FAZAIA BILQUIS COLLEGE OF EDUCATION FOR WOMEN PAF BASE NUR KHAN

COMPUTER SCIENCE DEPARTMENT

OPERATING SYSTEM

LAB MANUAL

WEEK # 1

1. Introduction to Operating System

An operating system (OS) is the fundamental software that manages computer hardware and software resources, providing essential services to both users and applications. It acts as an intermediary between hardware and user-level programs, enabling communication and resource management. Core functions of an OS include managing memory, processing tasks, handling input/output (I/O) operations, and ensuring security. Popular operating systems like Windows, macOS, Linux, and Android allow users to interact with computers efficiently, offering user-friendly interfaces while managing the underlying complexities of hardware resources.

1.2. Introduction to Ubuntu

Ubuntu is a popular open-source operating system based on the Linux kernel, known for its user-friendly interface and robust security features. Developed by Canonical, Ubuntu is designed to be accessible to both new and experienced users, offering a seamless experience for everyday computing tasks, programming, and server management. It comes pre-installed with essential software like LibreOffice, Firefox, and a Software Center for easy installation of additional applications. Ubuntu's regular updates, strong community support, and extensive documentation make it a preferred choice for developers, system administrators, and casual users alike. Available in both desktop and server versions, it is widely used for personal computers, cloud environments, and various enterprise solutions.

1.3. Installation of Ubuntu

Steps to Install Ubuntu on Virtual Box

1.3.1. Before we begin with the installation process, we need to Download ISO for Ubuntu. For that, all the versions of Ubuntu are available on the Official Site.

