`
- **Output**:



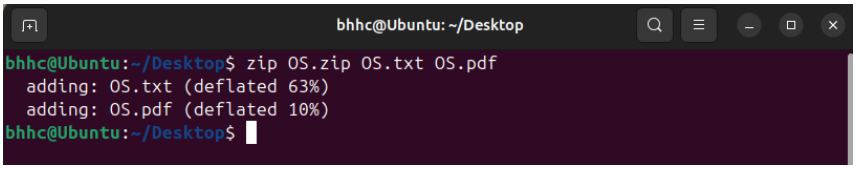
22. ping

- **Definition**: Tests network connectivity by sending packets to a specified host and measuring the response time.
- **Syntax**: `ping [host]`
- **Command**: `ping google.com`
- **Output**:



23. zip

- **Definition**: Compresses files and directories into a `.zip` archive to save space or simplify transfer.
- **Syntax**: `zip [archive.zip] [files]`
- **Command**: `zip OS.zip OS.txt OS.pdf`
- **Output**:



WEEK-2

AIM: Collect the basic information about your machine using proc in Linux.

Introduction to Proc File System (/proc)

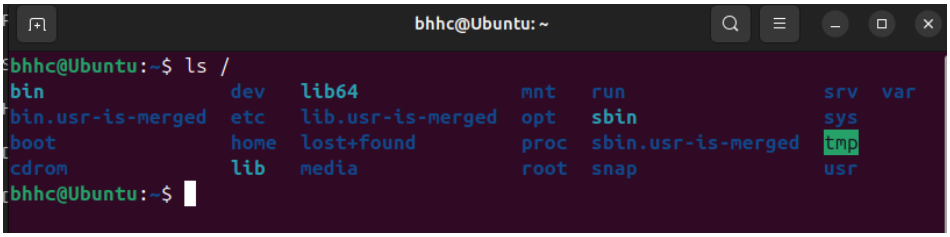
The **proc file system (procfs)** is a virtual file system created dynamically when the system boots and is removed upon shutdown. It serves as a control and information center for the kernel, containing real-time data about system processes. Additionally, it facilitates communication between kernel space and user space.

1. Listing Root Directories:

To list all directories under the root (`/`), use the following command:

```
ls /
```

Output:

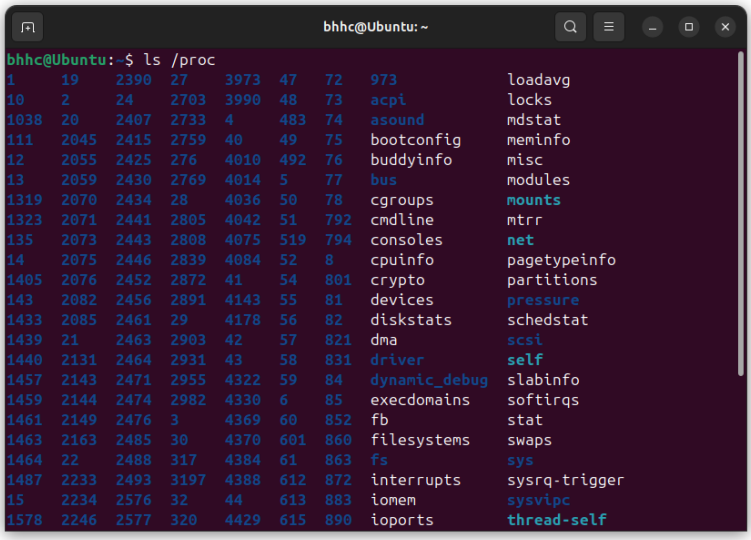


2. Listing Directories Under /proc:

The `/proc` directory contains various subdirectories, each corresponding to a running process. To view them, use:

```
ls /proc
```

Output:



