<u>Experiment no.1</u>

NAME: Atharv Vijay Deshpande

PRN: 21410044

BATCH: EN – 3

Title: Linux Installation procedure and basic linux commands

❖ **<u>Installation Procedure:-</u>**

1.Download Ubuntu

- Go to the official Ubuntu website and download the latest version of the Ubuntu ISO file.

2. Create a Bootable USB Drive

- You'll need a USB drive with at least 8 GB of storage.
- Use a tool like Rufus (for Windows) or Etcher (for Windows, macOS, and Linux) to create a bootable USB drive.
- Open the tool, select the downloaded Ubuntu ISO file, and follow the instructions to create the bootable USB.

3. Boot from the USB Drive

- Insert the bootable USB drive into your PC.
- Restart your PC and enter the BIOS/UEFI settings (usually by pressing a key like F2, F12, DEL, or ESC during startup).
- Change the boot order to prioritize the USB drive.
- Save the changes and exit the BIOS/UEFI settings. Your PC should now boot from the USB drive.

4. Start the Installation Process

- Once Ubuntu boots from the USB, you'll see the option to "Try Ubuntu" or "Install Ubuntu." Select "Install Ubuntu."
- Choose your preferred language and click "Continue."

5. Prepare the Installation

- Select your keyboard layout and click “Continue.”
- Choose the installation type. You can either:
  - **Erase disk and install Ubuntu**: This will delete all data on the disk and install Ubuntu as the only operating system.
  - **Install Ubuntu alongside Windows**: This will create a dual-boot setup, allowing you to choose between Ubuntu and Windows at startup.
- Click “Install Now” and confirm your choice.

6. Set Up Your System

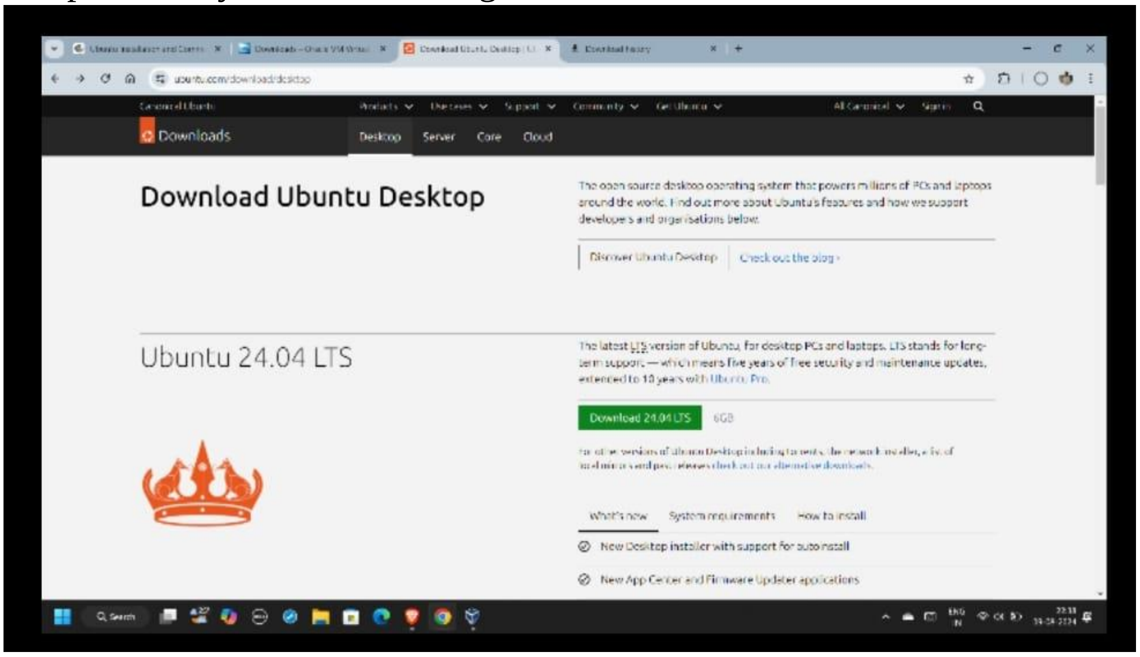
- Select your time zone and click “Continue.”
- Enter your personal details, such as your name, computer name, username, and password. Click “Continue.”

7. Complete the Installation

- The installer will copy files and install Ubuntu. This process may take some time.
- Once the installation is complete, you’ll be prompted to restart your PC. Remove the USB drive and press “Enter.”

8. First Boot

- After restarting, your PC will boot into Ubuntu. Log in with the username and password you created during the installation.



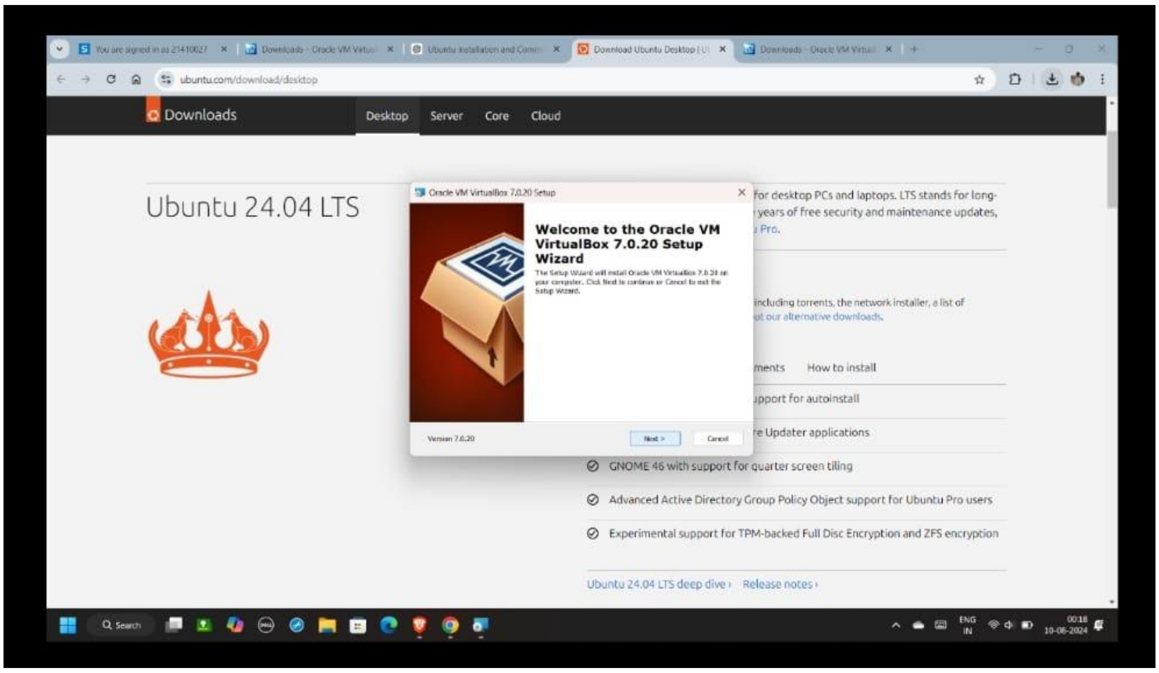
Download Ubuntu Desktop

The open source desktop operating system that powers millions of PCs and laptops around the world. Find out more about Ubuntu's features and how we support developers and organisations below.

Ubuntu 24.04 LTS

The latest LTS version of Ubuntu, for desktop PCs and laptops. LTS stands for long-term support — which means five years of free security and maintenance updates, extended to 10 years with Ubuntu Pro.

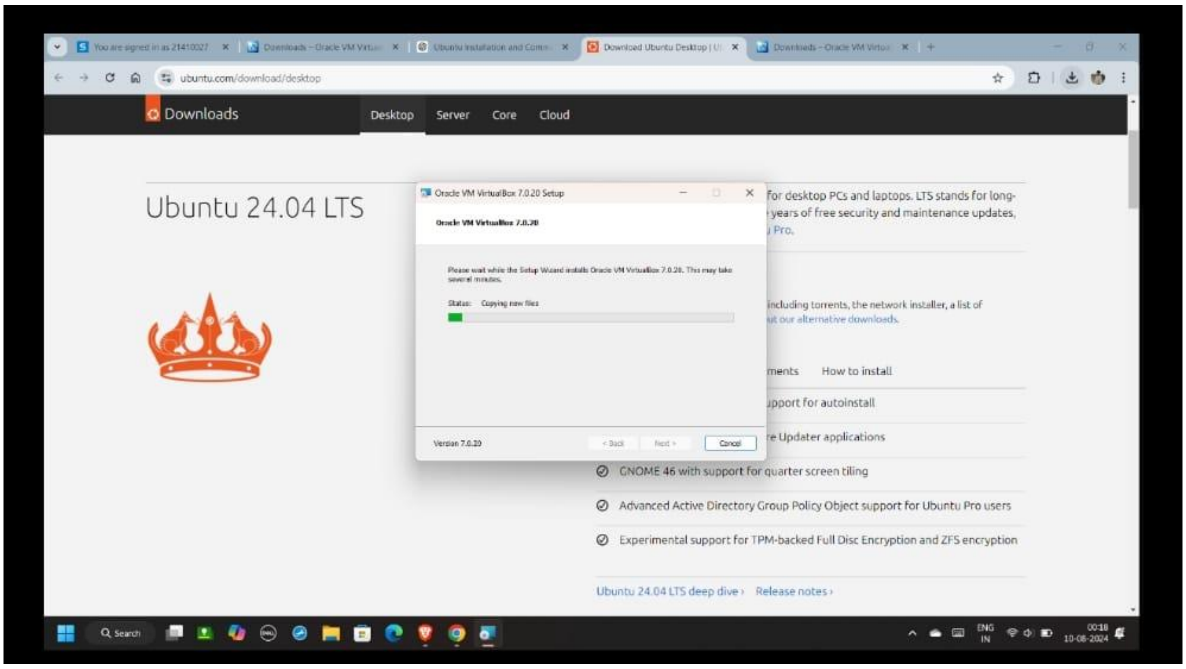
- New Desktop installer with support for autoinstall
- New App Center and Firmware Updater applications



Oracle VM VirtualBox 7.0.20 Setup

Welcome to the Oracle VM VirtualBox 7.0.20 Setup Wizard

The Setup Wizard will install Oracle VM VirtualBox 7.0.20 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

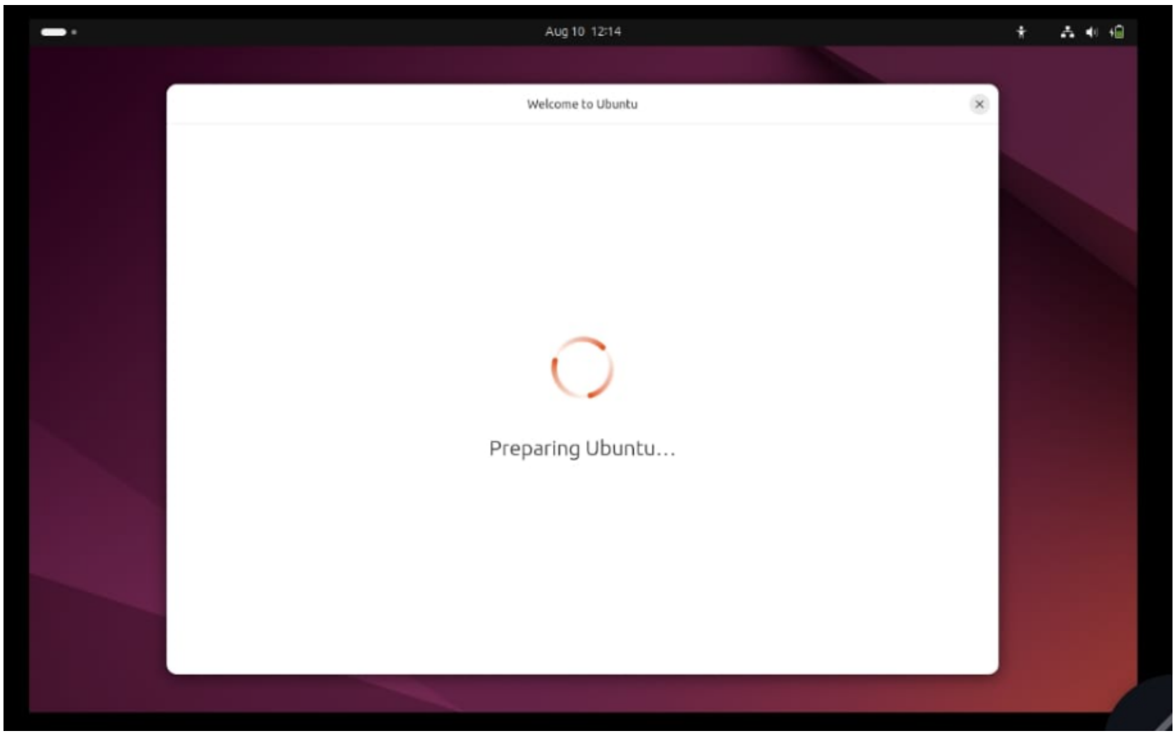


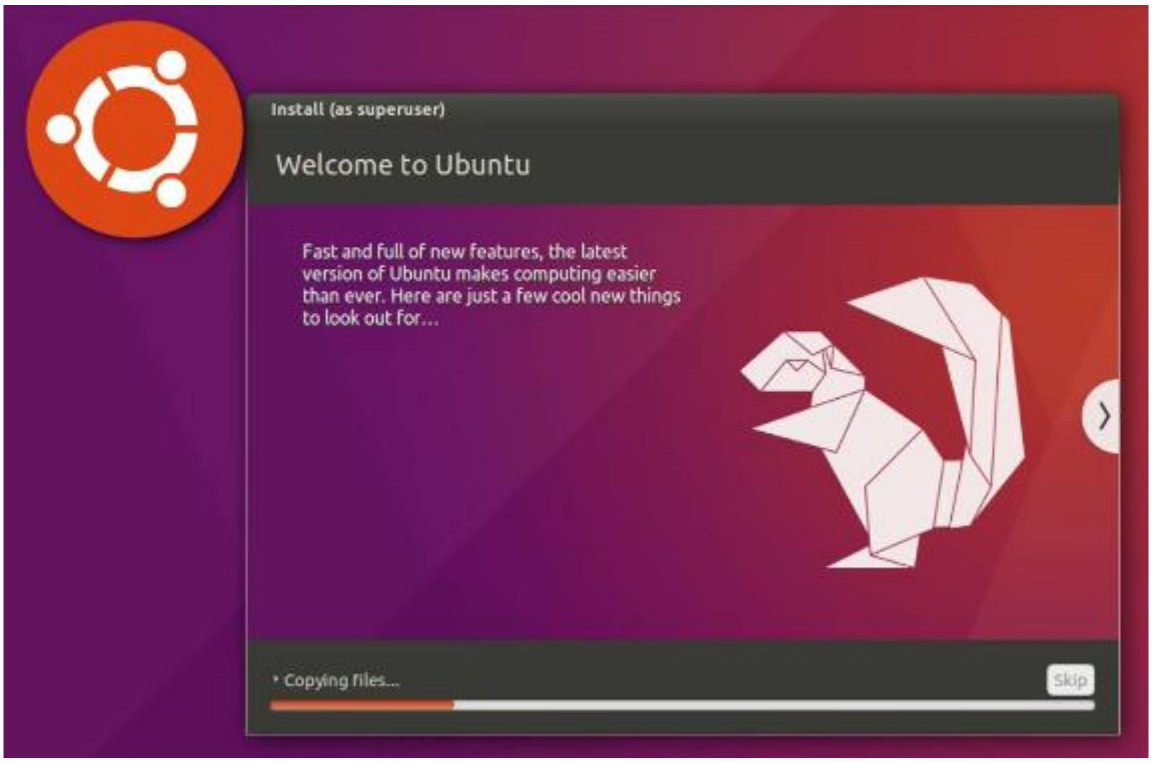
Oracle VM VirtualBox 7.0.20 Setup

Oracle VM VirtualBox 7.0.20

Please wait while the Setup Wizard installs Oracle VM VirtualBox 7.0.20. This may take several minutes.

Status: Copying new files

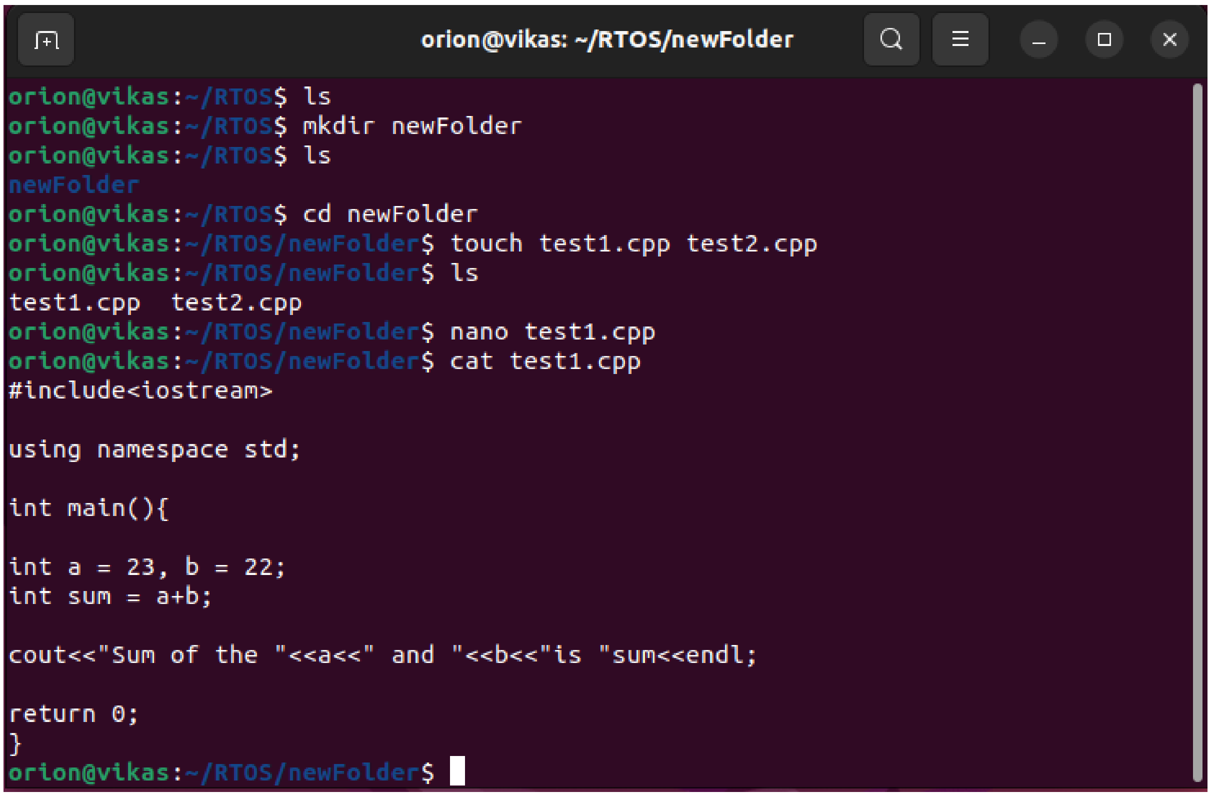




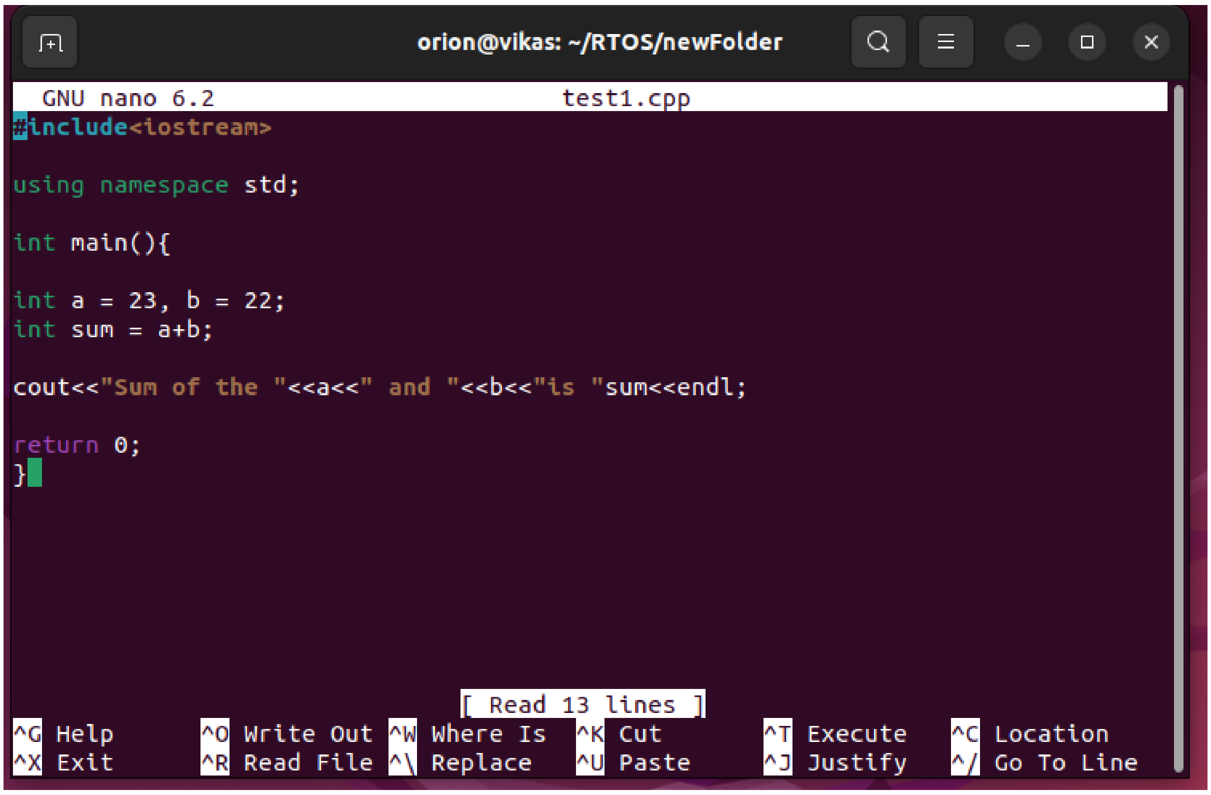
Fast and full of new features, the latest version of Ubuntu makes computing easier than ever. Here are just a few cool new things to look out for…

