21CSC202J - Operating Systems

LAB MANUAL

Bachelor of Technology

Semester III

Academic Year: 2023-2024 ODD SEMESTER

COLLEGE OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

RAMAPURAM CAMPUS,

CHENNAI- 600 089

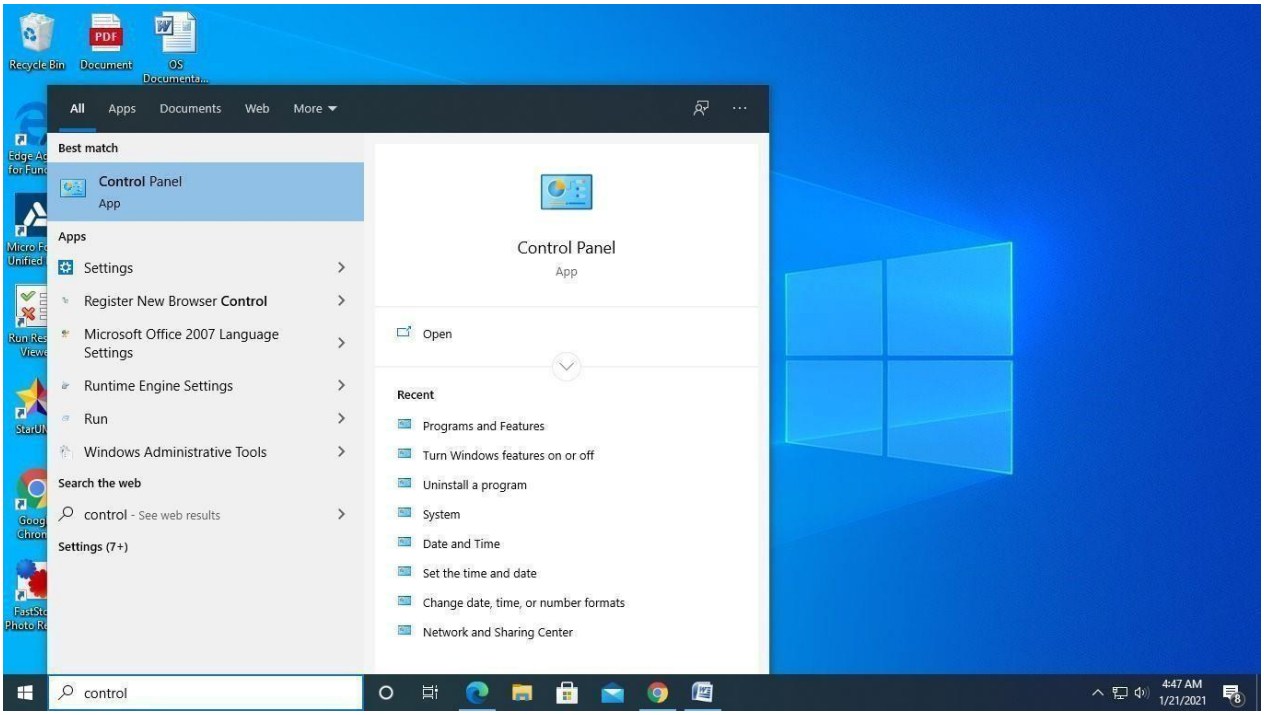
LIST OF EXPERIMENTS

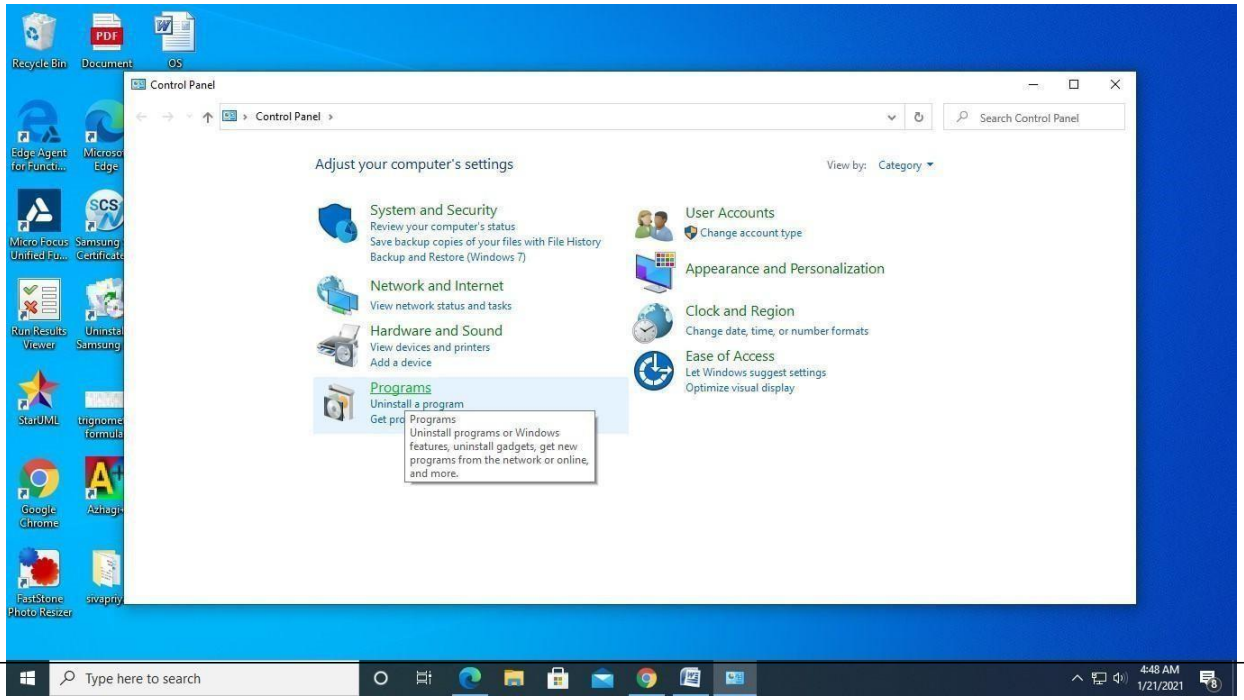
Ex.No.	Experiment Name
1	Operating system Installation, Basic Linux commands
2	Process Creation using fork() and Usage of getpid(), getppid(), wait() functions
3	Multithreading
4	Mutual Exclusion using semaphore and monitor
5	Reader-Writer problem
6	Dining Philosopher problem
7	Bankers Algorithm for Deadlock avoidance
8	FCFS and SJF Scheduling
9	Priority and Round robin scheduling
10	FIFO Page Replacement Algorithm
11	LRU and LFU Page Replacement Algorithm
12	Best fit and Worst fit memory management policies
13	Disk Scheduling algorithm
14	Sequential and Indexed file Allocation
15	File organization schemes for single level and two level directory

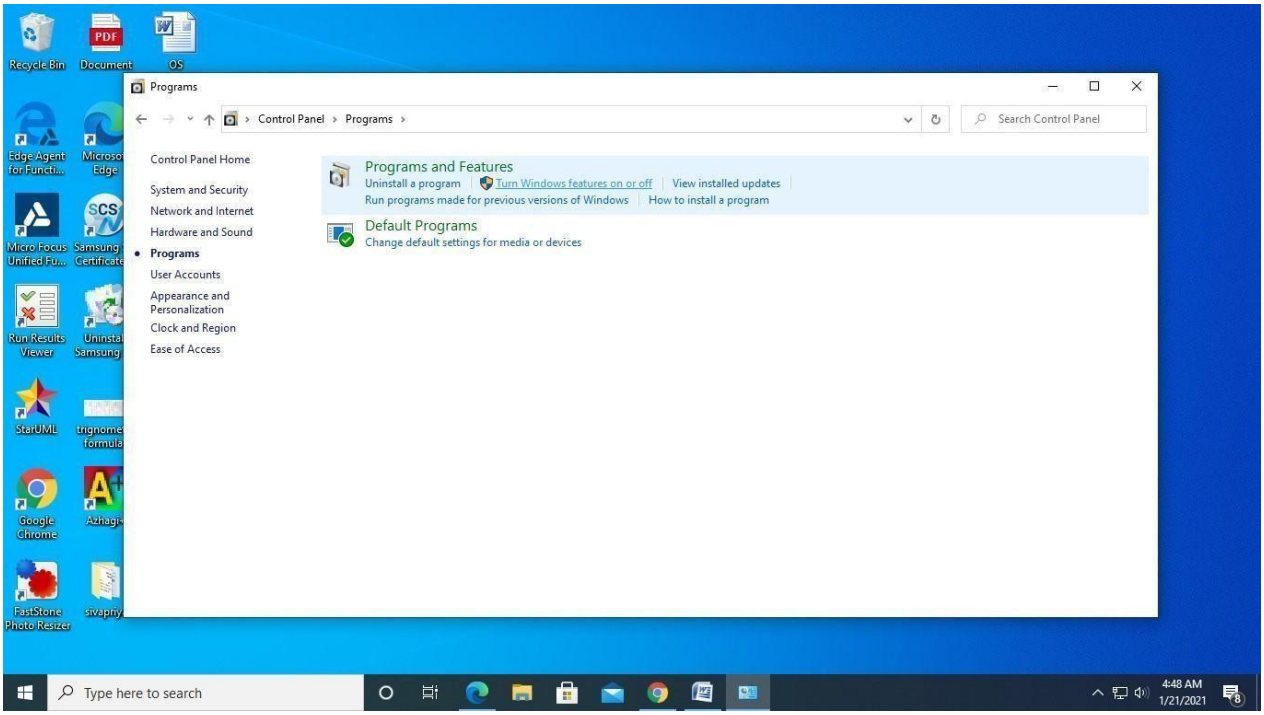
Ex.No:1	OPERATING SYSTEM INSTALLATION

Ubuntu installation guidelines in windows

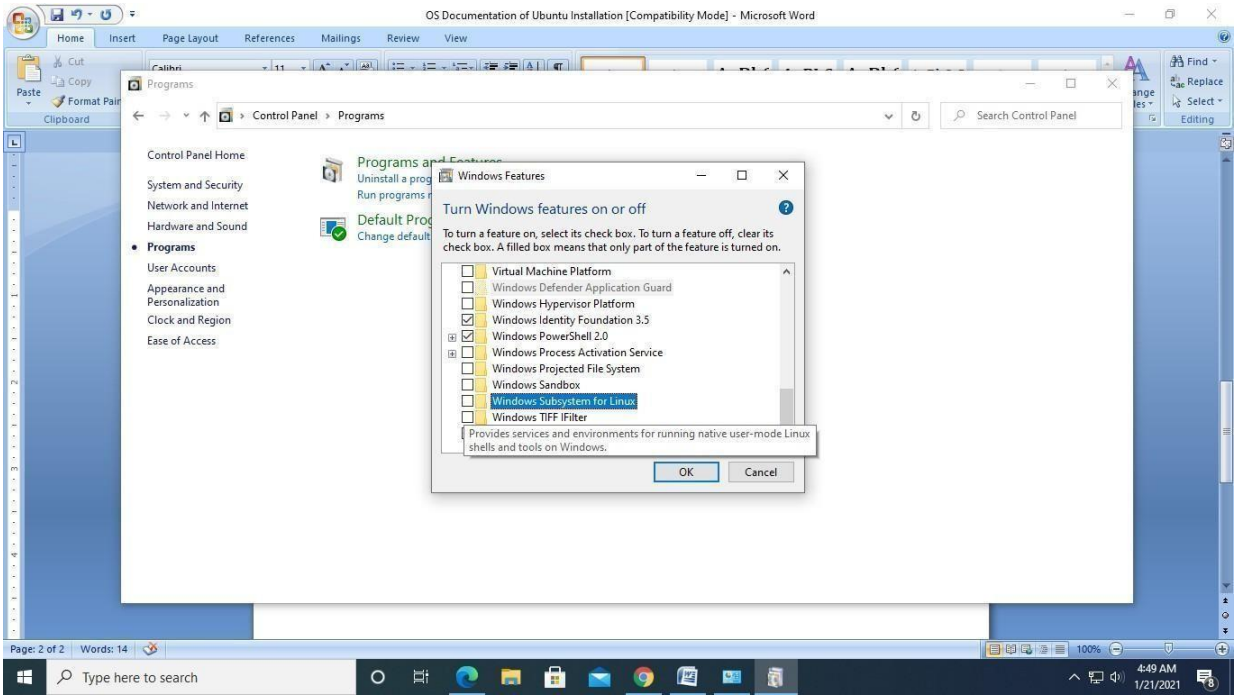
Installing Ubuntu in windows 10- 64 bit



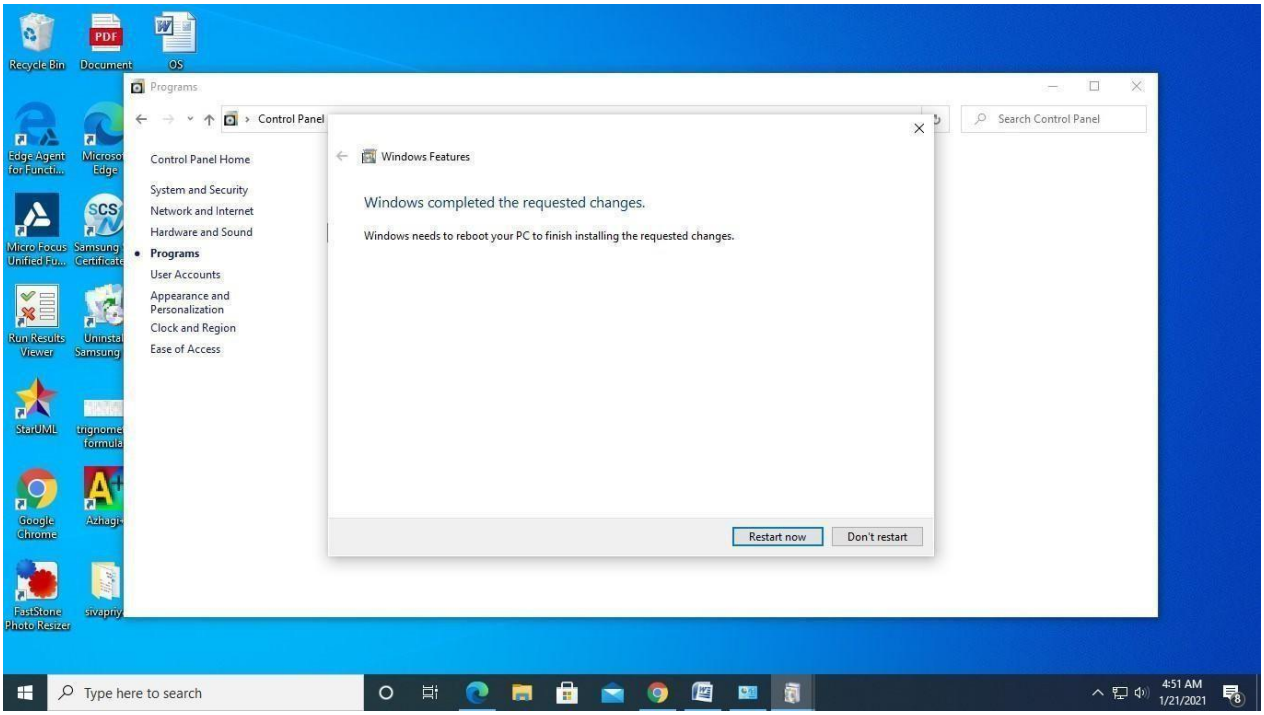




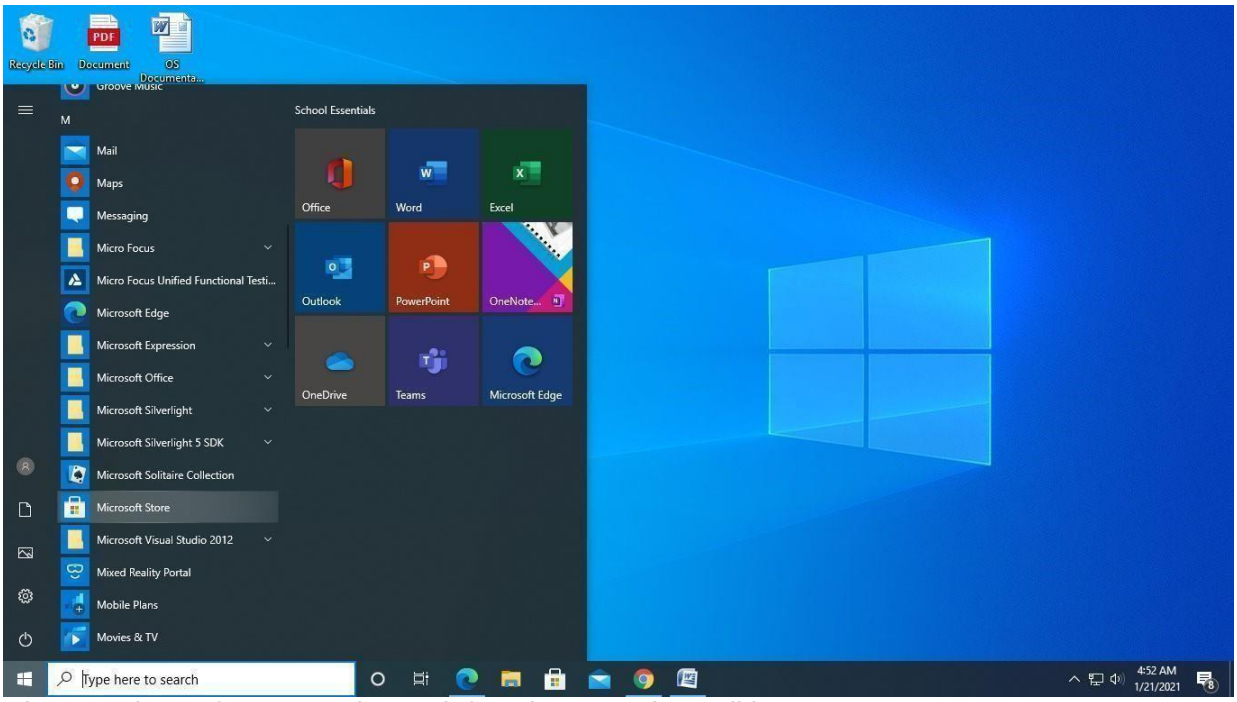
Select Turn Windows features On or Off



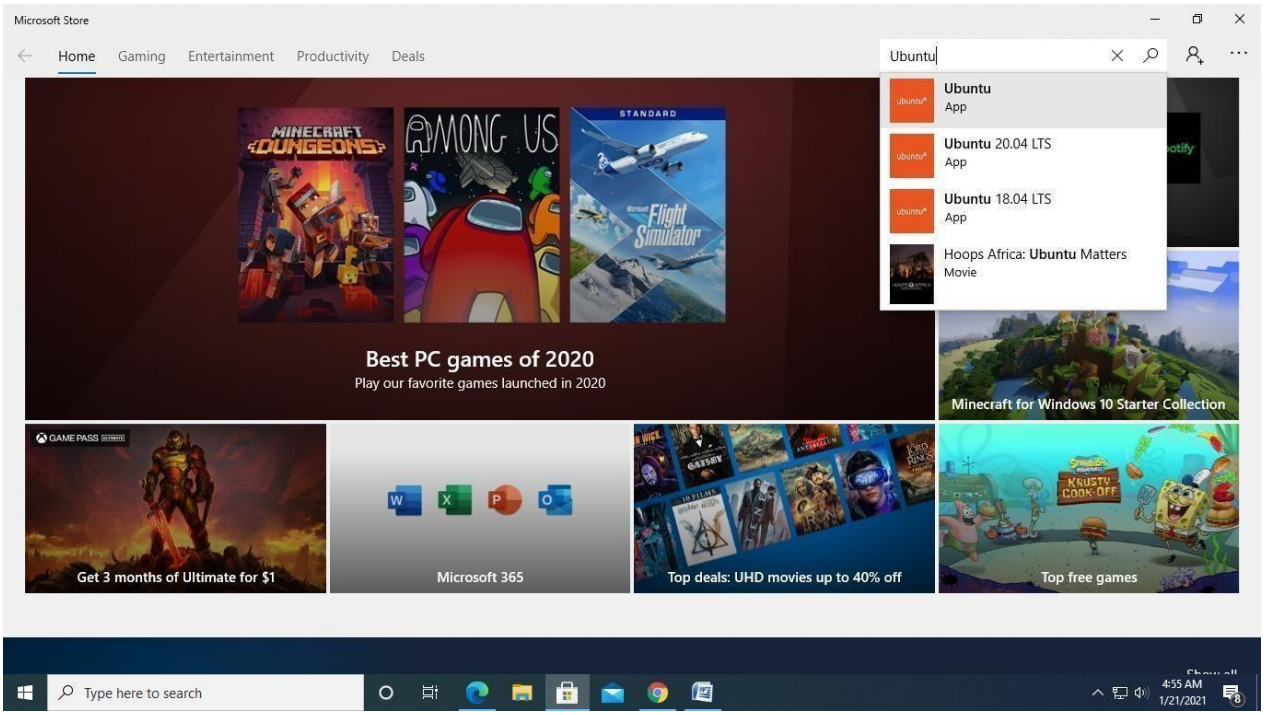
Select Windows subsystem for linux then press Ok