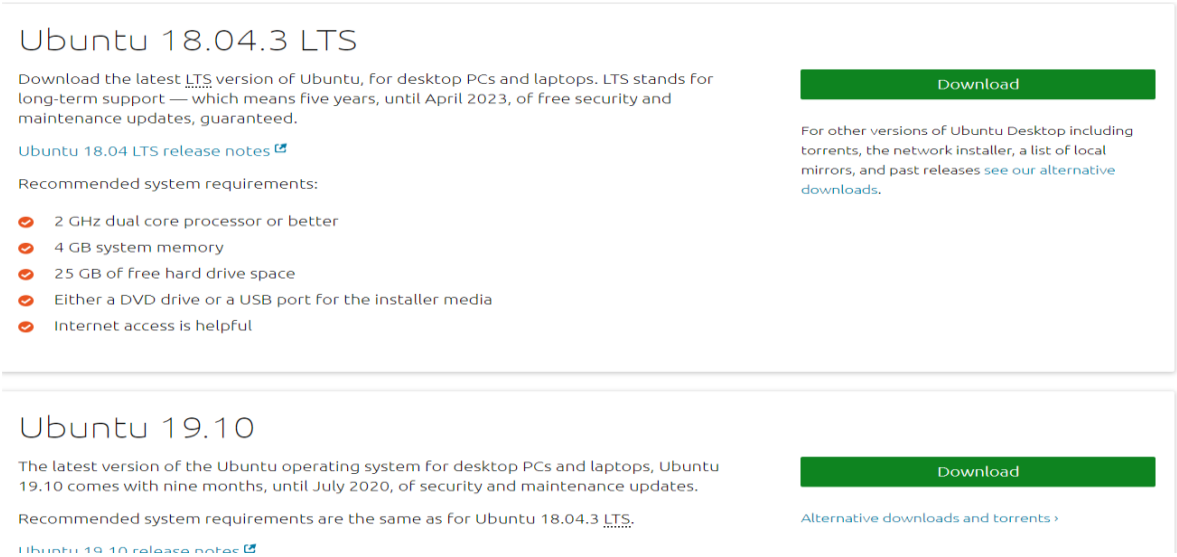


Figure 1.3.1

1.3.2. Open Virtual Box and click on the New button.

Figure 1.3.2

1.3.3. Give a Name to your Virtual Machine and select the Location for it to install.

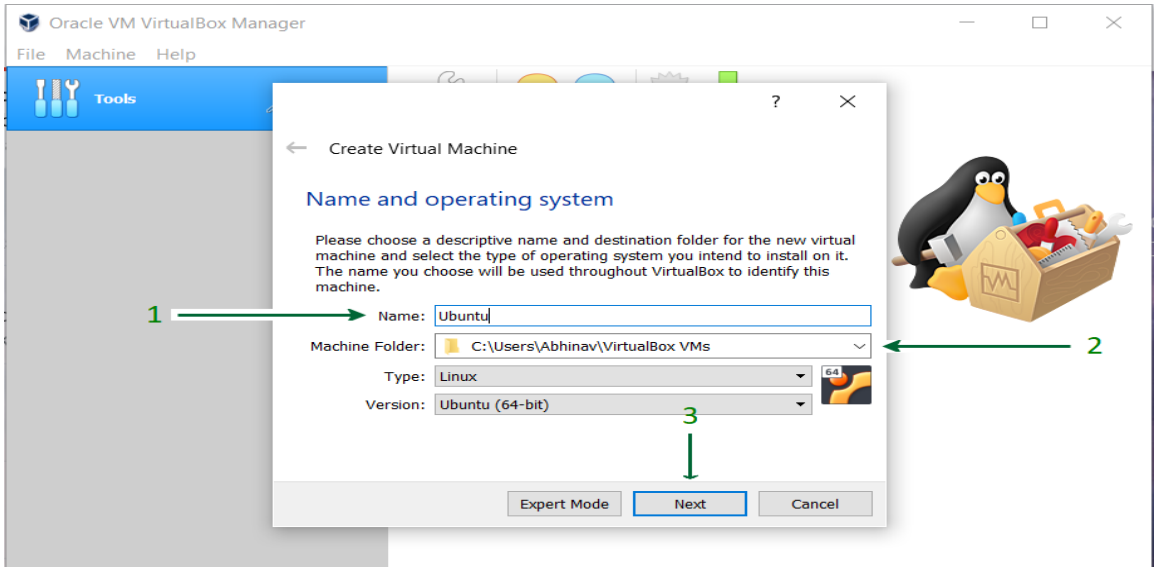


Figure 1.3.3

1.3.4. Assign RAM Size to your Virtual Machine.

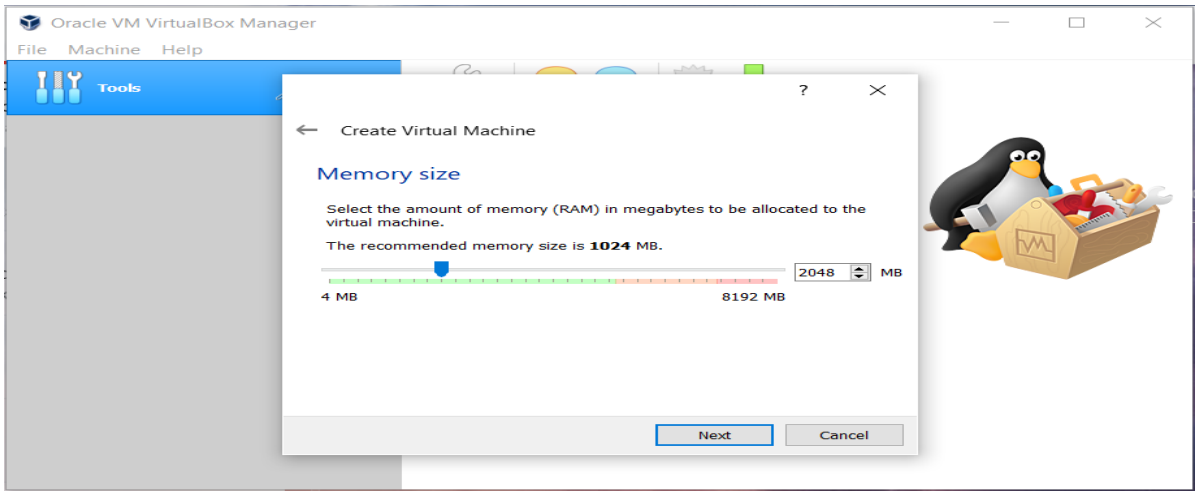


Figure 1.3.4

1.3.5. Create a Virtual Hard Disk for the machine to store files.

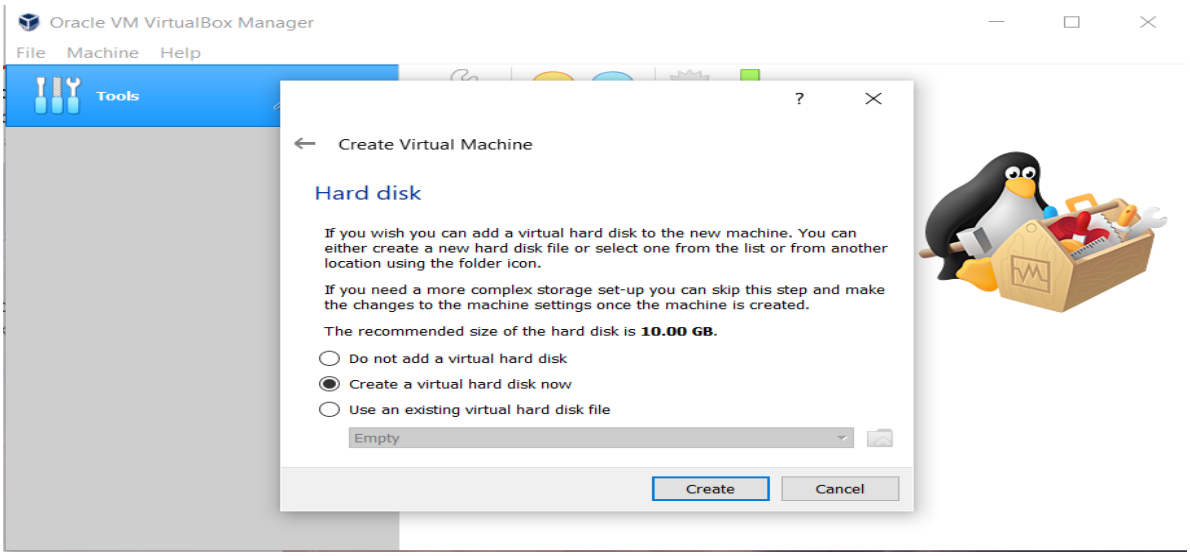


Figure 1.3.5

1.3.6. Select the type of Hard disk. Using VDI type is recommended.

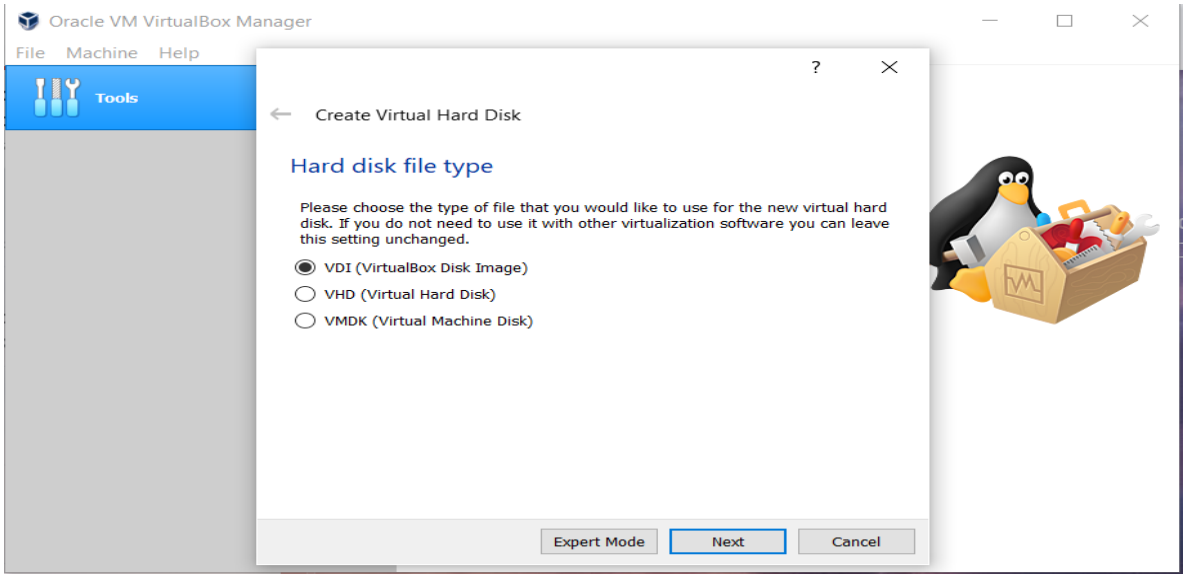


Figure 1.3.6

1.3.7. Either of the Physical Storage types can be selected. Using a Dynamically Allocated Disk is by default recommended.