➢ **<u>Linux commands:</u>**

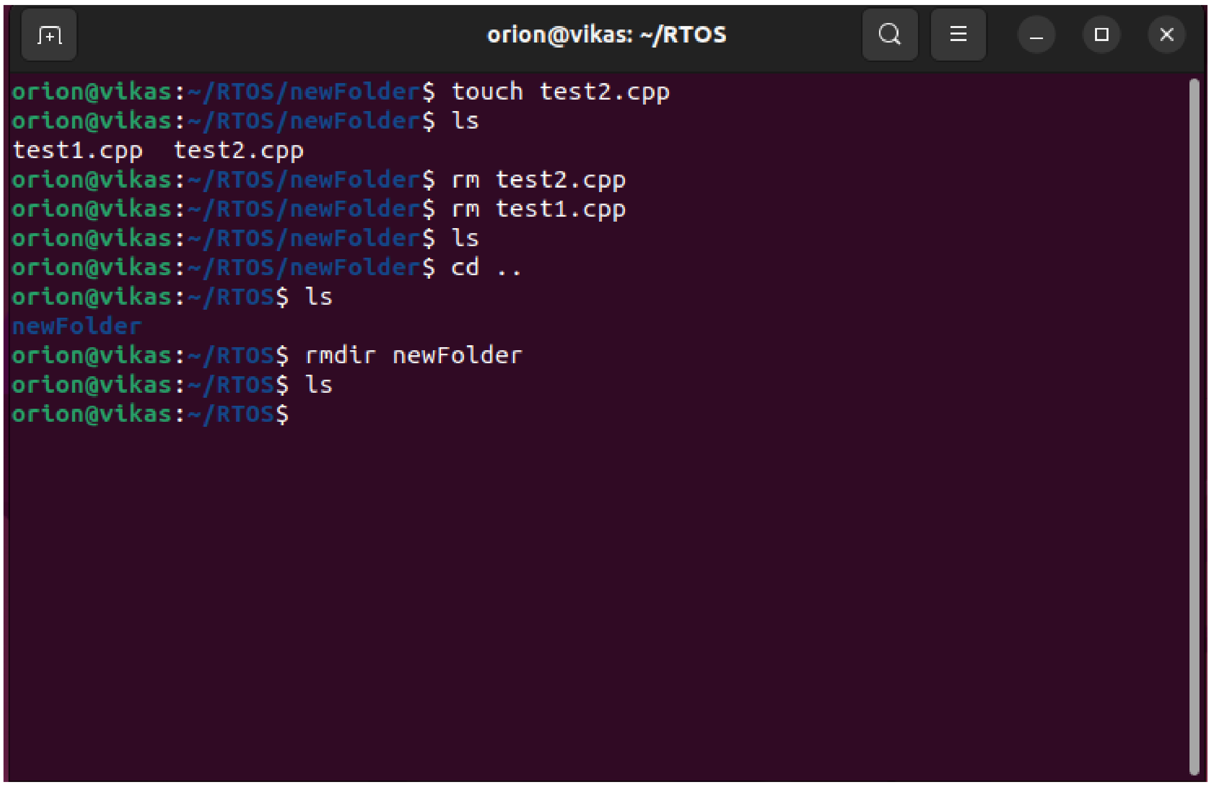
1. ls: The workhorse of directory listing. Use it to see what files and directories are in your current location.
2. pwd: Print the current working directory
3. cd: Change directory. Navigate around your file system with this command.
4. mkdir: Create a new directory (folder).
5. mv: Move or rename files and directories.
6. cp: Copy files and directories.
7. rm: Delete files or directories
8. touch: Create blank or empty files.
9. Nano: It is a command-line text editor that's simple and easy to use.
10. Gedit: It is a graphical text editor that comes pre-installed with the GNOME desktop environment. It's user-friendly and great for editing text files with a graphical interface.



```
orion@vikas:~/RTOS$ ls
orion@vikas:~/RTOS$ mkdir newFolder
orion@vikas:~/RTOS$ ls
newFolder
orion@vikas:~/RTOS$ cd newFolder
orion@vikas:~/RTOS/newFolder$ touch test1.cpp test2.cpp
orion@vikas:~/RTOS/newFolder$ ls
test1.cpp  test2.cpp
orion@vikas:~/RTOS/newFolder$ nano test1.cpp
orion@vikas:~/RTOS/newFolder$ cat test1.cpp
#include<iostream>

using namespace std;

int main(){

int a = 23, b = 22;
int sum = a+b;

cout<<"Sum of the "<<a<<" and "<<b<<"is "sum<<endl;

return 0;
}
orion@vikas:~/RTOS/newFolder$ 
```



```
orion@vikas: ~/RTOS/newFolder
  GNU nano 6.2                          test1.cpp
#include<iostream>

using namespace std;

int main(){

int a = 23, b = 22;
int sum = a+b;

cout<<"Sum of the "<<a<<" and "<<b<<"is "sum<<endl;

return 0;
}
                              [ Read 13 lines ]
^G Help       ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location
^X Exit       ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^/ Go To Line
```



```
orion@vikas: ~/RTOS
orion@vikas:~/RTOS/newFolder$ touch test2.cpp
orion@vikas:~/RTOS/newFolder$ ls
test1.cpp  test2.cpp
orion@vikas:~/RTOS/newFolder$ rm test2.cpp
orion@vikas:~/RTOS/newFolder$ rm test1.cpp
orion@vikas:~/RTOS/newFolder$ ls
orion@vikas:~/RTOS/newFolder$ cd ..
orion@vikas:~/RTOS$ ls
newFolder
orion@vikas:~/RTOS$ rmdir newFolder
orion@vikas:~/RTOS$ ls
orion@vikas:~/RTOS$
```

❖ C**onclusion**

- ❖ We learned how to install Linux Distribution inside a Virtual Machine and how to use it without actually needing the hardware of the machine.
- ❖ We also learned how Linux focuses more on terminal commands rather than GUI, due to which we learned various Linux commands which helped in understanding the Linux OS and how to use it.

Experiment No. 2

Name: Atharv Vijay Deshpande

PRN: 21410044

Batch: EN-3

Title: Execution of C program in Linux

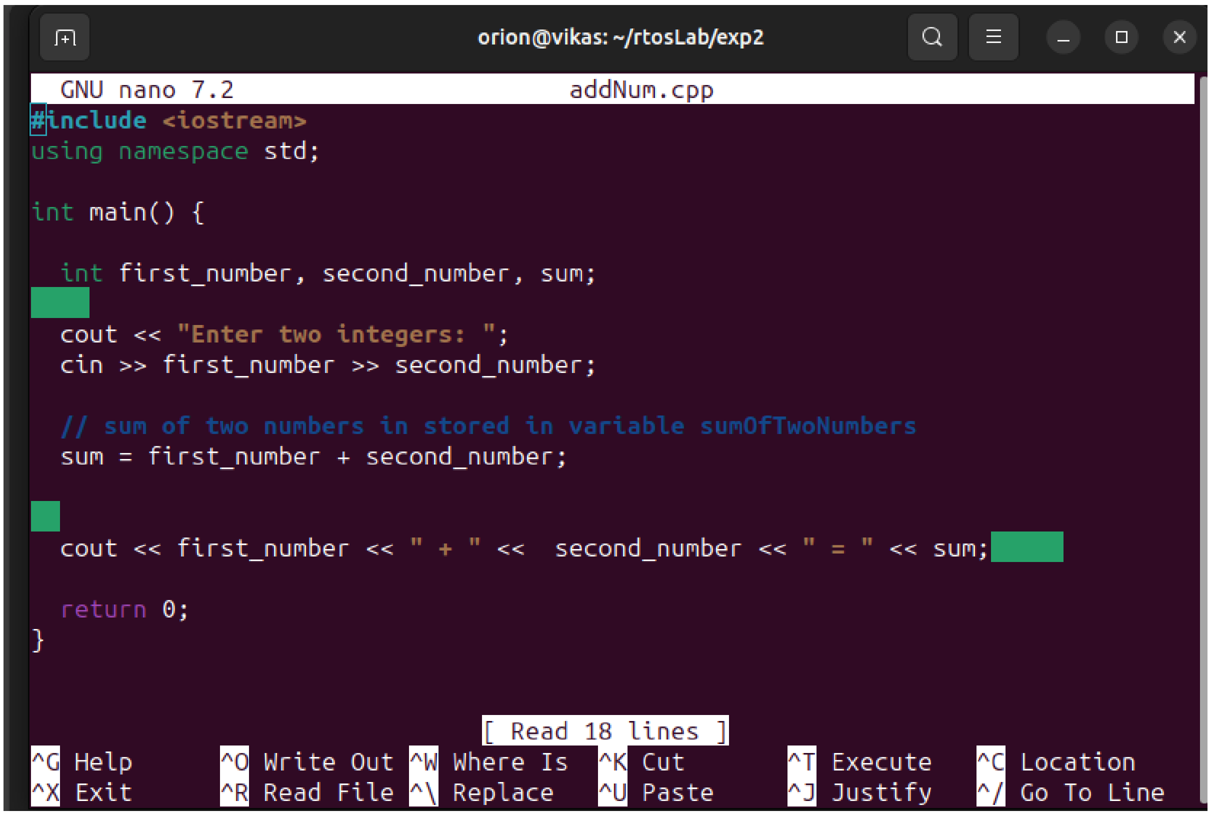
Part A: Single file C program

Step 1: Open a terminal in Linux.

Step 2: Create a new file using the command:

nano addNum.cpp

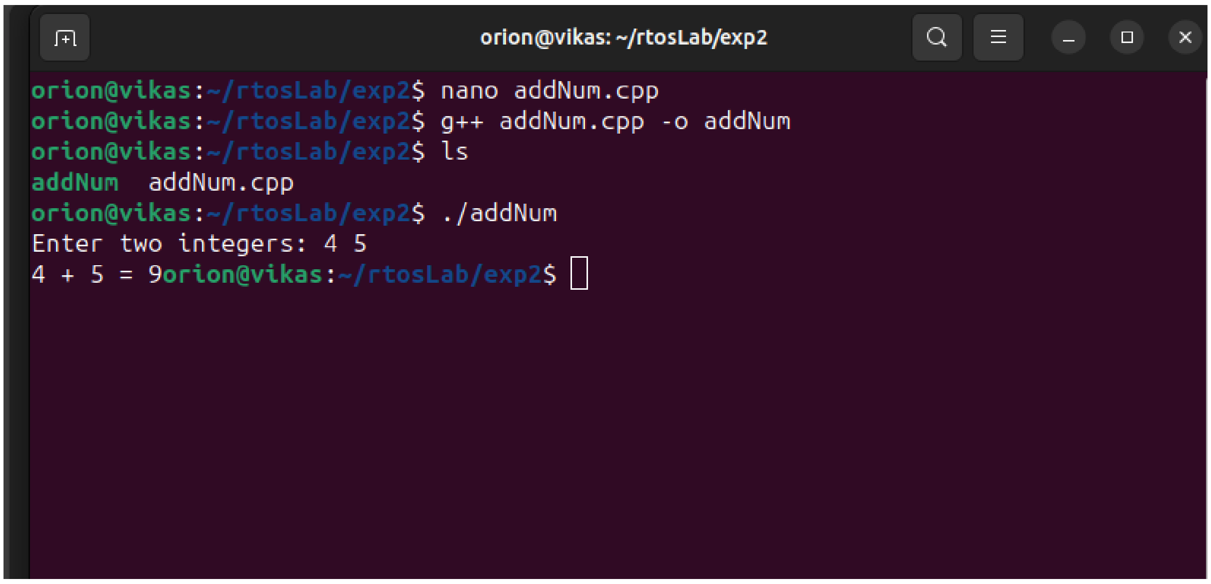
Step 3: Write the code into addNum.cpp.



```
  GNU nano 7.2                              addNum.cpp
#include <iostream>
using namespace std;

int main() {

  int first_number, second_number, sum;

  cout << "Enter two integers: ";
  cin >> first_number >> second_number;

  // sum of two numbers in stored in variable sumOfTwoNumbers
  sum = first_number + second_number;


  cout << first_number << " + " <<  second_number << " = " << sum;

  return 0;
}


                               [ Read 18 lines ]
^G Help         ^O Write Out ^W Where Is  ^K Cut        ^T Execute    ^C Location
^X Exit         ^R Read File ^\ Replace   ^U Paste      ^J Justify    ^/ Go To Line
```

Step 4: Save and exit the editor by pressing CTRL + S, CTRL + X, and Enter.

Step 5: Compile the C program using the GCC compiler



```
orion@vikas:~/rtosLab/exp2$ nano addNum.cpp
orion@vikas:~/rtosLab/exp2$ g++ addNum.cpp -o addNum
orion@vikas:~/rtosLab/exp2$ ls
addNum  addNum.cpp
orion@vikas:~/rtosLab/exp2$ ./addNum
Enter two integers: 4 5
4 + 5 = 9orion@vikas:~/rtosLab/exp2$ 
```

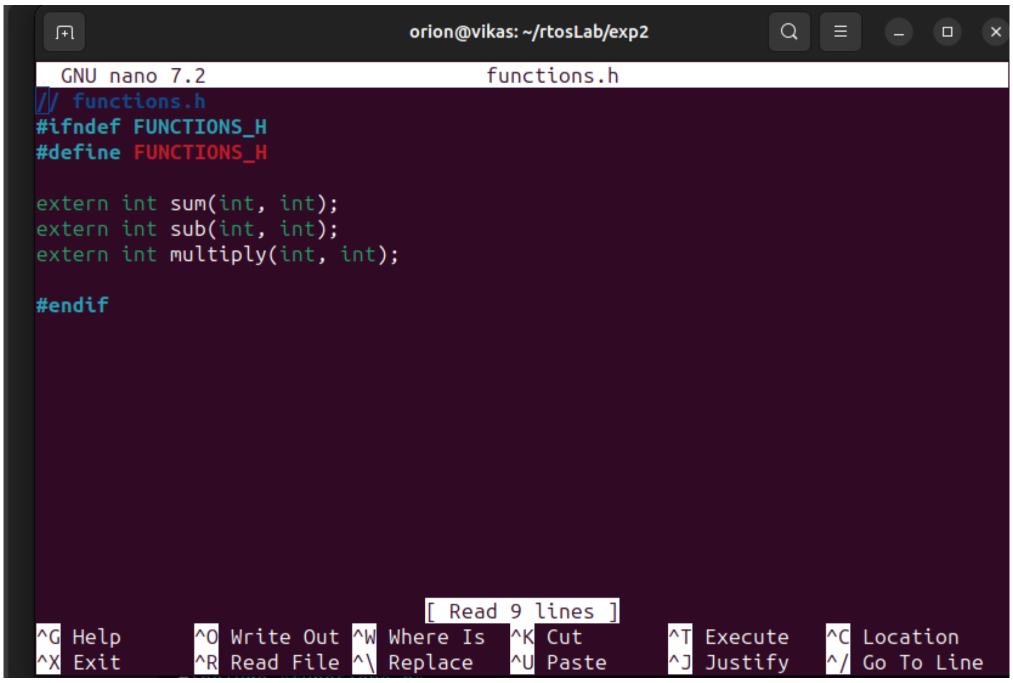
Part B: Multifile C Program

2. Procedure (Multifile)

- Step 1: Open a terminal in Linux.
- Step 2: Create the header file functions.h using the command:

  nano functions.h

- Step 3: Write the content of operations.h and save it.