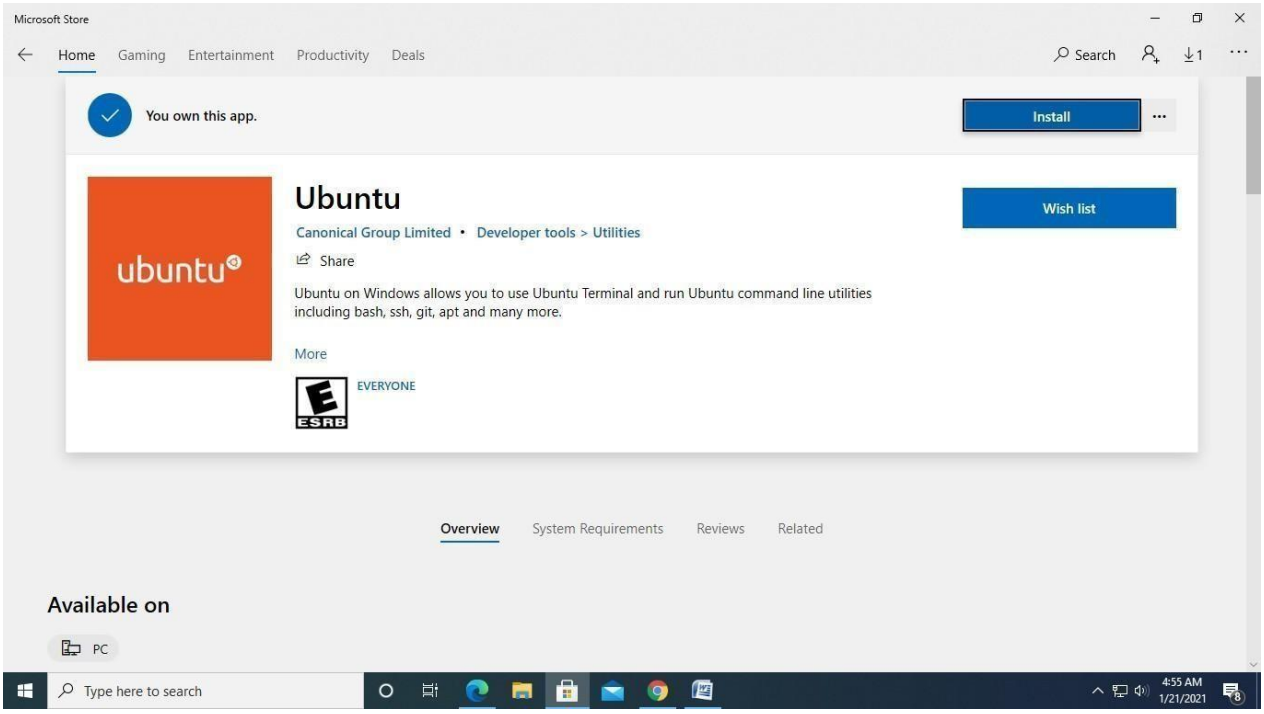


Now restart the PC to apply the changes

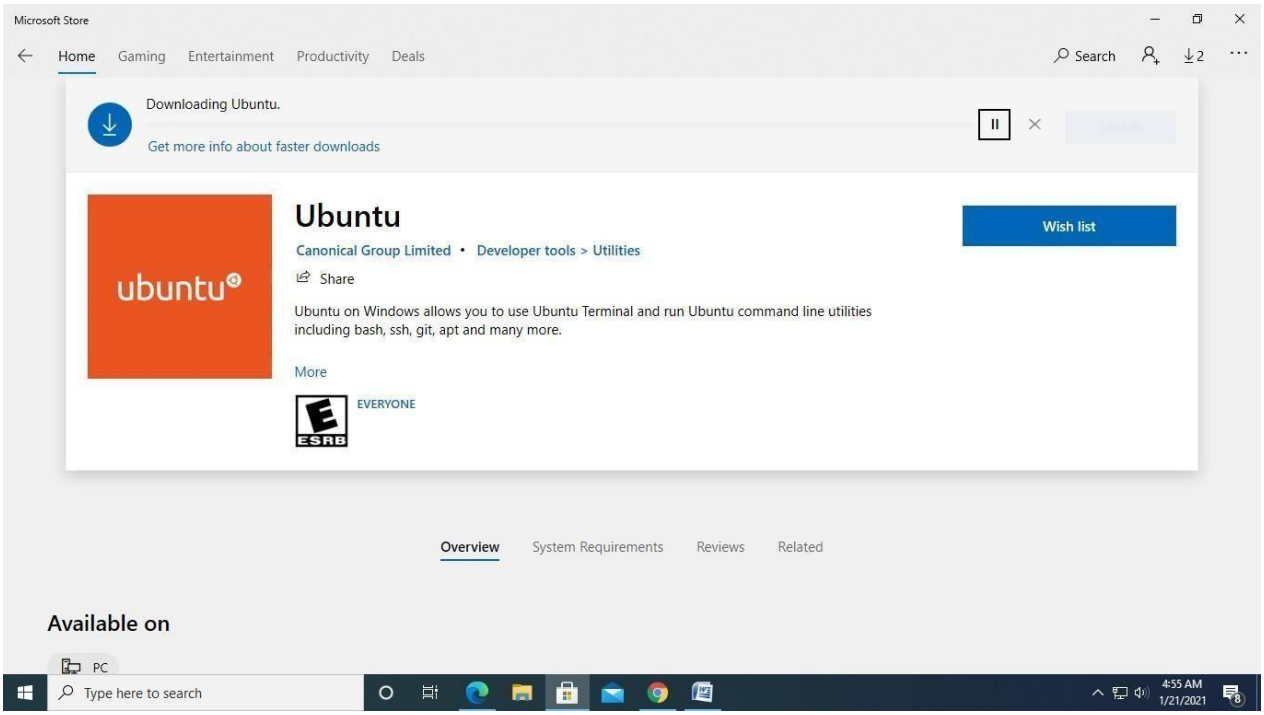


Choose Microsoft Store and search for Ubuntu and Install it





Click on Install


Microsoft Store
Home
Gaming
Entertainment
Productivity
Deals
Search
Downloading Ubuntu.
Get more info about faster downloads
Ubuntu
Canonical Group Limited • Developer tools > Utilities
Share
Ubuntu on Windows allows you to use Ubuntu Terminal and run Ubuntu command line utilities including bash, ssh, git, apt and many more.
More
EVERYONE
Wish list
Overview
System Requirements
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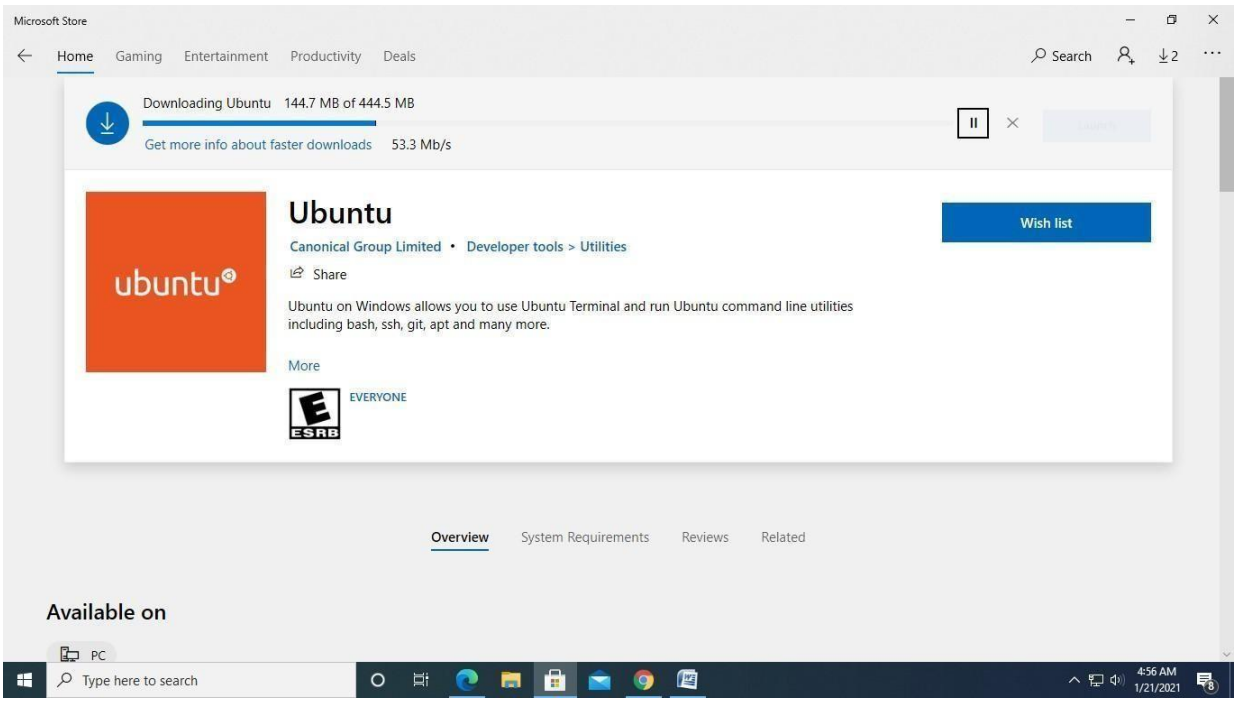
Available on
PC
Type here to search
4:55 AM
1/21/2021


Microsoft Store
Home
Gaming
Entertainment
Productivity
Deals
Search
Downloading Ubuntu 144.7 MB of 444.5 MB
Get more info about faster downloads 53.3 Mb/s
Ubuntu
Canonical Group Limited • Developer tools > Utilities
Share
Ubuntu on Windows allows you to use Ubuntu Terminal and run Ubuntu command line utilities including bash, ssh, git, apt and many more.
More
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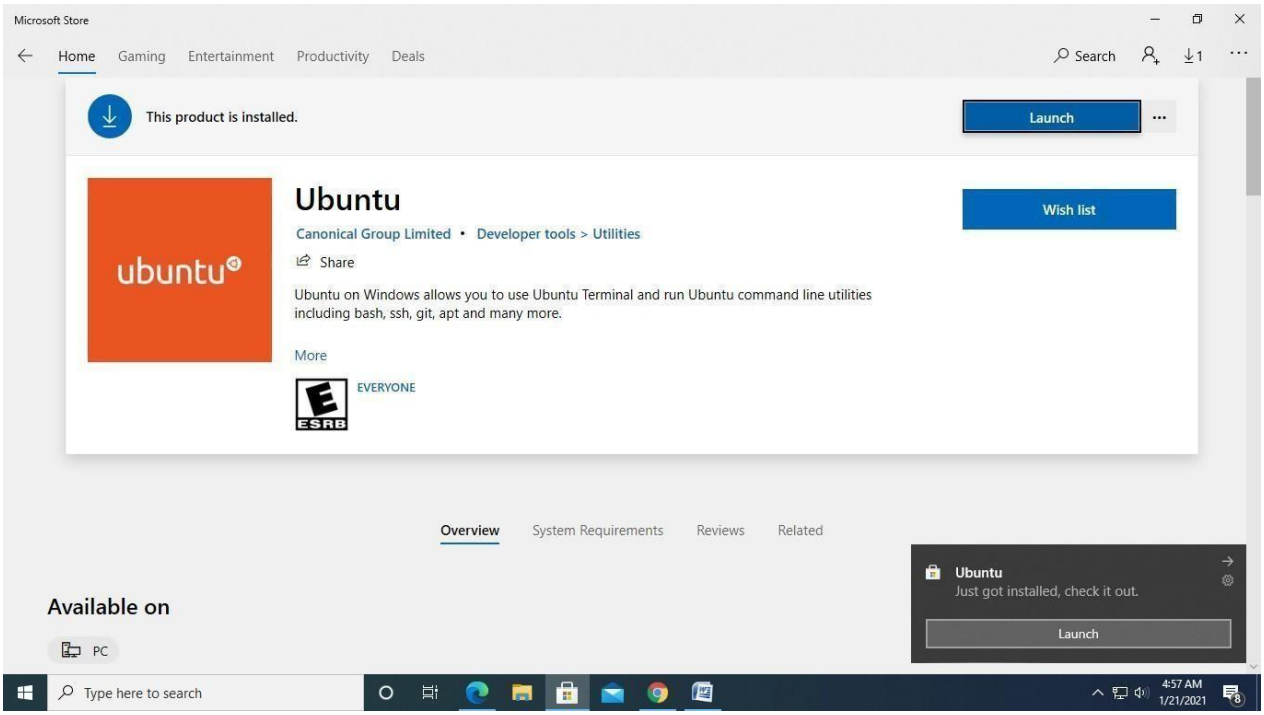
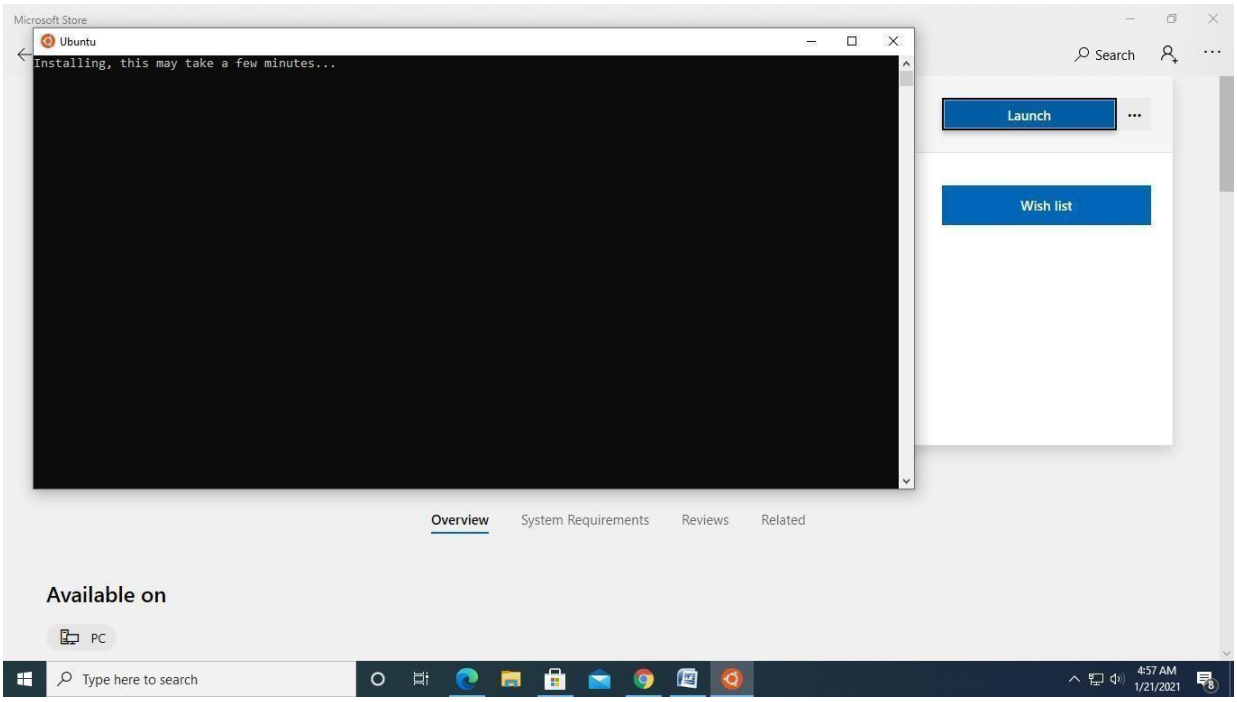
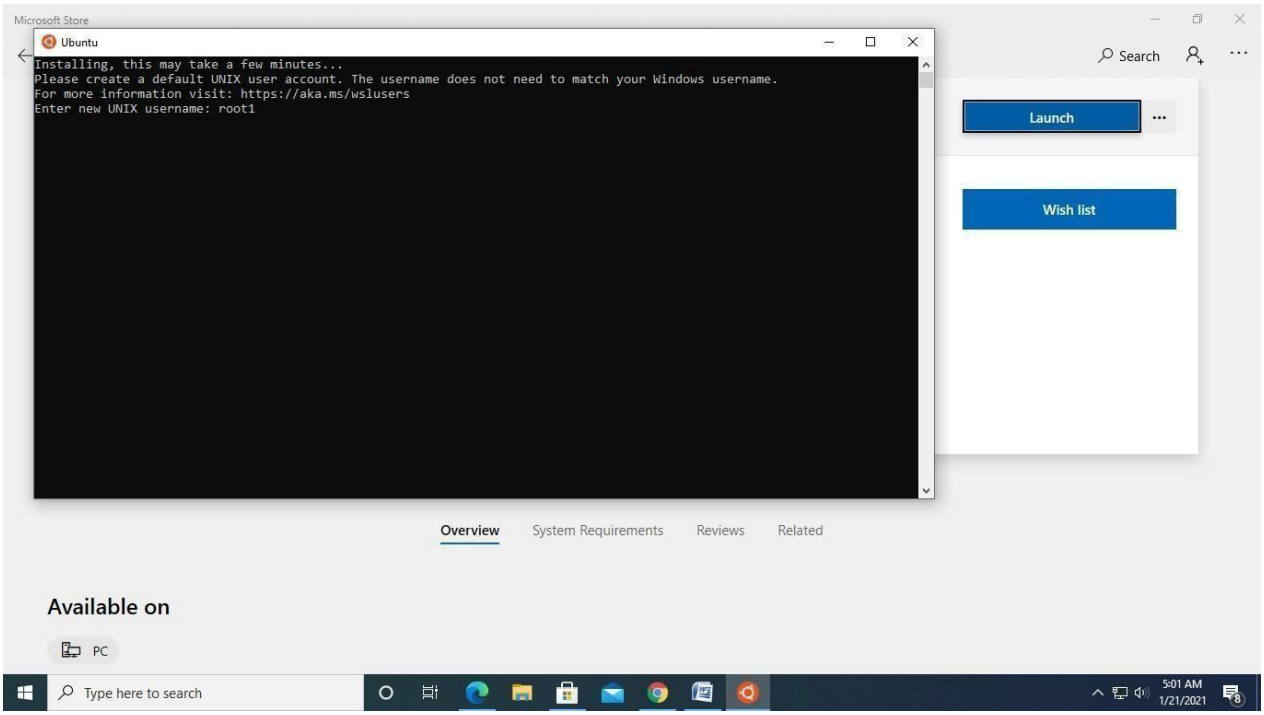