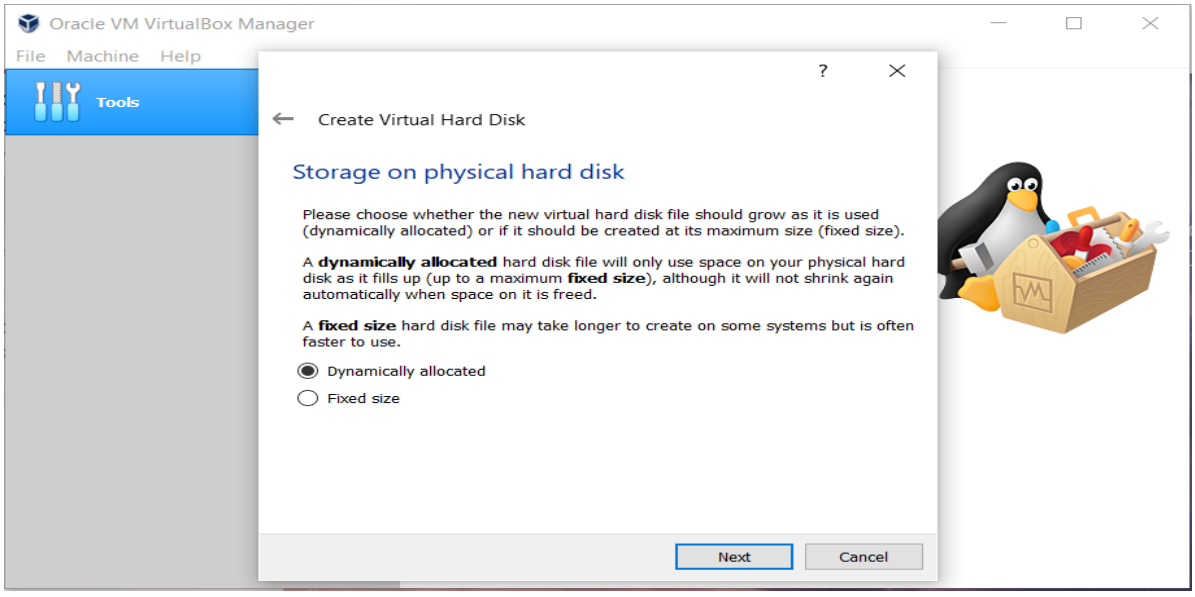


Figure 1.3.7

1.3.8. Select Disk Size and provide the Destination Folder to install.

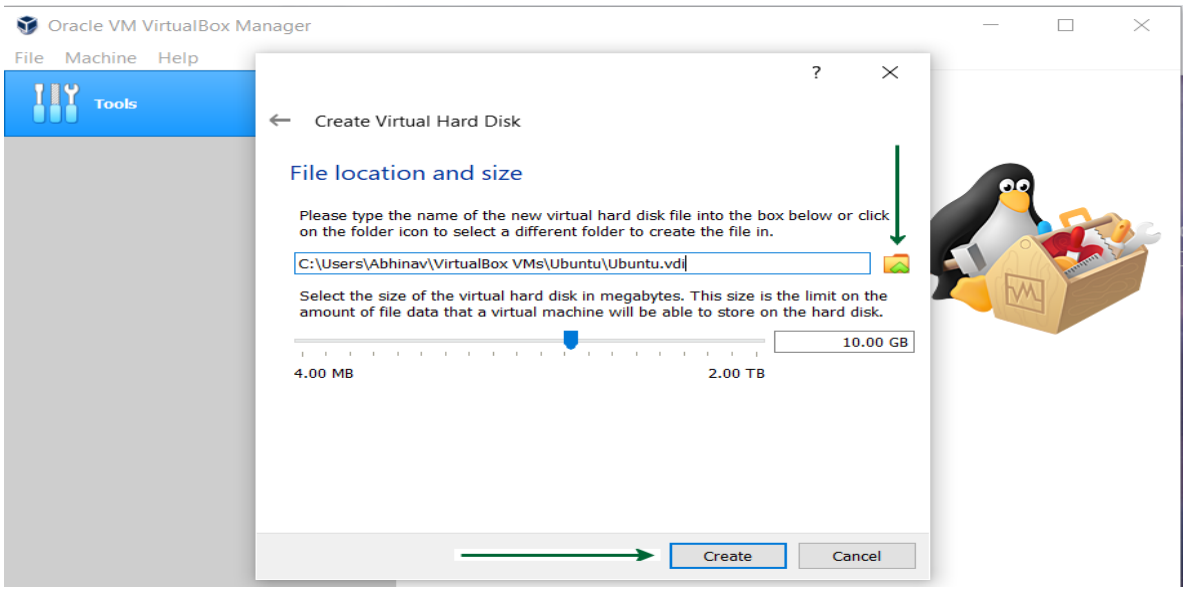


Figure 1.3.8

1.3.9. After the Disk creation is done, boot the Virtual Machine and begin installing Ubuntu.

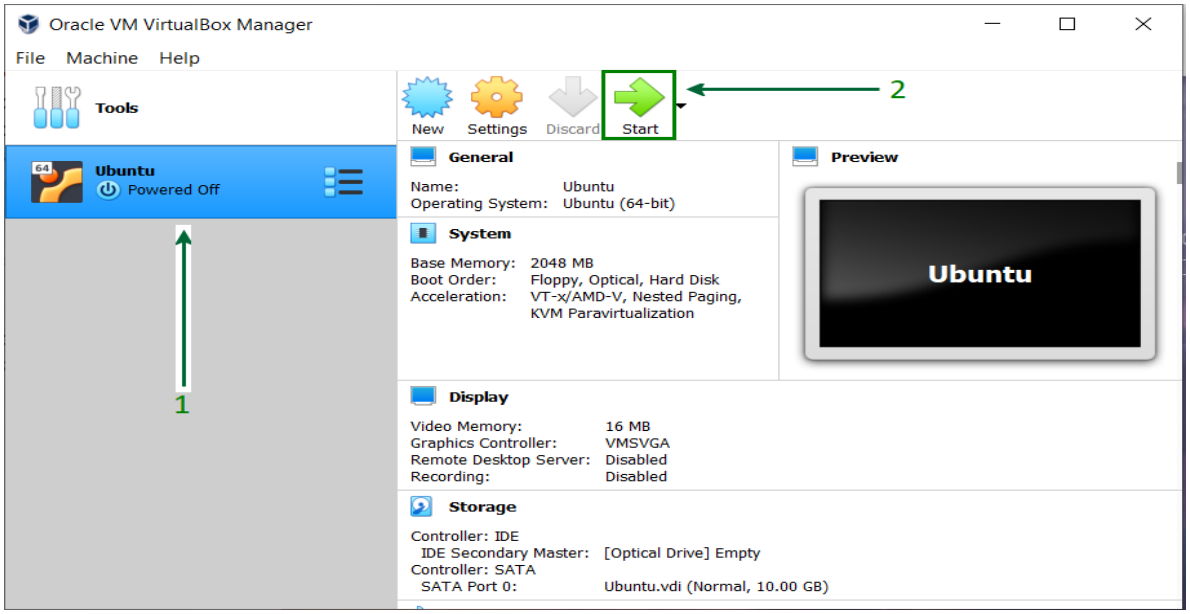


Figure 1.3.9

1.3.10. If the installation disk is not automatically detected. Browse the file location and select the ISO file for Ubuntu.