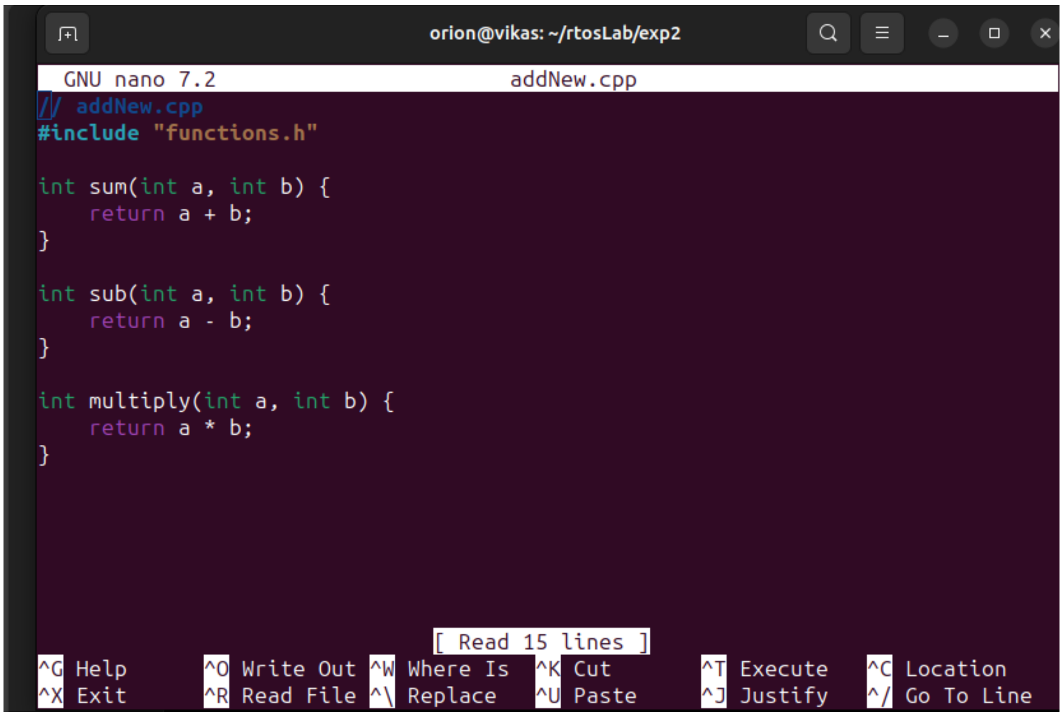


```
// functions.h
#ifndef FUNCTIONS_H
#define FUNCTIONS_H

extern int sum(int, int);
extern int sub(int, int);
extern int multiply(int, int);

#endif
```

- Step 4: Create the implementation file addNew.cpp:

nano addNew.cpp

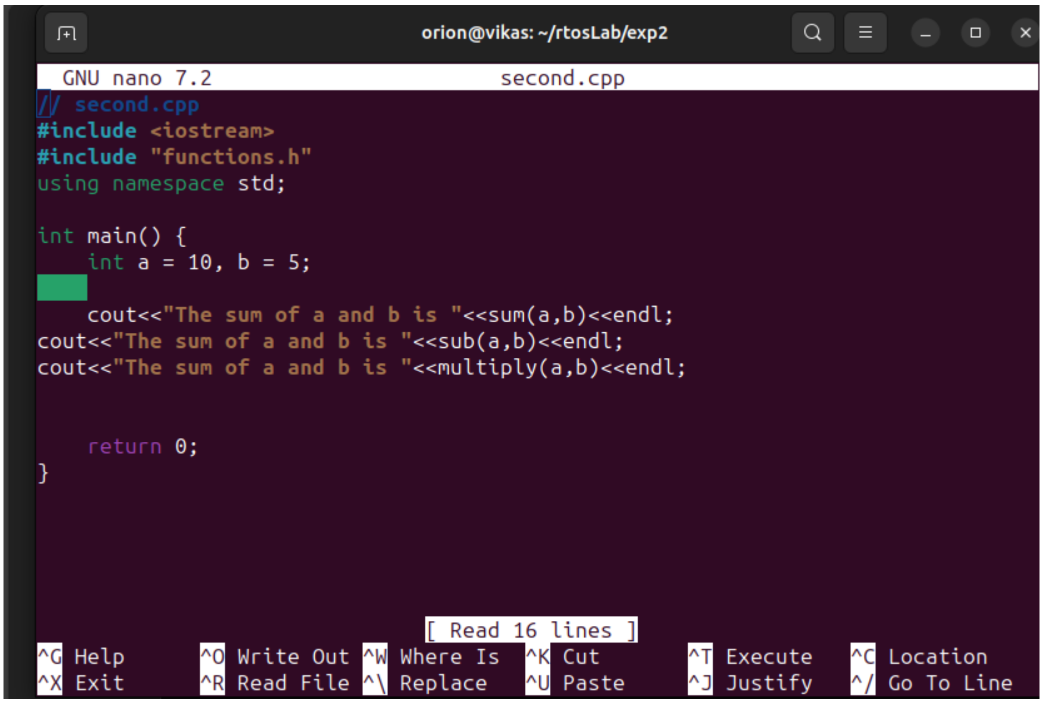
- Step 5: Write the content of operations.c and save it.



```
orion@vikas: ~/rtosLab/exp2
  GNU nano 7.2                    addNew.cpp
// addNew.cpp
#include "functions.h"

int sum(int a, int b) {
    return a + b;
}

int sub(int a, int b) {
    return a - b;
}

int multiply(int a, int b) {
    return a * b;
}

                         [ Read 15 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^/ Go To Line
```

- Step 6: Create the main file second.cpp:

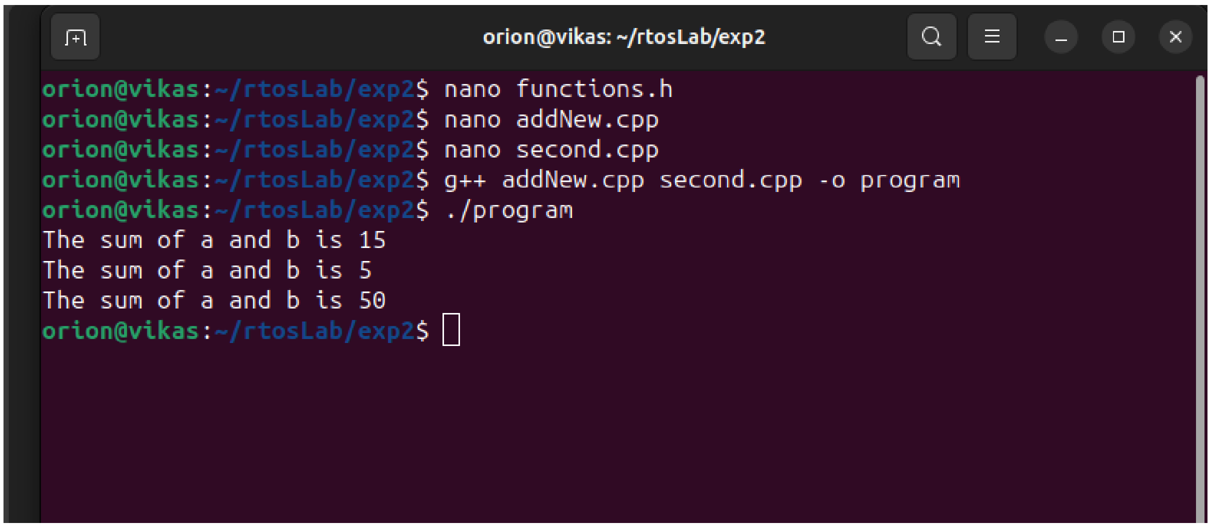
nano second.cpp



```
orion@vikas: ~/rtosLab/exp2
  GNU nano 7.2                    second.cpp
// second.cpp
#include <iostream>
#include "functions.h"
using namespace std;

int main() {
    int a = 10, b = 5;

    cout<<"The sum of a and b is "<<sum(a,b)<<endl;
cout<<"The sum of a and b is "<<sub(a,b)<<endl;
cout<<"The sum of a and b is "<<multiply(a,b)<<endl;


    return 0;
}

                         [ Read 16 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^/ Go To Line
```

- Step 7: Write the content of second.cpp and save it.

- Step 8: Compile the multifile program using the GCC compiler:
- Step 9: Execute the compiled program:
- Step 10: Observe the result.



```
orion@vikas:~/rtosLab/exp2$ nano functions.h
orion@vikas:~/rtosLab/exp2$ nano addNew.cpp
orion@vikas:~/rtosLab/exp2$ nano second.cpp
orion@vikas:~/rtosLab/exp2$ g++ addNew.cpp second.cpp -o program
orion@vikas:~/rtosLab/exp2$ ./program
The sum of a and b is 15
The sum of a and b is 5
The sum of a and b is 50
orion@vikas:~/rtosLab/exp2$ 
```

❖ **Conclusion :** In the g++ compilation of single and multiple files in C++, we explored how to compile and link programs effectively. For single-file compilation, we used g++ filename.cpp -o output, while for multi-file projects, we combined source files with g++ file1.cpp file2.cpp -o output. This ensures modular code development, allowing efficient compilation and linkage of large-scale C++ projects.

Answer to the Following Questions

1. **Meaning and Use of GCC in Linux:**
   - GCC stands for GNU Compiler Collection. It is a compiler system produced by the GNU Project that supports various programming languages, including C, C++, and others. In Linux, GCC is primarily used to compile C programs. When you write a program in C, it is written in a human-readable format called source code. GCC takes this source code and compiles it into machine code (an executable file) that the computer can run.
2. **Advantages and Disadvantages of Multifile C Programming:**
   - **Advantages:**

        - Modularity: By dividing the program into multiple files, you can keep related functions and definitions together, making the codebase easier to manage and understand. Each file can handle a specific aspect of the program, which simplifies both development and debugging.
        - Reusability: Functions and definitions written in one file can be reused in other projects or parts of the same project. For example, if you have a set of utility functions, you can place them in one file and reuse them whenever needed.
        - Collaboration: When working in a team, different team members can work on different files simultaneously without causing conflicts. This is particularly useful in large projects.
        - Easier Debugging: Since the code is divided into smaller parts, isolating and fixing bugs becomes easier. You can test individual components separately before integrating them.
    - **Disadvantages:**
        - Complexity: Managing multiple files can be more complex, especially for beginners. You have to ensure that the correct files are compiled and linked together, and that header files are properly included.
        - Dependency Management: If one file depends on another, changes in one file may necessitate changes in others. This can lead to increased maintenance effort, especially as the project grows.
        - Increased Compilation Time: In some cases, compiling multiple files can take more time compared to a single-file program, especially if there are many dependencies and large codebases.
        - Error Tracking: While modularity aids in debugging, it can sometimes make it harder to track errors that span multiple files, requiring careful attention to the interactions between different parts of the program**.**

Experiment No: 3

Name: Atharv Vijay Deshpande

PRN: 21410044

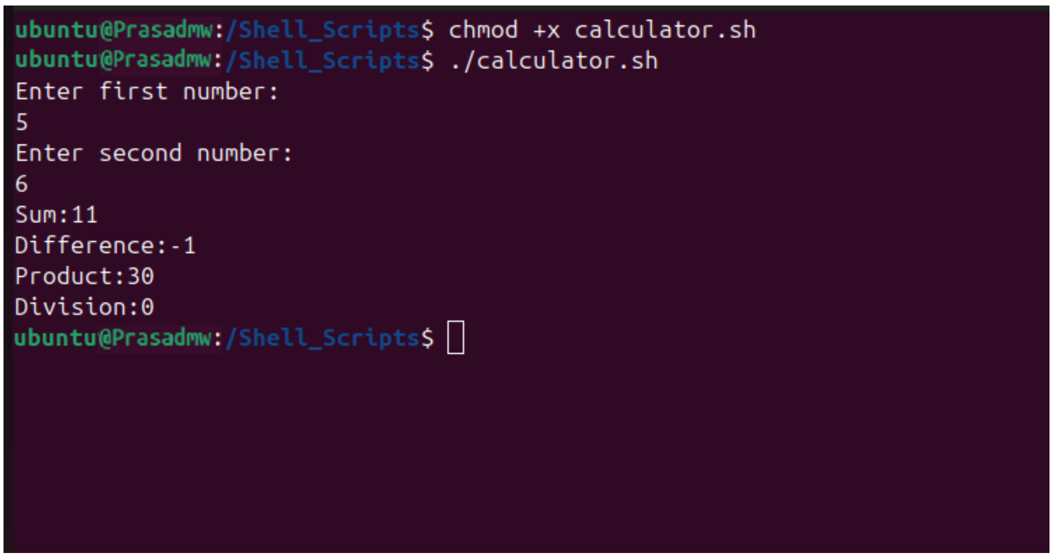
Batch: EN-3

Title: - Shell Scripting

Part A: Shell Scripting of Arithmetic Operations

- **Step 1:**Open a terminal and create the script file using:
- **Step 2**: Write the above script into calculator.sh and save it.
- **Step 3**: Make the script executable:
- **Step 4**: Run the script:
- **Step 5**: Enter the numbers and the operation when prompted, and observe the result.

Result:

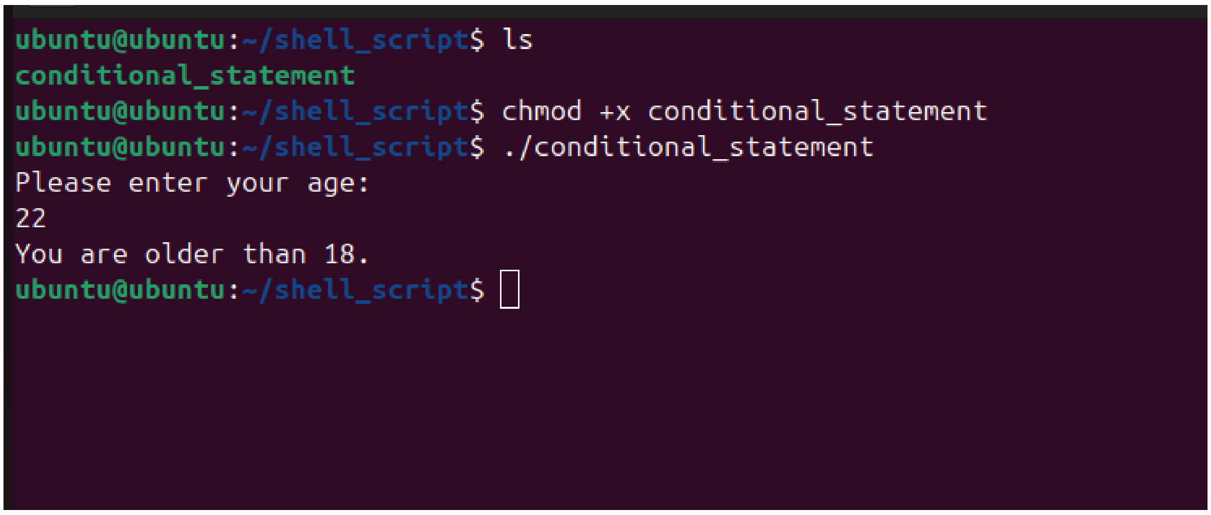


```
ubuntu@Prasadmw:/Shell_Scripts$ chmod +x calculator.sh
ubuntu@Prasadmw:/Shell_Scripts$ ./calculator.sh
Enter first number:
5
Enter second number:
6
Sum:11
Difference:-1
Product:30
Division:0
ubuntu@Prasadmw:/Shell_Scripts$ 
```

Part B: Shell Scripting of Conditional Statements

- **Step 1**: Open a terminal and create the script file using:
- **Step 2**: Write script into conditional.sh and save it:chmod +x check_age.sh
- **Step 4**: Run the script: ./check_age.sh
- **Step 5**: Enter your age when prompted and observe the result.

Result:



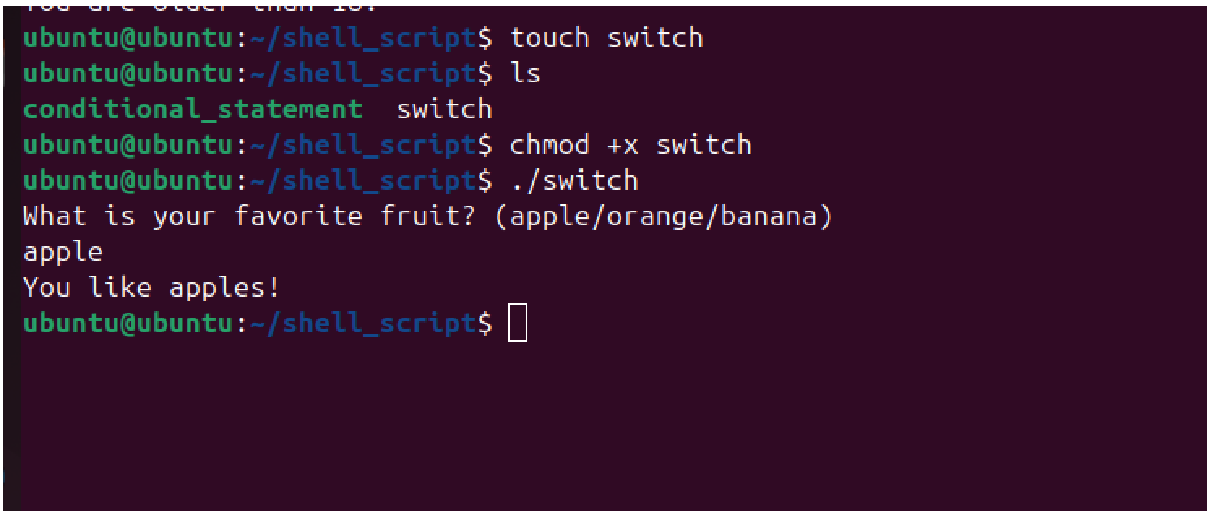
```
ubuntu@ubuntu:~/shell_script$ ls
conditional_statement
ubuntu@ubuntu:~/shell_script$ chmod +x conditional_statement
ubuntu@ubuntu:~/shell_script$ ./conditional_statement
Please enter your age:
22
You are older than 18.
ubuntu@ubuntu:~/shell_script$
```

Part C: Shell Scripting Using Loops and Switch Case

- Step 1: Open a terminal and create the script file using:
- Step 2: Write the above script into switch.sh and save it.
- Step 3: Make the script executable: chmod +x fruit_check.sh
- Step 4: Run the script: ./fruit_check.sh

- Step 5: Enter the name of a fruit when prompted and observe the result.

Result:



```
ubuntu@ubuntu:~/shell_script$ touch switch
ubuntu@ubuntu:~/shell_script$ ls
conditional_statement  switch
ubuntu@ubuntu:~/shell_script$ chmod +x switch
ubuntu@ubuntu:~/shell_script$ ./switch
What is your favorite fruit? (apple/orange/banana)
apple
You like apples!
ubuntu@ubuntu:~/shell_script$ 
```

Conclusion:

Shell scripting is an essential tool in Linux, offering the ability to automate tasks, streamline processes, and manage system operations efficiently. Through the execution of various scripts for arithmetic operations, conditional statements, and control structures like loops and switch cases, we observed how shell scripting simplifies complex tasks, reduces manual intervention, and enhances productivity.

Answer the following:

1. **Significance of Shell Script in Linux**:
    - Shell scripting in Linux allows users to automate tasks, simplify repetitive commands, and create more efficient workflows. It is a powerful tool for managing system operations, processing files, and configuring software.
2. **Types of Shells**:

- **Bash (Bourne Again Shell)**: The most common shell in Linux, offering extensive scripting capabilities and user-friendly features.
- **Sh (Bourne Shell)**: A simple shell used mainly for scripting.
- **Csh (C Shell)**: Similar to the C programming language, useful for users familiar with C syntax.
- **Ksh (Korn Shell)**: Combines features of Bourne Shell and C Shell, offering powerful scripting options.
- **Zsh (Z Shell)**: A highly customizable shell with advanced features for interactive use.

Experiment No. 4

Name: Atharv Vijay Deshpande

PRN: 21410044

Batch: EN-3

Title: Creation of a group and user and deletion into terminal.

Objective:

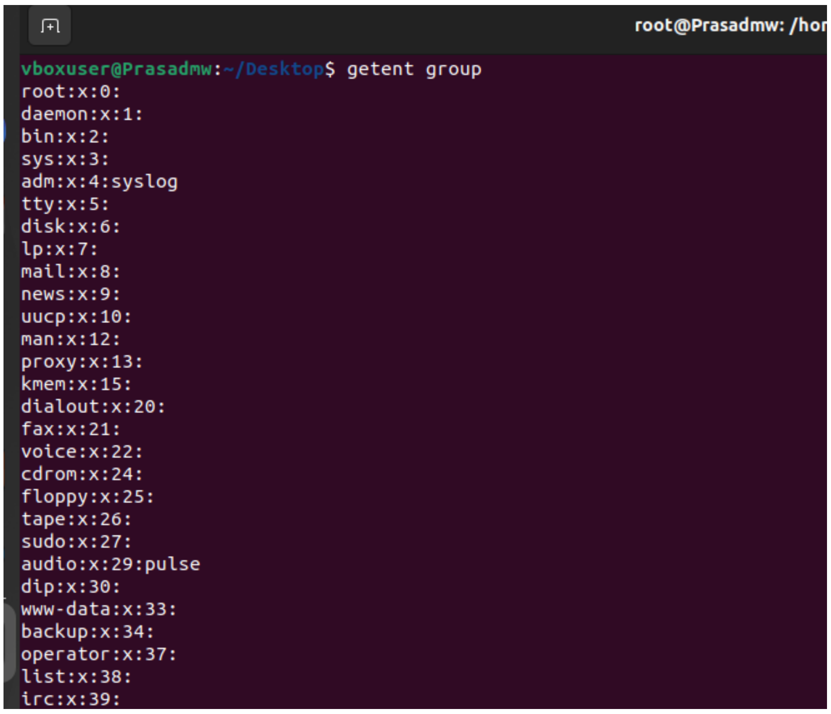
To Create Group and to add user to it using Linux Terminal.