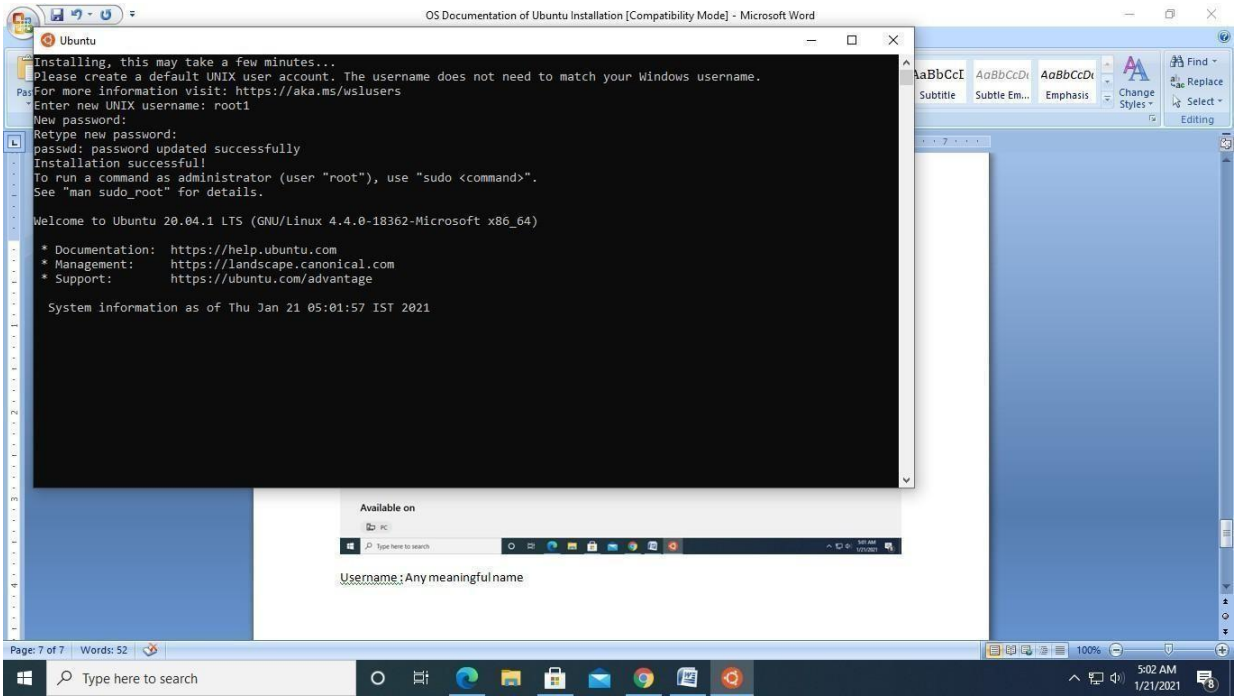
Now Launch the Ubuntu

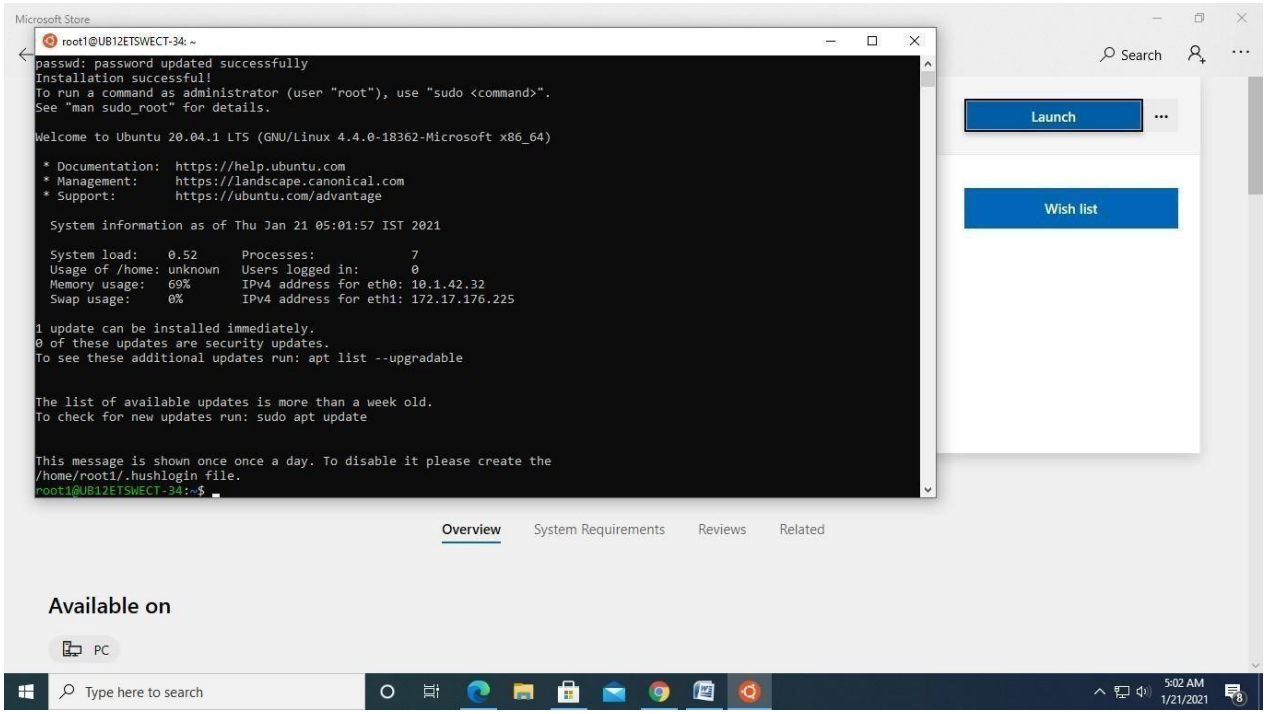




Username : Any meaningful

name Password: any name





Finally you will get the prompt on successful installation of Ubuntu in windows 10 64 bit

Ex. No. 1a	BASIC LINUX COMMANDS	Date :

a) Basics

1. *echo* SRM → to display the string SRM
2. *clear* → to clear the screen
3. *date* → to display the current date and time
4. *cal* 2003 → to display the calendar for the year 2003
   cal 6 2003 → to display the calendar for the June-2003
5. *passwd* → to change password

b) Working with Files

1. *ls* → list files in the present working directory
   ls –l → list files with detailed information (long list)
   ls –a → list all files including the hidden files
2. cat > f1 → to create a file (Press ^d to finish typing)
3. *cat* f1 → display the content of the file f1
4. *wc* f1 → list no. of characters, words & lines of a file f1
   wc –c f1 → list only no. of characters of file f1
   wc –w f1 → list only no. of words of file f1
   wc –l f1 → list only no. of lines of file f1
5. *cp* f1 f2 → copy file f1 into f2
6. *mv* f1 f2 → rename file f1 as f2
7. *rm* f1 → remove the file f1
8. *head* –5 f1 → list first 5 lines of the file f1
   tail –5 f1 → list last 5 lines of the file f1

c) Working with Directories

1. *mkdir* elias → to create the directory elias
2. *cd* elias → to change the directory as elias
3. *rmdir* elias → to remove the directory elias
4. *pwd* → to display the path of the present working directory
5. *cd* → to go to the home directory
   cd .. → to go to the parent directory
   cd - → to go to the previous working directory
   cd / → to go to the root directory

d) File name substitution

1. *ls f?* → list files start with 'f' and followed by any one character
2. *ls* *.c → list files with extension 'c'
3. *ls* [gpy]et → list files whose first letter is any one of the character g, p or y and followed by the word et
4. *ls* [a-d,l-m]ring → list files whose first letter is any one of the character from a to d and l to m and followed by the word ring.

e) I/O Redirection

1. Input redirection

   wc –l < ex1 → To find the number of lines of the file 'ex1'

2. Output redirection

   who > f2 → the output of 'who' will be redirected to file f2

3. *cat* >> f1 → to append more into the file f1

f) Piping

Syntax : Command1 | command2

Output of the command1 is transferred to the command2 as input. Finally output of the command2 will be displayed on the monitor.

ex. *cat* f1 | *more* → list the contents of file f1 screen by screen

head –6 f1 |*tail* –2 → prints the 5^{th} & 6^{th} lines of the file f1.

g) Environment variables

1. *echo $HOME* → display the path of the home directory
2. *echo $PS1* → display the prompt string $
3. *echo $PS2* → display the second prompt string (> symbol by default)
4. *echo $LOGNAME* → login name
5. *echo $PATH* → list of pathname where the OS searches for an executable file

h) File Permission

-- chmod command is used to change the access permission of a file.

Method-1

Syntax : *chmod* [ugo] [+/-] [rwxa] filename

u : user, g : group, o : others
+ : Add permission - : Remove the permission
r : read, w : write, x : execute, a : all permissions

ex. *chmod* ug+rw f1
adding 'read & write' permissions of file f1 to both user and group members.

Method-2

Syntax : *chmod* octnum file1

The 3 digit octal number represents as follows

- first digit -- file permissions for the user
- second digit -- file permissions for the group
- third digit -- file permissions for others

Each digit is specified as the sum of following
4 – read permission, 2 – write permission, 1 – execute permission

ex. *chmod* 754 f1

it change the file permission for the file as follows

- read, write & execute permissions for the user ie; 4+2+1 = 7
- read, & execute permissions for the group members ie; 4+0+1 = 5
- only read permission for others ie; 4+0+0 = 4

Ex. No. 1b	FILTERS and ADMIN COMMANDS	Date :

FILTERS

1. cut

- Used to cut characters or fileds from a file/input

  Syntax : **cut** **-c**chars filename
  -ffieldnos filename

- By default, tab is the filed separator(delimiter). If the fileds of the files are separated by any other character, we need to specify explicitly by **–d** option

  cut **-d**ddelimitchar **-f**fileds filname

2. grep

- Used to search one or more files for a particular pattern.

  Syntax : **grep** pattern filename(s)

  - Lines that contain the *pattern* in the file(s) get displayed
  - pattern can be any regular expressions
  - More than one files can be searched for a pattern

-v option displays the lines that do not contain the *pattern*
-l list only name of the files that contain the *pattern*
-n displays also the line number along with the lines that matches the *pattern*

3. sort

- Used to sort the file in order

  Syntax : **sort** filename

  - Sorts the data as text by default
  - Sorts by the first filed by default

-r option sorts the file in descending order
-u eliminates duplicate lines
-o filename writes sorted data into the file *fname*
-tdchar sorts the file in which fileds are separated by *dchar*
-n sorts the data as number
+1n skip first filed and sort the file by second filed numerically

4. Uniq

- Displays unique lines of a sorted file

  Syntax : **uniq** filename

-d option displays only the duplicate lines
-c displays unique lines with no. of occurrences.

5. diff

- Used to differentiate two files

Syntax : **diff** f1 f2
compare two files f1 & f2 and prints all the lines that are differed between f1 & f2.

Q1. Write a command to cut 5 to 8 characters of the file *f1*.
$

Q2. Write a command to display user-id of all the users in your system.
$

Q3. Write a command to check whether the user j*udith* is available in your system or not. (use grep)
$

Q4. Write a command to display the lines of the file *f1* starts with SRM.
$

Q5. Write a command to sort the file /etc/passwd in descending order
$

Q6. Write a command to display the unique lines of the sorted file *f21*. Also display the number of occurrences of each line.
$

Q7. Write a command to display the lines that are common to the files *f1* and *f2*.
$

EX:NO:2 Process Creation using fork() and Usage of getpid(), getppid(), wait() functions

Aim :

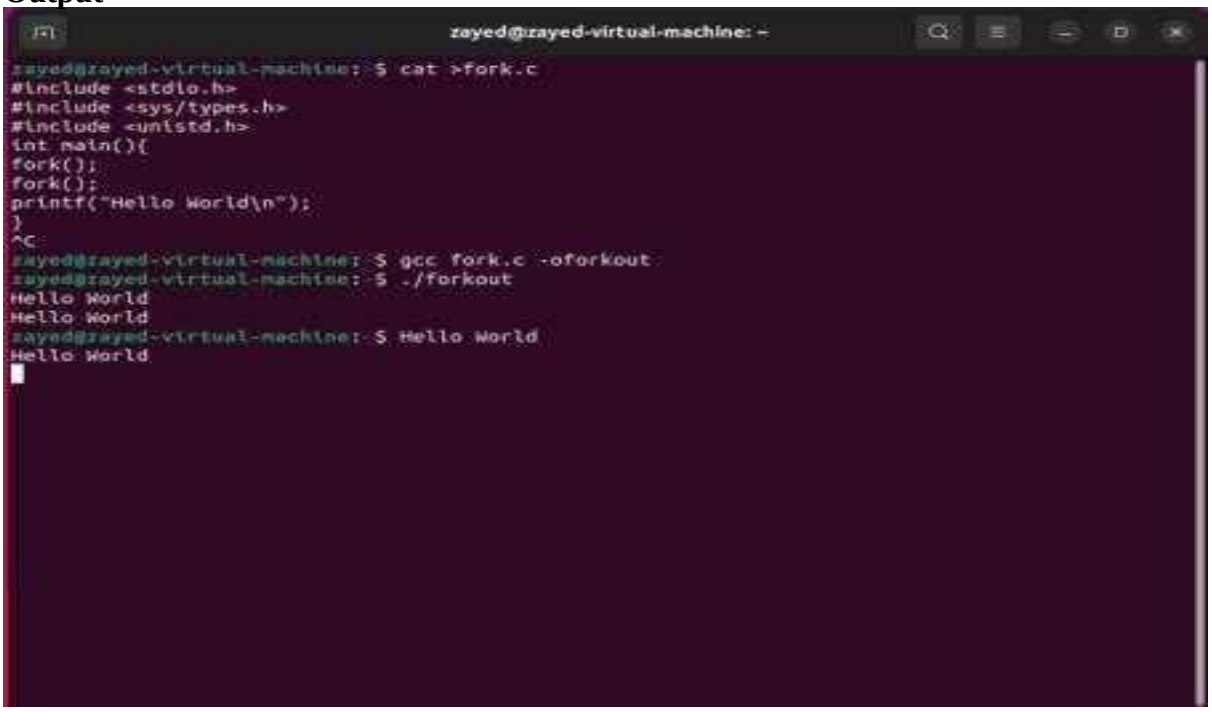
To write a program for process Creation using fork() and usage of getpid(), getppid(), wait() function.

Program :

- Process creating using fork()

```
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>
int
main(){
fork();
fork();
printf("Hello World\n");
}
```

Output

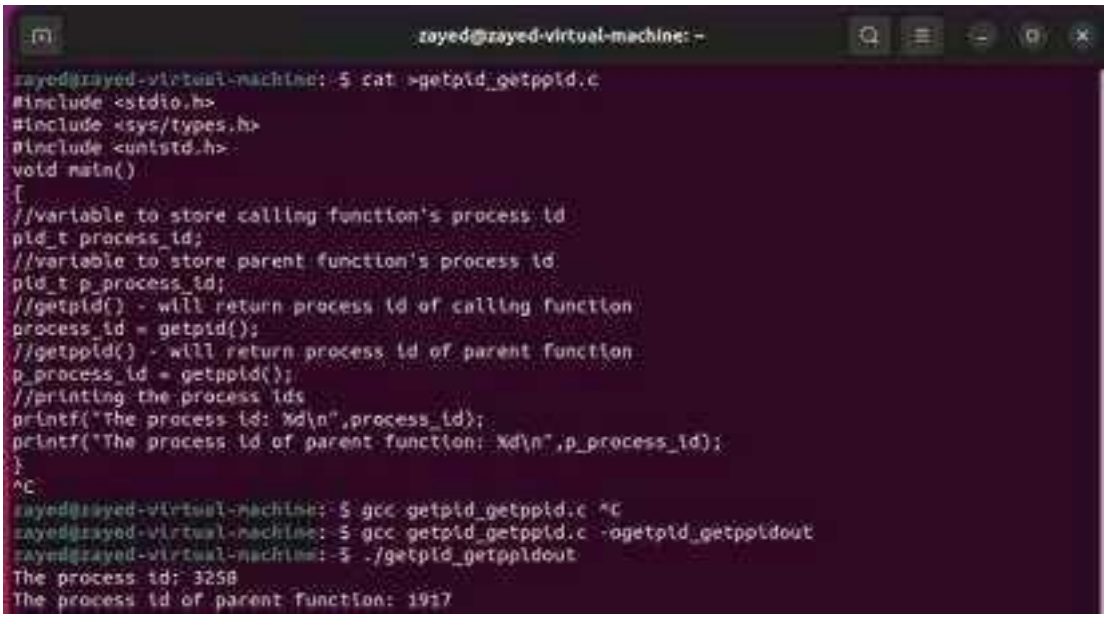


- Usage of getpid() and getppid()

```
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>
void main()
{
```

```
//variable to store calling function's
int process_id, p_ process_id;
//getpid() - will return process id of calling function
process_id = getpid();
//getppid() - will return process id of parent function
p_process_id = getppid();
//printing the process ids
printf("The process id: %d\n",process_id);
printf("The process id of parent function: %d\n",p_process_id);
 }
```

Output :



- Usage of wait()

```
#include<stdio.h>
#include<stdlib.h>
#include<sys/wait.h>
#include<unistd.h>
int main()
{
pid_t cpid;
if (fork()== 0)
exit(0); /* terminate child */
else
cpid = wait(NULL); /* reaping parent */
printf("Parent pid = %d\n", getpid());
printf("Child pid = %d\n", cpid);
return 0;
 }
```

Output:

Result :

Thus Successfully completed Process Creation using fork() and Usage of getpid(), getppid(), wait() functions.

EX:NO 3 Multithreading and pthread in C

Aim :

To implement and study Multithreading and pthread in C

Program :

```
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#define MAX 1000
#define MAX_THREAD 4

int array[1000];
int sum[4] = { 0 };
int arraypart = 0;

void* sum_array(void* arg)
{
    int thread_part = arraypart++;

   for (int i = thread_part * (MAX / 4); i < (thread_part + 1) * (MAX / 4); i++)
   {
      sum[thread_part] += array[i];
   }
}

void testSum()
{
  pthread_t threads[MAX_THREAD];

   for (int i = 0; i < MAX_THREAD; i++)
   {
      pthread_create(&threads[i], NULL, sum_array, (void*)NULL);
   }

   // joining threads
   for (int i = 0; i < MAX_THREAD; i++)
   {
      pthread_join(threads[i], NULL);
   }

    // print each thread
   for (int i = 0; i < MAX_THREAD; i++)
   {
      printf("Thread %d Sum is : %d \n",i, sum[i]);
   }
```

```
    // adding the 4 parts
    int total_sum = 0;
    for (int i = 0; i < MAX_THREAD; i++)
    {
        total_sum += sum[i];
    }
      printf("\nTotal Sum is : %d \n",total_sum);

}
void readfile(char* file_name)
{
   char ch;

   FILE *fp;


   fp = fopen(file_name,"r"); // read mode

   if( fp == NULL )
   {
     perror("Error while opening the file.\n");
     exit(EXIT_FAILURE);
   }


    char line [5]; /* line size */

    int i=0;

    printf("Reading  file:  ");
    fputs(file_name,stdout);
    printf("\n");


    while ( fgets ( line, sizeof line, fp) != NULL ) /* read a line */
    {
       if (i < 1000)
       {
         array[i] =atoi(line);
       }

      i++;
    }
```

```
   fclose(fp);

    printf("Reading file Complete, integers stored in array.\n\n");

}


int main(int argc, char* argv[])
{

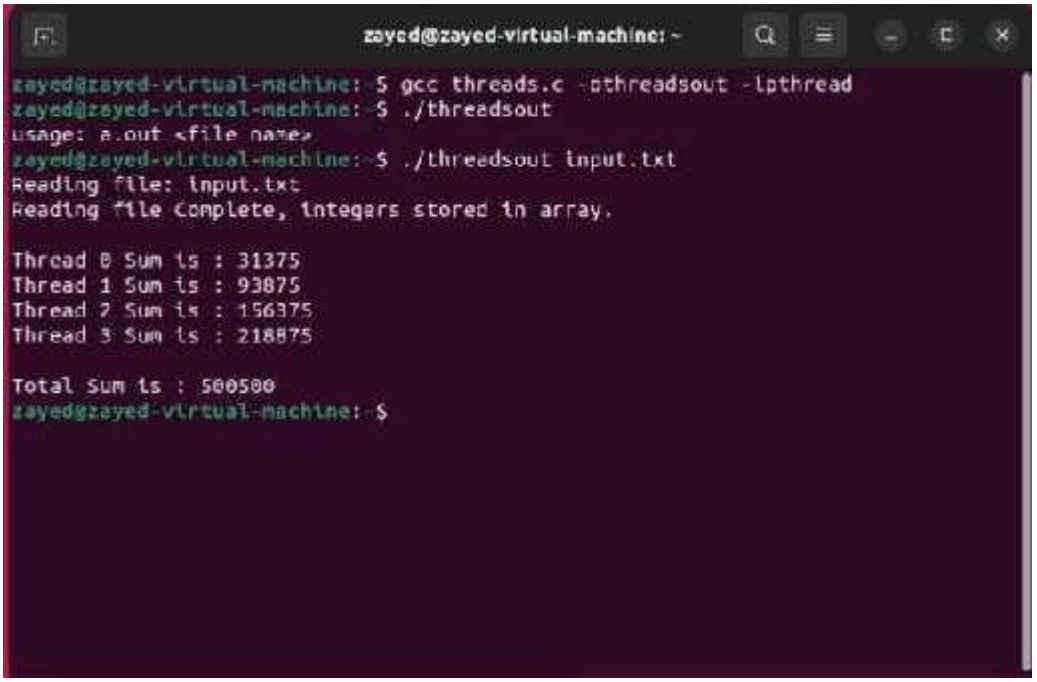
   if (argc != 2) {
         fprintf(stderr,"usage: a.out <file name>\n");
         /*exit(1);*/
         return -1;
    }

   readfile(argv[1]);


   //Debug code for testing only
   testSum();

   return 0;
}
```