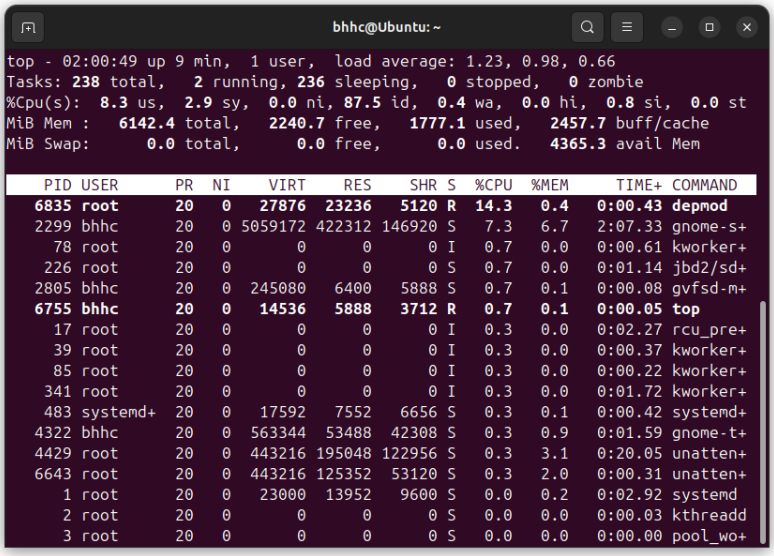
3. Viewing Active Processes Using the "top" Command:

The `top` command provides a dynamic real-time view of system processes. It displays CPU usage, memory consumption, and process details.

```
Top
```

PTO

Output:



4. Terminating Processes Using the Kill Command:

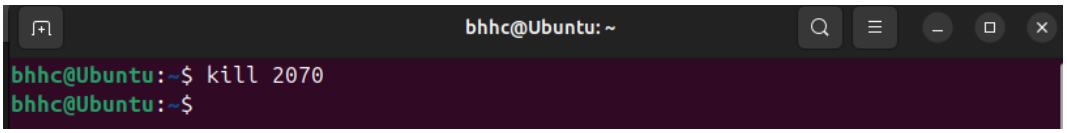
The `kill` command is used to terminate processes by their Process ID (PID).

```
kill <PID>
```

Alternatively, to forcefully kill a process:

```
kill -9 <PID>
```

Output:

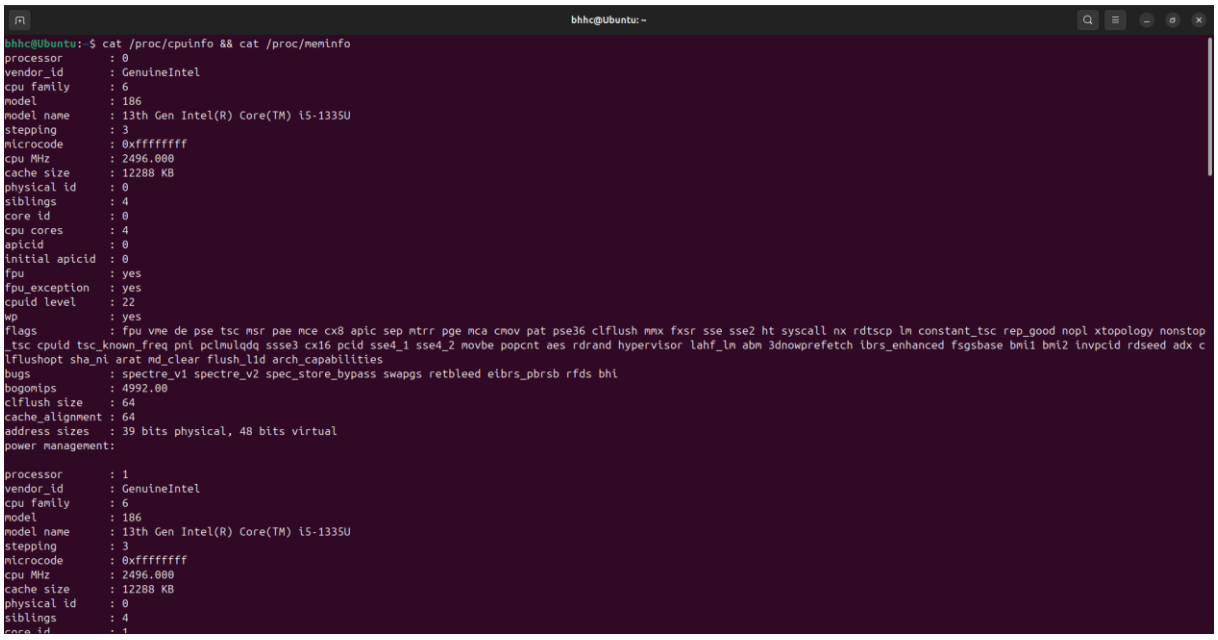


5. Using the Cat Command:

The `cat` command displays the contents of a file. It is useful for reading system and process information:

```
cat /proc/cpuinfo
cat /proc/meminfo
```