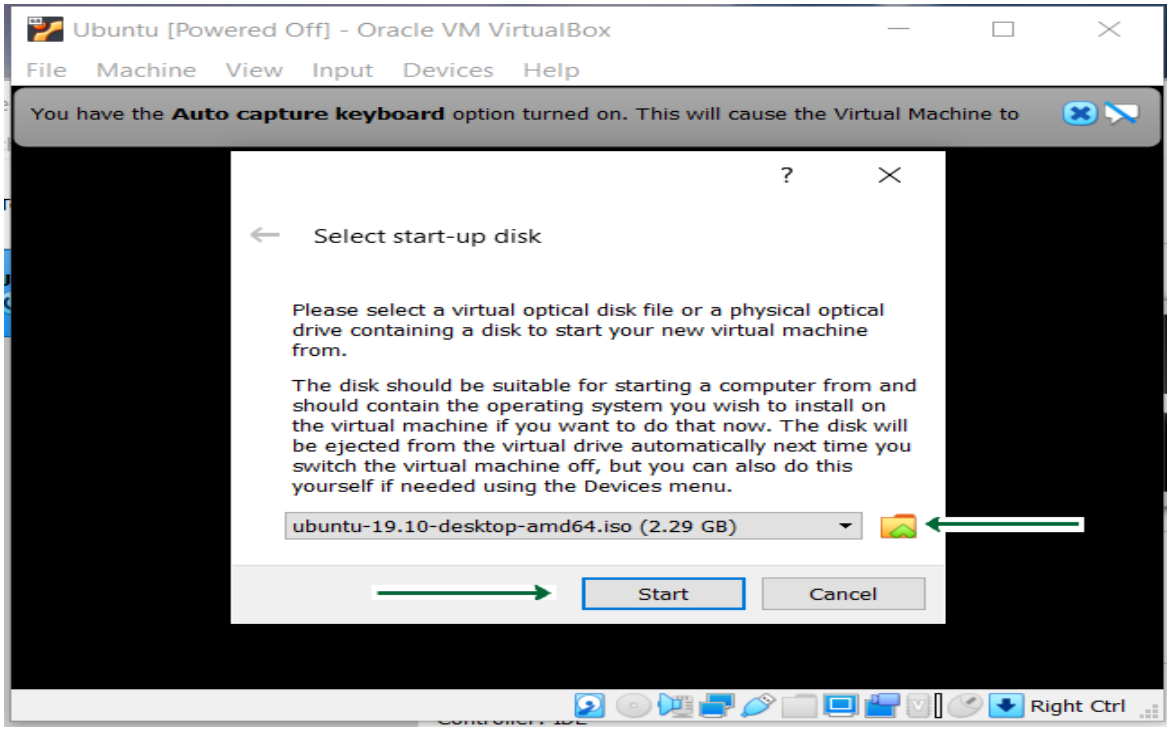


Figure 1.3.10

1.3.11. Proceed with the installation file and wait for further options.

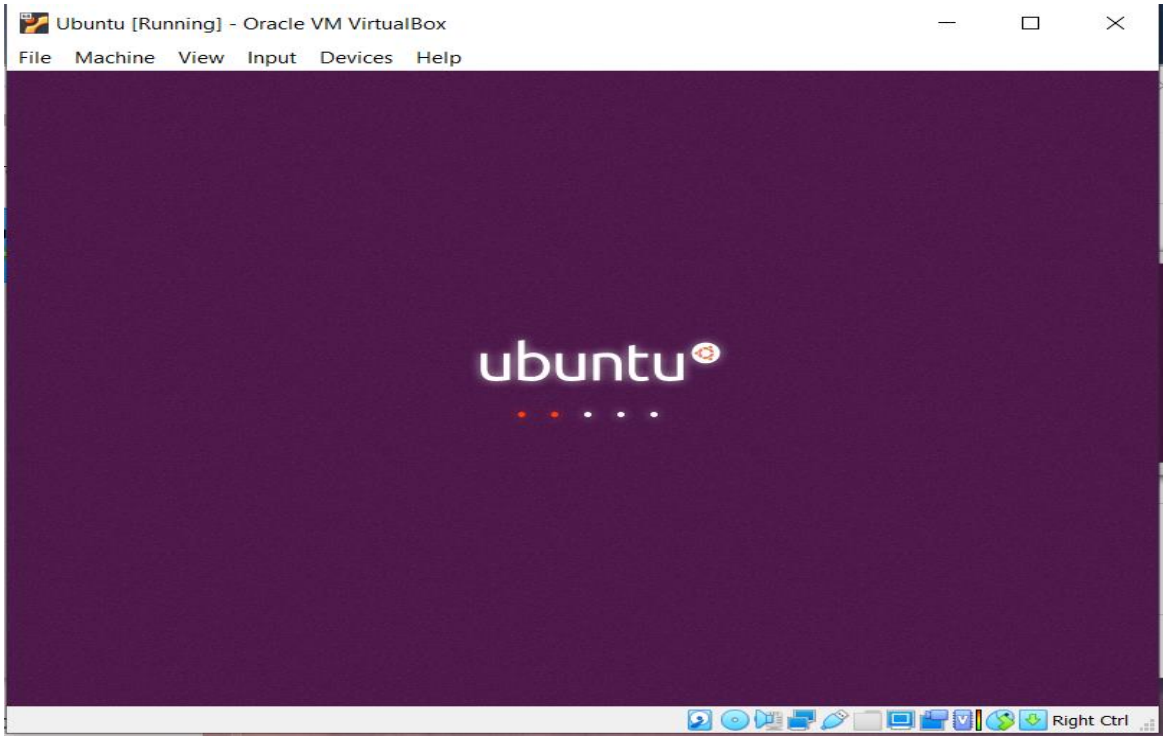


Figure 1.3.11

1.3.12. Click on the Install Ubuntu option, this might look different for other Ubuntu versions.

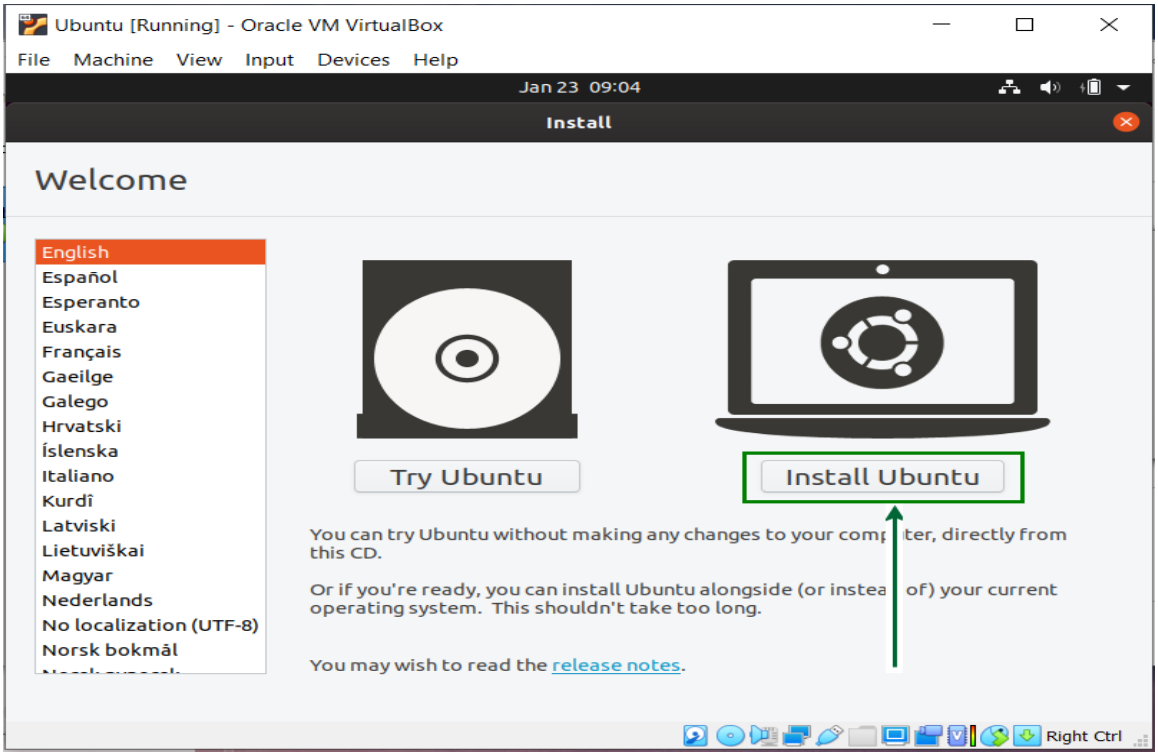


Figure 1.3.12

1.3.13. Select Keyboard Layout, if the defaults are compatible, just click on the Continue button and proceed.