Output :



Result :

Successfully implemented and studied Multithreading and pthread in C

EX:NO 4 Mutual Exclusion using semaphore and monitor

Aim :

To implement Mutual Exclusion using semaphore and monitor

Program :

USING SEMAPHORE

```
#include<stdio.h>
#include<pthread.h>
#include<semaphore.h>
#include<unistd.h>
#include<errno.h>
#include <stdlib.h>
#include<sched.h>
int philNo[5] = { 0, 1, 2, 3, 4 };
// my_semaphore structure
typedef struct {

  // Semaphore mutual exclusion variable
  pthread_mutex_t mutex;
  // Semaphore count variable
  int cnt;
  // Semaphore conditonal variable
  pthread_cond_t conditional_variable;
}
 my_semaphore;

// Function to initialise the semaphore variables
int init(my_semaphore *sema, int pshared, int val) {
  // The case when pshared == 1 is not implemeted as it was not required because the philosphers are implemented using threads and not processes.
```

```
  if(pshared == 1){
        printf("Cannot handle semaphores shared between processes!!! Exiting\n");
        return -1;
  }

  // Initialisng the semaphore conditonal variable
  pthread_cond_init(&sema->conditional_variable, NULL);

  // Initialisng the semaphore count variable
  sema->cnt = val;

  // Initialisng the semaphore mutual exclusion variable
  pthread_mutex_init(&sema->mutex, NULL);

  return 0;
}

int signal(my_semaphore *sema) {

  //This locks the mutex so that only thread can access the critical section at a time
  pthread_mutex_lock(&sema->mutex);
  sema->cnt = sema->cnt + 1;

  // This wakes up one waiting thread
  if (sema->cnt)
        pthread_cond_signal(&sema->conditional_variable);
```

```
  // A woken thread must acquire the lock, so it will also have to wait until we call unlock

  // This releases the mutex
  pthread_mutex_unlock(&sema->mutex);

  return 0;
}
int wait(my_semaphore *sema) {
  //This locks the mutex so that only thread can access the critical section at a time
  pthread_mutex_lock(&sema->mutex);
  // While the semaphore count variable value is 0 the mutex is blocked on the conditon variable
  while (!(sema->cnt))
    pthread_cond_wait(&sema->conditional_variable, &sema->mutex);
    // unlock mutex, wait, relock mutex

  sema->cnt = sema->cnt - 1;

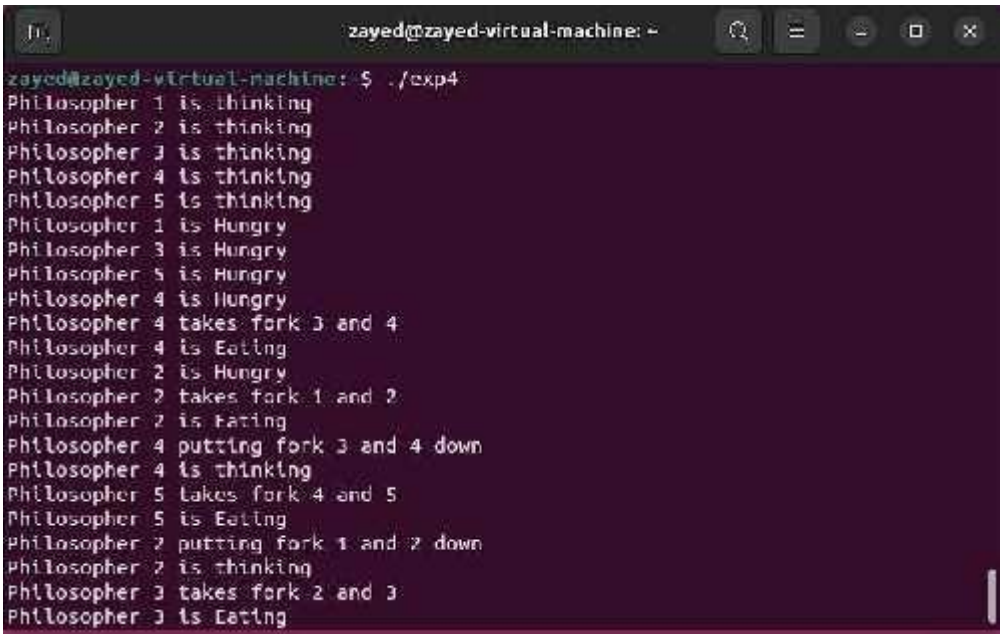
  // This releases the mutex and threads can access mutex
  pthread_mutex_unlock(&sema->mutex);
  return 0;
}
// Print semaphore value for debugging
void signal1(my_semaphore *sema) {
  printf("Semaphore variable value = %d\n", sema->cnt);
}
// Declaring the semaphore variables which are the shared resources by the threads
my_semaphore forks[5], bowls;

//Function for the philospher threads to eat
void *eat_food(void *arg) {
   while(1) {
        int* i = arg;
        // This puts a wait condition on the bowls to be used by the current philospher so that the philospher can access these forks whenever they are free
        wait(&bowls);
```

```
        // This puts a wait condition on the forks to be used by the current philospher so
that the philospher can access these forks whenever they are free
        wait(&forks[*i]);
        wait(&forks[(*i+4)%5]);
        sleep(1);
      //Print the philospher number, its thread ID and the number of the forks it uses for
        eating printf("Philosopher %d with ID %ld eats using forks %d and %d\n", *i+1,
pthread_self(), *i+1, (*i+4)%5+1);
       // This signals the other philospher threads that the bowls are    available for
eating signal(&bowls);
        // This signals the other philospher threads that these forks are available for
eating and thus other threads are woken up
        signal(&forks[*i]);
        signal(&forks[(*i+4)%5]);
        sched_yield();
    }
}
void main() {
    int i = 0;
    // Initialising the forks (shared variable) semaphores
    while(i < 5){
        init(&forks[i], 0, 1);
        i++;
    }
    // Initialising the bowl (shared variable) semaphore
    init(&bowls, 0, 1);
    // Declaring the philospher threads
    pthread_t phil[5];
    i = 0;
    // Creating the philospher threads
    while(i < 5) {
        pthread_create(&phil[i], NULL, eat_food, &philNo[i]);
```

```
    i++;
  }
  i = 0;
  // Waits for all the threads to end their execution before ending
  while(i < 5) {
    pthread_join(phil[i], NULL);
    i++;
  }}
```

Output :



USING MONITOR

```
monitor DP
{
   status state[5];
condition self[5];
// Pickup chopsticks
Pickup(int i)
{
   // indicate that I'm hungry
   state[i] = hungry;
   // set state to eating in test()
   // only if my left and right neighbors
   // are not eating
   test(i);
```

```
    // if unable to eat, wait to be signaled if

    (state[i] != eating)

        self[i].wait;

}

// Put down chopsticks
Putdown(int i)

{

    // indicate that I'm thinking

    state[i] = thinking;

    // if right neighbor R=(i+1)%5 is hungry and

    // both of R's neighbors are not eating,
    // set R's state to eating and wake it up by

    // signaling R's CV

        test((i + 1) % 5);

        test((i + 4) % 5);

    }

    test(int i)

    {
        if (state[(i + 1) % 5] != eating

            && state[(i + 4) % 5] != eating

            && state[i] == hungry) {

            // indicate that I'm eating

            state[i] = eating;


            // signal() has no effect during Pickup(),

            // but is important to wake up waiting

            // hungry philosophers during Putdown()

            self[i].signal();

        }
    }
    init()
    {
        // Execution of Pickup(), Putdown() and test()

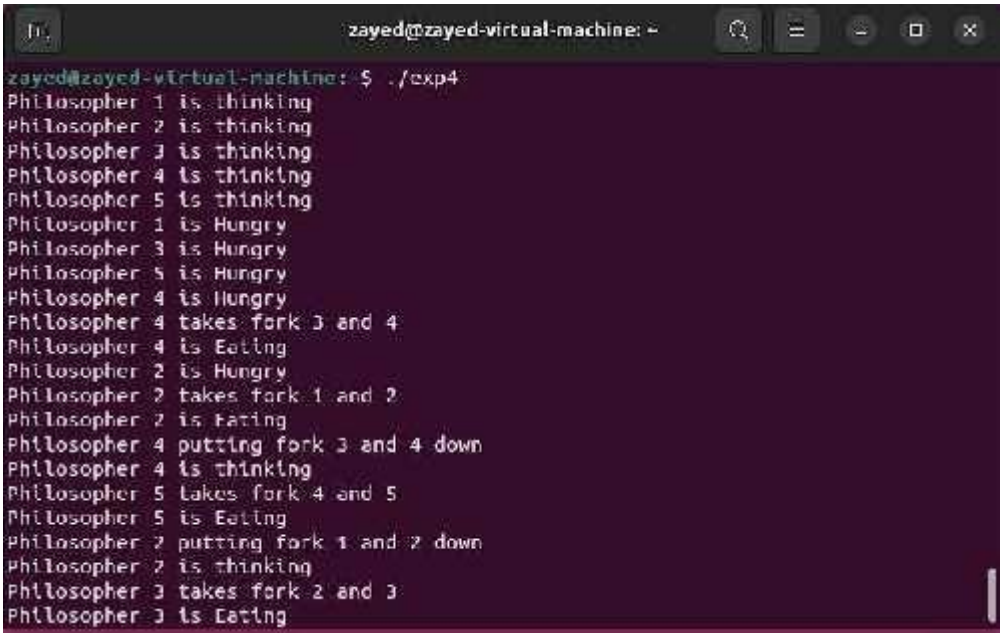
        // are all mutually exclusive,

        // i.e. only one at a time can be executing

for
    i = 0 to 4
```

```
        // Verify that this monitor-based solution is
        // deadlock free and mutually exclusive in that
        // no 2 neighbors can eat simultaneously
        state[i] = thinking;
    }
}
```

Output :



Result :

Successfully executed Mutual Exclusion using semaphore and monitor

EX:NO:5 Reader-Writer problem

Aim :

To study the Reader – Writer problem

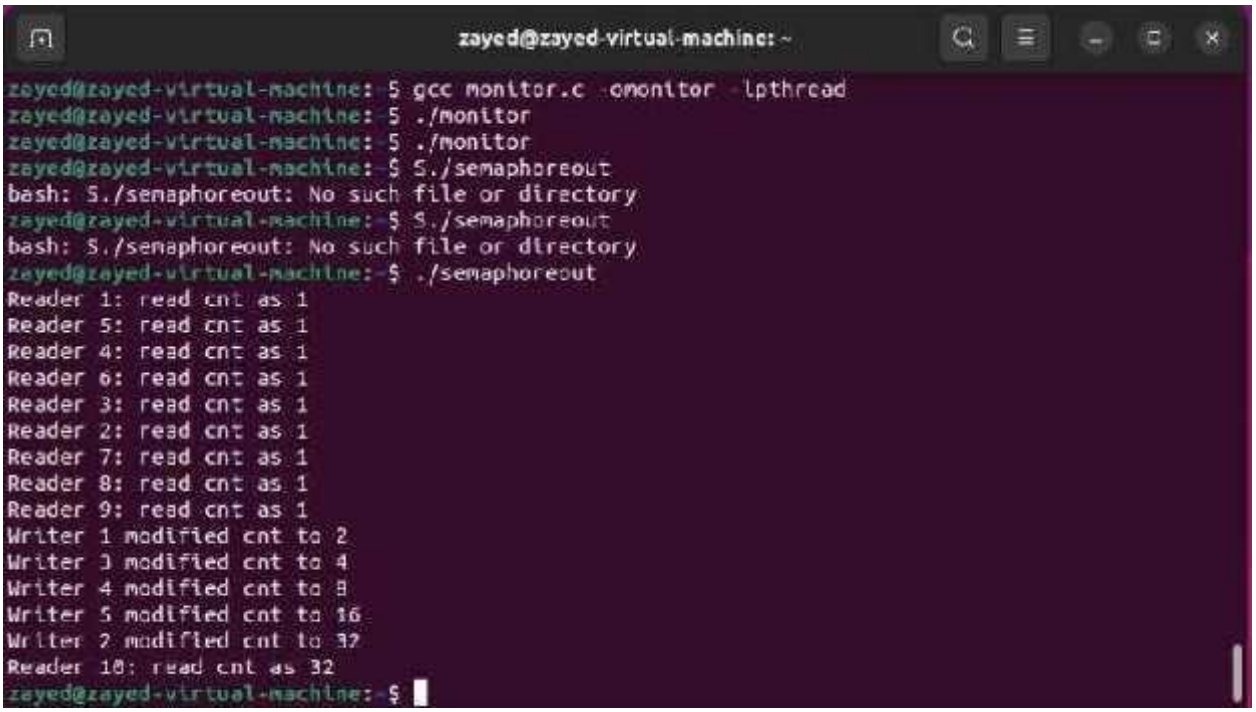
Program :

```
#include <pthread.h>
#include <semaphore.h>
#include <stdio.h>
sem_t wrt;
pthread_mutex_t
mutex; int cnt = 1;
int numreader = 0;
void *writer(void *wno)
{
   sem_wait(&wrt);
   cnt = cnt*2;
   printf("Writer %d modified cnt to %d\n",(*((int *)wno)),cnt);
   sem_post(&wrt);
}
void *reader(void *rno)
{
   // Reader acquire the lock before modifying numreader
   pthread_mutex_lock(&mutex);
   numreader++;
   if(numreader == 1) {
      sem_wait(&wrt); // If this id the first reader, then it will block the writer
   }
   pthread_mutex_unlock(&mutex);
   // Reading Section
   printf("Reader %d: read cnt as %d\n",*((int *)rno),cnt);
```

```
    // Reader acquire the lock before modifying numreader
    pthread_mutex_lock(&mutex);
    numreader--;
    if(numreader == 0) {
        sem_post(&wrt); // If this is the last reader, it will wake up the writer.
    }
    pthread_mutex_unlock(&mutex);
}
int main()
{
    pthread_t read[10],write[5];
    pthread_mutex_init(&mutex, NULL);
    sem_init(&wrt,0,1);
    int a[10] = {1,2,3,4,5,6,7,8,9,10}; //Just used for numbering the producer and consumer
    for(int i = 0; i < 10; i++) {
        pthread_create(&read[i], NULL, (void *)reader, (void *)&a[i]);
    }
    for(int i = 0; i < 5; i++) {
        pthread_create(&write[i], NULL, (void *)writer, (void *)&a[i]);
    }
    for(int i = 0; i < 10; i++) {
        pthread_join(read[i], NULL);
    }
    for(int i = 0; i < 5; i++) {
        pthread_join(write[i], NULL);
    }
    pthread_mutex_destroy(&mutex);
    sem_destroy(&wrt);
    return 0;

}
```

Output:



Result:

Thus Successfully provided a solution to Reader – Writer using mutex and semaphore.

EX:NO:6 Dining Philosopher's Problem

Aim:

To implement and study Dining Philosopher's Problem

Program:

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

//Function declarations
void *pickup_forks(void * philosopher_number); void *return_forks(void *
philosopher_number); void test(int philosopher_number);
int left_neighbor(int philosopher_number); int right_neighbor(int
philosopher_number); double think_eat_time(void);
void think(double think_time);
void eat(double eat_time);

//Constants to be used in the program.
#define PHILOSOPHER_NUM 5
#define MAX_MEALS 10
#define MAX_THINK_EAT_SEC 3

//States of philosophers.
enum {THINKING, HUNGRY, EATING} state[PHILOSOPHER_NUM];

//Array to hold the thread identifiers.
pthread_t philos_thread_ids[PHILOSOPHER_NUM];

//Mutex lock.
pthread_mutex_t mutex;

//Condition variables.
pthread_cond_t cond_vars[PHILOSOPHER_NUM];

//Array to hold the number of meals eaten for each philosopher.
int meals_eaten[PHILOSOPHER_NUM];

int main(int argc, char *argv[])
{
   //Ensure correct number of command line arguments.
   if(argc != 2)
```

```
    {
        printf("Please ensure that the command line argument 'run_time' is passed.\n");
    }
    else
    {
        //Set command line argument value to variable run_time;
        double run_time = atof(argv[1]);

        //Initialize arrays.
        int i;
        for(i = 0; i < PHILOSOPHER_NUM; i++)
        {
            state[i] = THINKING;
            pthread_cond_init(&cond_vars[i], NULL);
            meals_eaten[i] = 0;
        }
        //Initialize the mutex lock.
        pthread_mutex_init(&mutex, NULL);
        //Join the threads.
        for(i = 0; i < PHILOSOPHER_NUM; i++)
        {
            pthread_join(philos_thread_ids[i], NULL);
        }
        //Create threads for the philosophers.
        for(i = 0; i < PHILOSOPHER_NUM; i++)
        {
            pthread_create(&philos_thread_ids[i], NULL, pickup_forks, (void *)&i);
        }
        sleep(run_time);
        for(i = 0; i < PHILOSOPHER_NUM; i++)
        {
            pthread_cancel(philos_thread_ids[i]);
        }
        //Print the number of meals that each philosopher ate.
        for(i = 0; i < PHILOSOPHER_NUM; i++)
        {
            printf("Philosopher %d: %d meals\n", i, meals_eaten[i]);
        }
    }
    return 0;
}
void *pickup_forks(void * philosopher_number)
{
    int loop_iterations = 0;
    int pnum = *(int *)philosopher_number;
    while(meals_eaten[pnum] < MAX_MEALS)
```

```
    {
        printf("Philosoper %d is thinking.\n", pnum);
        think(think_eat_time());
        pthread_mutex_lock(&mutex);
        state[pnum] = HUNGRY;
        test(pnum);
        while(state[pnum] != EATING)
        {
            pthread_cond_wait(&cond_vars[pnum], &mutex);
        }
        pthread_mutex_unlock(&mutex);