Output:

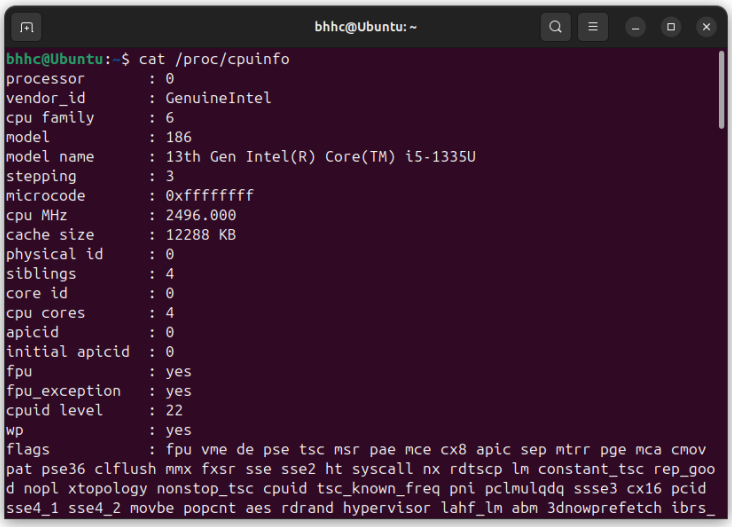


6. Retrieving CPU Information:

To obtain basic details about the CPU, use:

```
cat /proc/cpuinfo
```

Output:



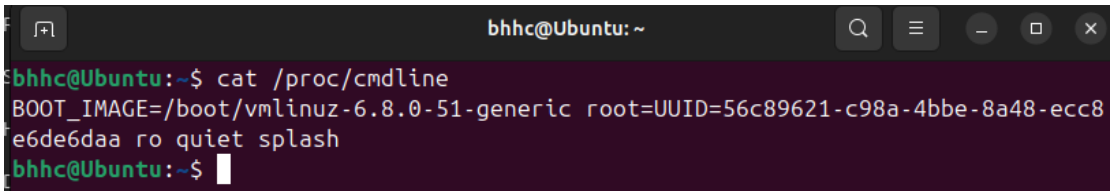
This provides information such as processor type, number of cores, and clock speed.

7. Retrieving Kernel Information:

To view the kernel command line arguments:

```
cat /proc/cmdline
```

Output:

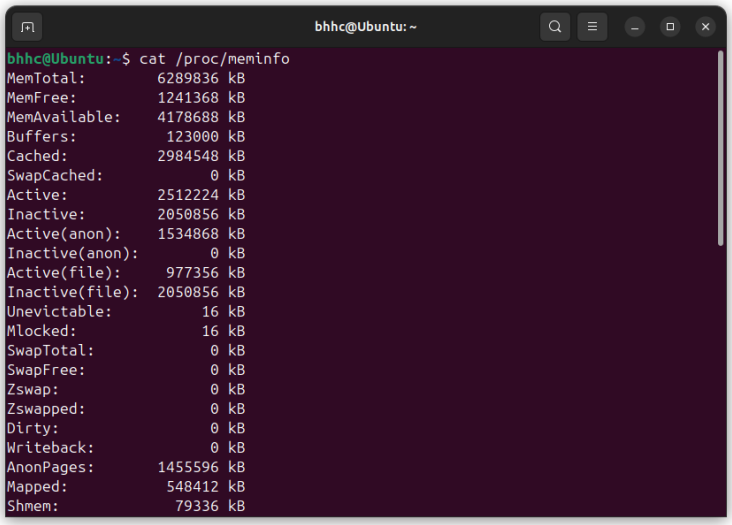


8. Retrieving Memory Information:

To check memory details:

```
cat /proc/meminfo
```

Output:



This displays total available memory, used memory, and free memory.