Procedure:

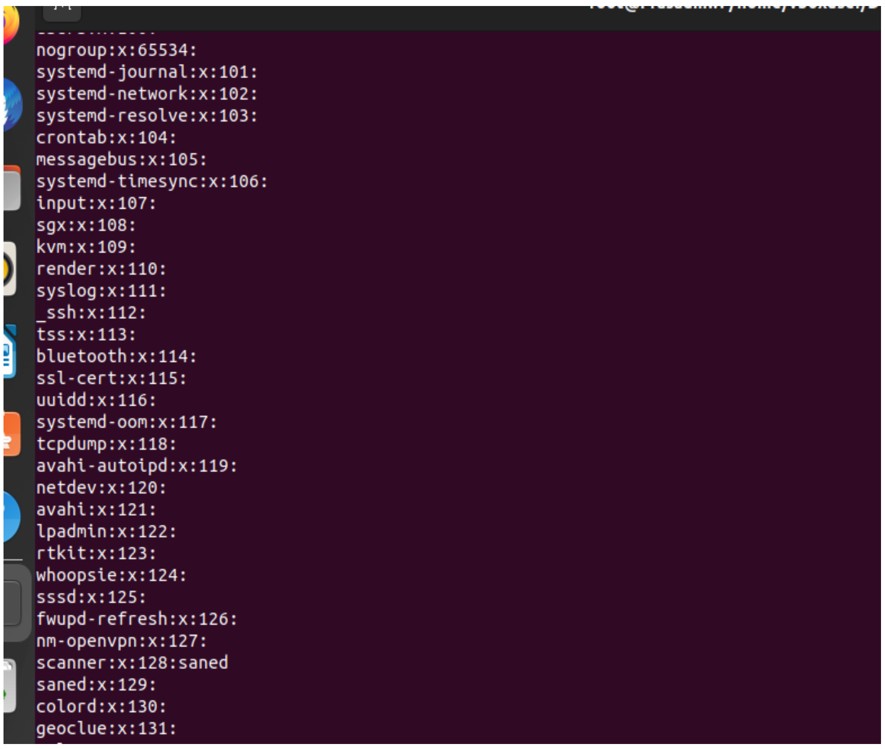
Procedure steps:

Step 1: List all groups name with username

Command: getent group

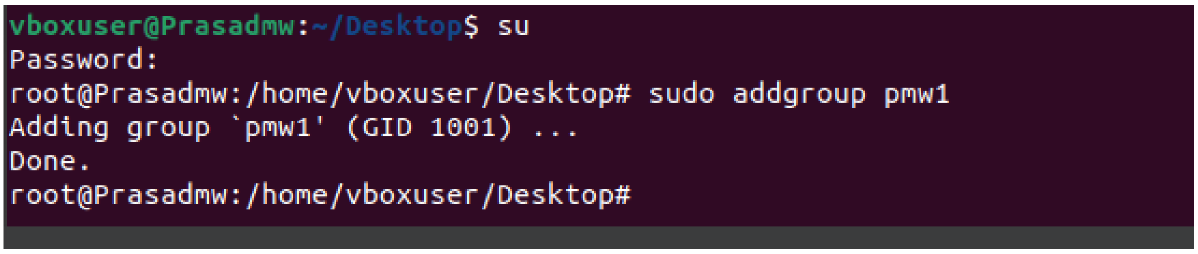


```
root@Prasadmw: /hor
vboxuser@Prasadmw:~/Desktop$ getent group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
dialout:x:20:
fax:x:21:
voice:x:22:
cdrom:x:24:
floppy:x:25:
tape:x:26:
sudo:x:27:
audio:x:29:pulse
dip:x:30:
www-data:x:33:
backup:x:34:
operator:x:37:
list:x:38:
irc:x:39:
```


```
nogroup:x:65534:
systemd-journal:x:101:
systemd-network:x:102:
systemd-resolve:x:103:
crontab:x:104:
messagebus:x:105:
systemd-timesync:x:106:
input:x:107:
sgx:x:108:
kvm:x:109:
render:x:110:
syslog:x:111:
_ssh:x:112:
tss:x:113:
bluetooth:x:114:
ssl-cert:x:115:
uuidd:x:116:
systemd-oom:x:117:
tcpdump:x:118:
avahi-autoipd:x:119:
netdev:x:120:
avahi:x:121:
lpadmin:x:122:
rtkit:x:123:
whoopsie:x:124:
sssd:x:125:
fwupd-refresh:x:126:
nm-openvpn:x:127:
scanner:x:128:saned
saned:x:129:
colord:x:130:
geoclue:x:131:
```

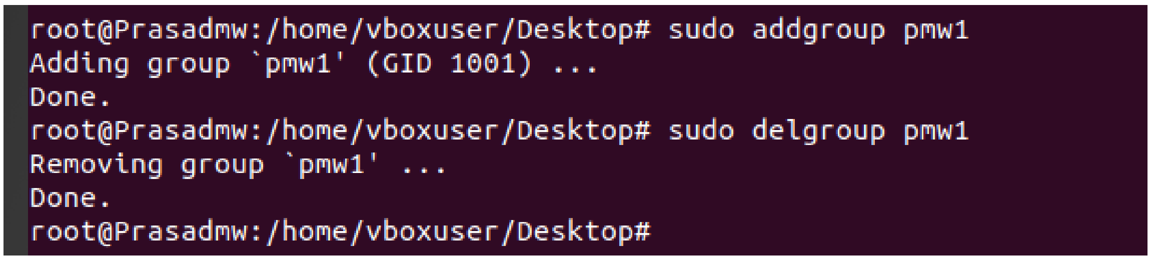
Step 2: Add Group

Command : sudo addgroup groupname


```
vboxuser@Prasadmw:~/Desktop$ su
Password:
root@Prasadmw:/home/vboxuser/Desktop# sudo addgroup pmw1
Adding group `pmw1' (GID 1001) ...
Done.
root@Prasadmw:/home/vboxuser/Desktop#
```

Step 3: Delete Group

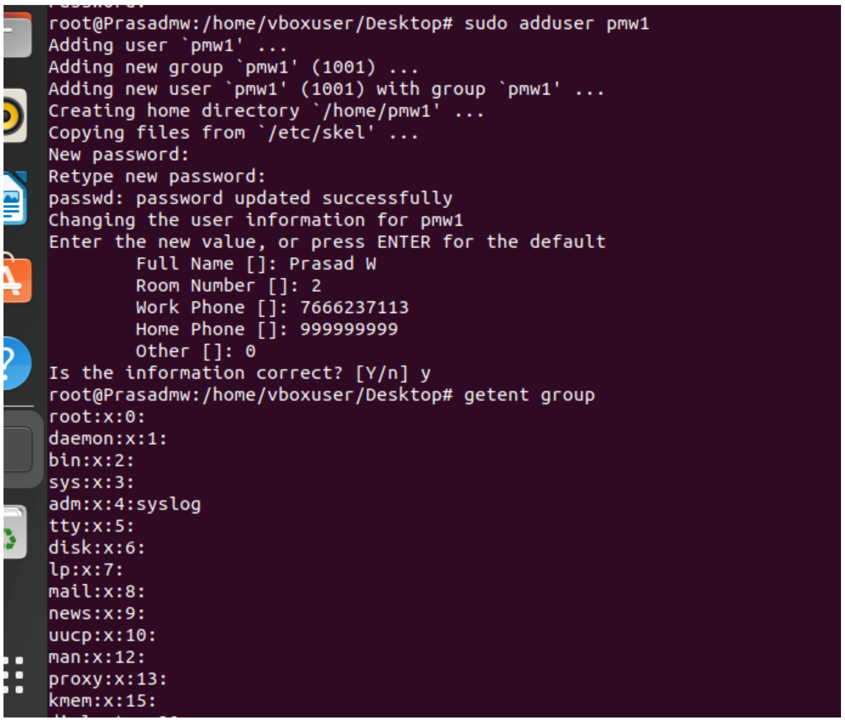
Command : sudo delgroup groupname



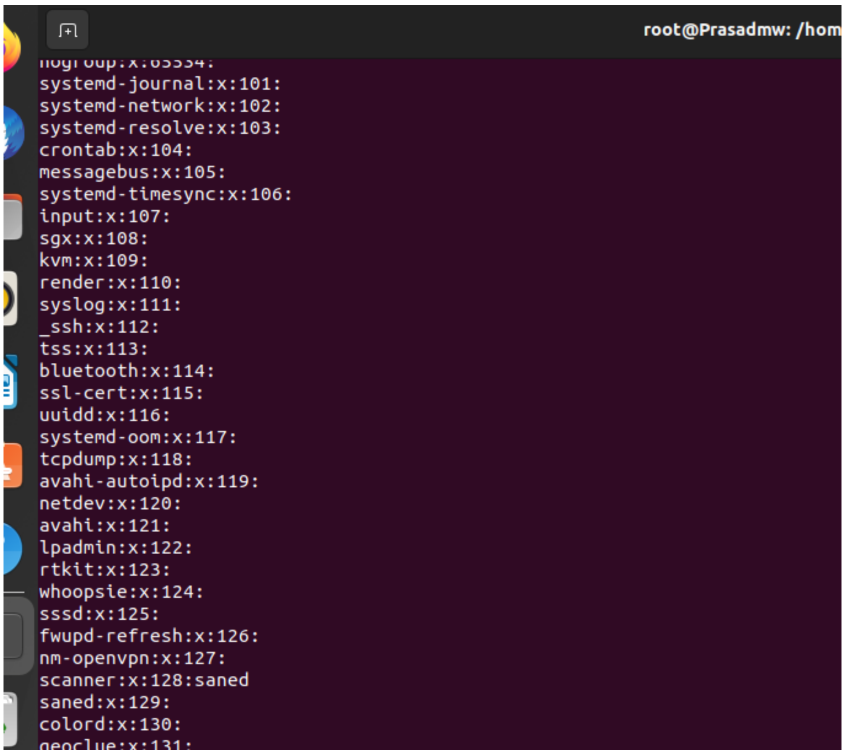
```
root@Prasadmw:/home/vboxuser/Desktop# sudo addgroup pmw1
Adding group `pmw1' (GID 1001) ...
Done.
root@Prasadmw:/home/vboxuser/Desktop# sudo delgroup pmw1
Removing group `pmw1' ...
Done.
root@Prasadmw:/home/vboxuser/Desktop#
```

Step 4: Add user

Command : sudo adduser username



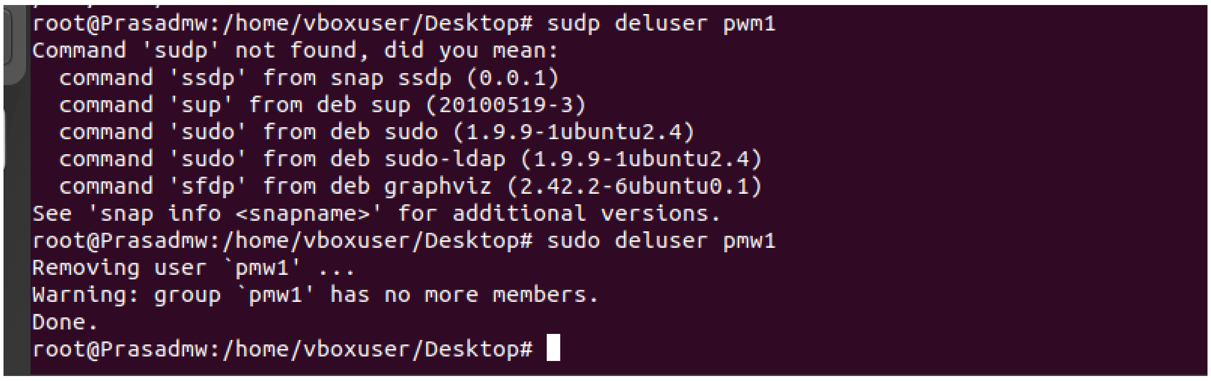
```
root@Prasadmw:/home/vboxuser/Desktop# sudo adduser pmw1
Adding user `pmw1' ...
Adding new group `pmw1' (1001) ...
Adding new user `pmw1' (1001) with group `pmw1' ...
Creating home directory `/home/pmw1' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for pmw1
Enter the new value, or press ENTER for the default
        Full Name []: Prasad W
        Room Number []: 2
        Work Phone []: 7666237113
        Home Phone []: 999999999
        Other []: 0
Is the information correct? [Y/n] y
root@Prasadmw:/home/vboxuser/Desktop# getent group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:syslog
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
```



```
nogroup:x:65534:
systemd-journal:x:101:
systemd-network:x:102:
systemd-resolve:x:103:
crontab:x:104:
messagebus:x:105:
systemd-timesync:x:106:
input:x:107:
sgx:x:108:
kvm:x:109:
render:x:110:
syslog:x:111:
_ssh:x:112:
tss:x:113:
bluetooth:x:114:
ssl-cert:x:115:
uuidd:x:116:
systemd-oom:x:117:
tcpdump:x:118:
avahi-autoipd:x:119:
netdev:x:120:
avahi:x:121:
lpadmin:x:122:
rtkit:x:123:
whoopsie:x:124:
sssd:x:125:
fwupd-refresh:x:126:
nm-openvpn:x:127:
scanner:x:128:saned
saned:x:129:
colord:x:130:
geoclue:x:131:
```

Step 5: Delete user

Command : sudo deluser username



```
root@Prasadmw:/home/vboxuser/Desktop# sudp deluser pwm1
Command 'sudp' not found, did you mean:
  command 'ssdp' from snap ssdp (0.0.1)
  command 'sup' from deb sup (20100519-3)
  command 'sudo' from deb sudo (1.9.9-1ubuntu2.4)
  command 'sudo' from deb sudo-ldap (1.9.9-1ubuntu2.4)
  command 'sfdp' from deb graphviz (2.42.2-6ubuntu0.1)
See 'snap info <snapname>' for additional versions.
root@Prasadmw:/home/vboxuser/Desktop# sudo deluser pmw1
Removing user `pmw1' ...
Warning: group `pmw1' has no more members.
Done.
root@Prasadmw:/home/vboxuser/Desktop# 
```

Conclusion : In the performance of users and groups practical in Linux, we efficiently managed user accounts, assigned group permissions, and controlled access to resources, ensuring a secure multi-user environment. By using commands and modifying file permissions, we streamlined user management and collaboration. This practice enhances system security and improves the organization of resources in a shared Linux environment.

Answer the following.

1.Significance of creating user and group.
→

Creating a user and group in Linux is significant for several reasons:

1. **Access Control and Security**: Users and groups help in managing access permissions to files, directories, and system resources. By assigning specific users to groups, administrators can control who has read, write, or execute permissions.
2. **Multi-User Environment**: Linux is designed as a multi-user system, and each user should have a unique account. Groups allow users to share permissions and collaborate on files or projects efficiently.
3. **Privilege Management**: Users can be given specific roles or levels of access. For example, an admin group might have elevated privileges (like sudo access), while regular users have restricted access.
4. **System Administration**: By organizing users into groups, system administrators can apply settings, run scripts, and assign permissions collectively to a group rather than individually, improving efficiency.

Experiment No. 5

Name: Atharv Vijay Deshpande

PRN: 21410044

Batch: EN-3

Title: Use of Makefile

Procedure:

1. **Install make (if not already installed)**

2.**Create a file** named Makefile (no extension) in your project directory. This file will contain rules and commands to compile and manage your project. touch Makefile

The structure of a Makefile typically includes:

- **Targets**: What you want to build (e.g., the final executable or object files).
- **Dependencies**: Files that the target depends on.
- **Commands**: Actions to execute (usually commands to compile or link code).

3. **Run the Makefile**

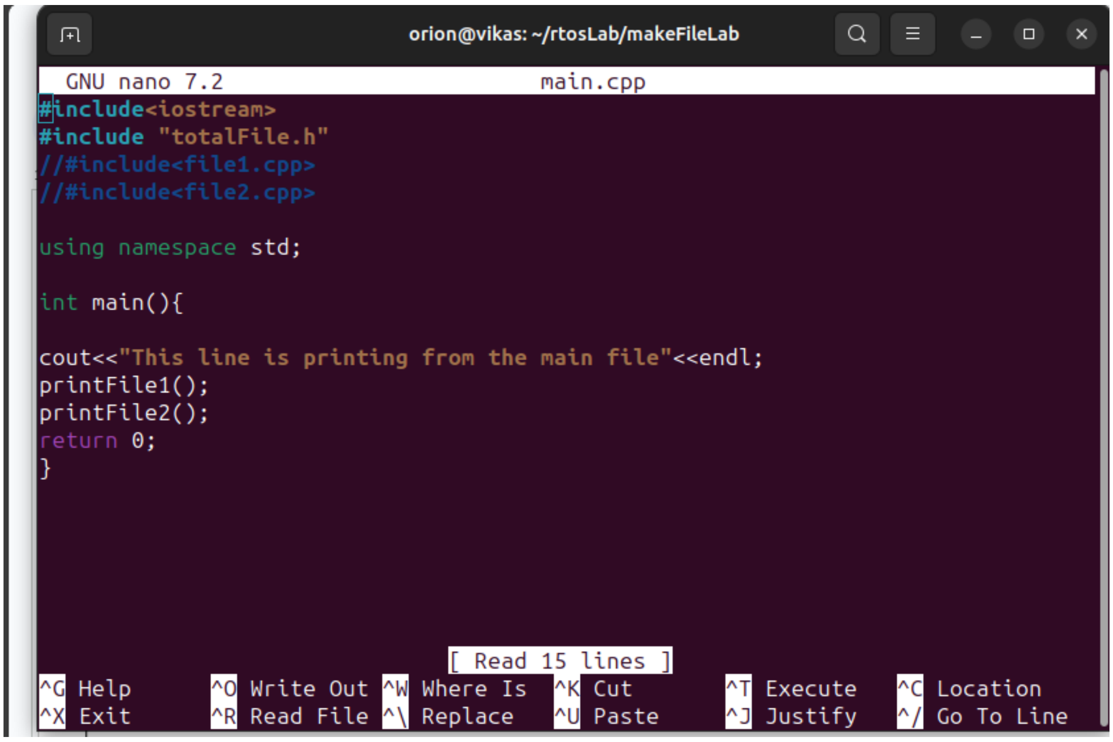
- In the terminal, navigate to the directory containing the Makefile:
- cd /path/to/your/project

· Run make to build the target specified in the Makefile.

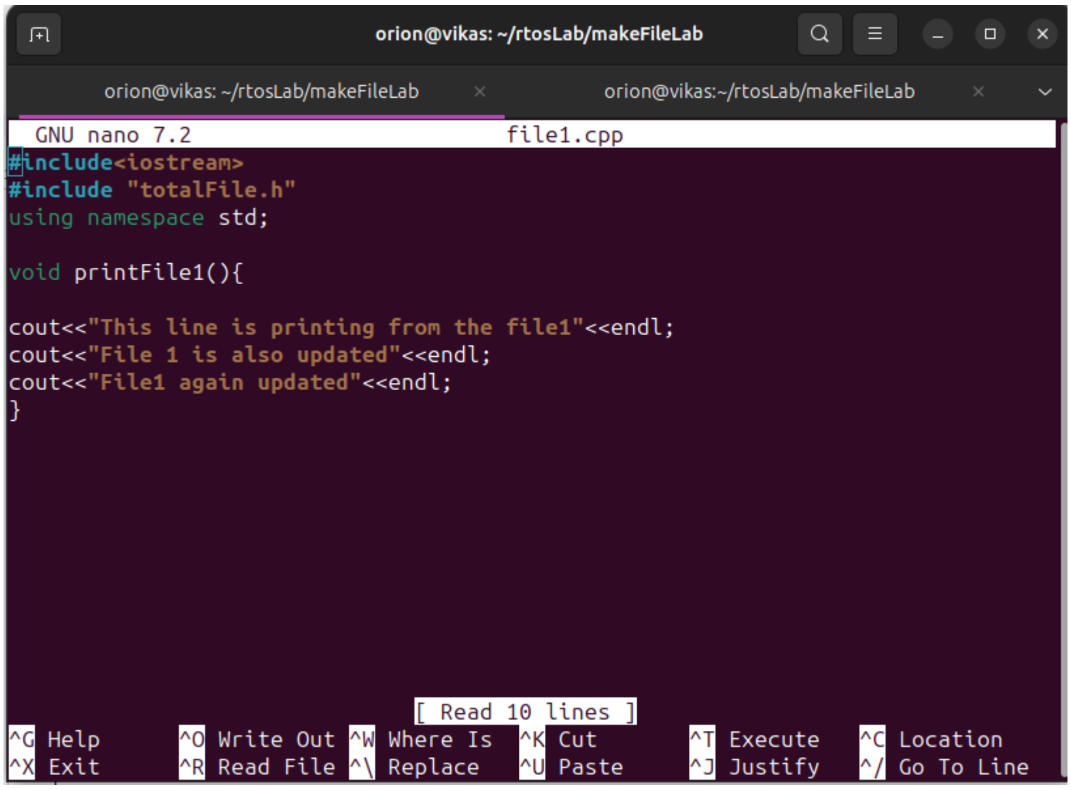
· This will execute the commands in the Makefile and build your program. By default, it looks for the first target (in this case, all).