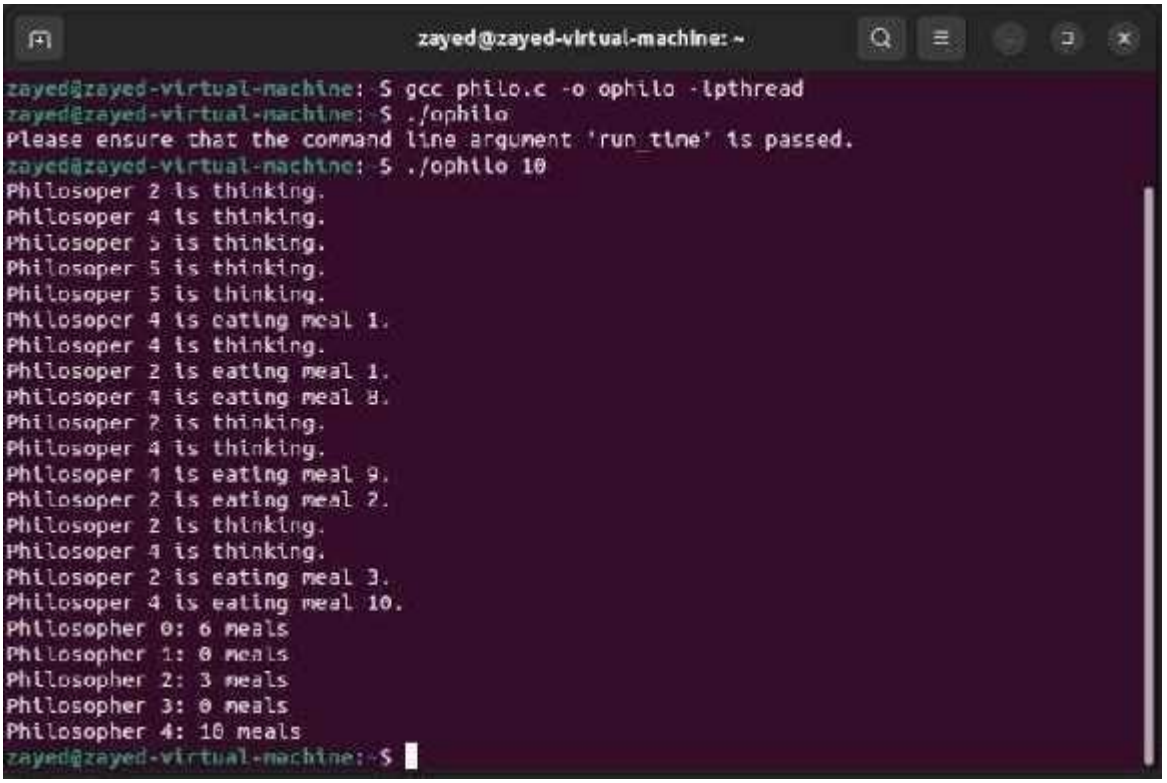
        (meals_eaten[pnum])++;

        printf("Philosoper %d is eating meal %d.\n", pnum, meals_eaten[pnum]);
        eat(think_eat_time());
        return_forks((philosopher_number));
        loop_iterations++;
    }
}
void *return_forks(void * philosopher_number)
{
    pthread_mutex_lock(&mutex);
    int pnum = *(int *)philosopher_number;
    state[pnum] = THINKING;
    test(left_neighbor(pnum));
    test(right_neighbor(pnum));
    pthread_mutex_unlock(&mutex);
}
int left_neighbor(int philosopher_number)
{
    return ((philosopher_number + (PHILOSOPHER_NUM - 1)) % 5);
}
int right_neighbor(int philosopher_number)
{
    return ((philosopher_number + 1) % 5);
}
void test(int philosopher_number)
{
    if((state[left_neighbor(philosopher_number)] != EATING) &&
        (state[philosopher_number] == HUNGRY) &&
        (state[right_neighbor(philosopher_number)] != EATING))
    {
        state[philosopher_number] = EATING;
        pthread_cond_signal(&cond_vars[philosopher_number]);
    }
}
```

```
double think_eat_time(void)
{
   return ((double)rand() * (MAX_THINK_EAT_SEC - 1)) / (double)RAND_MAX + 1;
}
void think(double think_time)
{
   sleep(think_time);
}

void eat(double eat_time)
{
   sleep(eat_time);
}
```

Output:



Result:

Thus Successfully implemented the concepts of Dining Philosophers Problem.

EX:NO:7 Bankers Algorithm for Deadlock avoidance

Aim :

To implement and study Bankers Algorithm for Deadlock Avoidance Problem

Program :

Banker's Algorithm

```
#include <stdio.h>

int m, n, i, j, al[10] [10], max[10] [10], av[10], need[10] [10], temp, z, y, p, k;
void main() {

printf("\n Enter no of processes : ");
scanf("%d", &m); // enter numbers of processes

printf("\n Enter no of resources : ");
scanf("%d", &n); // enter numbers of resources

for (i = 0; i < m; i++) {
for (j = 0; j < n; j++) {
printf("\n Enter instances for al[%d] [%d] = ", i,j); // al[] [] matrix is for allocated
instances scanf("%d", &al[i] [j]);
 al[i] [j] =temp;
}
}

for (i = 0; i < m;
i++) {
for (j = 0; j < n; j++) {printf("\n Enter instances for max[%d] [%d] = ", i,j); // max[] []
matrix is for max instances
scanf("%d", &max[i] [j]);
}
}

for (i = 0; i < n; i++) {
printf("\n Available Resource for av[%d] = ",i); // av[] matrix is for available instances
scanf("%d", &av[i]);
        }
```

```
        // Print allocation values
printf("Alocation Values :\n");
for (i = 0; i < m; i++) {
for (j = 0; j < n; j++) {printf(" \t %d", al[i][j]); // printing allocation matrix
        }
printf("\n");
}

printf("\n\n");

// Print max values
printf("Max Values :\n");
for (i = 0; i < m; i++) {
for (j = 0; j < n; j++) {
printf(" \t %d", max[i][j]); // printing max matrix
}
printf("\n");
}

printf("\n\n");

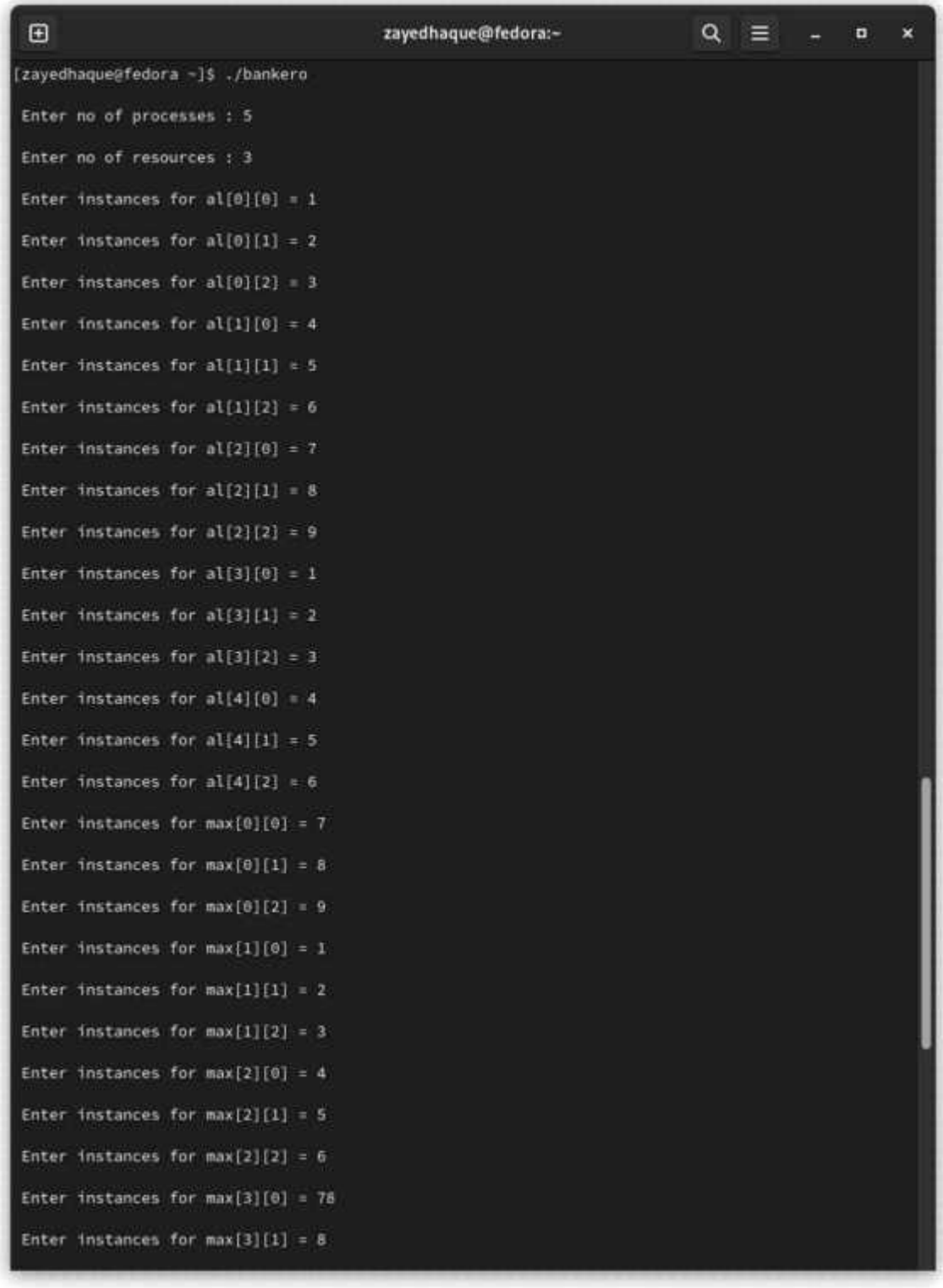
// Print need values
printf("Need Values :\n");
for (i = 0; i < m; i++) {
for (j = 0; j < n; j++) {
need[i][j] = max[i][j] - al[i][j]; // calculating need matrix
printf("\t %d", need[i][j]);      //  printing need matrix
}
printf("\n");
}
p = 1; // used for terminating while loop
y = 0;
while (p != 0) {
for (i = 0; i < m; i++) {
z = 0;
for (j = 0; j < n; j++) {
if (need[i][j] <= av[j] &&
(need[i][0] != -1)) { // comparing need with available instance and
// checking if the process is done
// or not
z++;                // counter if condition TRUE
}
        }
if (z == n) { // if need<=available TRUE for all resources then condition
// is TRUE
for (k = 0; k < n; k++) {
av[k] += al[i][k]; // new work = work + allocated
}
```

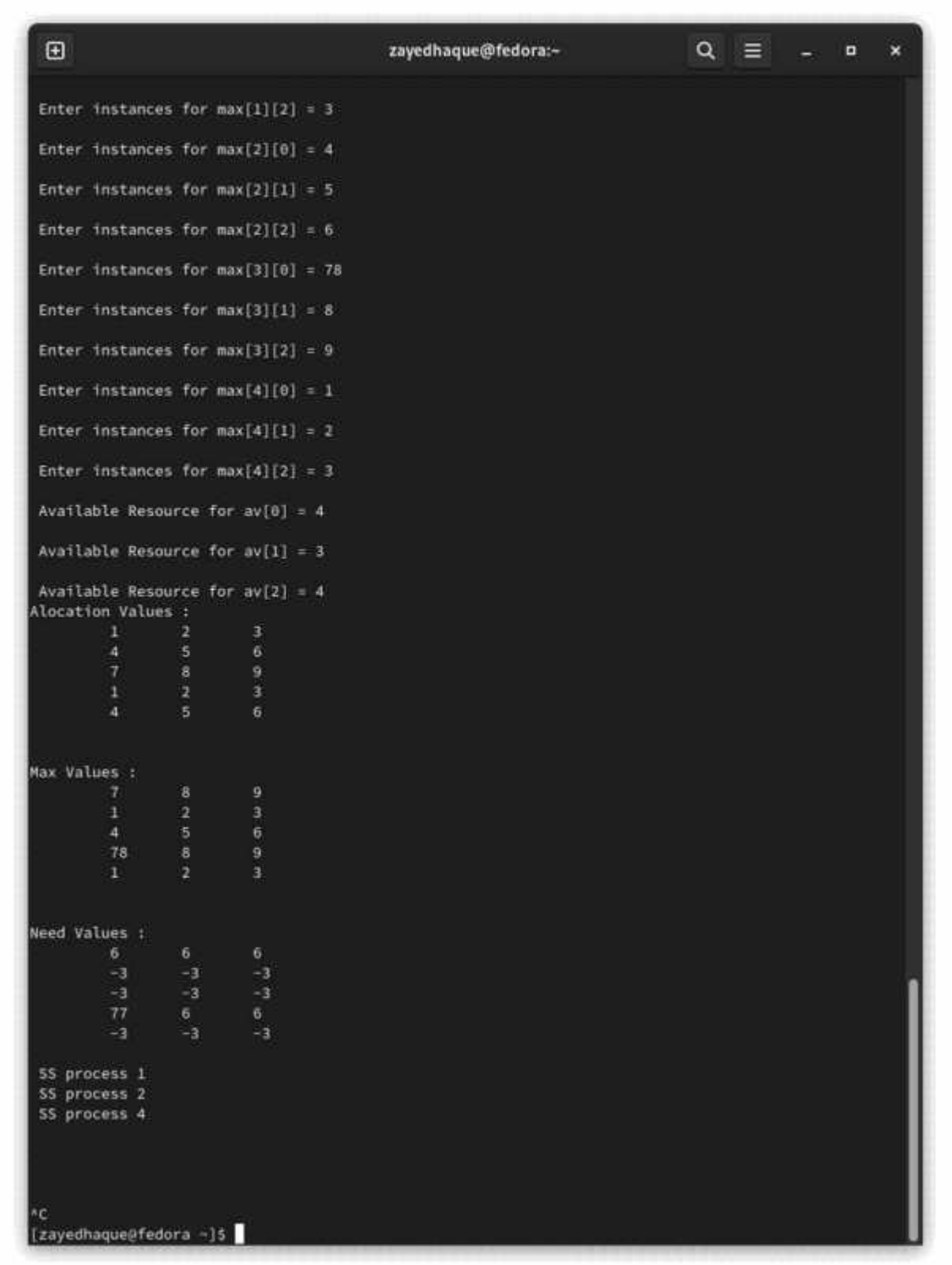
```
printf("\n SS process %d", i); // Print the Process
need[i] [0] = -1;              // assign -1 if Process done
y++;                           // cont if process done
}

} // end for loop

if (y == m) { // if all done then
p = 0;      // exit while loop
}} // end while printf("\n");
          }
```

Output :





Result :

Successfully implemented the concepts of Banker’s Algorithm.

EX:NO:8 FCFS and SJF Scheduling

Aim :

To study the concepts of FCFS and SJF Scheduling

Program :

FCFS Scheduling

```
#include <stdio.h>
typedef struct fcfs
{
   int process;    //Process
   Number int burst;      //Burst
   Time
   int arrival;    //Arrival Time
   int tat;        //Turn Around
   Time int wt;         //Waiting
   Time
}fcfs;
int sort(fcfs [] , int);

int main()
{
   int n, i, temp = 0, AvTat = 0, AvWt = 0;
   printf ("Enter the number of processes: ");
   scanf ("%d", &n);
   fcfs arr[n] ;    //Array of type
   fcfs int tct[n] ;
   for (i = 0; i < n; i++)
   {
      arr[i] .process = i;
      printf ("Enter the process %d data\n", arr[i] .process);
      printf ("Enter CPU Burst: ");
      scanf ("%d", &(arr[i] .burst));
      printf ("Enter the arrival time:
      "); scanf ("%d",
      &(arr[i] .arrival));
   }

   //Sorting the processes according to their arrival
   time sort(arr, n);

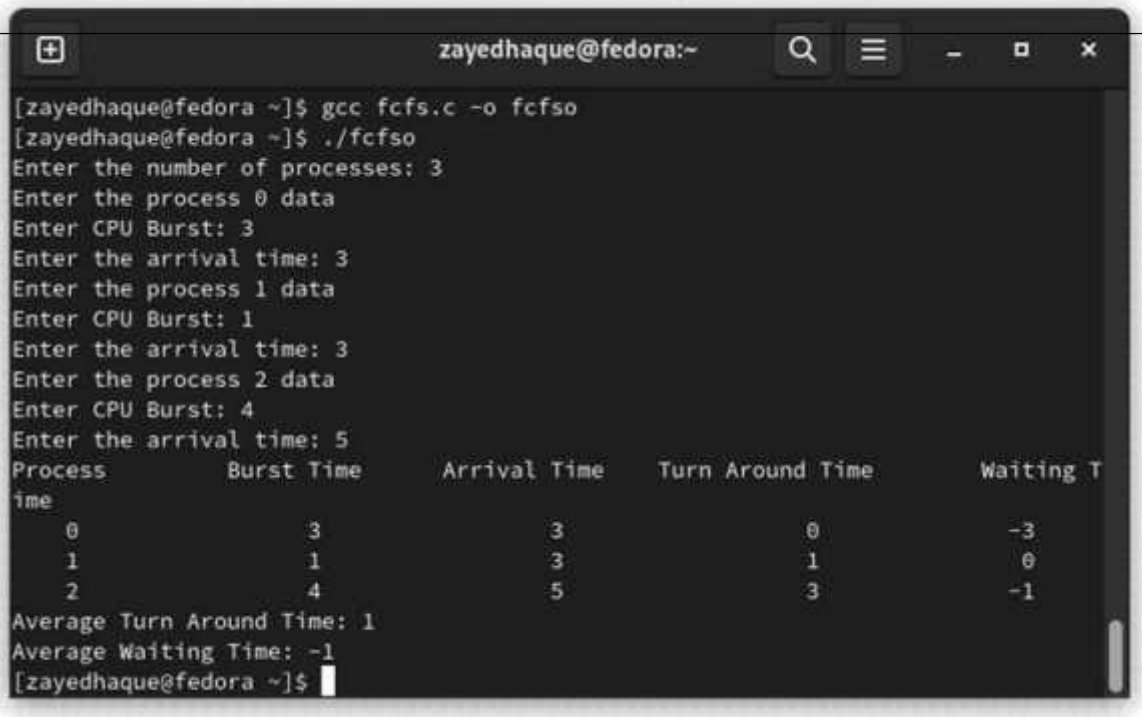
   printf ("Process\t\tBurst Time\tArrival Time\tTurn Around Time\tWaiting
   Time\n");
   for (i = 0; i < n; i++)
   {
      tct[i] = temp + arr[i] .burst;
      temp = tct[i] ;
```

```
        arr[i].tat = tct[i] - arr[i].arrival;
        arr[i].wt = arr[i].tat - arr[i].burst;
        AvTat = AvTat + arr[i].tat;
        AvWt = AvWt + arr[i].wt;
        printf ("%5d\t%15d\t\t%9d\t%12d\t%12d\n", arr[i].process, arr[i].burst,
    arr[i].arrival, arr[i].tat, arr[i].wt);
      }
      printf ("Average Turn Around Time: %d\nAverage Waiting Time: %d\n", AvTat / n,
    AvWt / n);
      return 0;
    }

    //Bubble Sort
    int sort(fcfs arr[], int n)
    {
      int i, j;
      fcfs k;

      for (i = 0; i < n - 1; i++)
      {
        for (j = i + 1; j < n; j++)
        {
          //Sorting the processes according to their arrival time
          if (arr[i].arrival > arr[j].arrival)
          {
            k = arr[i];
            arr[i] = arr[j];
            arr[j] = k;
          }
        }
      }
      return 0;
    }
```

Output-

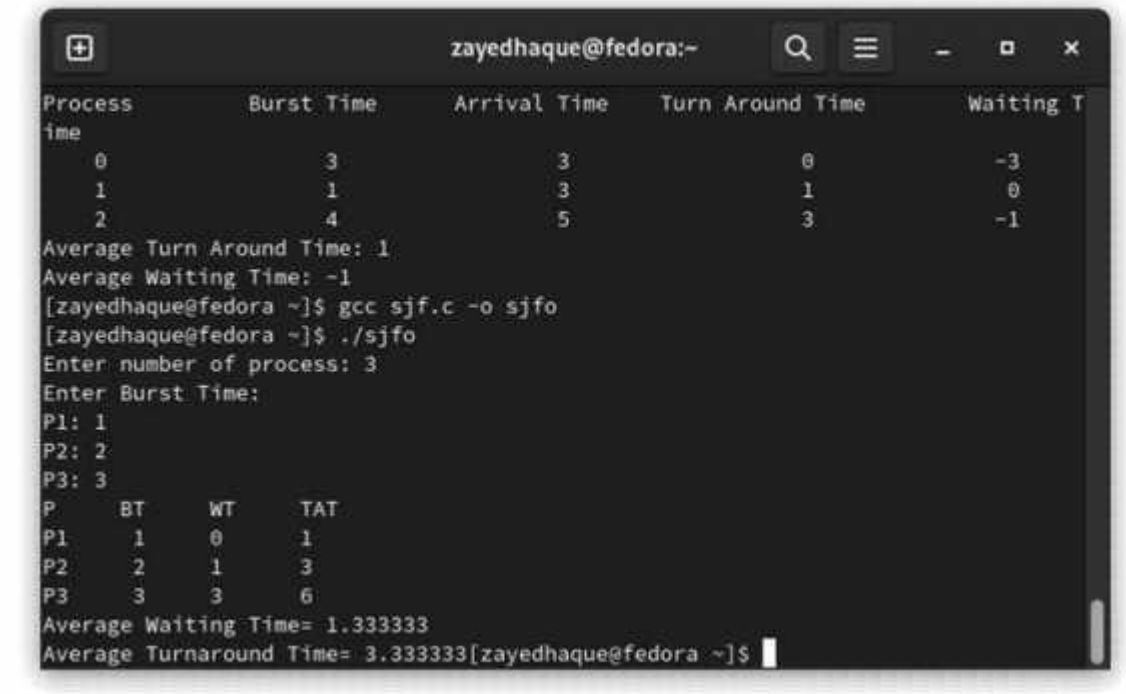


SJF Scheduling