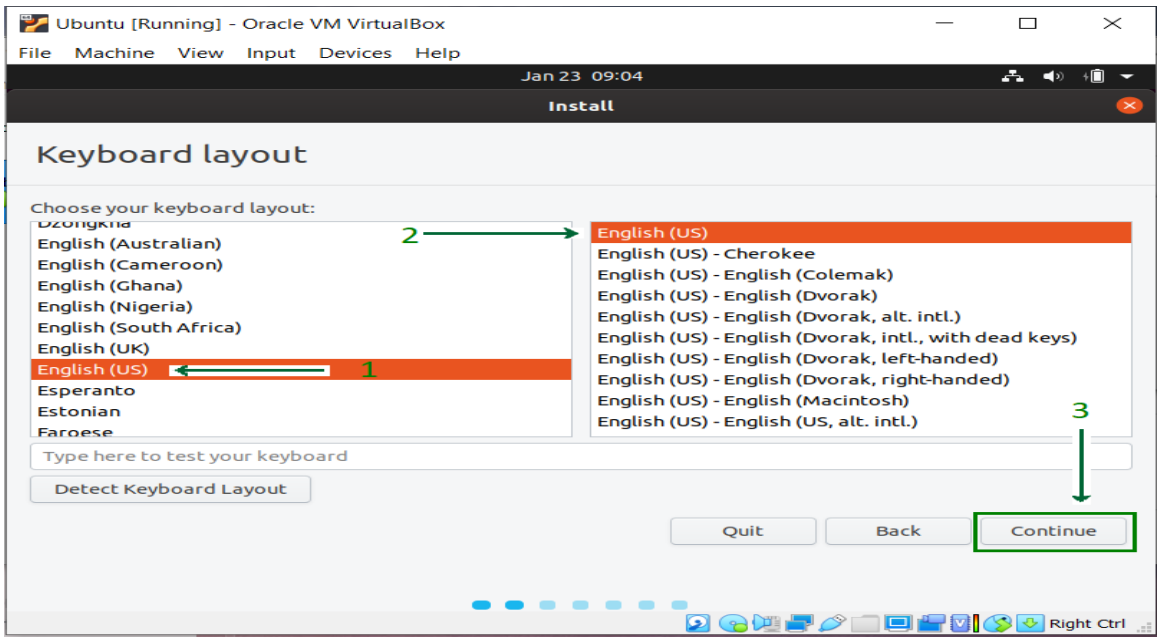


Figure 1.3.13

1.3.14. Wait for the installation process to complete.

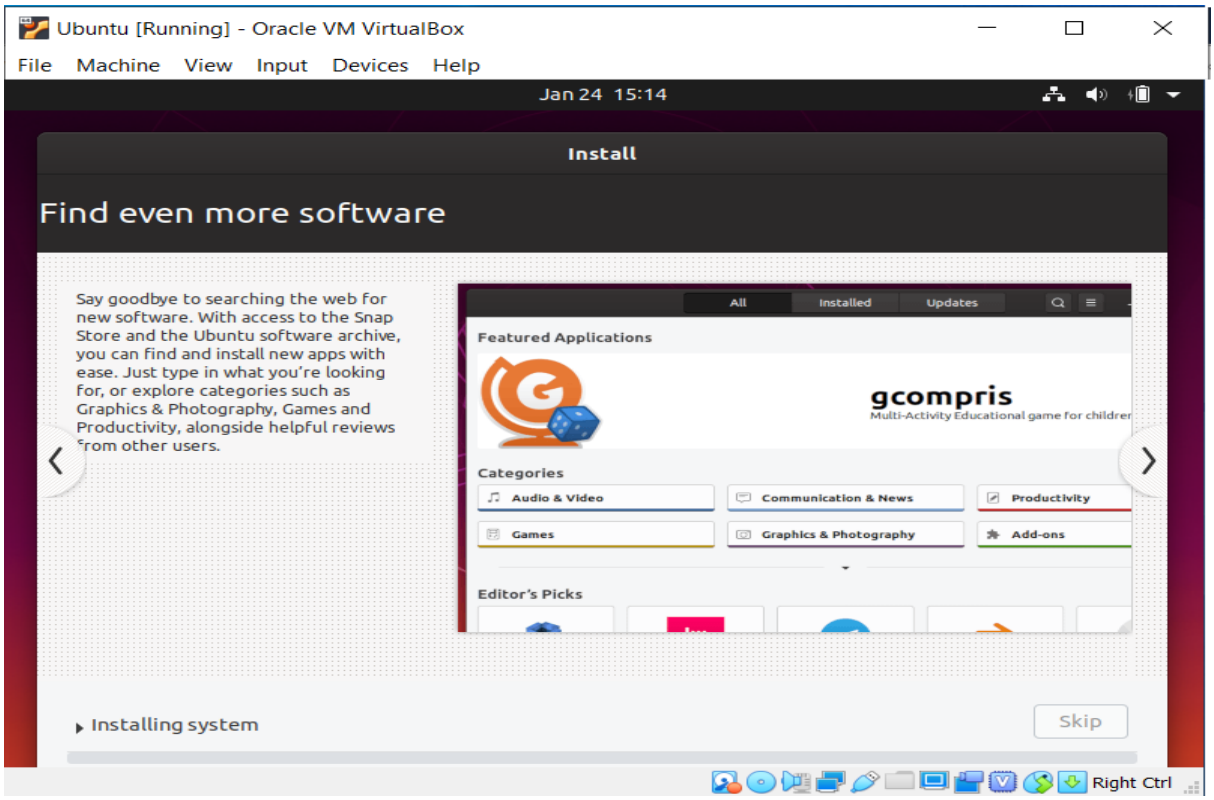


Figure 1.3.14

1.3.15. Once the installation process is over, reboot your Virtual Machine.

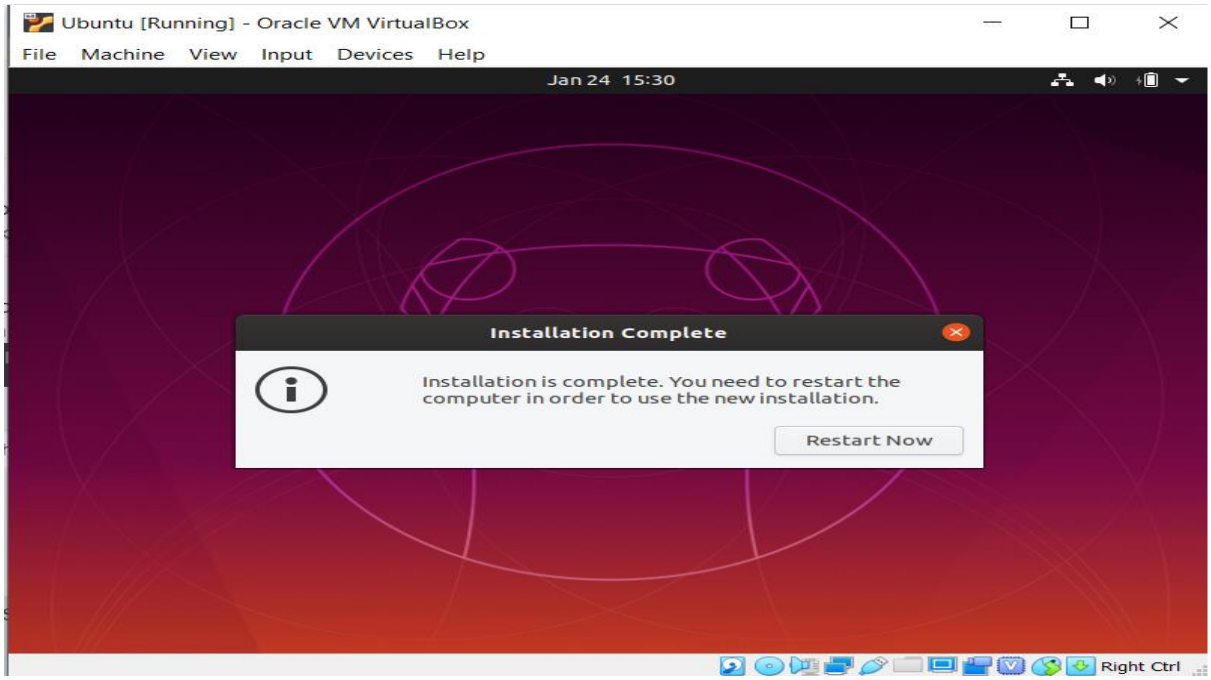


Figure 1.3.15

1.3.16. You're finished with the installation process. Now you can use Ubuntu along with Windows, without creating a dual boot.