4. You can also run specific targets, for example, to clean the build files:

make clean

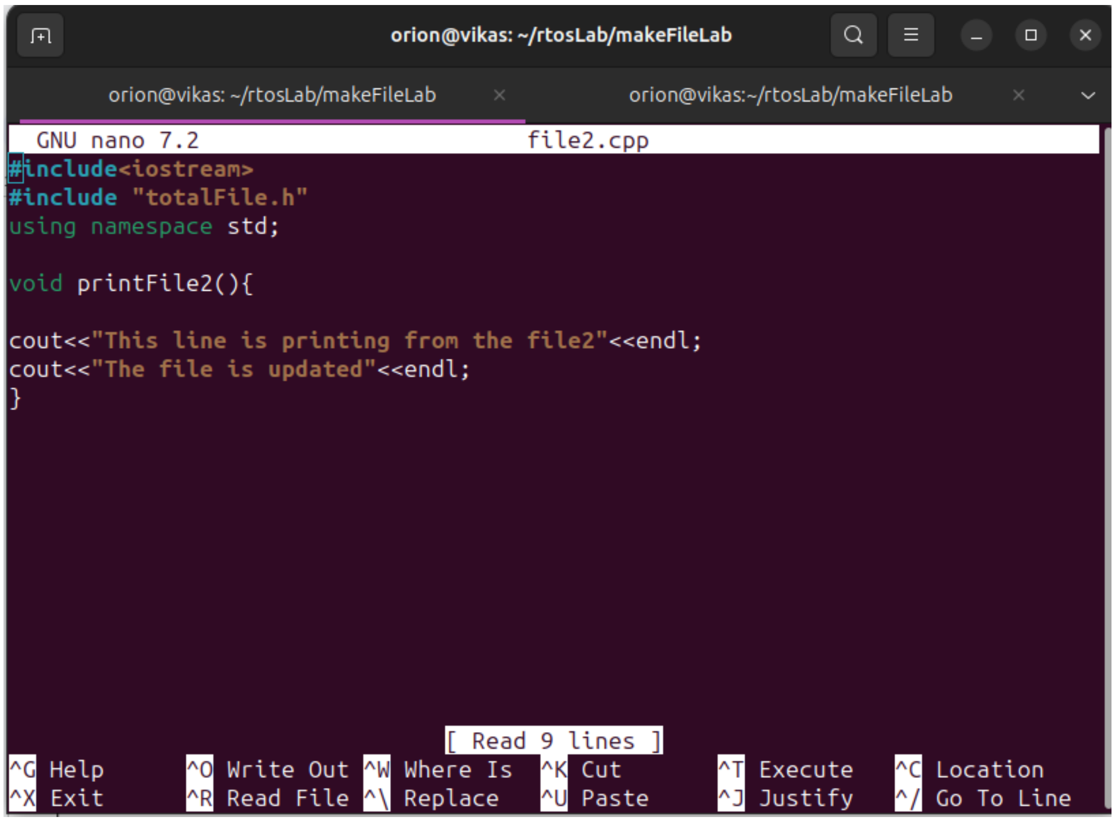

orion@vikas: ~/rtosLab/makeFileLab

```
  GNU nano 7.2                    main.cpp
#include<iostream>
#include "totalFile.h"
//#include<file1.cpp>
//#include<file2.cpp>

using namespace std;

int main(){

cout<<"This line is printing from the main file"<<endl;
printFile1();
printFile2();
return 0;
}

                              [ Read 15 lines ]
^G Help       ^O Write Out ^W Where Is  ^K Cut        ^T Execute    ^C Location
^X Exit       ^R Read File ^\ Replace   ^U Paste      ^J Justify    ^/ Go To Line
```

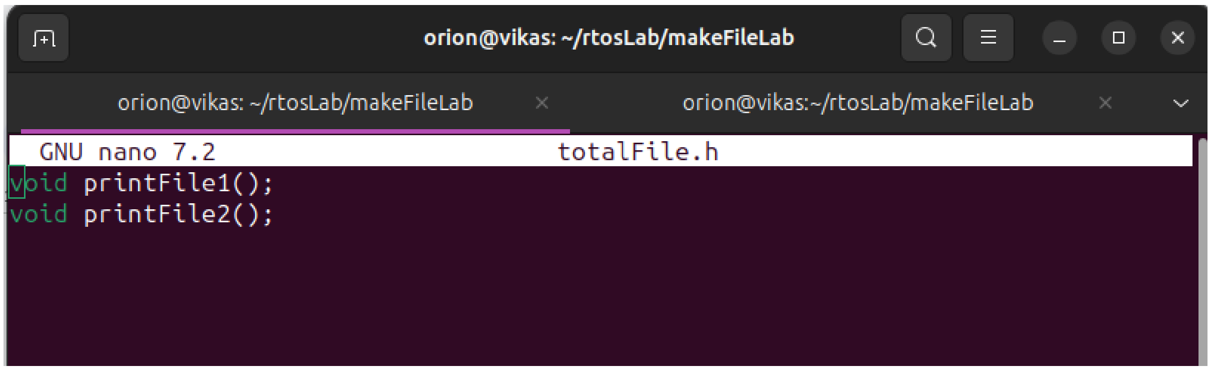

orion@vikas: ~/rtosLab/makeFileLab

orion@vikas: ~/rtosLab/makeFileLab   orion@vikas:~/rtosLab/makeFileLab

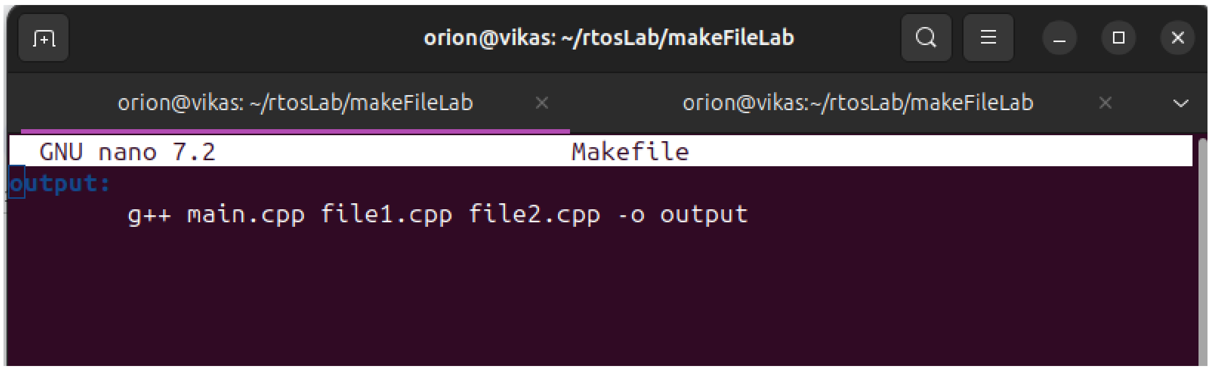
```
  GNU nano 7.2                    file1.cpp
#include<iostream>
#include "totalFile.h"
using namespace std;

void printFile1(){

cout<<"This line is printing from the file1"<<endl;
cout<<"File 1 is also updated"<<endl;
cout<<"File1 again updated"<<endl;
}

                              [ Read 10 lines ]
^G Help       ^O Write Out ^W Where Is  ^K Cut        ^T Execute    ^C Location
^X Exit       ^R Read File ^\ Replace   ^U Paste      ^J Justify    ^/ Go To Line
```


orion@vikas: ~/rtosLab/makeFileLab
orion@vikas: ~/rtosLab/makeFileLab
orion@vikas:~/rtosLab/makeFileLab

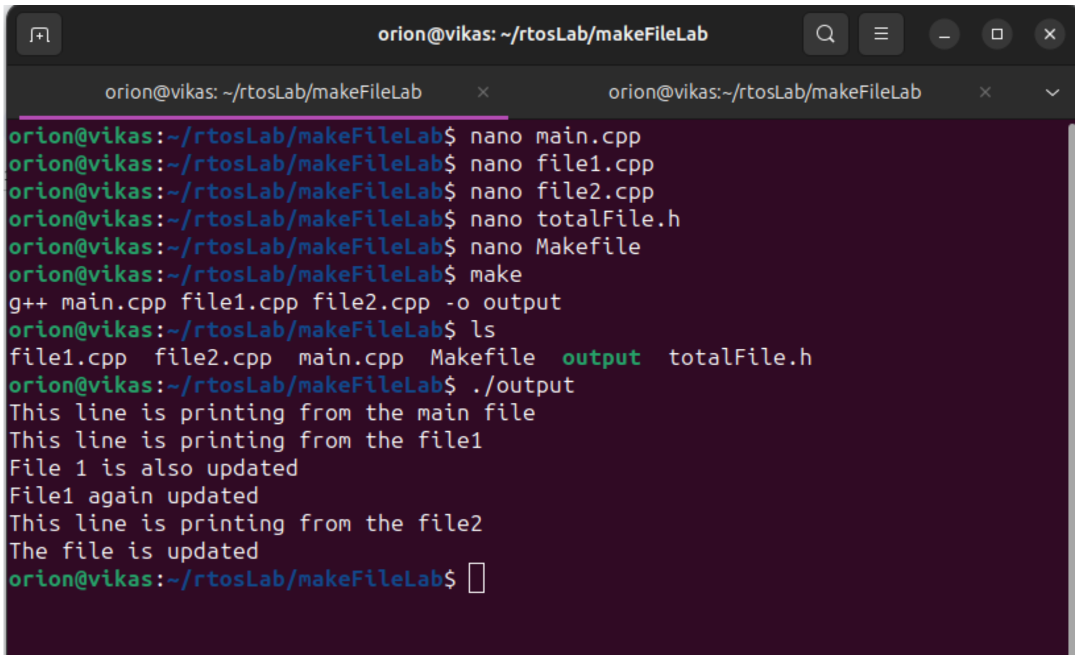
```
  GNU nano 7.2                         file2.cpp
#include<iostream>
#include "totalFile.h"
using namespace std;

void printFile2(){

cout<<"This line is printing from the file2"<<endl;
cout<<"The file is updated"<<endl;
}

                                [ Read 9 lines ]
^G Help        ^O Write Out ^W Where Is  ^K Cut        ^T Execute    ^C Location
^X Exit        ^R Read File ^\ Replace   ^U Paste      ^J Justify    ^/ Go To Line
```


orion@vikas: ~/rtosLab/makeFileLab
orion@vikas: ~/rtosLab/makeFileLab
orion@vikas:~/rtosLab/makeFileLab

```
  GNU nano 7.2                         totalFile.h
void printFile1();
void printFile2();
```


orion@vikas: ~/rtosLab/makeFileLab
orion@vikas: ~/rtosLab/makeFileLab
orion@vikas:~/rtosLab/makeFileLab

```
  GNU nano 7.2                          Makefile
output:
        g++ main.cpp file1.cpp file2.cpp -o output
```



```
orion@vikas:~/rtosLab/makeFileLab$ nano main.cpp
orion@vikas:~/rtosLab/makeFileLab$ nano file1.cpp
orion@vikas:~/rtosLab/makeFileLab$ nano file2.cpp
orion@vikas:~/rtosLab/makeFileLab$ nano totalFile.h
orion@vikas:~/rtosLab/makeFileLab$ nano Makefile
orion@vikas:~/rtosLab/makeFileLab$ make
g++ main.cpp file1.cpp file2.cpp -o output
orion@vikas:~/rtosLab/makeFileLab$ ls
file1.cpp  file2.cpp  main.cpp  Makefile  output  totalFile.h
orion@vikas:~/rtosLab/makeFileLab$ ./output
This line is printing from the main file
This line is printing from the file1
File 1 is also updated
File1 again updated
This line is printing from the file2
The file is updated
orion@vikas:~/rtosLab/makeFileLab$ 
```

❖ Conclusion

The experiment of usage of makefile is performed successfully with proper screenshot as expected. Using the Makefile we can run multiple commands and achieve automation.

Answer the following:

Significance of use of makefile

- **Automation of Tasks:** A Makefile automates repetitive tasks, such as compiling, linking, and cleaning up, making it easier to build projects consistently.
- **Dependency Management:** It handles dependencies between source files, ensuring that only the changed files are recompiled, thus saving time.
- **Build Process Customization:** It allows users to customize the build process by defining different rules for compilation, linking, and cleaning, among other actions.
- **Cross-Platform Development:** Makefiles are widely used in cross-platform development, providing a uniform build process across different operating systems.

- **Simplifies Complex Projects:** For large projects with many files, a Makefile simplifies the compilation process, as all instructions are consolidated in one file.
- **Error Reduction:** By automating tasks, it reduces human errors, especially in complex, multi-step build processes.

Experiment No : 6

Name: Atharv Vijay Deshpande

PRN: 21410044

Batch: EN-3

Title : Execution of Python file in Linux

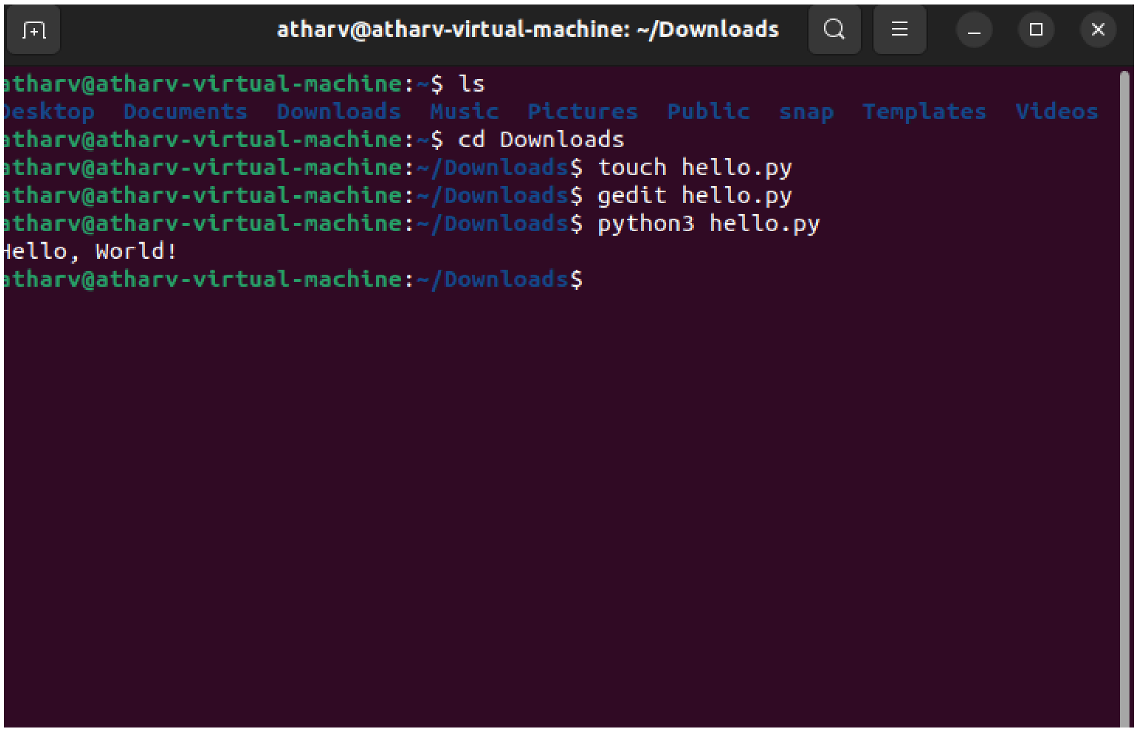
Objective: To create and execute single Python file and multiple Python files using && operator as well as using shellscript.

Procedure:

- **Procedure Steps: For Single Python File**

Steps: Create a Python file:

- Open the terminal.
- Use a text editor like nano, vim, or gedit to create a Python file.
- Use python3 command to execute the python file.



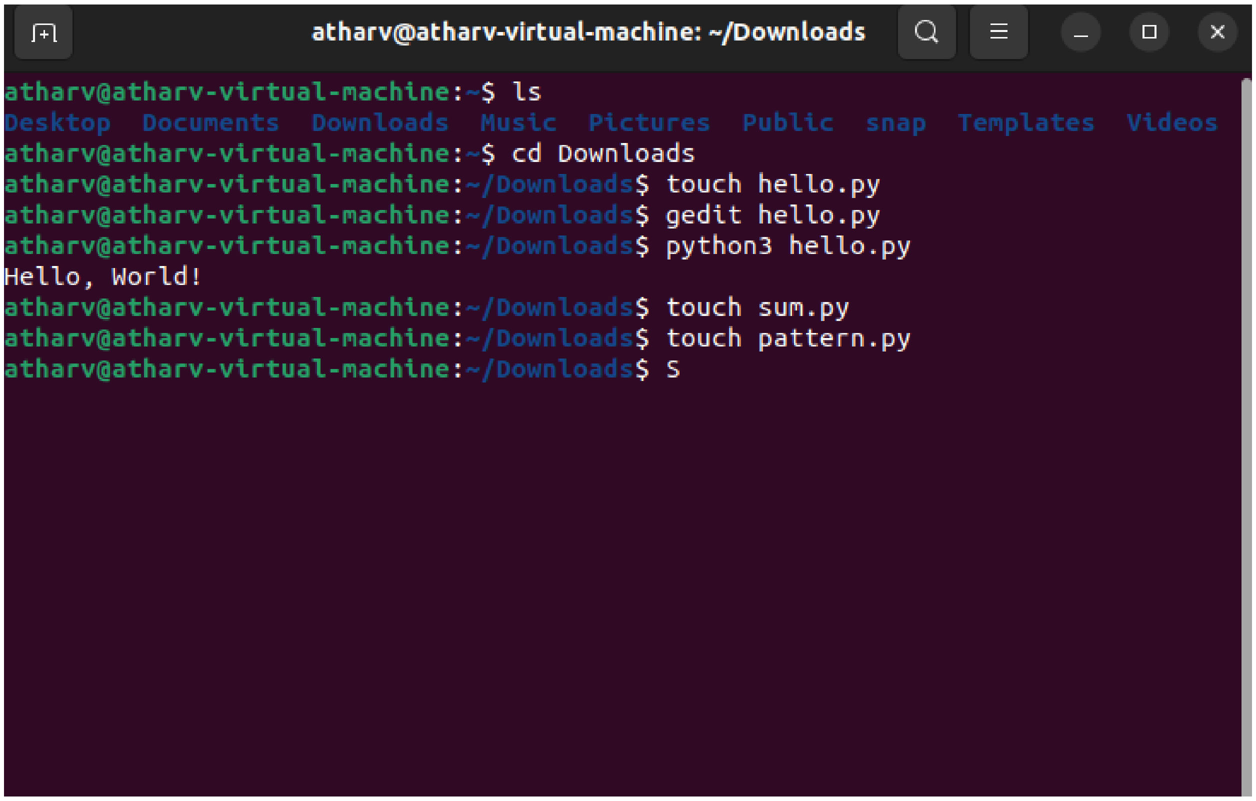
```
atharv@atharv-virtual-machine: ~/Downloads
tharv@atharv-virtual-machine:~$ ls
esktop  Documents  Downloads  Music  Pictures  Public  snap  Templates  Videos
tharv@atharv-virtual-machine:~$ cd Downloads
tharv@atharv-virtual-machine:~/Downloads$ touch hello.py
tharv@atharv-virtual-machine:~/Downloads$ gedit hello.py
tharv@atharv-virtual-machine:~/Downloads$ python3 hello.py
ello, World!
tharv@atharv-virtual-machine:~/Downloads$
```

Procedure Steps :

- **For multiple Python Files**

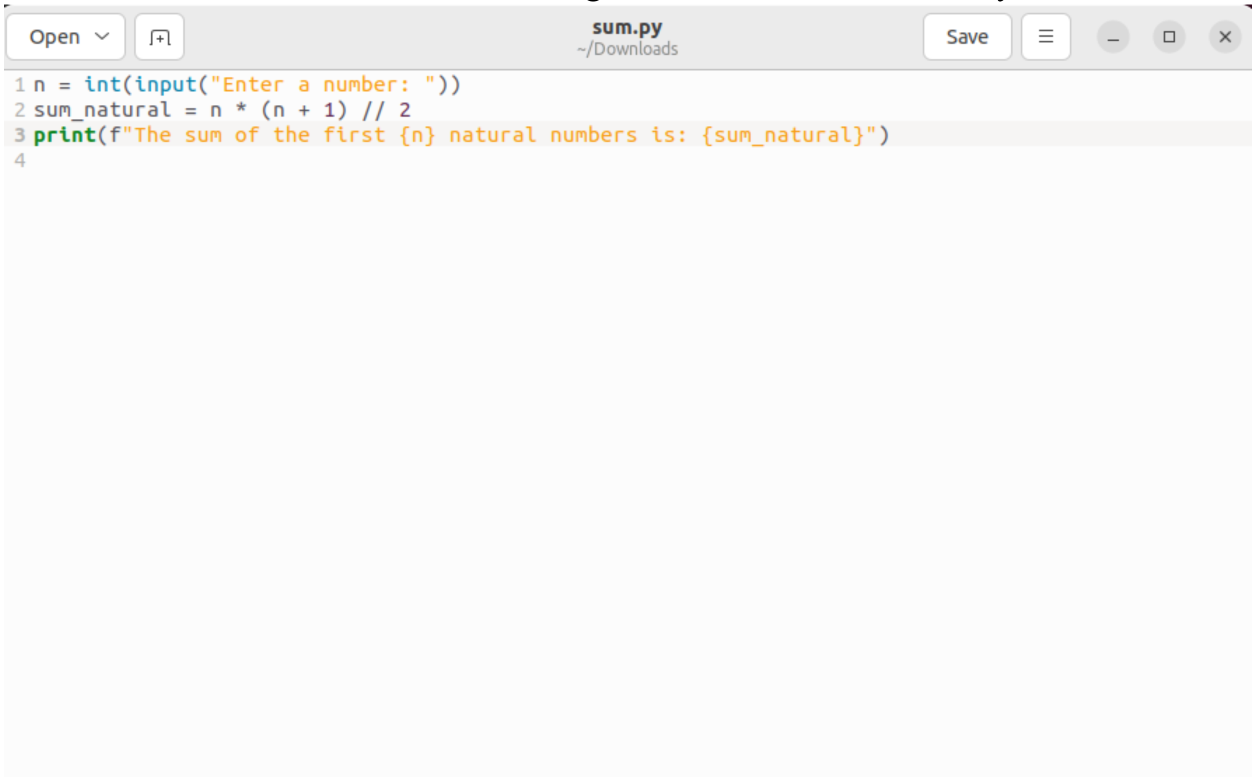
  Steps : Create multiple python files using touch command in terminal

  - Open the terminal.
  - Use touch command to create multiple python files.