```
#include <stdio.h>
int main()
{
   int A[100][4]; // Matrix for storing Process Id, Burst
                  // Time, Average Waiting Time & Average
                  // Turn Around
   Time. int i, j, n, total = 0,
   index, temp; float avg_wt,
   avg_tat;
   printf("Enter number of process: ");
   scanf("%d", &n);
   printf("Enter Burst Time:\n");
   // User Input Burst Time and alloting Process
   Id. for (i = 0; i < n; i++) {
      printf("P%d: ", i + 1);
      scanf("%d",
      &A[i][1]); A[i][0]
      = i + 1;
   }
   // Sorting process according to their Burst
   Time. for (i = 0; i < n; i++) {
  index = i;
  for (j = i + 1; j < n; j++)
     if (A[j][1] < A[index][1])
        index = j;
  temp = A[i][1];
  A[i][1] = A[index][1];
  A[index][1] = temp;
  temp = A[i][0];
```

```
            A[i][0] = A[index][0];
            A[index][0] = temp;
        }
        A[0][2] = 0;
        // Calculation of Waiting Times for
        (i = 1; i < n; i++) {
            A[i][2] = 0;
            for (j = 0; j < i; j++)
                A[i][2] += A[j][1];
            total += A[i][2];
        }
        avg_wt = (float)total / n;
        total = 0;
        printf("P    BT    WT    TAT\n");
        // Calculation of Turn Around Time and printing the
        // data.
        for (i = 0; i < n; i++) {
            A[i][3] = A[i][1] + A[i][2];
            total += A[i][3];
            printf("P%d    %d    %d    %d\n", A[i][0],
                A[i][1], A[i][2], A[i][3]);
        }
        avg_tat = (float)total / n;
        printf("Average Waiting Time= %f", avg_wt);
        printf("\nAverage Turnaround Time= %f", avg_tat);
    }
```

Output :



Result :

Implemented the concepts of FCFS and SJF Scheduling in C successfully.

EX:NO:9 Priority and Round Robin Scheduling

Aim :

To study the concepts of Priority and Round Robin Scheduling

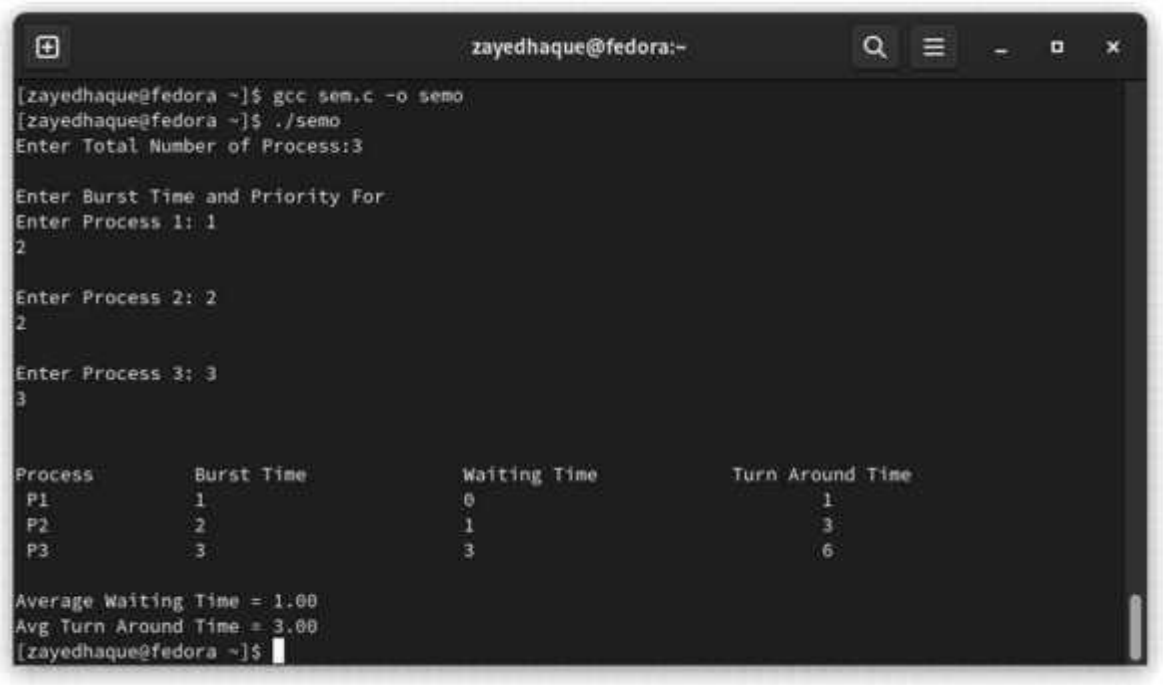
Program :

Priority Scheduling

```
#include<stdio.h>
#define max 10
int main()
{
int i,j,n,bt[max],p[max],wt[max],tat[max],pr[max],total=0,pos,temp;
float avg_wt,avg_tat;
printf("Enter Total Number of Process:");
scanf("%d",&n);
printf("\nEnter Burst Time and Priority For ");
for(i=0;i<n;i++)
{
printf("\nEnter Process %d: ",i+1);
scanf("%d",&bt[i]);
scanf("%d",&pr[i]);
p[i]=i+1;
}
for(i=0;i<n;i++)
{ pos=i;
for(j=i+1;j<n;j++)
{
if(pr[j]<pr[pos])
pos=j;
} temp=pr[i];
pr[i]=pr[pos];
pr[pos]=temp;
temp=bt[i];
bt[i]=bt[pos];
bt[pos]=temp;
temp=p[i];
p[i]=p[pos];
p[pos]=temp;
} wt[0]=0;
for(i=1;i<n;i++)
{ wt[i]=0;
for(j=0;j<i;j++)
wt[i]+=bt[j];
total+=wt[i];
}
avg_wt=total/n;
total=0;
```

```
printf("\n\nProcess\t\tBurst Time\t\tWaiting Time\t\tTurn Around Time");
for(i=0;i<n;i++)
{
tat[i] =bt[i] +wt[i] ;
total+=tat[i] ;
printf("\n P%d\t\t%d\t\t\t%d\t\t\t\t%d",p[i] ,bt[i] ,wt[i] ,tat[i] );
   }
avg_tat=total/n;
printf("\n\nAverage Waiting Time = %.2f",avg_wt);
printf("\nAvg Turn Around Time = %.2f\n",avg_tat);
return 0;
}
```

Output :



Round Robin Scheduling

```
#include<stdio.h>

int main()
{
   //Input no of processed
   int  n;
   printf("Enter Total Number of Processes:");
   scanf("%d", &n);
   int wait_time = 0, ta_time = 0, arr_time[n], burst_time[n], temp_burst_time[n];
   int x = n;

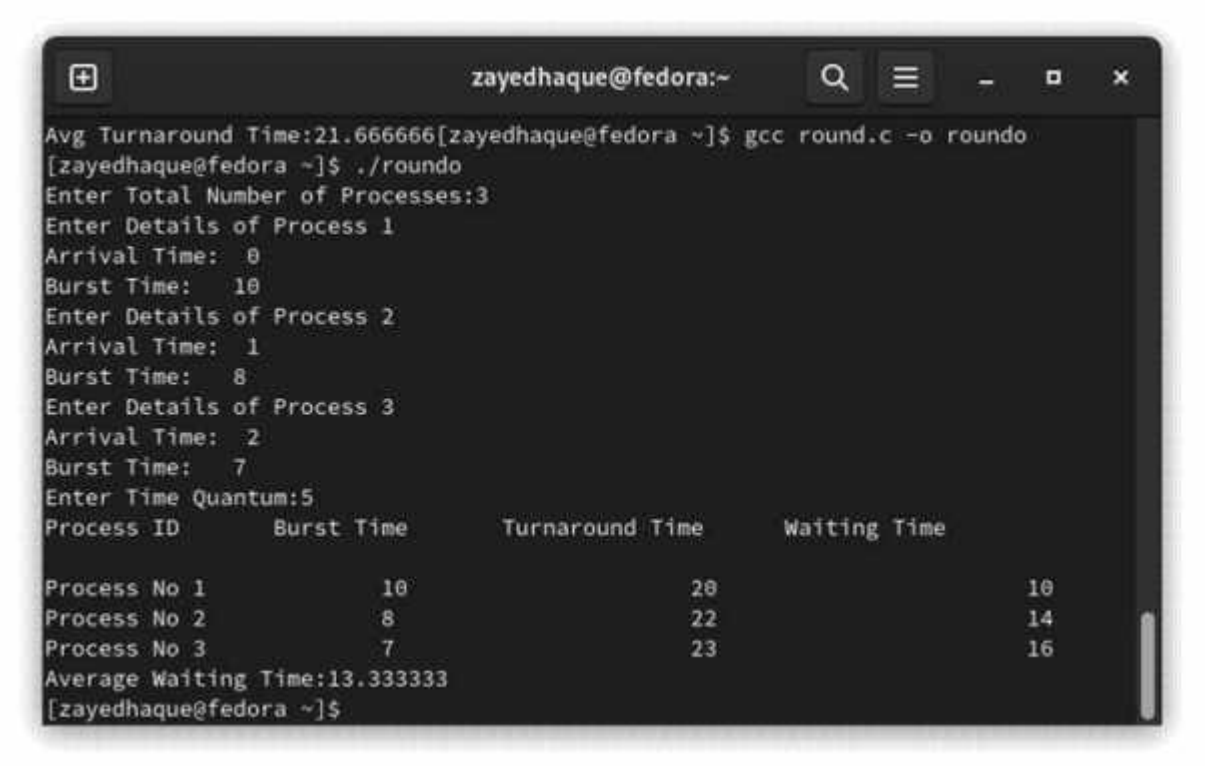
   //Input details of processes
   for(int i = 0; i < n; i++)
   {
      printf("Enter Details of Process %d \n", i + 1);
      printf("Arrival Time:  ");
      scanf("%d", &arr_time[i]);
      printf("Burst Time:   ");
      scanf("%d", &burst_time[i]);
      temp_burst_time[i] = burst_time[i];
   }

   //Input time slot
   int time_slot;
   printf("Enter Time Slot:");
   scanf("%d", &time_slot);

   //Total indicates total time
   //counter indicates which process is executed
   int total = 0,  counter = 0,i;
   printf("Process ID      Burst Time      Turnaround Time      Waiting Time\n");
   for(total=0, i = 0; x!=0; )
   {
      // define the conditions
      if(temp_burst_time[i] <= time_slot && temp_burst_time[i] > 0)
      {
         total = total + temp_burst_time[i];
         temp_burst_time[i] = 0;
         counter=1;
      }
      else if(temp_burst_time[i] > 0)
      {
```

```
            temp_burst_time[i] = temp_burst_time[i] - time_slot;
            total  += time_slot;
        }
        if(temp_burst_time[i]==0 && counter==1)
        {
            x--; //decrement the process no.
            printf("\nProcess No %d  \t\t %d\t\t\t%d\t\t\t %d", i+1, burst_time[i],
                  total-arr_time[i], total-arr_time[i]-burst_time[i]);
            wait_time = wait_time+total-arr_time[i]-burst_time[i];
            ta_time += total -arr_time[i];
            counter =0;
        }
        if(i==n-1)
        {
            i=0;
        }
        else if(arr_time[i+1]<=total)
        {
            i++;
        }
        else
        {
            i=0;
        }
    }
    float average_wait_time = wait_time * 1.0 / n;
    float average_turnaround_time = ta_time * 1.0 / n;
    printf("\nAverage Waiting Time:%f", average_wait_time);
    printf("\nAvg Turnaround Time:%f", average_turnaround_time);
    return 0;
}
```

Output :



Result :

Implemented the concepts of Priority Scheduling and Round Robin Scheduling in C successfully

EX:NO:10 FIFO Page Replacement Algorithm

Aim :

To implement FIFO page replacement algorithm

Program :

FIFO Page Replacement Algorithm

```
#include <stdio.h>
int a[100],b[100],i,n,z,f,j,pf,h,temp;
void main(){
printf("\nEnter the no. of pages : ");          // no. of page
referencing scanf("%d",&n);
printf("\nEnter the size of frame : ");         // no. of page
frames scanf("%d",&f);
printf("\n Enter the pages value :\n");              // values of page
referencing for(i=0;i<n;i++){
scanf("%d",&a[i]);
}
for(i=0;i<f;i++){                                          // assign values of
page frames 1 innitially
b[i]=-1;
}
i=0;j=0;h=0; // i , j used for loop, h for hit count all initialized to 0
while(i<n){
if(b[i]=-1 && i<f ){   // when frames are empty so for starting
enquee b[i]=a[i];
pf++;                                  // page fault counter
}
else
{
z=0
;
for(j=0;j<f;j++){

        if(b[j]==a[i]){                // to check if value already
        present h++;                          // hit counter
        }
        else{
        z++;                           // if not hit count increment
        }
}
if(z==f){                                      // if no value
        matched pf++;                                 // page
        fault counter for(j=0;j<f-1;j++){          // shifting
        values
```

```
            temp=b[j];
            b[j]=b[j+1]
            ;
            b[j+1]=tem
            p;
            }
            b[f-1]=a[i];                    // insert new values
}
} // end else
printf("\n Current Frame:  %d \t %d \t %d \n",b[2],b[1],b[0]);      // frames value for
every iteration
i++;
}         //end while
printf("\n frame at the end :");
for(i=0;i<f;i++){
printf("\n b[%d]  = %d",i,b[i]);                 // frame values at the end
}
printf("\n Page Fault = %d ",pf);                // no. of page
faults printf("\n Hit = %d ",h);                                    //
no. of hitS
printf("\n");



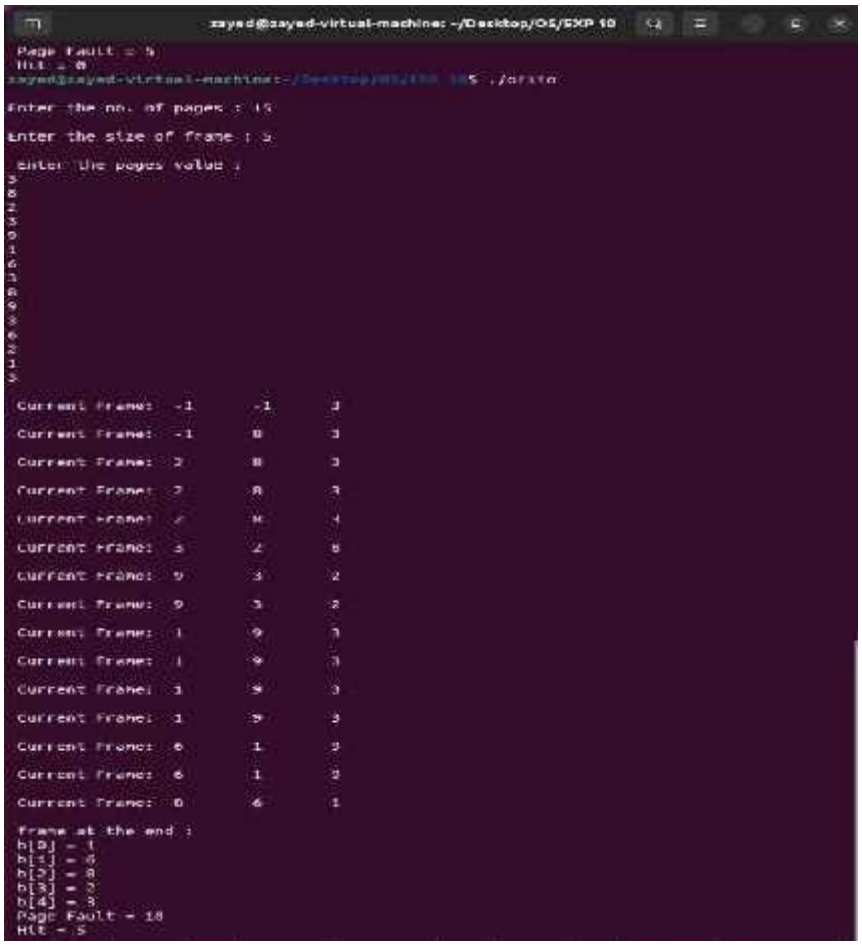






}
```

Output :



Result :

Successfully implemented page replacement using FIFO algorithm

EX:NO:11 LRU AND LFU Page Replacement Algorithm

Aim :

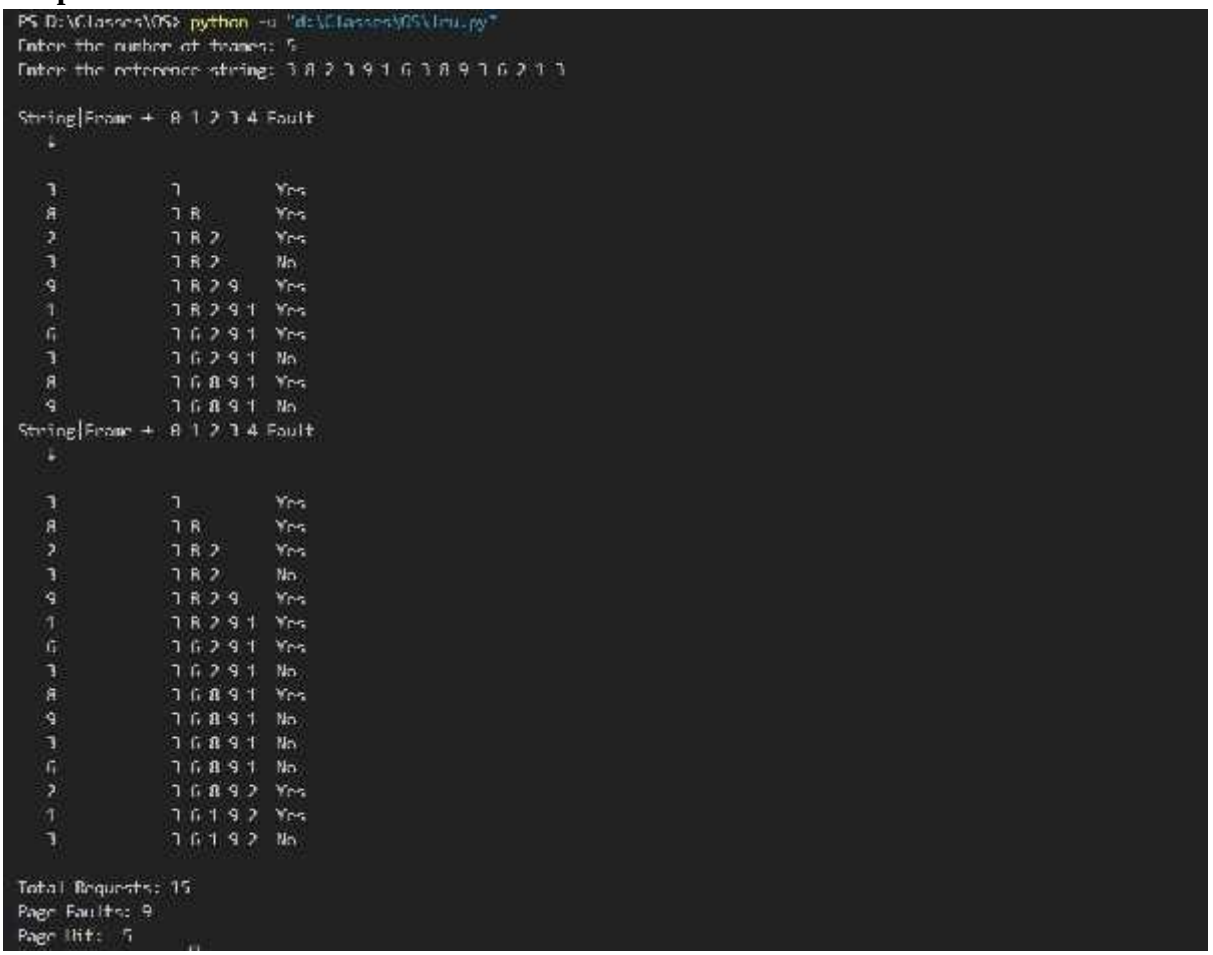
To implement page replacement using LRU and LFU

Program :

LRU