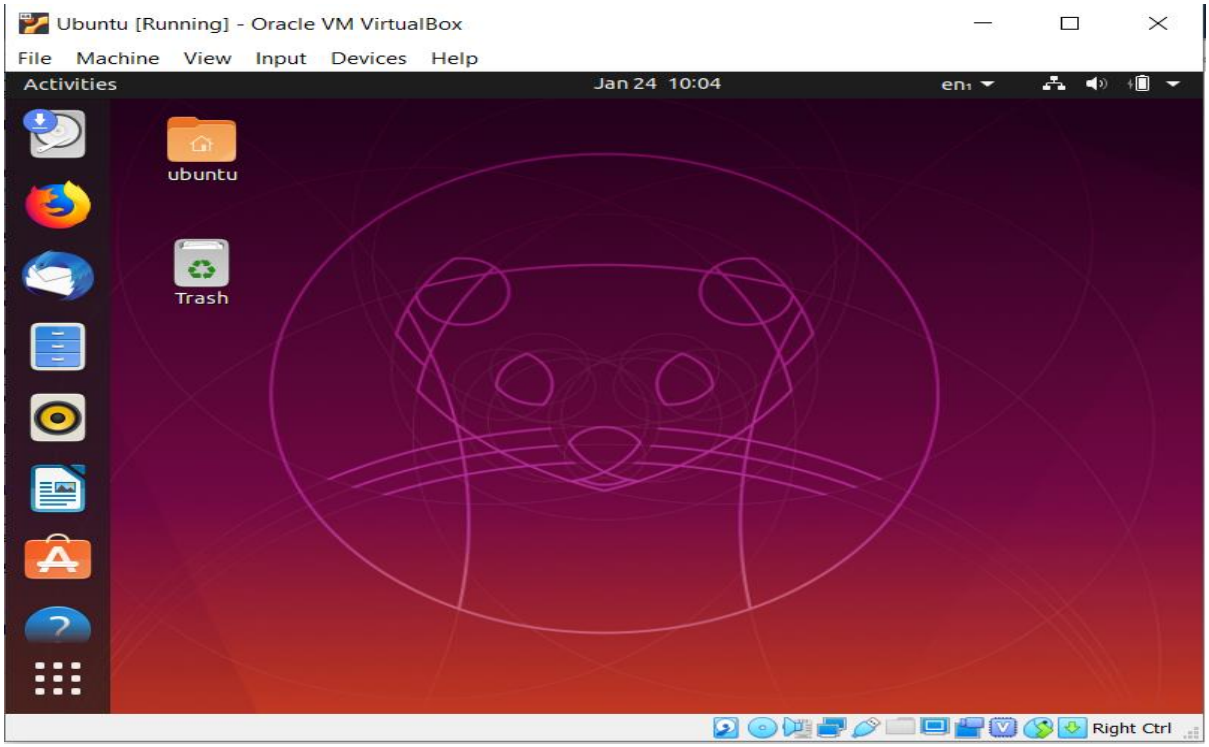


Figure 1.3.16

2. COMMAND PROMPT

The Command Prompt (CMD) in Windows is a command-line interpreter application available in most Windows operating systems. It is used to execute entered commands, which allows users to perform various tasks on the computer without needing a graphical user interface.

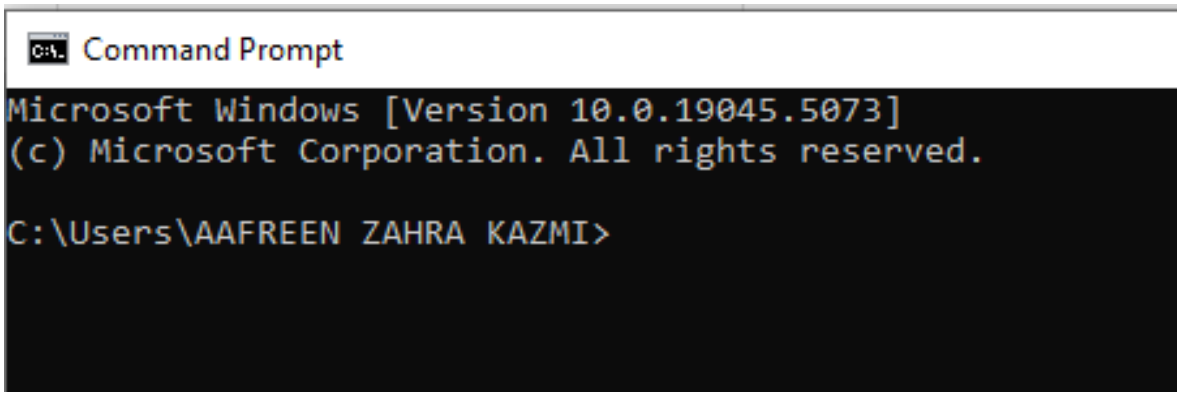


Figure 2

2.1. COMMAND'S EXECUTION

Files Command

2.1.1. Title aafreen

- This command sets the title of the Command Prompt window to the specified text. It's useful for customizing the Command Prompt window for specific tasks.

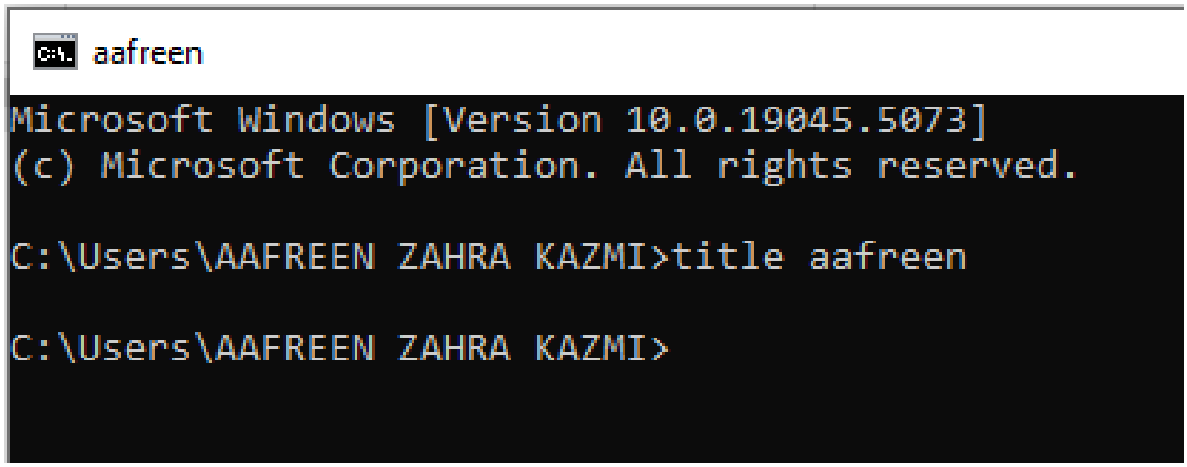


Figure 2.1.1

2.1.2. date

- Displays the current system date and allows the user to change it if necessary. When executed without options, it prompts for a new date.