WEEK-3

AIM: Implementation of write () and read () system calls.

System Calls: A system call provides an interface to services provided by the operating system (OS).

Services of OS

1. User Interface
2. Program Execution
3. I/O Operations
4. File System Manipulations
5. Communications
6. Error Detection
7. Resource Allocation
8. Accounting
9. Protection & Security

Kernel Mode vs User Mode:

- **Kernel Mode:** A program can access all the resources directly. However, there is no backup for kernel mode execution. If one process fails, the entire system crashes.
- **User Mode:** The safest mode for program execution, but it cannot directly access resources. It sends system calls to the kernel mode to request access.
- **Context Switching:** The process of switching between user mode and kernel mode. The calls made by the OS for context switching are known as **System Calls**.

Write System Call:

Syntax:

```
#include <unistd.h>
ssize_t write(int fd, const void *buf, size_t count);
```

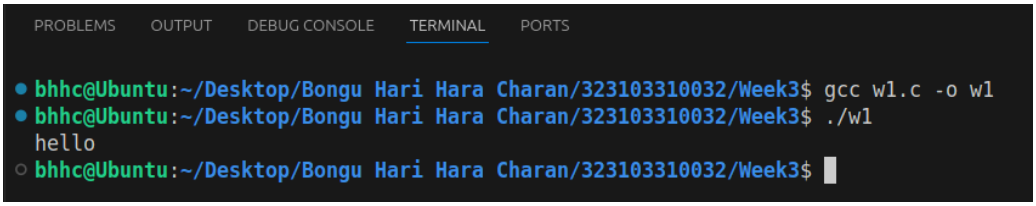
- **fd** – File Descriptors:
  - 1 – Standard output device
  - 0 – Standard input device
  - 2 – Standard error device
- **Return Type:** ssize_t – Returns the number of bytes written. If write() fails, it returns -1.

Program 1: Basic Write System Call

```c
#include <unistd.h>
int main()
{
    write(1, "hello\n", 6);
    return 0;
}
```

PTO

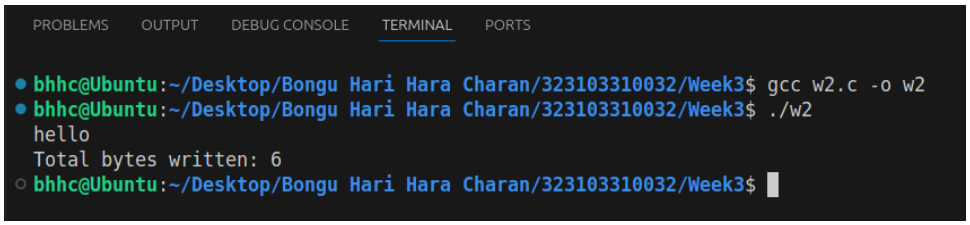
Output:



Program 2: Write System Call with Byte Count

```c
#include <stdio.h>
#include <unistd.h>
int main()
{
    int count;
    count = write(1, "hello\n", 6);
    printf("Total bytes written: %d\n", count);
    return 0;
}
```

Output:



Read System Call

Syntax:

```c
#include <unistd.h>
ssize_t read(int fd, void *buf, size_t count);
```

Program 1: Read Data from Standard Input and Write to Screen

```c
#include <unistd.h>
#include <stdio.h>
int main()
{
    char buff[20];
    printf("\n Enter any text");
    read(0, buff, 10);
    printf("\n Your text is read as");
    write(1, buff, 10);
    return 0;
}
```

PTO

Output:

Program 2: Read Data, Write to Screen, and Count Characters Read

```c
#include <unistd.h>
#include <stdio.h>
int main()
{
    int nread;
    char buff[20];
    printf("\n Enter any text");
    nread = read(0, buff, 10);
    printf("\n Your text is read as");
    write(1, buff, nread); // Print characters from the buffer on the screen
    printf("\n Number of characters read: %d", nread);
    printf("\n");
    return 0;
}
```

Output:

WEEK-4

AIM: Implementation of open (), fork () system calls

Open System Call: The `open()` system call is used to open a file in multiple modes depending on the requirement.