```
print("Enter the number of frames: ",end="")
capacity = int(input())
f,st,fault,pf = [],[],0,'No'
print("Enter the reference string: ",end="") s =
list(map(int,input().strip().split()))
print("\nString|Frame →\t",end='')
for i in range(capacity):
    print(i,end=' ')
print("Fault\n   ↓\n") for
i in s:
    if i not in f:
        if len(f)<capacity:
            f.append(i)
            st.append(len(f)-1)
        else:
            ind = st.pop(0)
            f[ind] = i
            st.append(ind)
        pf = 'Yes' fault
        += 1
    else:
        st.append(st.pop(st.index(f.index(i))))
        pf = 'No'
    print("   %d\t\t"%i,end='')
    for x in f:
        print(x,end=' ')
    for x in range(capacity-len(f)):
        print(' ',end=' ')
    print(" %s"%pf)
print("\nTotal Requests: %d\nPage Faults: %d"%(len(s),fault))
print("Page Hit: ",len(st))
```

Output :



LFU

```
print("Enter the number of frames: ",end="")
capacity = int(input())
f,st,fault,pf = [],[],0,'No'
print("Enter the reference string: ",end="")
s = list(map(int,input().strip().split()))
print("\nString|Frame →\t",end='')
for i in range(capacity):
    print(i,end=' ')
print("Fault\n  ↓\n")
for i in s:
    if i not in f:
        if len(f)<capacity:
            f.append(i)
            st.append(len(f)-1)
        else:
            ind = st.pop(0)
            f[ind] = i
```

```
            st.append(ind)
        pf = 'Yes'
        fault += 1
    else:
        st.append(st.pop(st.index(f.index(i))))
        pf = 'No'
    print("   %d\t\t"%i,end='')
    for x in f:
        print(x,end=' ')
    for x in range(capacity-len(f)):
        print(' ',end=' ')
    print(" %s"%pf)
print("\nTotal Requests: %d\nPage Faults: %d"%(len(s),fault))
print("Page Hit: ",len(st))
```

Output

```
String|Frame →  0 1 2 3 4 Fault
    ↓

    3           3         Yes
    8           3 8       Yes
    2           3 8 2     Yes
    3           3 8 2     No
    9           3 8 2 9   Yes
    1           3 8 2 9 1 Yes
    6           3 6 2 9 1 Yes
    3           3 6 2 9 1 No
    8           3 6 8 9 1 Yes
    9           3 6 8 9 1 No
    3           3 6 8 9 1 No
    6           3 6 8 9 1 No
    2           3 6 8 9 2 Yes
    1           3 6 1 9 2 Yes
    3           3 6 1 9 2 No

Total Requests: 15
Page Faults: 9
Page Hit:  5
```

Result :

Successfully implemented page replacement using LRU and LFU algorithms

EX:NO:12 Best Fit and Worst Fit Memory Management Policies

Aim :

To implement and study Best fit and Worst fit memory management policies in C.

Program :

```
# Function to allocate memory to
blocks
# as per Best fit
algorithm
def bestFit(blockSize, m, processSize,
n):

    # Stores block id of the block
    # allocated to a
    process allocation
    = [-1] * n
    # pick each process and find suitable
    # blocks according to its size ad
    # assign to it
    for i in range(n):

        # Find the best fit block for
        # current process
        bestIdx = -1
        for j in range(m):
            if blockSize[j] >= processSize[i]:
                if bestIdx == -1:
                    bestIdx = j
                elif blockSize[bestIdx] > blockSize[j]:
                    bestIdx = j

        # If we could find a block for
        # current process
        if bestIdx != -1:
            # allocate block j to p[i] process
            allocation[i] = bestIdx

            # Reduce available memory in this block.
            blockSize[bestIdx] -= processSize[i]

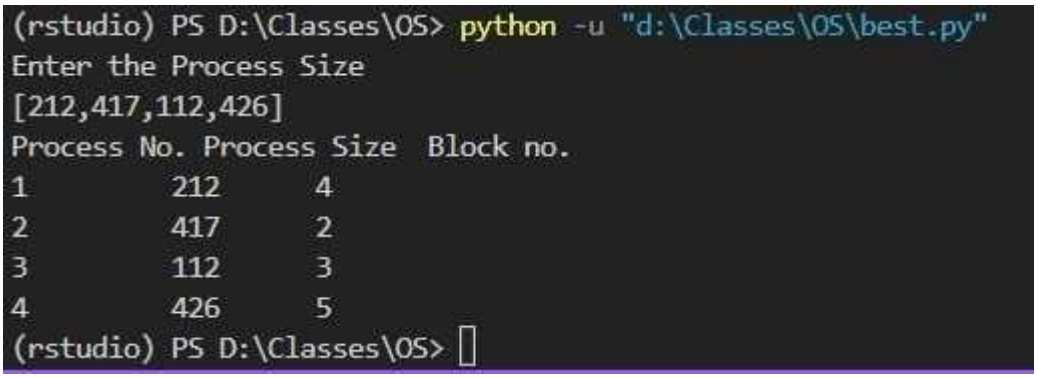
    print("Process No. Process Size  Block no.")
    for i in range(n):
        print(i + 1, "       ", processSize[i],
                            end = "      ")
```

```
        if allocation[i] != -1:
            print(allocation[i] + 1)
        else:
            print("Not Allocated")

# Driver code
if __name__ == '__main__':
    print("Enter the Process Size")
    l=input()
    blockSize = [100, 500, 200, 300, 600]
    processSize = [212, 417, 112, 426]
    m = len(blockSize)
    n = len(processSize)

    bestFit(blockSize, m, processSize, n)
```

Outp
ut :



Worst Fit Policy

Algorithm :
1- Input memory blocks and processes with sizes.
2- Initialize all memory blocks as free.
3- Start by picking each process and find the minimum block size that can be assigned to current process i.e., find min(bockSize[1], blockSize[2],.....blockSize[n]) > processSize[current], if found then assign it to the current process.
5- If not then leave that process and keep checking the further processes.

Program :

```
# Function to allocate memory to blocks as
# per worst fit algorithm
def worstFit(blockSize, m, processSize, n):

    # Stores block id of the block
    # allocated to a process

    # Initially no block is assigned
    # to any process
    allocation = [-1] * n
```

```
    # pick each process and find suitable blocks
    # according to its size ad assign to it for i in range(n):

            # Find the best fit block for
        # current process wstIdx = -1
        for j in range(m):
                    if blockSize[j] >= processSize[i]:
                            if wstIdx == -1:

                wstIdx = j
            elif blockSize[wstIdx] < blockSize[j]:
                wstIdx = j

        # If we could find a block for
        # current process
        if wstIdx != -1:

            # allocate block j to p[i] process
            allocation[i] = wstIdx

            # Reduce available memory in this block.
            blockSize[wstIdx] -= processSize[i]

    print("Process No. Process Size Block no.")
    for i in range(n):
        print(i + 1, "       ",
            processSize[i], end = "  ")
        if allocation[i] != -1:
            print(allocation[i] + 1)
        else:
            print("Not Allocated")

# Driver code
if __name__ == '__main__':
    print("Enter the Process Size")
    l=input()
    blockSize = [100, 500, 200, 300, 600]
    processSize = [212, 417, 112, 426]
    m = len(blockSize)
    n = len(processSize)
    worstFit(blockSize, m, processSize, n)
```

Output :

```
(rstudio) PS D:\Classes\OS> python -u "d:\Classes\OS\worst.py"
Enter the Process Size
[212,417,112,426]
Process No. Process Size Block no.
1         212  5
2         417  2
3         112  5
4         426  Not Allocated
(rstudio) PS D:\Classes\OS>
```

Result :

Successfully implemented and studied Best fit and Worst fit memory management policies in C.

EX:NO:13 Disk Scheduling Algorithm

Aim :

To implement and study disk scheduling algorithms.

Program :

```
from heapq import *
# hp is initial head position
# and requests is the list of requests
# no of cylinders is 200 def

FCFS(hp,requests):

    time = 0

    n = len(requests)

    pos = hp

    for request in requests:

        time += abs(request-pos)

        pos = request

        print("        ",pos,"  seeked")


    # calculate average seek time

    avg_seek_time = time / n

    return avg_seek_time

# Shortest Seek Time First

def SSTF(hp,reqs):

    requests = reqs.copy()

    time = 0

    position = hp

    n = len(requests)

    heap=[]

    while len(requests)>0:

        for r in requests:
```

```
            heappush(heap,(abs(position-r),r))
        x=heappop(heap)[1]
        time+=abs(position-x)
        position=x
        print("       ",x,"  seeked")
        requests.remove(x)
        heap=[]
    # calculate average seek time
    avg_seek_time = time/n
    return avg_seek_time
def SCAN(hp,reqs):
    requests = reqs.copy()
    pos = hp
    time  =  0
    end=200
    start=0
    #seek from curr_pos to end which is 200
    for i in range(pos,end+1):
        if i in requests:
            time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
    time+=abs(pos-end)
    pos=end
    #seek back to start
    for i in range(end,start-1,-1):
```

```
        if i in requests:
            time+=abs(pos-i)
            # print(time)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
    print(time)
    # calculate average seek time
    avg_seek_time = time/n
    return avg_seek_time
def C_SCAN(hp,reqs):
    requests = reqs.copy()
    pos = hp
    time  =  0
    end=200
    start=0
    #seek from curr_pos to end which is 200
    for i in range(pos,end+1):
        if i in requests:
            time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
    time+=abs(pos-end)
```

```
    pos=end
    #seek to hp from start
    for i in range(start,hp+1):
        if i in requests:
            time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)

    # calculate average seek time
    avg_seek_time = time/n return
    avg_seek_time
def LOOK(hp,reqs): requests =
    reqs.copy() pos = hp
    time = 0 end=max(requests)
    start=min(requests)
    #seek from curr_pos to end which is 200 for i in range(pos,end+1):
        if i in requests: time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
```

```
    #seek back to start
    for i in range(end,start-1,-1):
        if i in requests: time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
    print(time)
    # calculate average seek time avg_seek_time = time/n return avg_seek_time
def C_LOOK(hp,reqs): requests = reqs.copy() pos
    = hp
    time = 0 end=max(requests)
    start=min(requests)
    #seek from curr_pos to max of list for i in range(pos,end+1):
        if i in requests: time+=abs(pos-i) pos=i
        print("       ",i,"  seeked")
            requests.remove(i)
    time+=abs(pos-start)
    pos=start
    #seek to hp from start
    for i in range(start,hp+1):
        if i in requests:
            time+=abs(pos-i)
            pos=i
            print("       ",i,"  seeked")
            requests.remove(i)
```

```
    # calculate average seek time avg_seek_time = time/n return avg_seek_time

if __name__=='__main__': print("DISK SCHEDULING:") print("Provide

    number of I/O requests")

    #n is the number of I/O requests n

    = int(input())

    print("Provide initial position of disc arm (total cylinders=200)")

    hp = int(input())

    while hp>200:

    print("!!! INVALID !!! try again")

    hp = int(input())
print("Provide positions to visit : max is 200")
requests = []
for i in range(n): req = int(input()) requests.append(req)

print(requests)

#calling the functions
print("  **********     FCFS       *********")
print("Avg seek time for  fcfs was ", FCFS(hp,requests))

print("  **********     SSTF       *********")

print("Avg seek time for  sstf was ", SSTF(hp,requests))

print("  **********     SCAN       *********")

print("Avg seek time for  scan was ", SCAN(hp,requests))

print("  **********     C-SCAN     *********")

print("Avg seek time for  C-scan was ",

    C_SCAN(hp,requests))

print("  **********     LOOK       *********")

print("Avg seek time for  look was ",

    LOOK(hp,requests))

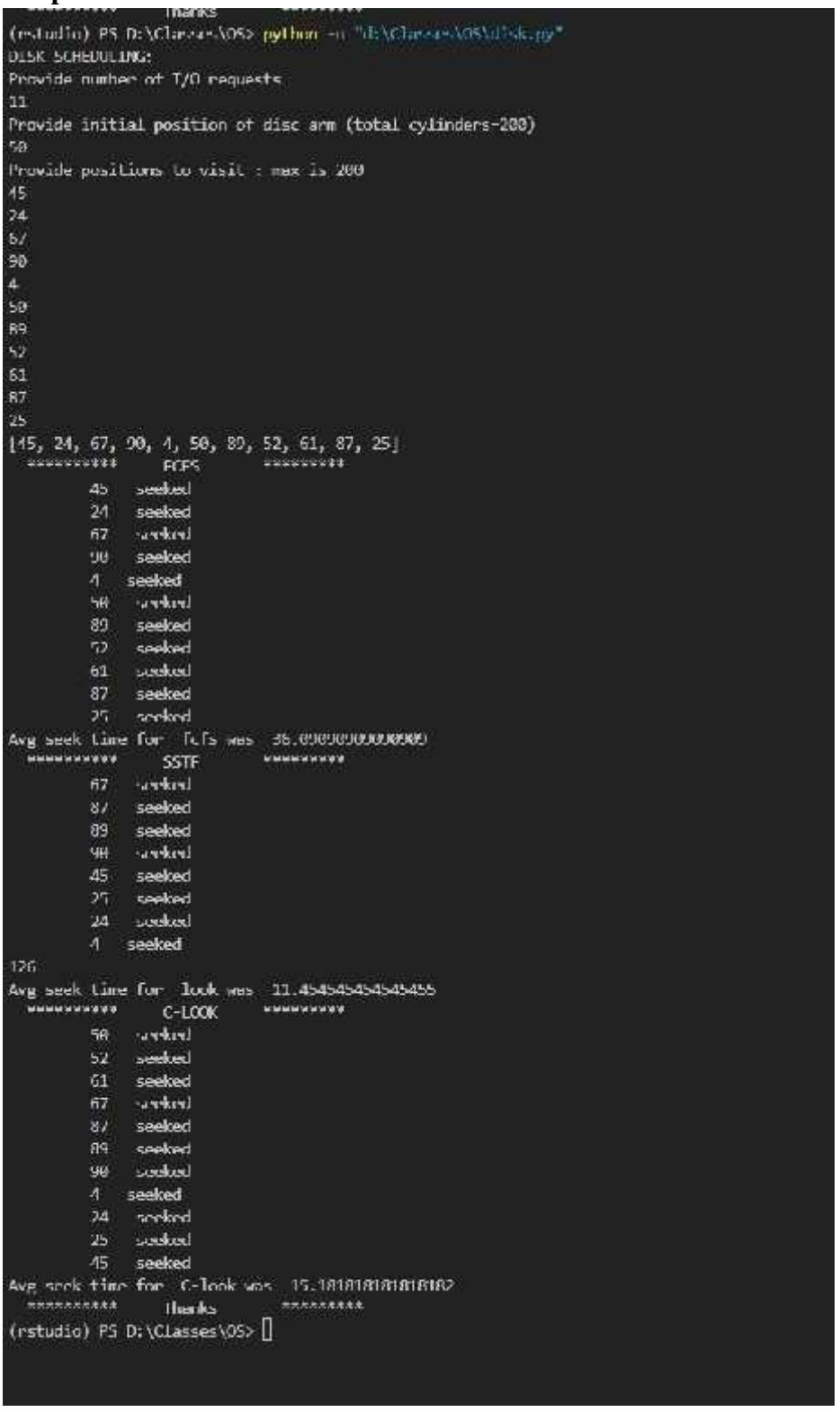
print("  **********     C-LOOK     *********")


print("Avg seek time for  C-look was ",

    C_LOOK(hp,requests))

print("  **********     Thanks       *********")
```

Output :



Result :

Successfully implemented various types of Disk Scheduling Algorithms.

Sequential and Indexed File Allocation

Aim :
To implement and study Sequential and Indexed File Allocation

Sequential File Allocation

Algorithm :
Step 1: Start the program.
Step 2: Get the number of memory partition and their sizes.
Step 3: Get the number of processes and values of block size for each process.
Step 4: First fit algorithm searches all the entire memory block until a hole which is big enough is encountered. It allocates that memory block for the requesting process.
Step 5: Best-fit algorithm searches the memory blocks for the smallest hole which can be allocated to requesting process and allocates it.
Step 6: Worst fit algorithm searches the memory blocks for the largest hole and allocates it to the process.
Step 7: Analyses all the three memory management techniques and display the best algorithm which utilizes the memory resources effectively and efficiently.
Step 8: Stop the program.

Program :

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define TOTAL_DISK_BLOCKS 32
#define TOTAL_DISK_INODES 8

#ifndef MAX
#define MAX 15
#endif

int blockStatus[TOTAL_DISK_BLOCKS]; // free = 0
int blockStart;

struct file_table { char fileName[20];
  int startBlock;
  int fileSize;
  int allotStatus;
};

struct file_table fileTable[TOTAL_DISK_BLOCKS - TOTAL_DISK_INODES];
```

```
int AllocateBlocks(int Size) {
  int i = 0, count = 0, inList = 0, nextBlock = 0;
  int allocStartBlock = TOTAL_DISK_INODES;
  int allocEndBlock = TOTAL_DISK_BLOCKS - 1;

  // check whether sufficient free blocks are available
  for (i = 0; i < (TOTAL_DISK_BLOCKS - TOTAL_DISK_INODES); i++)
        if (blockStatus[i] == 0)
        count++;
  if (count < Size)
        return 1; // not enough free blocks

  count = 0;
  while (count < Size) {
        nextBlock = (rand() % (allocEndBlock - allocStartBlock + 1)) + allocStartBlock;

        for (i = nextBlock; i < (nextBlock + Size); i++) {
        if (blockStatus[i] == 0)

        count = count + 1;
        else { count =
        0; break;
        }
        }
  }
  blockStart = nextBlock;
  for (int i = 0; i < Size; i++) {
        blockStatus[blockStart + i] = 1;
  }
  if (count == Size)
        return nextBlock; // success
  else
    return 1; // not successful
}

   void main() {
  int i = 0, j = 0, numFiles = 0, nextBlock = 0, ret = 1, totalFileSize = 0;
  char s[20];
  //-- -
  char *header[] = {"FILE_fileName", "FILE_SIZE", "BLOCKS_OCCUPIED"};

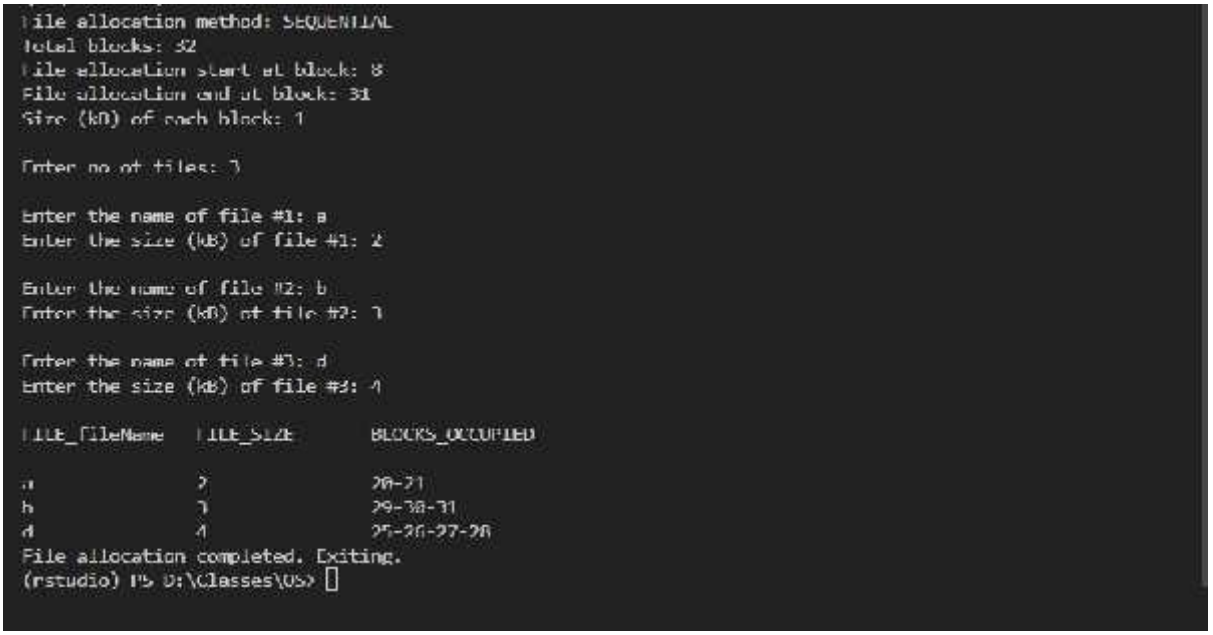
  printf("File allocation method: SEQUENTIAL\n");
  printf("Total blocks: %d\n", TOTAL_DISK_BLOCKS);
  printf("File allocation start at block: %d\n", TOTAL_DISK_INODES);
  printf("File allocation end at block: %d\n", TOTAL_DISK_BLOCKS - 1);
  printf("Size (kB) of each block: 1\n\n");
  printf("Enter no of files: ");
  scanf("%d", &numFiles);
```

```
//numFiles = 3;
for (i = 0; i < numFiles; i++) {
        //-- -
        printf("\nEnter the name of file #%d: ", i+1);
        scanf("%s", fileTable[i].fileName); printf("Enter
        the size (kB) of file #%d: ", i+1); scanf("%d",
        &fileTable[i].fileSize);

        //strcpy(fileTable[i].fileName, "testfile");
        srand(1234);
        ret = AllocateBlocks(fileTable[i].fileSize);

        //-- -
        if (ret == 1) {
        exit(0);
        } else {
          fileTable[i].startBlock = ret;
        }
}
//-- -
printf("\n%*s %*s %*s\n", -MAX, header[0], -MAX, header[1], MAX, header[2]);
//Seed the pseudo-random number generator used by rand() with the value seed
srand(1234);
//-- -
for (j = 0; j < numFiles; j++) {
        printf("\n%*s %*d ", -MAX, fileTable[j].fileName, -MAX, fileTable[j].fileSize);
        for(int k=0;k<fileTable[j].fileSize;k++) {
        printf("%d%s", fileTable[j].startBlock+k, (k == fileTable[j].fileSize-1) ? "" : "-");
        }
}
printf("\nFile allocation completed. Exiting.\n");
}
```

Output :



Indexed File Allocation

Algorithm :

Step 1: Start.