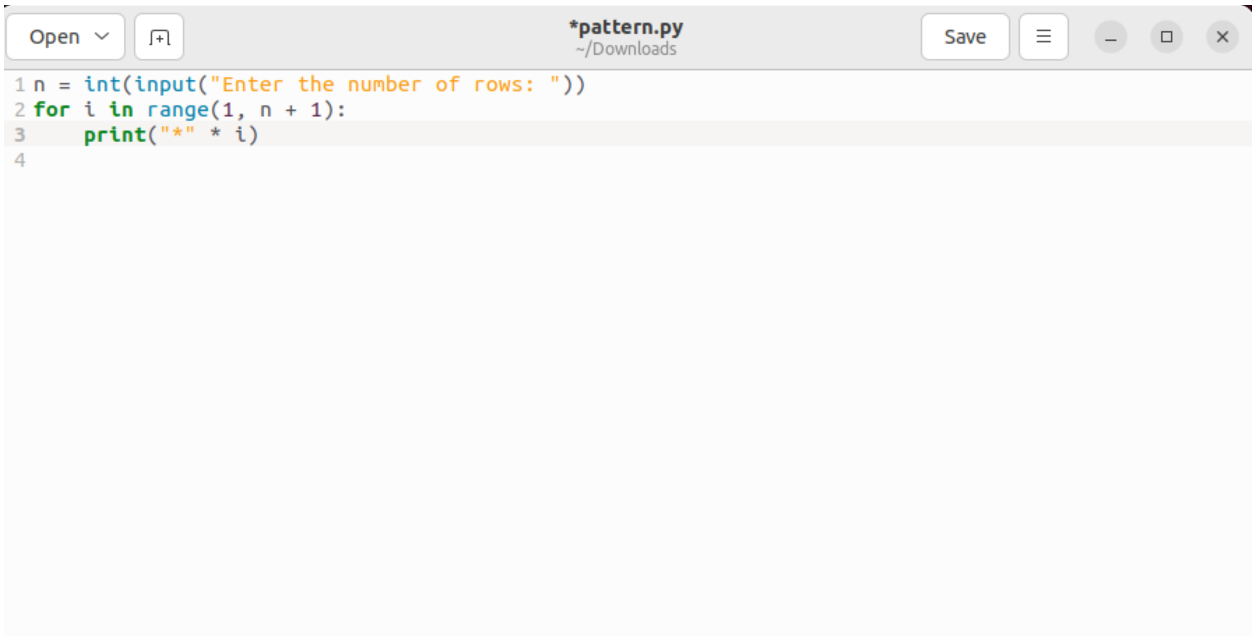


```
atharv@atharv-virtual-machine:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  snap  Templates  Videos
atharv@atharv-virtual-machine:~$ cd Downloads
atharv@atharv-virtual-machine:~/Downloads$ touch hello.py
atharv@atharv-virtual-machine:~/Downloads$ gedit hello.py
atharv@atharv-virtual-machine:~/Downloads$ python3 hello.py
Hello, World!
atharv@atharv-virtual-machine:~/Downloads$ touch sum.py
atharv@atharv-virtual-machine:~/Downloads$ touch pattern.py
atharv@atharv-virtual-machine:~/Downloads$ S
```

- Use a text editor like nano, vim, or gedit to write code in a Python file.

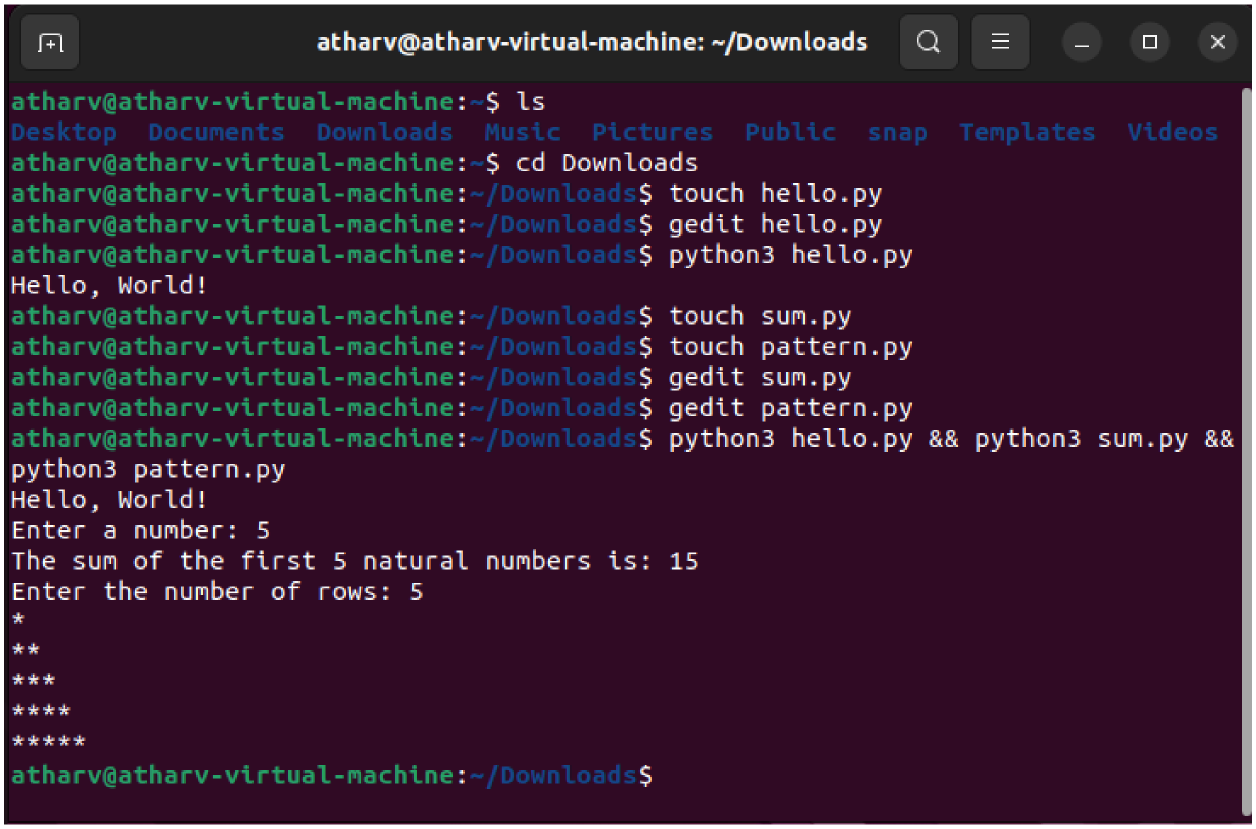


```python
n = int(input("Enter a number: "))
sum_natural = n * (n + 1) // 2
print(f"The sum of the first {n} natural numbers is: {sum_natural}")
```



```python
n = int(input("Enter the number of rows: "))
for i in range(1, n + 1):
    print("*" * i)
```

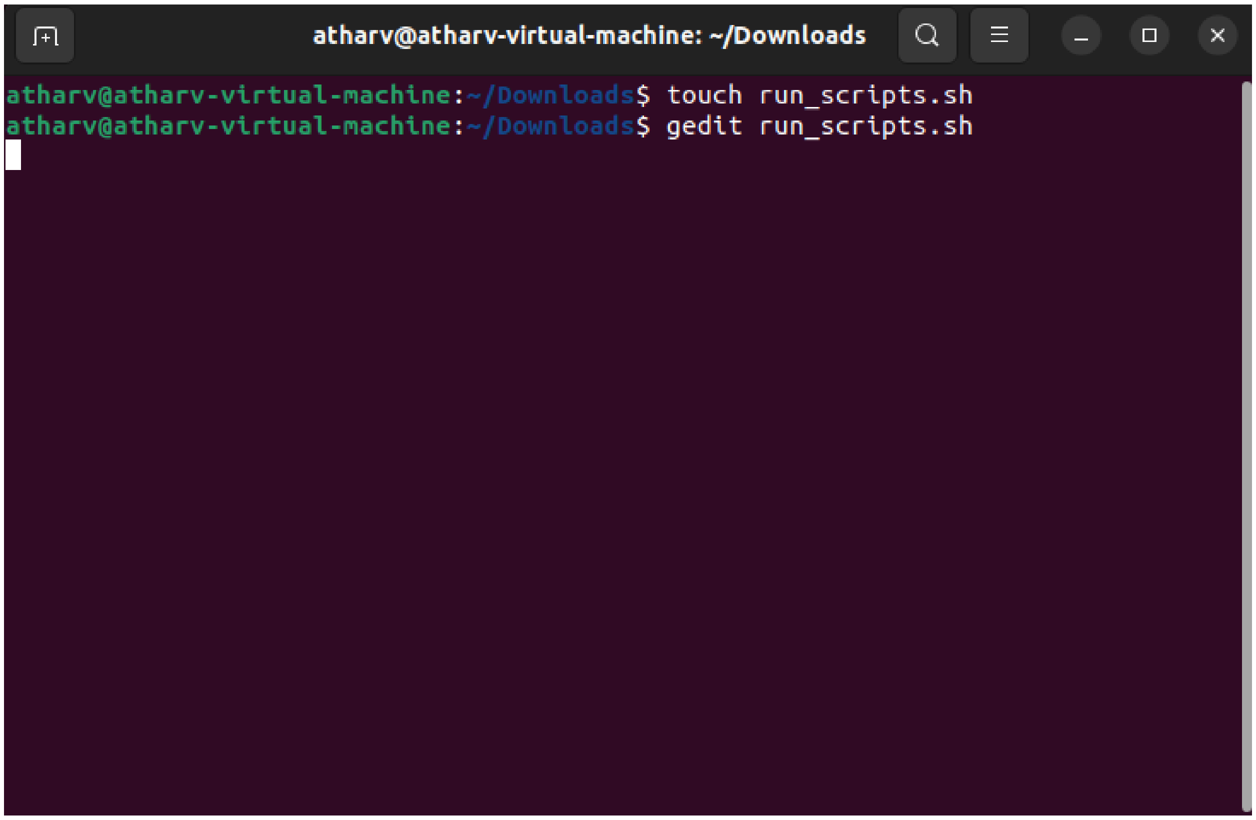
❖ Using && operator for execution of multiple files.



```
atharv@atharv-virtual-machine:~$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  snap  Templates  Videos
atharv@atharv-virtual-machine:~$ cd Downloads
atharv@atharv-virtual-machine:~/Downloads$ touch hello.py
atharv@atharv-virtual-machine:~/Downloads$ gedit hello.py
atharv@atharv-virtual-machine:~/Downloads$ python3 hello.py
Hello, World!
atharv@atharv-virtual-machine:~/Downloads$ touch sum.py
atharv@atharv-virtual-machine:~/Downloads$ touch pattern.py
atharv@atharv-virtual-machine:~/Downloads$ gedit sum.py
atharv@atharv-virtual-machine:~/Downloads$ gedit pattern.py
atharv@atharv-virtual-machine:~/Downloads$ python3 hello.py && python3 sum.py &&
python3 pattern.py
Hello, World!
Enter a number: 5
The sum of the first 5 natural numbers is: 15
Enter the number of rows: 5
*
**
***
****
*****
atharv@atharv-virtual-machine:~/Downloads$
```

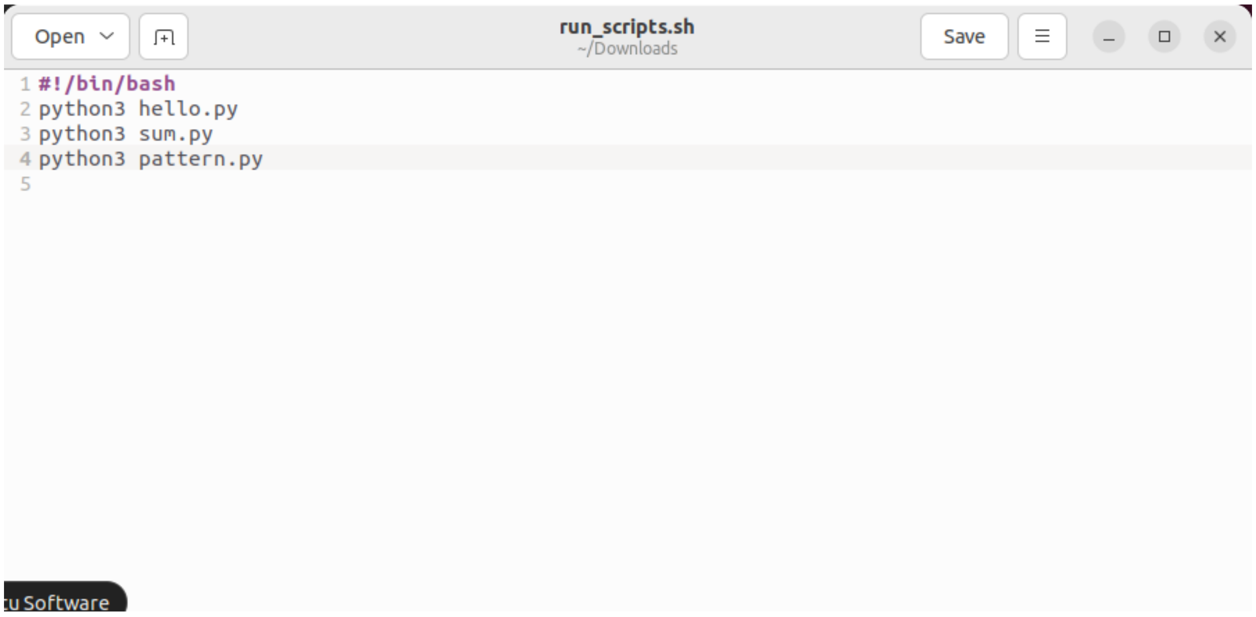
❖ Executing Python Files Using a Shell Script

- Create a shell script file using touch.
- Open the shell script file using gedit.



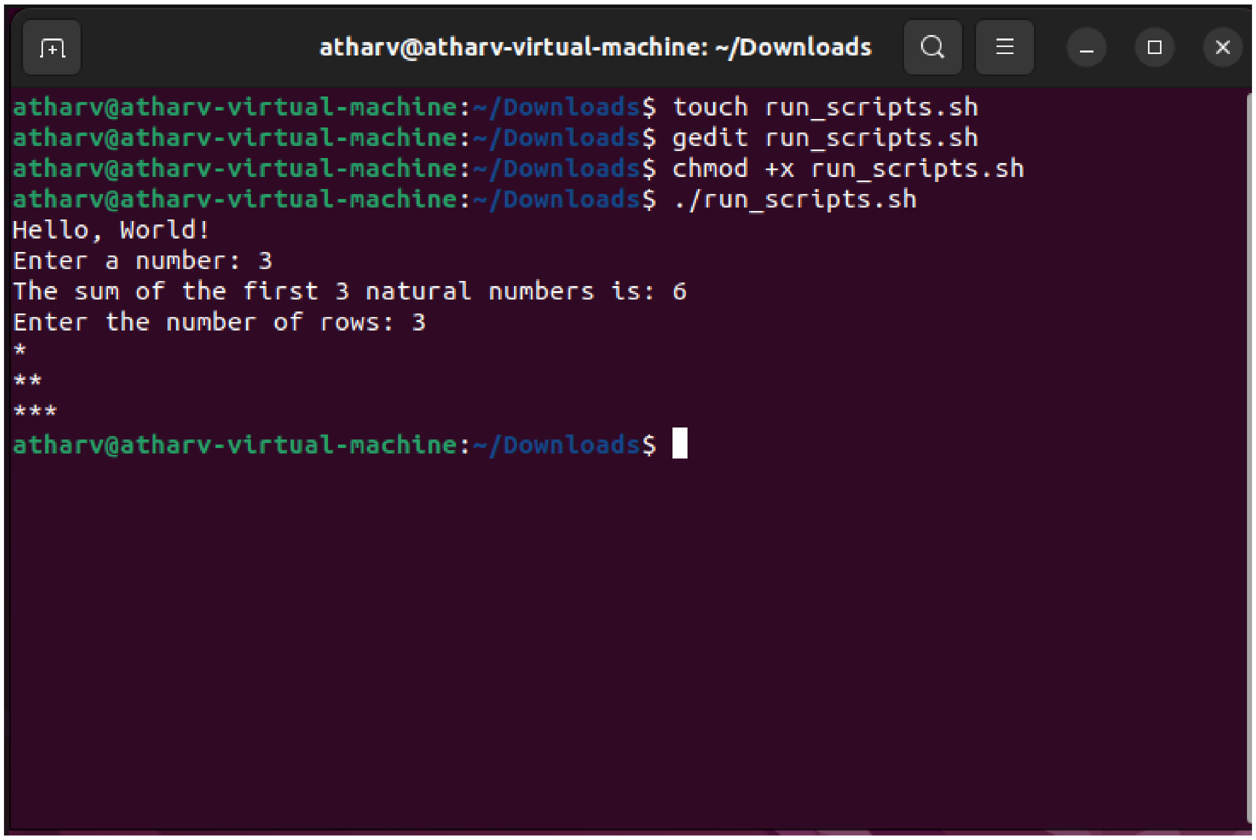
```
atharv@atharv-virtual-machine:~/Downloads$ touch run_scripts.sh
atharv@atharv-virtual-machine:~/Downloads$ gedit run_scripts.sh
```

- Write the shell script in gedit.



```
#!/bin/bash
python3 hello.py
python3 sum.py
python3 pattern.py
```

- Make the shell script executable using chmod command.
- Execute the shell script.



```
atharv@atharv-virtual-machine:~/Downloads$ touch run_scripts.sh
atharv@atharv-virtual-machine:~/Downloads$ gedit run_scripts.sh
atharv@atharv-virtual-machine:~/Downloads$ chmod +x run_scripts.sh
atharv@atharv-virtual-machine:~/Downloads$ ./run_scripts.sh
Hello, World!
Enter a number: 3
The sum of the first 3 natural numbers is: 6
Enter the number of rows: 3
*
**
***
atharv@atharv-virtual-machine:~/Downloads$
```

Conclusion;

The experiment demonstrated the steps to create and execute Python files in a Linux environment using basic terminal commands. By leveraging tools like touch for file creation and gedit for file editing, we successfully executed both single and multiple Python files. The && operator was used to run multiple files sequentially, ensuring error-free execution of each before proceeding to the next. Additionally, the creation of a shell script provided an efficient way to automate the execution of multiple Python files. Overall, the experiment emphasized the simplicity and flexibility of managing Python files in Linux.