Syntax:

```
int open(const char *pathname, int flags);
int open(const char *pathname, int flags, mode_t mode);
```

The `open()` system call returns an integer file descriptor:

- `0` - Standard input
- `1` - Standard output
- `2` - Standard error

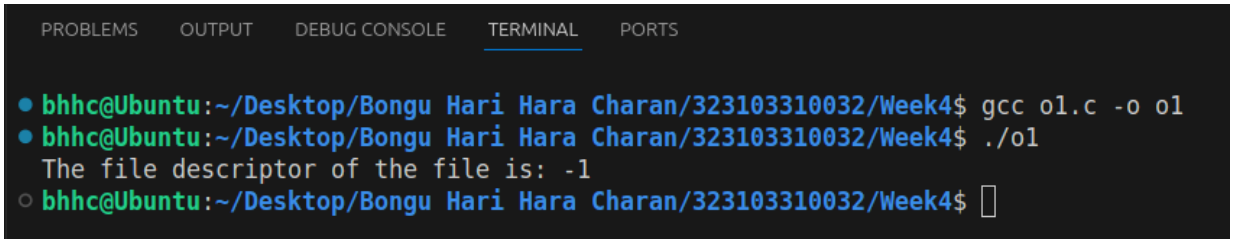
Flags:

- `O_RDONLY` - Read-only mode
- `O_WRONLY` - Write-only mode
- `O_RDWR` - Read and write mode

Read-Only Mode Example
Program to Read First 10 Characters from a File

```c
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

int main() {
    int n, fd;
    char buff[50];
    fd = open("test.txt", O_RDONLY);
    printf("The file descriptor of the file is: %d\n", fd);
    n = read(fd, buff, 10);
    write(1, buff, n);
    return 0;
}
```

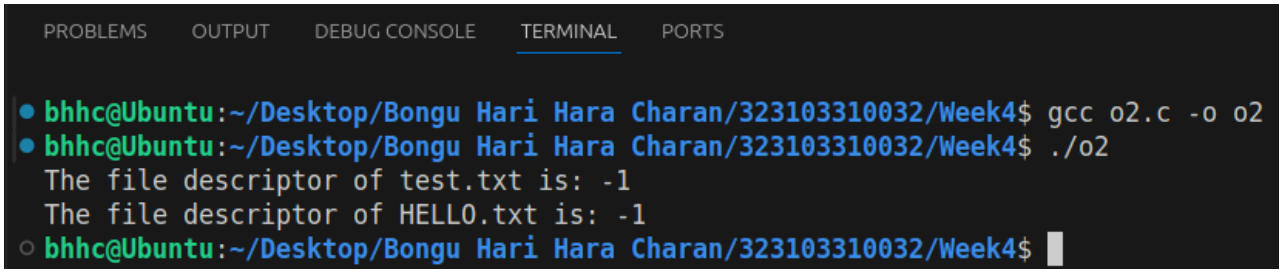
Output:



Program to Read from One File and Write to Another

```c
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

int main() {
    int n, fd1, fd2;
    char buff[50];
    fd1 = open("test.txt", O_RDONLY);
    fd2 = open("HELLO.txt", O_WRONLY);
    printf("The file descriptor of test.txt is: %d\n", fd1);
    printf("The file descriptor of HELLO.txt is: %d\n", fd2);
    n = read(fd1, buff, 20);
    write(fd2, buff, n);
    return 0;
}
```

Output:



How it Works?

1. Create a file **test.txt** and write some content into it (more than 10 characters).
2. The `open()` system call opens `test.txt` in read-only mode and returns a file descriptor stored in `fd`.
3. The `read()` function reads 10 characters from the file into a buffer.
4. The buffer content is displayed on the screen using `write()`.

Expected Output:

1. Create the file `test.txt` and write "`1234567890abcdefghij54321`" into it.
2. Compile the program `open.c`.
3. Run the compiled program.

fork() System Call

The `fork()` system call is used to create a new process. The new process is called a **child process**, and the original process is called the **parent process**.