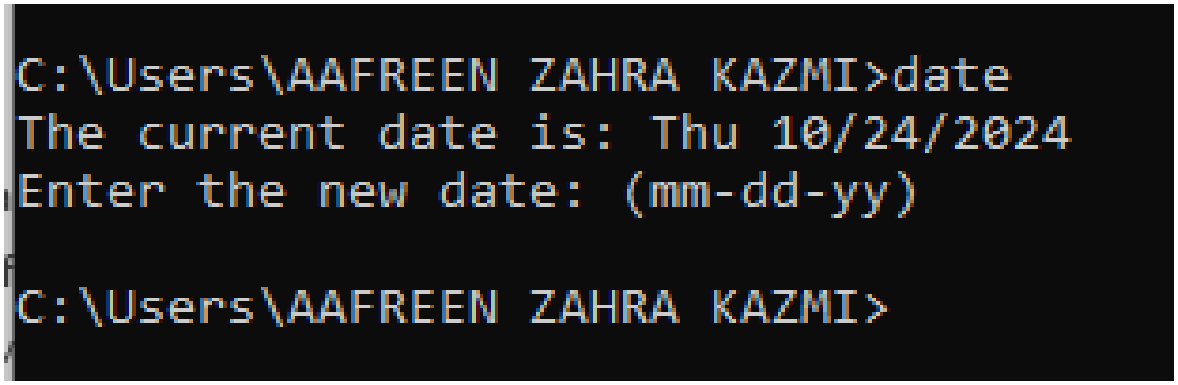


Figure 2.1.2

2.1.3. Time

- Displays or sets the system time.

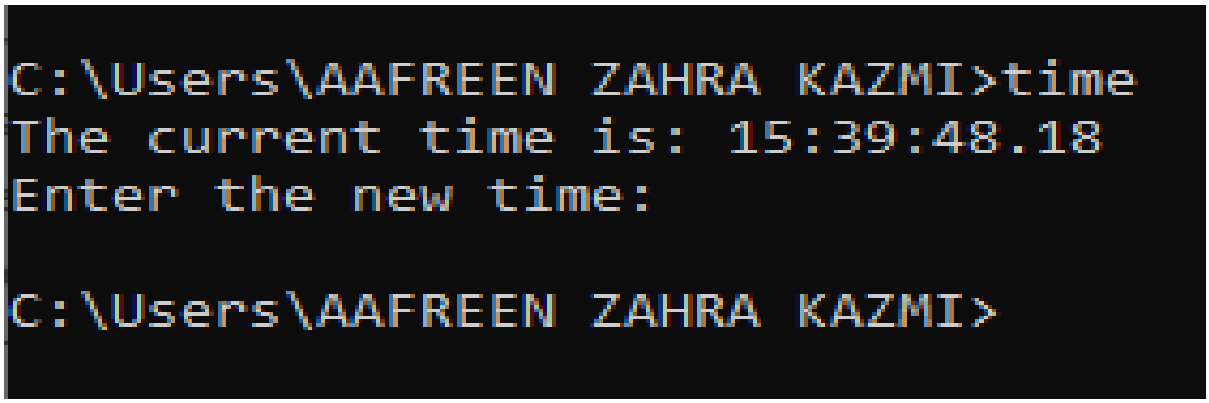


Figure 2.1.3

2.1.4. Hostname

- Displays the name of the compute

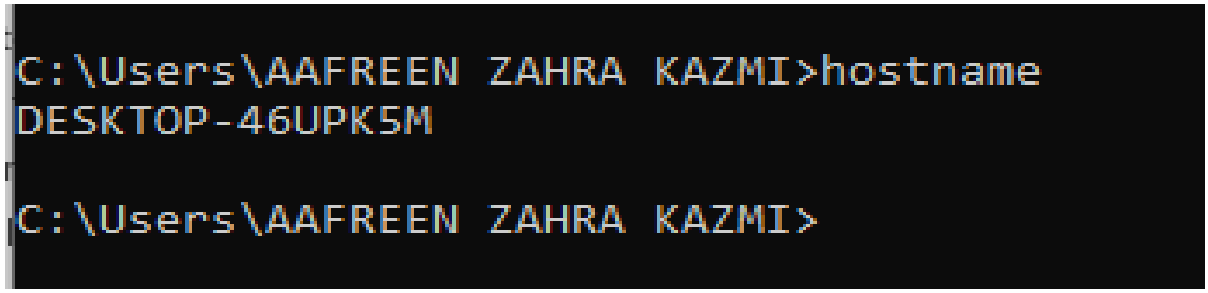


Figure 2.1.4

2.1.5. cls

- Clears the command prompt screen.

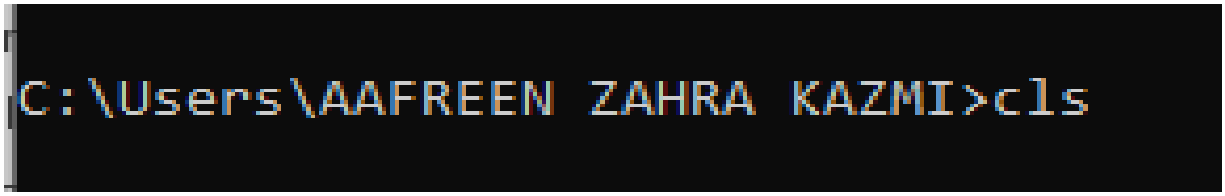


Figure 2.1.5

2.1.6. Color fb

- Changes the text and background colors in CMD

Figure 2.1.6

2.1.7. Color 0a

- Changes the text and background colors

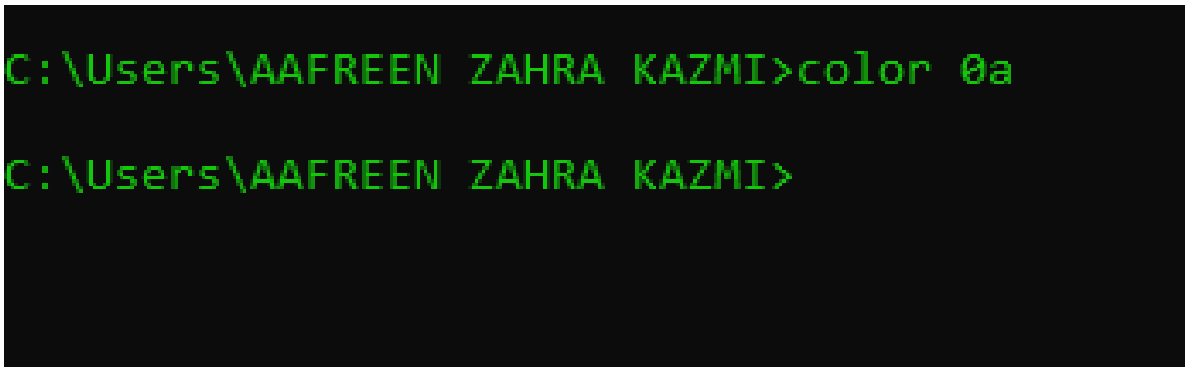


Figure 2.1.7

2.1.8. Ver

- Displays the version of Windows.

```
C:\Users\AAFREEN ZAHRA KAZMI>ver

Microsoft Windows [Version 10.0.19045.5073]
```

Figure 2.1.8

2.1.9. Cd

- Display the current directory.

```
C:\Users\AAFREEN ZAHRA KAZMI>cd
C:\Users\AAFREEN ZAHRA KAZMI
```