Answer the following:

Que: Write short note on interpreter and compiler in the context of linux.

Ans:

In Linux, **interpreters** and **compilers** are tools used to execute or convert code written in high-level programming languages into machine code that the system can understand.

1. **Interpreter:**
   - An **interpreter** translates code **line by line** and executes it immediately. This means it reads the source code, interprets it, and runs it directly, without needing to compile the entire code first.
   - Popular interpreters in Linux include Python, Bash, and Ruby.
   - Since interpreters process code at runtime, errors are detected and displayed when they are encountered.
   - Example: Executing a Python script with the python3 script.py command runs the script line by line.
2. **Compiler:**
   - A **compiler** translates the entire source code into machine code (binary) **all at once** before execution. The output is usually an executable file that can be run on the system.
   - Common Linux compilers include gcc (for C/C++), javac (for Java).
   - Compilers produce a binary executable, and errors are flagged at the time of compilation, not execution.
   - Example: Compiling a C program using gcc program.c -o program creates an executable named program, which can then be run.

EXPERIMENT NO.8

Name: Atharv Vijay Deshpande
PRN: 21410044
Batch: EN-3

Title: Concept of multitasking, virtual parallelism using RTOS.

Objective:

1. Understanding the concept of multitasking.
2. Understanding the concept of virtual parallelism.
3. Installation of µCos-II based application.
4. Significance of all folders and files.
5. Creating of 3 tasks and observing waveforms using logic analyzer.

Multitasking:

Multitasking, as the name suggests, is a technique used to handle the execution of multiple tasks. It can be defined as, "the execution of multiple software routines in pseudo-parallel. Each routine represents a separate thread of execution. The OS simulates parallelism by dividing the CPU processing time to each individual thread. The second term to define is real-time. A real-time system is a system based on stringent time constraints. For a system to be real-time, there must be a guaranteed time frame where within a task must execute. In a multitasking RTOS the task scheduling, switching and execution elements are key to the effectiveness of the OS in achieving its real-time requirements.

Concept of virtual parallelism:

1. Virtual parallelism is a technique used in RTOS to emulate the behaviour of running multiple tasks in parallel, even when the underlying hardware is single core. The idea is to create the illusion that several tasks are executing simultaneously, despite the limitation of the hardware.

2. Virtual parallelism is a concept related to parallel computing, which involves the simultaneous execution of multiple tasks or processes to improve computational efficiency and speed. Virtual parallelism, however, does not necessarily involve physical parallel processing units like multiple processors or cores. Instead, it is a technique that makes it appear as if parallelism exists, even when the underlying hardware might not support true parallel execution.

3. In above example we observed that, in first waveform it looks like each task execute at the same time, but after zooming in we can observe significant difference between execution of first task, second task, third task. It is practical example of virtual parallelism.

4. Virtual parallelism is particularly useful in scenarios where hardware constraints limit the degree of parallelism that can be achieved. For example, on a single core processor, multiple tasks can be scheduled in such a way that they share processing time, giving the appearance of parallelism. This approach can improve overall system responsiveness

and throughput, especially in applications where tasks may spend a significant amount of time waiting for external resources (I/O operations, network requests, etc.).

5. Virtual parallelism can be achieved by task decomposition, task scheduling, concurrency, resource management, and synchronization. In task decomposition, first task or problem is divided into smaller, independent task or threads, and then executed. Task scheduling is required at the time of single processor, a scheduler or task manager is used to interleave the execution of these sub-tasks. In concurrency, tasks are not truly executing in parallel on separate processing units, they are being executed concurrently, meaning that multiple tasks are taking turns running in a way that creates the impression of parallelism. Virtual parallelism often involves managing shared resources, like memory and input/output operations, to ensure that tasks do not interfere with each other and cause conflicts. To maintain data consistency and avoid race conditions, synchronization mechanisms are used to coordinate the execution of tasks.

Installation:

Installation of uCOS-II based application requires IDE i.e., Integrated Development Environment, and for that here we use Keil uVision 4.

Step 1: Download the setup of Keil from below link, after downloading extract this file

https://www.keil.com/demo/eval/armv4.htm

Step 2: Install the mdk410 setup file , then click on Next, then Next, then agree to terms and condition

Step 3: Then do further process, and fill information in customer information. After completing this , click on Next, it will start to setup and display status about it.

Step 4: After this finish the setup

Significance of folder:

1) **ARM:**

   In this folder all device dependent files are present as we are using ARM processor. These files include processor and implementation specific constants, these files are in c and assembly language.
   In Os_cpu_c.c folder contain many files related to interfaces like lcd, led, uart, config file, relay etc. which includes program of each interface and which includes basic functions.

2) **µCOS-II:**

   In this folder all device independent files are present, which needs to include as system can be of any type or of any system, so for compatibility it must be included in project.

It consists of various .c files with respect to real time operating system.
It includes file like OS_core.c, OS_FLAG.c, OS_SEM.c , OS_TASK.c , OS_TIME.c and many more, which includes functions related to OS.

3) MD2148:

It includes a board specific folder which contains function related to interfacing board. Like lcd.c , led.c, uart.c etc.

4) Main:

It includes folder for application programmer. This folder contains all application programs.

Program for 3 tasks of LED Blinking with different delay:

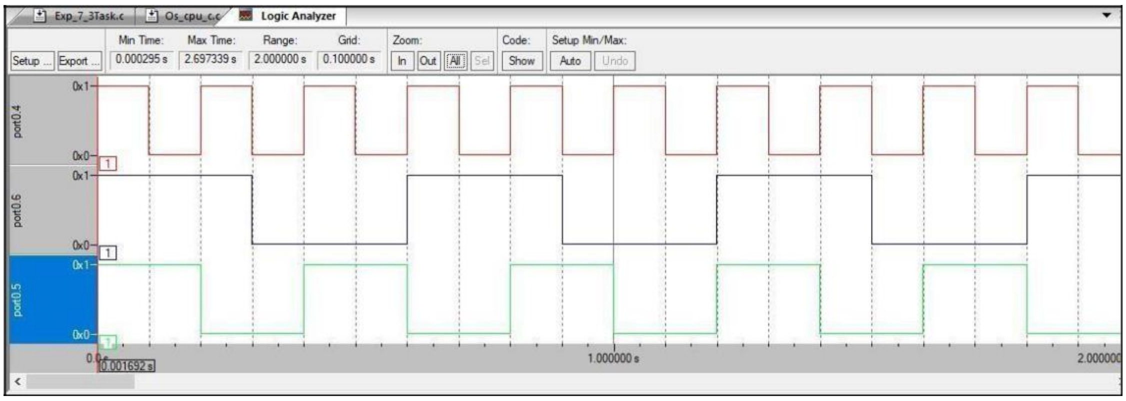
Code:

```
#include "config.h"
#include "stdlib.h"
#include <stdio.h>

#define     TaskStkLengh 64                         //Define the Task0 stack length

OS_STK      TaskStk0 [TaskStkLengh];                //Define the Task stack
OS_STK      TaskStk1 [TaskStkLengh];                //Define the Task stack
OS_STK      TaskStk2 [TaskStkLengh];                //Define the Task stack

void        Task0(void *pdata);
void        Task1(void *pdata);
void        Task2(void *pdata);

// Required for sending time to serial
port char buffer[25];

int main (void)
{
      LED_init();

      TargetInit();
      OSInit ();

      OSTaskCreate (Task0,(void *)0, &TaskStk0[TaskStkLengh - 1], 6);
      OSTaskCreate (Task1,(void *)0, &TaskStk1[TaskStkLengh - 1], 7);
      OSTaskCreate (Task2,(void *)0, &TaskStk2[TaskStkLengh - 1], 8);
      OSStart();
```

```
        return 0;

}

void Task0 (void *pdata)
{
        pdata = pdata;                                          /* Dummy data */

        while(1)
        {


                LED_on(0);
                OSTimeDly(10);
                LED_off(0);
                OSTimeDly(10);

        }
}

void Task1 (void *pdata)
{
        pdata = pdata;                                          /* Dummy data */

        while(1)
        {
                LED_on(1);
                OSTimeDly(20);
                LED_off(1);
                OSTimeDly(20);

        }
}
void Task2 (void *pdata)
{
        pdata = pdata;                                          /* Dummy data */

        while(1)
        {
                LED_on(2);
                OSTimeDly(30);
                LED_off(2);
                OSTimeDly(30);
        }
}
```

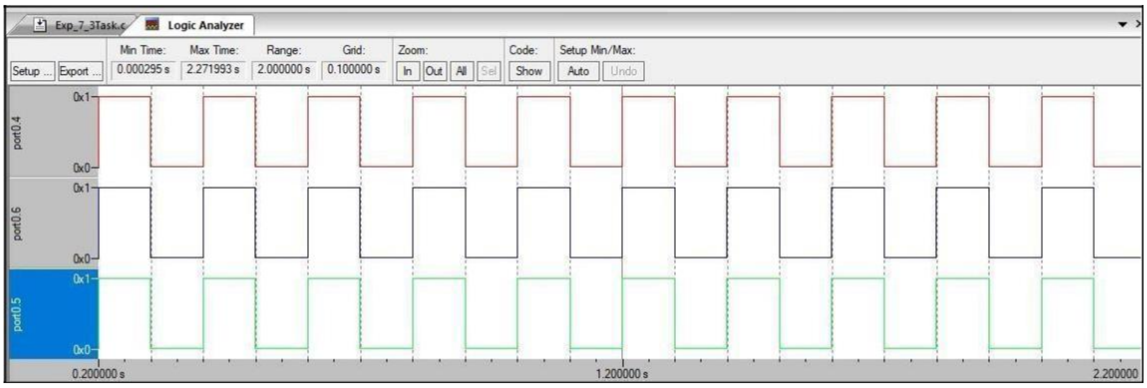
Observations:

1) **Different time delay:**


Exp_7_3Task.c | Os_cpu_c.c | Logic Analyzer

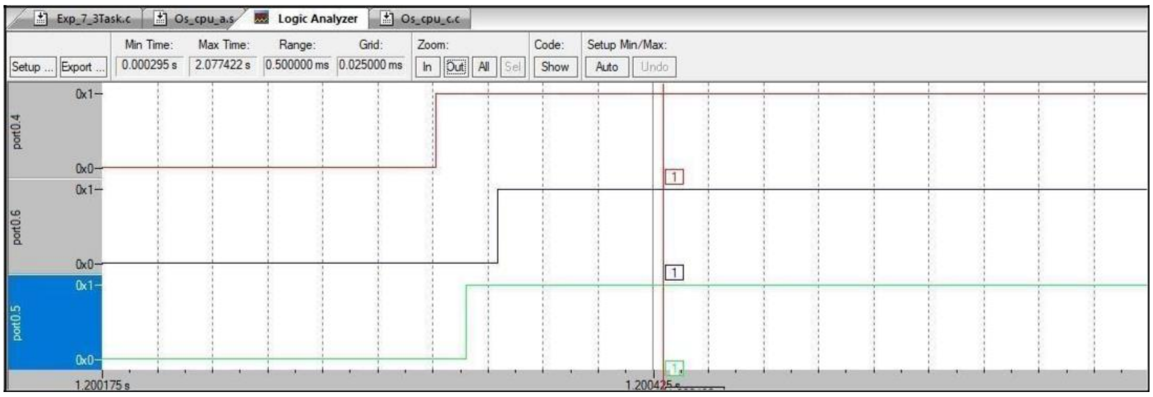
Min Time: 0.000295 s Max Time: 2.697339 s Range: 2.000000 s Grid: 0.100000 s

2) **Same time delay:**


Exp_7_3Task.c | Logic Analyzer

Min Time: 0.000295 s Max Time: 2.271993 s Range: 2.000000 s Grid: 0.100000 s

If we zoom in the above waveforms, it can be seen that all tasks are not carried out at same time


Exp_7_3Task.c | Os_cpu_a.s | Logic Analyzer | Os_cpu_c.c

Min Time: 0.000295 s Max Time: 2.077422 s Range: 0.500000 ms Grid: 0.025000 ms

Here we can see difference between two waveform is in microsec. It looks like waveforms are executing at the same time, but it is not. So, it can be understood using concept of virtual parallelism.

Conclusion:

1) From the output of the code, we can see that multiple tasks are running at the same time. Hence it is a multitasking.
2) Virtual parallelism means, to create an illusion that several tasks are running simultaneously.

EXPERIMENT NO. 9

Name: Atharv Vijay Deshpande

PRN: 21410044

Batch: EN-3

Title: Program to illustrate need of semaphore.

Objective-

1. Understand the need of semaphore and its functionality.
2. Understand the concept of priority inversion.

What is semaphore?

A semaphore is a protocol mechanism offered by most multitasking kernels. Semaphores are used to:

a) Control the access of the shared resources (mutual exclusion);

b) Allow two tasks to synchronize the activities.

c) Signal the occurrence of an event.

A semaphore is a key that your code acquires in order to continue execution. If semaphore is already in use, the requesting task is suspended until the semaphore is released by its current owner.

There are two types of semaphores:

a) Binary Semaphore: The binary semaphores are like counting semaphores but their value is restricted to 0 and 1.

b) Counting Semaphore: These are integer value semaphores and can be any non-negative integer.

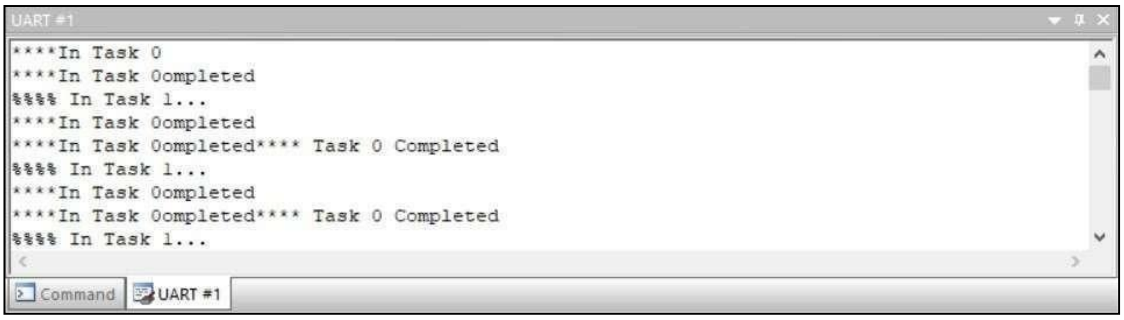
1. Code without Semaphore:

```
    #include  "config.h"

    #include   "stdlib.h"

    #include <stdio.h>


    #define TaskStkLengh 64                    //Define Task stack length
 OS_STK TaskStk0 [TaskStkLengh];               //Define the Task0 stack

OS_STK TaskStk1 [TaskStkLengh];                //Define the Task1 stack

    // declare the tasks
```

```
void Task0(void *pdata);
void Task1(void *pdata);
OS_EVENT *MySem;
unsigned char err;

 int main (void)
{
      LED_init();
      UART0_Init();
      TargetInit();
      OSInit ();
      MySem = OSSemCreate(1);
      OSTaskCreate (Task0,(void *)0, &TaskStk0[TaskStkLengh - 1], 6);
      OSTaskCreate (Task1,(void *)0, &TaskStk1[TaskStkLengh - 1], 7);
      OSStart();
      return 0;
}
void Task0 (void *pdata)
{
      pdata = pdata;
      while(1)
      {
                  //Uncomment pend and post to see semaphores in action
                  //OSSemPend(MySem, 0, &err);
                  UART0_SendData ("****In Task 0\n");
                  OSTimeDly(4);
                  UART0_SendData ("**** Task 0 Completed\r");
                  //OSSemPost(MySem);
      }
}
```

```
void Task1 (void *pdata)
{
      pdata = pdata;
      while (1)
      {
                  //Uncomment pend and post to see semaphores in action
                  //OSSemPend(MySem, 0, &err);
                  OSTimeDly(4);
                  UART0_SendData ("%%%% In Task 1...\n");
                  OSTimeDly(4);
                  UART0_SendData ("%%%% Task 1 Completed");
                  //OSSemPost(MySem);
      }
}
```

Output:



```
****In Task 0
****In Task 0ompleted
%%%% In Task 1...
****In Task 0ompleted
****In Task 0ompleted**** Task 0 Completed
%%%% In Task 1...
****In Task 0ompleted
****In Task 0ompleted**** Task 0 Completed
%%%% In Task 1...
```

2. Code with Semaphore:

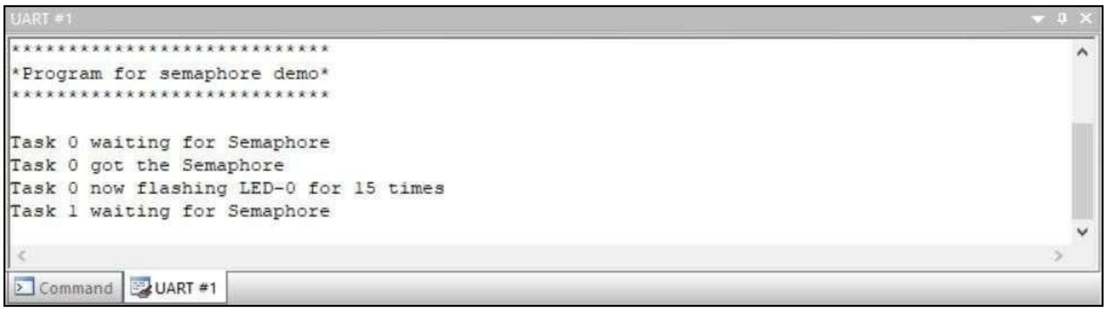
```
#include "config.h"
#include "stdlib.h"

#define TaskStkLengh64          //Define the Task0 stack length

OS_STK          TaskStk0 [TaskStkLengh];                //Define the Task0 stack
OS_STK          TaskStk1 [TaskStkLengh];                //Define the Task0 stack
```

```
void    Task0(void *pdata);                              // Task0
void    Task1(void *pdata);                              // Task1


OS_EVENT *MySem;

unsigned char err;


int main (void)

{

        LED_init();

        lcd_init();

        UART0_Init();

        UART0_SendData("\n\r****************************\n\r");

        UART0_SendData ("*Program for semaphore demo*\n\r");

        UART0_SendData  ("****************************\n\r");



        TargetInit();

        OSInit ();

        MySem = OSSemCreate(1);

        OSTaskCreate (Task0,(void *)0, &TaskStk0[TaskStkLengh - 1], 6);

        OSTaskCreate (Task1,(void *)0, &TaskStk1[TaskStkLengh - 1], 7);


        OSStart();

        return 0;

}
```

```
void Task0      (void *pdata)
{
        int i;
        pdata = pdata;                                          /* Dummy data */
        while(1)
        {
                UART0_SendData("\n\rTask 0 waiting for Semaphore");
                lcd_command(0x80);
                LCD_SendData("                ");
                lcd_command(0x80);
                LCD_SendData("Task 0 waiting");
                OSSemPend(MySem, 0, &err);
                UART0_SendData("\n\rTask 0 got the Semaphore");
                UART0_SendData("\n\rTask 0 now flashing LED-0 for 15 times");

                lcd_command(0x80);
                LCD_SendData("                ");
                lcd_command(0x80);
                LCD_SendData("Task 0 got sem");

                for(i=0; i<15;i++)
                {
                        LED_on(0);
                        OSTimeDly(10);
                        LED_off(0);
                        OSTimeDly(10);
                }

                UART0_SendData("\n\rTask 0 released Semaphore \n\r");
                lcd_command(0x80);
                LCD_SendData("                ");
                lcd_command(0x80);
                LCD_SendData("Task 0 released");

                OSSemPost(MySem);
                //OSTimeDly(150);
        }
}

void Task1      (void *pdata)
{
        int i;
        pdata = pdata;                                          /* Dummy data */

        while (1)
        {
                UART0_SendData("\n\rTask 1 waiting for Semaphore");

                lcd_command(0xC0);
                LCD_SendData("                ");
                lcd_command(0xC0);
                LCD_SendData("Task 1 waiting");

                OSSemPend(MySem, 0, &err);
                UART0_SendData("\n\rTask 1 got the Semaphore");
                UART0_SendData("\n\rTask 1 now flashing LED-1 for 10 times");

                lcd_command(0xC0);
                LCD_SendData("                ");
```

```
                    lcd_command(0xC0);
                    LCD_SendData("Task 1 got sem");

                    for(i=0; i<15;i++)
                    {
                            LED_on(1);
                            OSTimeDly(10);
                            LED_off(1);
                            OSTimeDly(10);
                    }

                    UART0_SendData("\n\rTask 1 released Semaphore\n\r");
                    lcd_command(0xC0);
                    LCD_SendData("                ");
                    lcd_command(0xC0);
                    LCD_SendData("Task 1 released");
                    OSSemPost(MySem);
            }
    }
```

Output:



```
****************************
*Program for semaphore demo*
****************************

Task 0 waiting for Semaphore
Task 0 got the Semaphore
Task 0 now flashing LED-0 for 15 times
Task 1 waiting for Semaphore
```

Priority Inversion:

Priority Inversion is an operating system scenario in which a higher priority process is preempted by a lower priority process. This implies the inversion of priorities of the two tasks.