Syntax:

```c
#include <unistd.h>
pid_t fork(void);
```

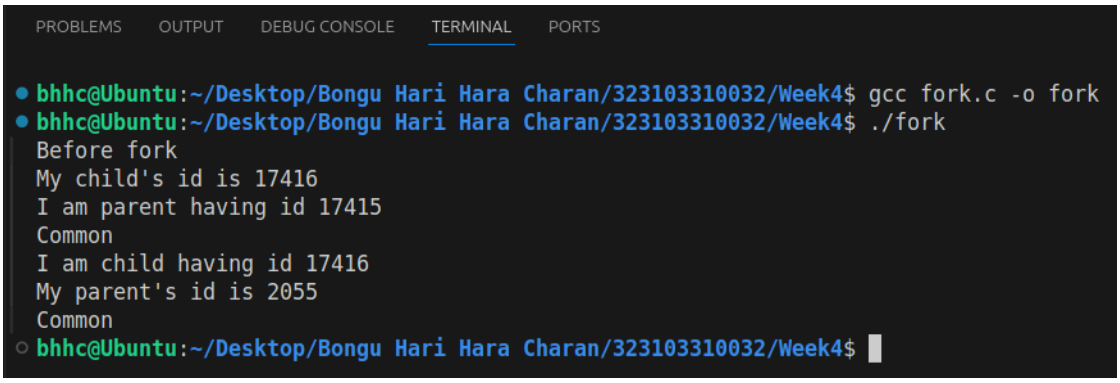
- `fork()` returns `-1` on failure.
- On success, it returns `0` in the child process and the **process ID of the child** in the parent process.

Why Use fork()?
A process may need to perform **two independent tasks**. Instead of executing them sequentially, the parent process creates a **child process** to handle one task while it handles the other. This reduces execution time.

Example Program for fork()

```c
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>

int main() {
    pid_t p;
    printf("Before fork\n");
    p = fork();

    if (p == 0) {
        printf("I am child having id %d\n", getpid());
        printf("My parent's id is %d\n", getppid());
    } else {
        printf("My child's id is %d\n", p);
        printf("I am parent having id %d\n", getpid());
    }
    printf("Common\n");
}
```

Output:



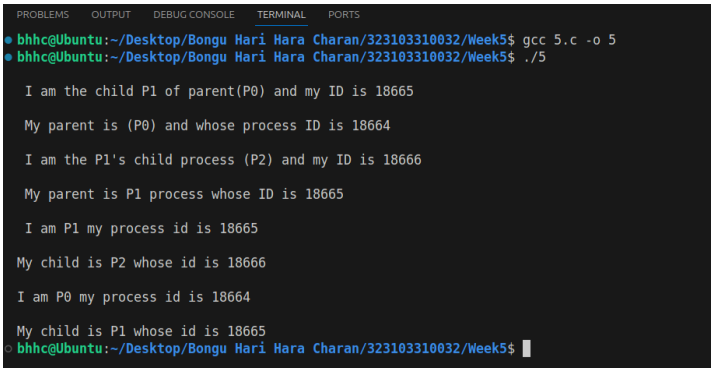
WEEK-5

AIM: Implement a program using fork () system call to create a hierarchy of 3 process such that P2 is the child of P1 and P1 is the child of P.

Program:

```c
#include <sys/wait.h>
#include <sys/types.h>
#include <unistd.h>
#include <stdio.h>

int main(void) {
    pid_t pid1, pid2;
    int status;

    pid1 = fork();
    if (pid1 == 0) { // P1 child process
        printf("\n I am the child P1 of parent(P0) and my ID is %d\n", getpid());
        printf("\n My parent is (P0) and whose process ID is %d\n", getppid());

        pid2 = fork();
        if (pid2 == 0) { // P2 child process
            printf("\n I am the P1's child process (P2) and my ID is %d\n",
getpid());
            printf("\n My parent is P1 process whose ID is %d\n", getppid());
        } else {
            waitpid(pid2, NULL, 0);
            printf("\n I am P1 my process id is %d\n", getpid());
            printf("\nMy child is P2 whose id is %d\n", pid2);
        }
    } else { // P0 parent process
        waitpid(pid1, NULL, 0);
        printf("\nI am P0 my process id is %d\n", getpid());
        printf("\nMy child is P1 whose id is %d\n", pid1);
    }

    return 0;
}
```

Output:



WEEK-6

a) AIM: Program to create an Orphan process.