Step 2: Let n be the size of the buffer

Step 3: check if there are any producer

Step 4: if yes check whether the buffer is full

Step 5: If no the producer item is stored in the buffer

Step 6: If the buffer is full the producer has to wait

Step 7: Check there is any consumer. If yes check whether the buffer is empty

Step 8: If no the consumer consumes them from the buffer

Step 9: If the buffer is empty, the consumer has to wait.

Step 10: Repeat checking for the producer and consumer till required

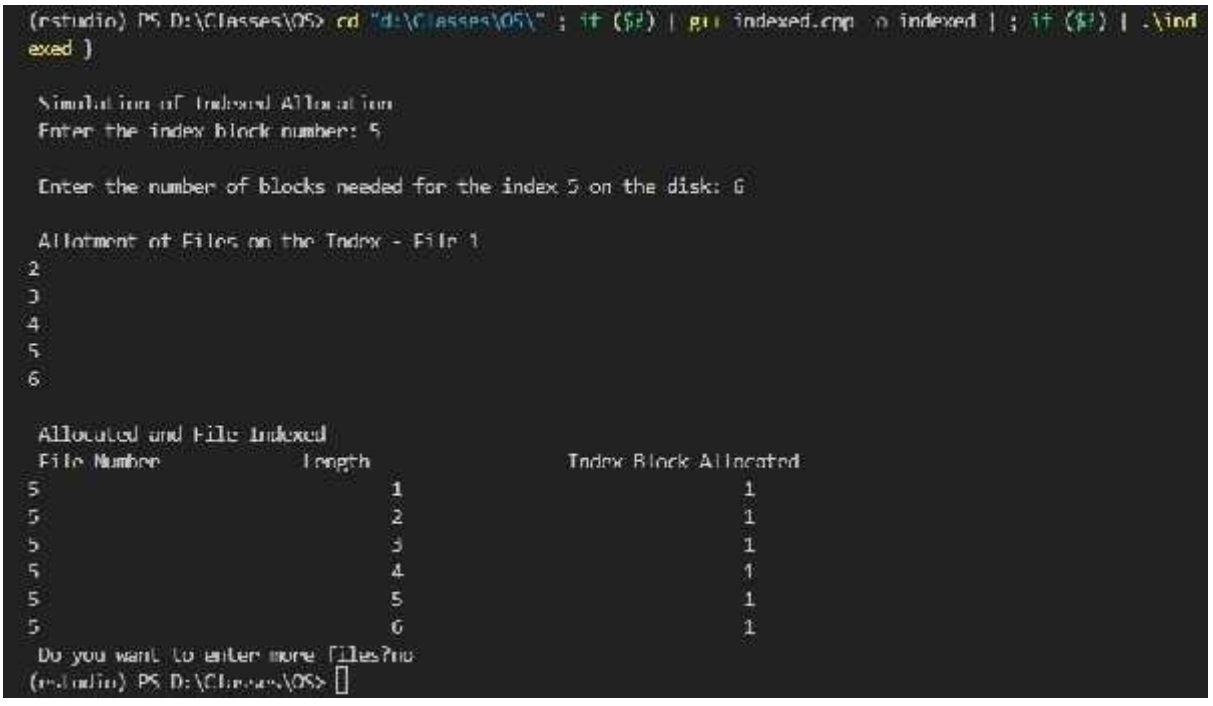
Step 11: Terminate the process

Program :

```
#include <iostream>
using namespace std;
int MaximumSizeAvailable=12;
int BlockFiles[12];
int BlockIndex[12];
int IndexBlock, n;int i;int j; int k; int Choice=0;
void Allotment();
void IndexedAllocation(){
cout << "\n Enter the index block number: ";
cin >> IndexBlock;
if (BlockFiles[IndexBlock] != 1){
cout << "\n Enter the number of blocks needed for the index " <<
IndexBlock << " on the disk: ";
cin >> n;
}
else{
cout << IndexBlock << " is already allocated \n" << endl;
IndexedAllocation();
} Allotment();
}
void Allotment(){
int occupied = 0;
cout<<"\n Allotment of Files on the Index - File ";
for (i=0; i<n; i++){
cin >> BlockIndex[i];
if (BlockFiles[BlockIndex[i]] == 0)
occupied++;
}if (occupied == n){ //All the files are alloted and indexed for (j=0; j<n; j++){
BlockFiles[BlockIndex[j]] = 1;
}
cout << "\n Allocated and File Indexed";
cout<<"\n File Number \t\t Length \t\t Index Block Allocated";
for (k=0; k<n; k++){
cout <<"\n"<< IndexBlock << " \t\t\t\t " << BlockIndex[k] << " \t\t\t\t "
<< BlockFiles[BlockIndex[k]];
```

```
}
}
else{
cout << "\n File in the index is already allocated";
cout << "\n Enter another file to index"; Allotment();
}
cout << "\n Do you want to enter more files?";
cin >> Choice;
if (Choice == 1)
IndexedAllocation();
else
exit(0);
return;
}
int main()
{ cout<<"\n Simulation of Indexed Allocation";
for(int i=0;i<MaximumSizeAvailable;i++){
BlockFiles[i] =0;
BlockIndex[i] =0;
}
IndexedAllocation();
return 0;
}
```

Output :



Result :

Successfully implemented and studied Sequential and Indexed File Allocation.

File Organization Schemes for Single and Two Level Directory

Aim :
To implement and study file organization schemes for single and two level directory

Single-level directory
Program :

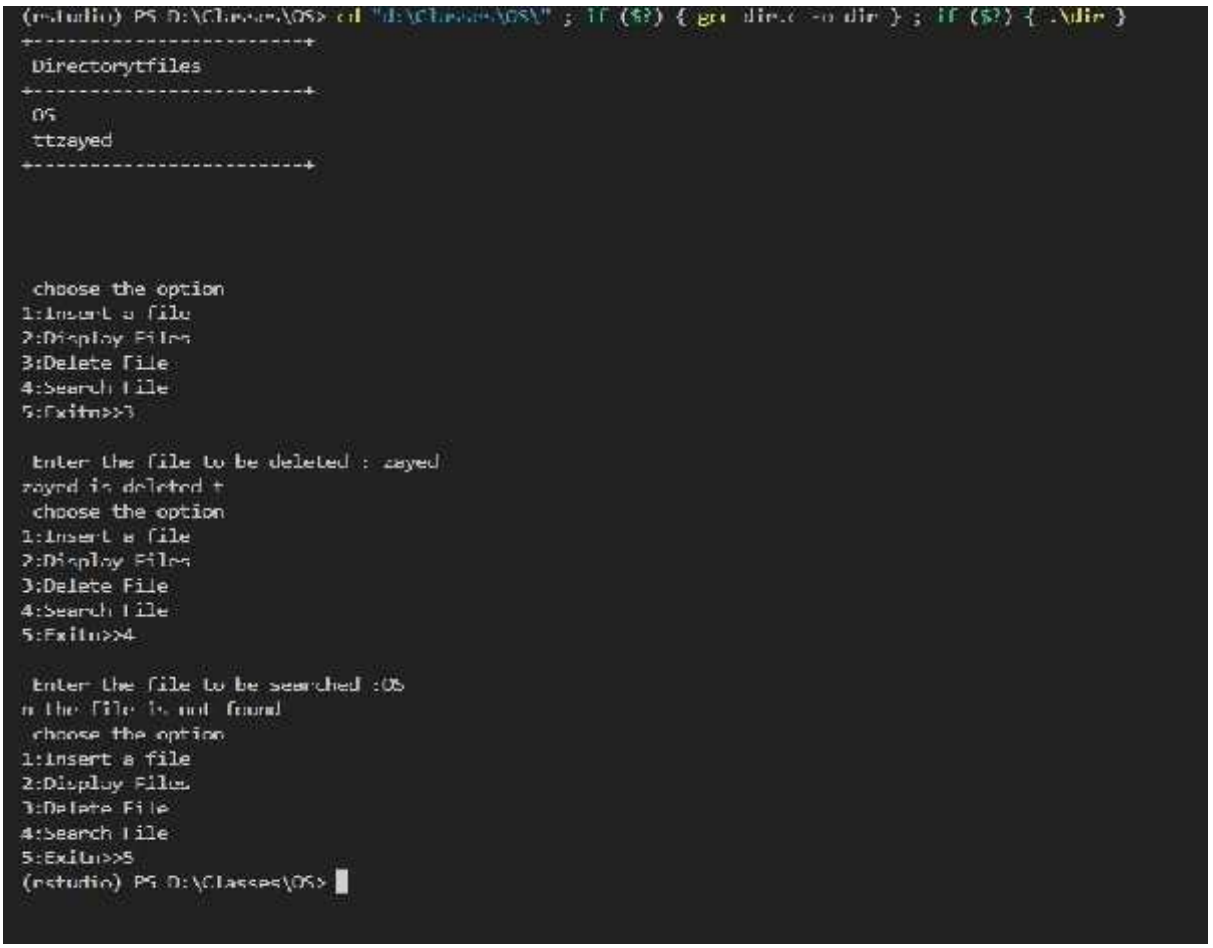
```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
struct file
{
   char fileName[15][20];
   char dirName[10];
   int fno;
};
struct file dir;
int i, n;
void InsertFile()
{
   printf("\n Enter the File name ");
   scanf("%s", dir.fileName[dir.fno]);
   dir.fno++;
}
void DisplayFiles()
{
   printf("\n\n\n\n");
   printf("+-----------------------+");
   printf("\n Directorytfiles   \n");
   printf("+-----------------------+");
   printf("\n %s", dir.dirName);
   for (i = 0; i < dir.fno; i++)
   {
      printf("\n tt%s", dir.fileName[i]);
   }
   printf("\n+-----------------------+");
   printf("\n\n\n\n");
}
void DeleteFile()
{
   char name[20];
   printf("\n Enter the file to be deleted : ");
   scanf("%s", name);
   for (i = 0; i < dir.fno; i++)
   {
      if (strcmp(dir.fileName[i], name) == 0)
```

```
        {
            printf("%s is deleted t", dir.fileName[i]);
            strcpy(dir.fileName[i], dir.fileName[dir.fno - 1]);
            dir.fno--;
        }
    }
}

void SearchFile()
{
    char name[20];
    int found = -1;
    printf("\n Enter the file to be searched :");
    scanf("%s", name);
    for (i = 0; i < dir.fno; i++)
    {
        if (strcmp(dir.fileName[i], name) == 0)
        {
            printf("\n The File is found at position %d", i + 1);
            found = 1;
            break;
        }
    }
    if (found == -1)
        printf("n the file is not found ");
}
int main()
{
    int op;
    dir.fno = 0;
    printf("\n Enter the directory name : ");
    scanf("%s", dir.dirName);
    while (1)
    {
        printf("\n choose the option \n1:Insert a file\n2:Display Files\n3:Delete File\n4:Search
File\n5:Exitn>>");
        scanf("%d", &op);
        switch (op)
        {
        case 1:
            InsertFile();
            break;
        case 2:
            DisplayFiles();
            break;
        case 3:
            DeleteFile();
            break;
```

```
        case 4:
            SearchFile();
            break;
        case 5:
            exit(0);
        }
    }
    return 0;
}
```

Output :



Two-level directory

Program :

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
struct
{
char dname[10],fname[10][10];
int fcnt;
}dir[10];
void main()
{
int i,ch,dcnt,k; char
f[30], d[30]; dcnt=0;
while(1)
{
printf("\n\n 1. Create Directory\t 2. Create File\t 3. Delete File"); printf("\n 4.
Search File \t \t 5. Display \t 6. Exit \t Enter your choice -- ");
scanf("%d",&ch);
switch(ch)
{
case 1: printf("\n Enter name of directory -- ");
scanf("%s", dir[dcnt].dname); dir[dcnt].fcnt=0;
dcnt++;
printf("Directory created");
break;
case 2: printf("\n Enter name of the directory -- ");
scanf("%s",d);
for(i=0;i<dcnt;i++)
if(strcmp(d,dir[i].dname)==0)
{
printf("Enter name of the file -- ");
scanf("%s",dir[i].fname[dir[i].fcnt]);
dir[i].fcnt++;
printf("File created");
break;
}
if(i==dcnt)
printf("Directory %s not found",d);
break;
case 3: printf("\nEnter name of the directory -- ");
scanf("%s",d);
for(i=0;i<dcnt;i++)
{
if(strcmp(d,dir[i].dname)==0)
{
```

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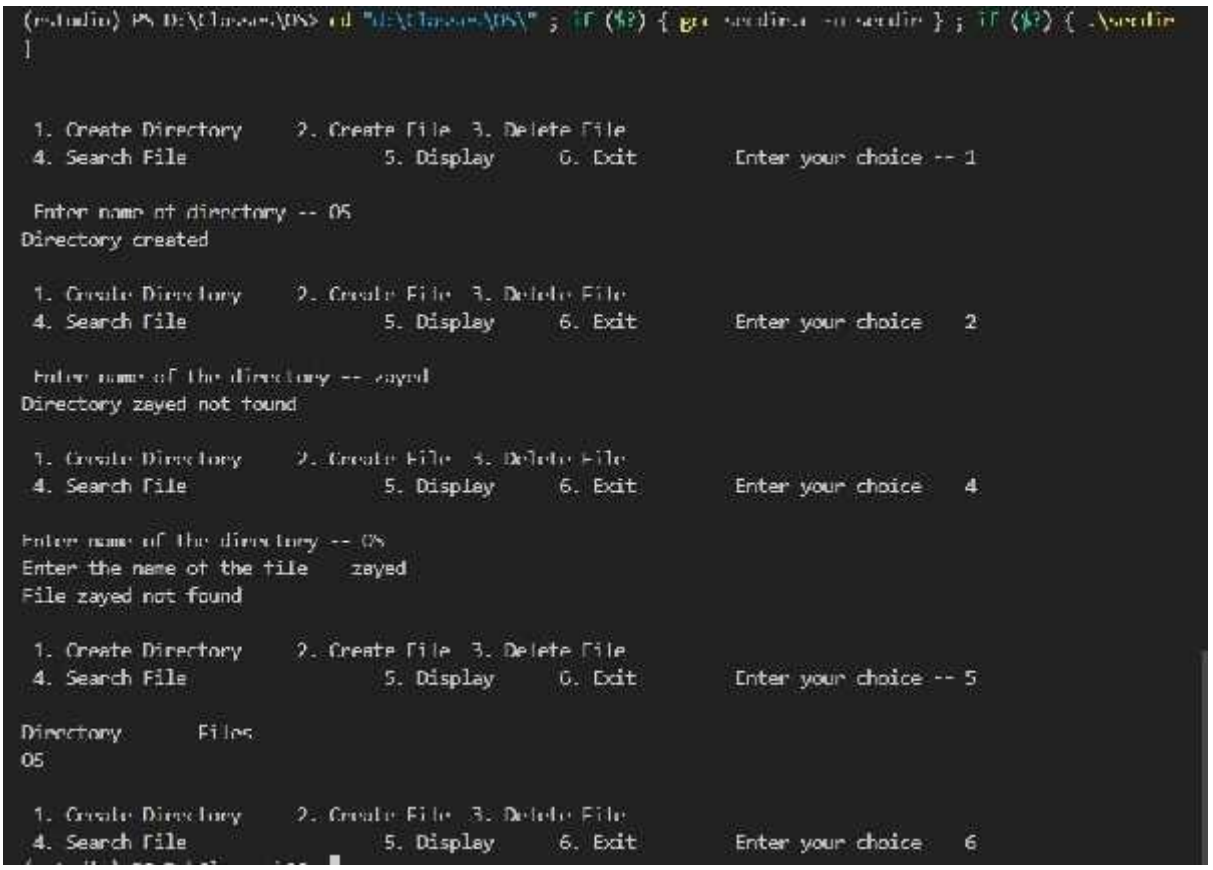
printf("Enter name of the file -- ");
scanf("%s",f);
for(k=0;k<dir[i].fcnt;k++)
{
if(strcmp(f, dir[i].fname[k])==0)
{
printf("File %s is deleted ",f); dir[i].fcnt--;
strcpy(dir[i].fname[k],dir[i].fname[dir[i].fcnt]);
goto jmp;
}
}
printf("File %s not found",f);
goto jmp;
}
}
printf("Directory %s not found",d);
jmp : break;
case 4: printf("\nEnter name of the directory -- ");
scanf("%s",d);
for(i=0;i<dcnt;i++)
{
if(strcmp(d,dir[i].dname)==0)
{
printf("Enter the name of the file -- ");
scanf("%s",f); for(k=0;k<dir[i].fcnt;k++)
{
if(strcmp(f, dir[i].fname[k])==0)
{
printf("File %s is found ",f);
goto jmp1;}
}
printf("File %s not found",f);
goto jmp1;}}
printf("Directory %s not found",d);
jmp1: break;
case 5: if(dcnt==0)
printf("\nNo Directory's ");
else
{ printf("\nDirectory\tFiles");
for(i=0;i<dcnt;i++)
{ printf("\n%s\t\t",dir[i].dname);
for(k=0;k<dir[i].fcnt;k++)
printf("\t%s",dir[i].fname[k]);
}
} break;
default:exit(0);
}
}
return;}
```

Output



Result :

Successfully implemented file organization schemes for single level and two level directory.