It is not possible to totally avoid it. But it’s effect can be minimized by:

a. Priority ceiling
b. Disabling interrupts
c. Priority inheritance
d. No blocking
e. Random boosting

Conclusion:

- When we don’t use semaphore in the code the output will be not in an order. That means any other function will start running before the completion of current function.
- When we use semaphore, it allows tasks to synchronise their activity.

EXPERIMENT NO. – 10

Name: Harsh Ravsaheb Bandgar

PRN: 21410045

Batch: EN-5

Title: Program to illustrate mailbox.

Objective:

To deeply understand the concept of mailbox.

Mailbox:

uCOS-II (MicroCOS-II) is a real-time operating system (RTOS) designed for embedded systems. In uCOS-II, a mailbox is a communication mechanism that allows tasks to exchange messages or data with each other. The mailbox is a way for tasks to communicate asynchronously, meaning that tasks can send and receive messages without having to be synchronized in time.

• Purpose: The purpose of a mailbox is to provide a way for tasks to send messages to each other. A task can post a message to a mailbox, and another task can read or retrieve that message from the mailbox.

• Data Structure: In uC/OS-II, a mailbox is typically implemented as a data structure that can hold messages. The structure may include fields for the message itself, the sender's task identifier, and other relevant information.

• API Functions: uC/OS-II provides specific API functions for working with mailboxes.

The key functions include:

1. OSMboxCreate: Creates a mailbox.
2. OSMboxDel: Deletes a mailbox.
3. OSMboxPost: Posts a message to a mailbox.
4. OSMboxPend: Waits for a message to be available in a mailbox and retrieves it.

• Blocking and Non-Blocking Operations: Tasks can use OSMboxPend to wait for a message to be available in the mailbox. This function can be set to either block the task until a message is available or return immediately if no message is present (non-blocking).

• Message Passing: The messages exchanged through a mailbox can be of any data type, depending on the application's requirements. The sender and receiver tasks need to agree on the format and interpretation of the messages.

Programs to understand use of Mailbox:

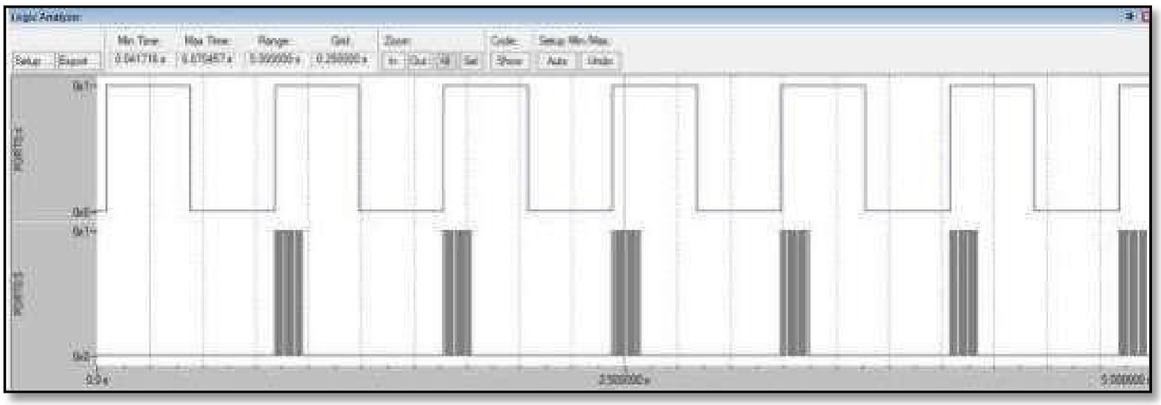
Here, there are two tasks namely Task0 and Task1.

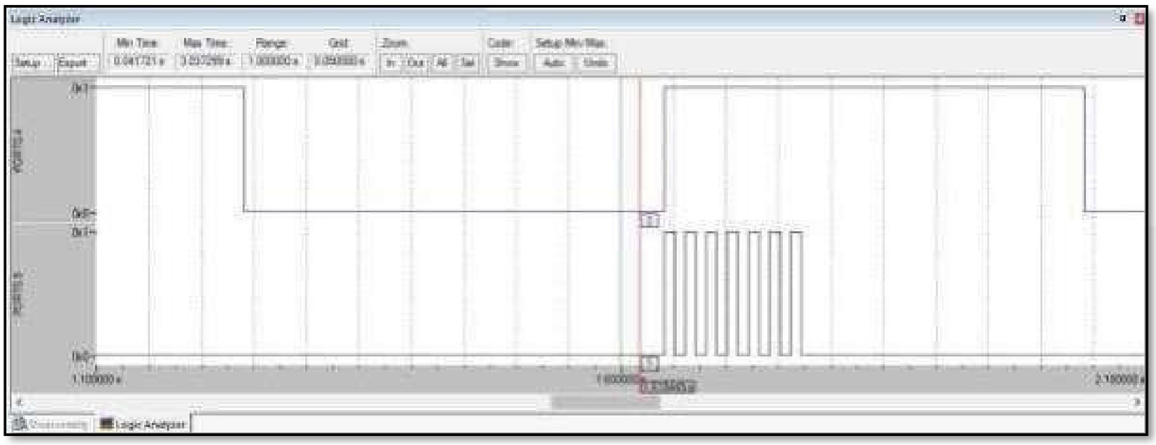
The Task0 sends message to Task1 i.e., a variable ‘c’ is sent from Task0 to Task1. The value of variable ‘c’ will define the number of cycles will the port pin related to task1 will have.

Code:

```
 #include    "config.h"
 #include     "stdlib.h"
 #include <stdio.h>

#define TaskStkLengh 64                          //Define the Task0 stack length


OS_STK    TaskStk0    [TaskStkLengh];        //Define the Task stack
OS_STK TaskStk1 [TaskStkLengh];             //Define the Task stack
 void Task0(void *pdata);
 void Task1(void *pdata);
 OS_EVENT *MyMailBox; // mail box uint8 err;

 // Required for sending time to serial port char
 buffer[25];
 int main (void)
 {
            LED_init();
            UART0_Init();
            UART0_SendData("\r\n*************************************\r\n");
            UART0_SendData ("* Program for demo of Mailbox *\r\n");
            UART0_SendData ("*************************************\r\n");
            TargetInit();
            OSInit ();
            MyMailBox = OSMboxCreate((void*)0); // create mail box with no message
            OSTaskCreate (Task0,(void *)0, &TaskStk0[TaskStkLengh - 1], 6);
            OSTaskCreate (Task1,(void *)0, &TaskStk1[TaskStkLengh - 1], 7);
            OSStart(); return 0;
 }


 /**********************************************************
 ** Task0
 **********************************************************/
 void Task0 (void *pdata)
 { unsigned int c; int i;
            pdata = pdata; /* Dummy data */ while(1)
            { c = 12;
                        LED_on(0);
                        OSTimeDly(40); LED_off(0);
                        OSTimeDly(40);
                        OSMboxPost(MyMailBox, &c);
            }
}

void Task1 (void *pdata)
{ unsigned int* ptr; int i;
            unsigned int b; pdata = pdata; /*
            Dummy data */ while(1)
            { ptr = OSMboxPend(MyMailBox, 0, &err);
            b=*ptr; for(i=0;i<b-5;i++) {
            LED_on(1);
            OSTimeDly(1); LED_off(1);
            OSTimeDly(1);
            }
            }
}
```

Output:





Conclusion:

1. In OS tasks can communicate within themselves.
2. The concept of mailbox is used to send and receive inter task messages.

Experiment No. 7

Name: Harsh Ravsaheb Bandgar

PRN: 21410045

Batch: EN-5

Title: Review of C language.

(Write answers for the following questions)

1) Data Types

What is the need of Data types?

Ans: Data types are essential in programming because they define the type of data that can be stored and manipulated within a program. They help the compiler understand how to treat data, enabling operations to be performed correctly and efficiently.

What is the size of character data type? (in byte)

Ans: The size of the char data type is typically 1 byte.

What is the range of values the character data type can hold? (mention signed and unsigned values)

Ans : Signed char: -128 to 127

Unsigned char: 0 to 255

When to use signed char and when to use unsigned char?

Ans: Use signed char when you need to represent negative values, and use unsigned char when you only need positive values and want to maximize the range of positive integers.

What is the size of integer data type?

Ans: The size of the int data type is typically 4 bytes (32 bits), but this can vary depending on the system.

What is the range of values the integer data type can hold? (mention signed and unsigned values)

Ans: The size of the int data type is typically 4 bytes (32 bits), but this can vary depending on the system.

What is the purpose of integer data type?

Ans: Signed int: -2,147,483,648 to 2,147,483,647

Unsigned int: 0 to 4,294,967,295

What is the size of float data type? (in byte)

Ans: The size of the float data type is typically 4 bytes.

What is the range of values the float data type can hold? (mention signed and unsigned values)

Ans: Signed float: Approximately -3.4E38 to 3.4E38 (specific range depends on implementation)

What is the purpose of float data type?

Ans: The float data type is used for storing single-precision floating-point numbers (decimals).

What is the size of long data type? (in byte)

Ans: The size of the long data type is typically 4 bytes on 32-bit systems and 8 bytes on 64-bit systems.

What is the range of values the long data type can hold? (mention signed and unsigned values)

Ans: Signed long: -2,147,483,648 to 2,147,483,647 (32-bit), or -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807 (64-bit)

Unsigned long: 0 to 4,294,967,295 (32-bit), or 0 to 18,446,744,073,709,551,615 (64-bit)

What is the purpose of long data type?

Ans: The long data type is used for storing larger whole numbers than what can be stored in a regular int.

Why is it better to explicitly declare signed or unsigned? (For long data type)

Ans: Explicitly declaring signed or unsigned helps clarify the intended range of values and prevents accidental overflow or underflow in calculations.

What is the size of double data type? (in byte)

Ans: The size of the double data type is typically 8 bytes.

What is the range of values the double data type can hold? (mention signed and unsigned values)

Ans: Signed double: Approximately -1.7E308 to 1.7E308

What is the purpose of double data type?

Ans: The double data type is used for storing double-precision floating-point numbers (decimals) and offers greater precision than float.

What is the meaning of void?

Ans: void indicates the absence of a value or type. It is commonly used in functions to indicate that no value is returned.

Can we declare variable of void type? Why?

Ans: No, we cannot declare a variable of void type because it does not represent any data type or value.

What is the size of void data type?

Ans: The size of void is not defined, as it does not represent any data type.

What is the purpose of void?

Ans: void is used to indicate that a function does not return a value or to define generic pointers.

2) Pointers in C:

What is a pointer?

Ans: A pointer is a variable that stores the memory address of another variable. It allows for indirect access and manipulation of the variable's value.

What are the advantages of pointer?

Ans:

- Efficient memory usage
- Dynamic memory allocation
- Easy array manipulation
- Facilitates data structures like linked lists and trees

How to declare pointer? Why do we need to specify the data type while declaring it?

Ans: To declare a pointer, use the syntax data_type *pointer_name;. Specifying the data type is necessary because it informs the compiler how much memory to access and how to interpret the data at that memory location**.**

Write a program to list the use of pointer. And mention the possible outcomes.

Ans:

```
#include <stdio.h>

int main() {

   int a = 10;

   int *p = &a; // Pointer declaration and initialization

   printf("Value of a: %d\n", a);

   printf("Pointer p points to value: %d\n", *p); // Dereferencing

  *p = 20; // Modifying value using pointer

   printf("New value of a: %d\n", a);

    return 0;

}
```

Possible outcomes:

- Original value of a: 10
- Value pointed by p: 10
- New value of a: 20

What is void pointer?

Ans: A void pointer is a pointer that does not have a specific data type. It can point to any data type but must be cast to the appropriate type before dereferencing.

What is null pointer?

Ans: A null pointer is a pointer that does not point to any valid memory location. It is typically used to signify that the pointer is not initialized or does not reference any object.

3) Structure in C:

What is a structure?

Ans: A structure is a user-defined data type that groups different types of variables under a single name. It allows you to create complex data types that model real-world entities.

Write advantages of structures?

Ans: Group related data together

 Improve code organization

 Facilitate data management

How to declare structure? Why do we need to specify the data type while declaring it?

Ans: To declare a structure, use the syntax:

```
struct structure_name {

   data_type member1;

   data_type member2;

};
```

Specifying the data type for members is necessary to define the type of data each member will hold.

Write a program to list the use of structure. And mention the possible outcomes.

Ans:

```
#include <stdio.h>


struct Student {

   char name[50];

   int age;

};


int main() {

   struct Student student1 = {"Alice", 20};


   printf("Name: %s\n", student1.name);
```

```
    printf("Age: %d\n", student1.age);


    return 0;

}
```

Possible outcomes:

- Name: Alice
- Age: 20

4) Writing portable c CODE

Illustrate portability with 1 example.

Ans: Consider a program that uses sizeof(int) to allocate memory. The size of int may differ between systems, causing portability issues. Using standardized types like int32_t from <stdint.h> ensures consistent sizes across platforms.

Write the guidelines to be followed while writing portable code.

Ans: Use standard data types (e.g., int32_t, float, double)

 Avoid system-specific features or functions

 Use ANSI C standards

 Test on multiple platforms

 Document any system-dependent features

Whether the RTOS code should be portable? Why?

Ans: Yes, RTOS code should ideally be portable to allow for flexibility in deployment across different hardware platforms, enhancing maintainability and reducing development costs. However, certain hardware-specific optimizations may be necessary depending on the application.

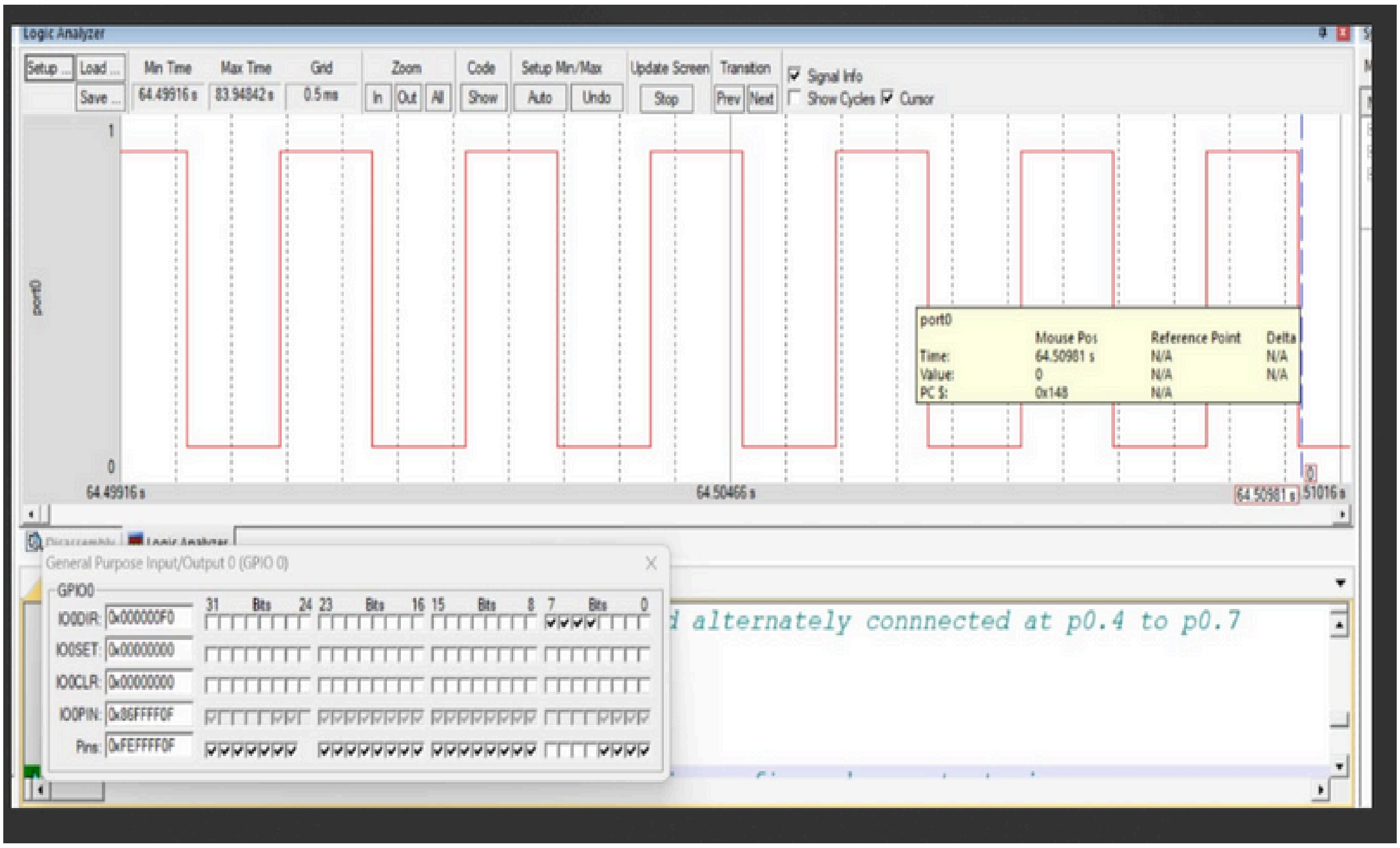
Review of Keil Software:

Title of Task: LED blinking

Program:

```
#include <LPC213X.H>
//Flash Led connected at p0.4
void delay()
{
unsigned int i;
for(i=0;i<2000;i++);
}
void main()
{
 IODIR0 = 0x000000F0; //port pin p0.4 is configured as output pin
while(1)
{
IOPIN0 = 0x00000010;
delay();
IOCLR0 = 0x00000010;
delay();
}
}
```

Result:



Min Time: 64.49916 s
Max Time: 83.94842 s
Grid: 0.5 ms
☑ Signal Info
☐ Show Cycles
☑ Cursor

```
port0
         Mouse Pos     Reference Point   Delta
Time:    64.50981 s    N/A               N/A
Value:   0             N/A               N/A
PC $:    0x148         N/A
```

General Purpose Input/Output 0 (GPIO 0)

GPIO0

	Value	31 – 24	23 – 16	15 – 8	7 – 0
IO0DIR:	0x000000F0	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	✓✓✓✓☐☐☐☐
IO0SET:	0x00000000	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐
IO0CLR:	0x00000000	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐
IO0PIN:	0x86FFFF0F	✓☐☐☐☐✓✓☐	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	☐☐☐☐✓✓✓✓
Pins:	0xFEFFFF0F	✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	☐☐☐☐✓✓✓✓

```
d alternately connnected at p0.4 to p0.7
```