Program:

```c
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>

int main() {
    pid_t p;
    p = fork();
    if (p == 0) {
        sleep(5);
        printf("I am child having PID %d\n", getpid());
        printf("My parent PID is %d\n", getppid());
    } else {
        printf("I am parent having PID %d\n", getpid());
        printf("My child PID is %d\n", p);
    }
    return 0;
}
```

Output:

b) AIM: Create two child process C1 and C2. Make sure that only C2 becomes an Orphan process.

Program:

```c
#include <stdio.h>
#include<unistd.h>
#include<sys/types.h>
int main() {
    pid_t c,c1;
    printf("before fork of c:\n");
    c=fork();
    if(c==0)
    {
        printf("I am c1 having id:%d\n",getpid());
        printf("my parent c id is:%d\n",getppid());
        printf("before fork of c1:\n");
        c1=fork();
        if(c1==0)
        {
            sleep(2);
            printf("after termination\n");
            printf("i am c2 having id:%d\n",getpid());
            printf("my parent c1 id is:%d\n",getppid());

        }
        else
        {
            printf("I am c1 having id:%d\n",getpid());
        printf("my child c2 id is:%d\n",c1);
        }
    }
    else
    {
         printf("I am c having id:%d\n",getpid());
        printf("my child c1 id is:%d\n",c);
    }
    return 0;
}
```

Output:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week6$ gcc 6b.c -o 6b
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week6$ ./6b
before fork of c:
I am c having id:19242
my child c1 id is:19243
I am c1 having id:19243
my parent c id is:2055
before fork of c1:
I am c1 having id:19243
my child c2 id is:19244
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week6$ after termination
i am c2 having id:19244
my parent c1 id is:2055
```

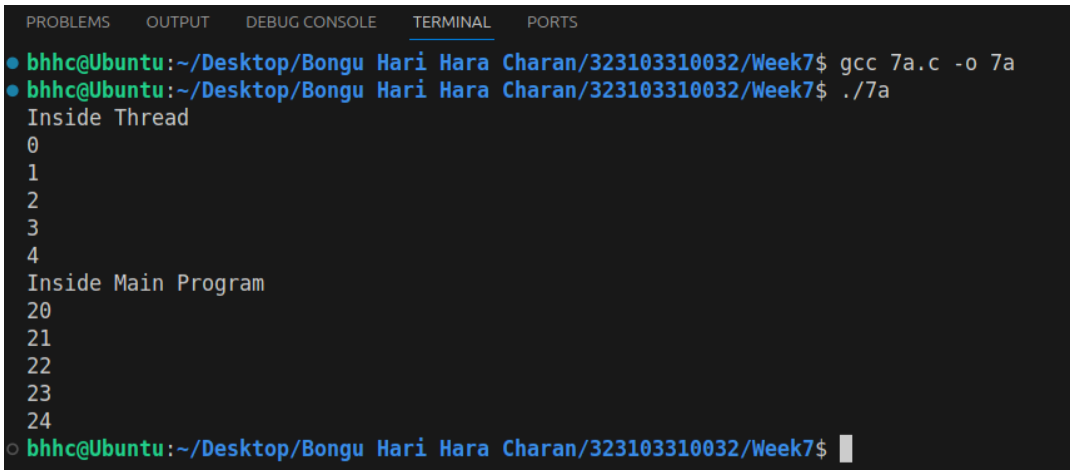
WEEK-7

a) AIM: Program to create threads in Linux. Thread prints 0-4 while the main process prints 20-24

Program:

```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <pthread.h>

void *thread_function(void *arg);
int i, j;

int main() {
    pthread_t a_thread;
    pthread_create(&a_thread, NULL, thread_function, NULL);
    pthread_join(a_thread, NULL);
    printf("Inside Main Program\n");
    for (j = 20; j < 25; j++) {
        printf("%d\n", j);
        sleep(1);
    }
}

void *thread_function(void *arg) {
    printf("Inside Thread\n");
    for (i = 0; i < 5; i++) {
        printf("%d\n", i);
        sleep(1);
    }
}
```

Output:



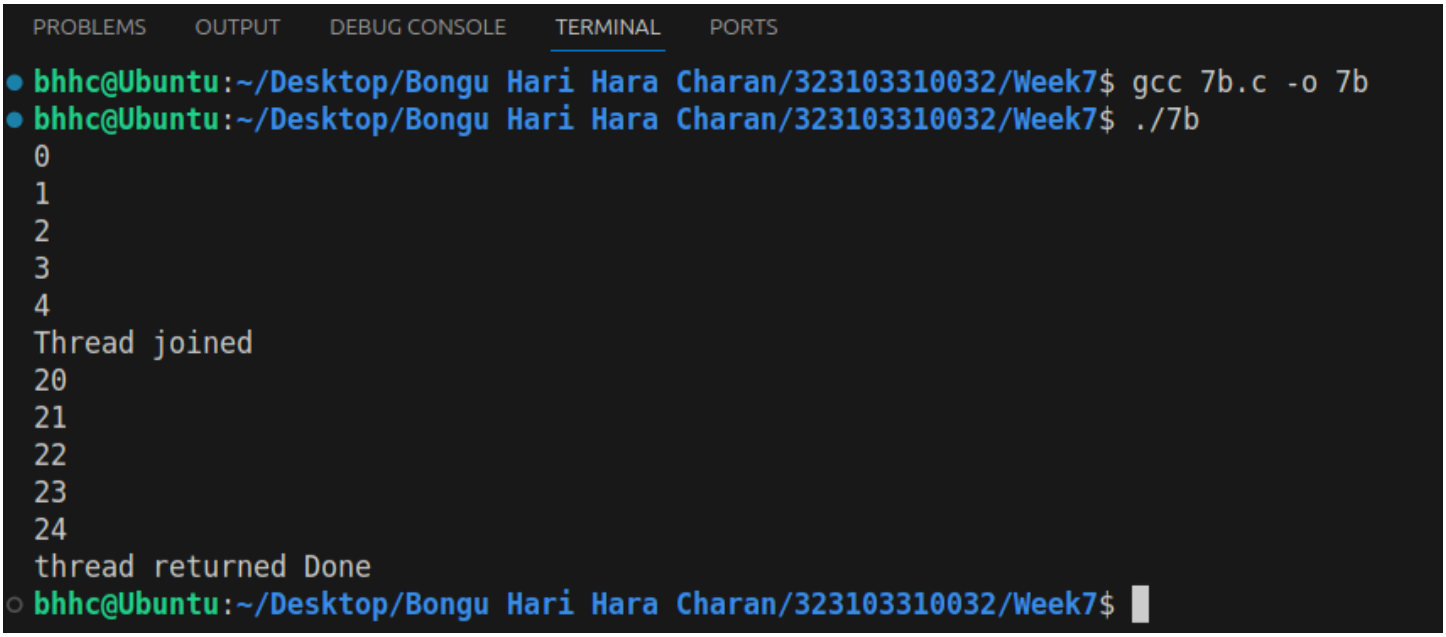
b) AIM: Program to create a thread. The thread prints numbers from zero to n, where value of n is passed from the main process to the thread. The main process also waits for the thread to finish first and then prints from 20-24.

Program:

```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <pthread.h>
#include <string.h>

void *thread_function(void *arg);
int i, n, j;

int main() {
    char *m = "5";
    pthread_t a_thread;
    void *result;

    pthread_create(&a_thread, NULL, thread_function, m);
    pthread_join(a_thread, &result);

    printf("Thread joined\n");
    for (j = 20; j < 25; j++) {
        printf("%d\n", j);
        sleep(1);
    }
    printf("thread returned %s\n", (char *)result);

    return 0;
}

void *thread_function(void *arg) {
    int sum = 0;
    n = atoi(arg);

    for (i = 0; i < n; i++) {
        printf("%d\n", i);
        sleep(1);
    }
    pthread_exit("Done");
}
```

PTO

Output:


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
PORTS
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week7$ gcc 7b.c -o 7b
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week7$ ./7b
0
1
2
3
4
Thread joined
20
21
22
23
24
thread returned Done
bhhc@Ubuntu:~/Desktop/Bongu Hari Hara Charan/323103310032/Week7$