Figure 2.1.9

2.1.10. dir

- Lists the files and directories in the current directory.

```
C:\Users\AAFREEN ZAHRA KAZMI>dir
 Volume in drive C has no label.
 Volume Serial Number is 78B4-1C1D

 Directory of C:\Users\AAFREEN ZAHRA KAZMI

10/22/2024  08:57 PM    <DIR>          .
10/22/2024  08:57 PM    <DIR>          ..
05/28/2024  05:44 PM    <DIR>          .dotnet
03/28/2024  12:09 PM                16 .emulator_console_auth_token
03/25/2024  07:35 PM    <DIR>          .librarymanager
03/28/2024  11:07 AM    <DIR>          .m2
05/05/2024  12:05 PM    <DIR>          .nuget
03/21/2024  08:32 PM    <DIR>          .temp
03/25/2024  04:23 AM    <DIR>          .templateengine
10/24/2024  10:34 AM    <DIR>          .VirtualBox
08/17/2024  06:18 PM    <DIR>          .vscode
09/28/2024  05:17 PM    <DIR>          3D Objects
03/21/2024  08:32 PM    <DIR>          build-tools
03/21/2024  12:13 PM    <DIR>          Contacts
07/22/2024  03:38 PM    <DIR>          Desktop
07/08/2024  03:19 PM    <DIR>          Documents
10/24/2024  03:30 PM    <DIR>          Downloads
03/21/2024  08:05 PM    <DIR>          emulator
03/21/2024  08:32 PM    <DIR>          extras
03/21/2024  12:13 PM    <DIR>          Favorites
05/06/2024  04:38 PM            80,240 java_error_in_studio64_4144.log
03/21/2024  08:05 PM    <DIR>          licenses
03/21/2024  12:13 PM    <DIR>          Links
03/21/2024  12:13 PM    <DIR>          Music
10/24/2024  09:42 AM    <DIR>          OneDrive
03/21/2024  08:32 PM    <DIR>          platform-tools
03/21/2024  08:32 PM    <DIR>          platforms
03/21/2024  12:13 PM    <DIR>          Saved Games
03/21/2024  12:15 PM    <DIR>          Searches
07/19/2024  01:20 PM    <DIR>          source
03/21/2024  08:32 PM    <DIR>          system-images
08/28/2024  03:27 PM    <DIR>          Tracing
03/21/2024  02:21 PM    <DIR>          Videos
09/14/2024  11:20 AM    <DIR>          VirtualBox VMs
               2 File(s)         80,256 bytes
              32 Dir(s)  33,607,139,328 bytes free
```

Figure 2.1.10

2.1.11. find/?

- Displays help for the find command.

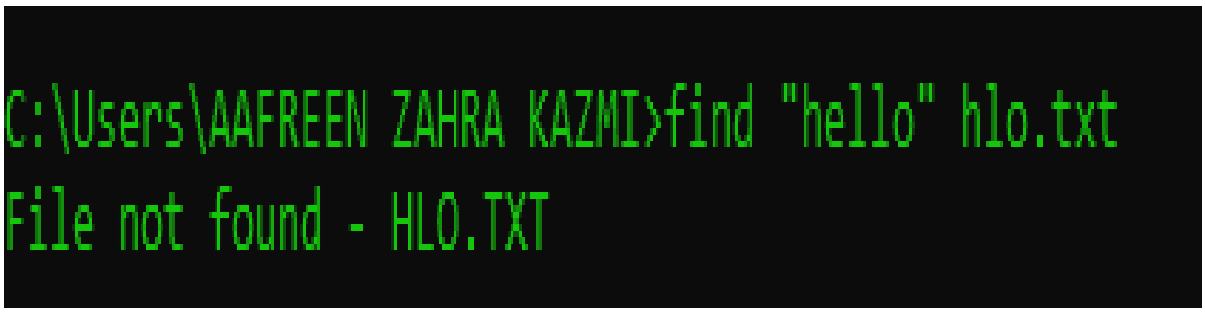


Figure 2.1.11

2.1.12. runas

- Runs a program as a different user.

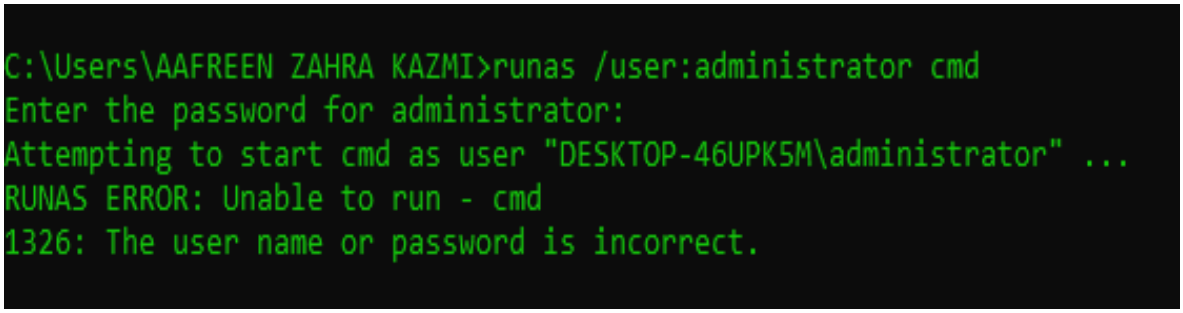


Figure 2.1.12

2.1.13. cd download

- Changes the current directory.

Figure 2.1.13

2.1.14. Sort

- Sorts the input and displays the sorted output.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>sort hlo.txt


_its_kashaf
2428aafreen#
kashaf123#
```

Figure 2.1.14

2.1.15. Taskkill

- Ends tasks or processes by process ID (PID) or image name.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>taskkill /PID 1234
ERROR: The process "1234" not found.
```

Figure 2.1.15

2.1.16. Tasklist

- Displays a list of currently running process

```
aafreen
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>tasklist

Image Name                     PID Session Name        Session#    Mem Usage
========================= ======== ================ =========== ============
System Idle Process              0 Services                   0          8 K
System                           4 Services                   0      3,040 K
Secure System                   56 Services                   0     22,768 K
Registry                       108 Services                   0     84,468 K
smss.exe                       428 Services                   0      1,020 K
csrss.exe                      672 Services                   0      4,500 K
wininit.exe                    868 Services                   0      5,876 K
csrss.exe                      876 Console                    1      5,668 K
services.exe                   948 Services                   0     10,000 K
LsaIso.exe                     968 Services                   0      3,488 K
lsass.exe                      976 Services                   0     22,312 K
svchost.exe                    616 Services                   0     33,700 K
fontdrvhost.exe                708 Services                   0      3,152 K
svchost.exe                    780 Services                   0     19,264 K
svchost.exe                    676 Services                   0      8,300 K
winlogon.exe                   800 Console                    1     11,008 K
fontdrvhost.exe               1072 Console                    1     10,068 K
svchost.exe                   1148 Services                   0      7,300 K
svchost.exe                   1160 Services                   0      5,348 K
svchost.exe                   1252 Services                   0     10,740 K
svchost.exe                   1260 Services                   0      8,200 K
svchost.exe                   1276 Services                   0     11,444 K
svchost.exe                   1304 Services                   0     10,632 K
svchost.exe                   1372 Services                   0     10,252 K
svchost.exe                   1508 Services                   0      8,232 K
svchost.exe                   1516 Services                   0     16,960 K
dwm.exe                       1612 Console                    1     65,836 K
svchost.exe                   1676 Services                   0      7,860 K
svchost.exe                   1772 Services                   0      8,368 K
svchost.exe                   1820 Services                   0     11,856 K
svchost.exe                   1852 Services                   0     10,864 K
svchost.exe                   1940 Services                   0      7,836 K
svchost.exe                   1952 Services                   0     15,440 K
svchost.exe                   2000 Services                   0     11,220 K
svchost.exe                   2072 Services                   0      5,916 K
svchost.exe                   2144 Services                   0     10,736 K
svchost.exe                   2208 Services                   0     13,200 K
svchost.exe                   2252 Services                   0      7,788 K
svchost.exe                   2280 Services                   0     18,796 K
svchost.exe                   2336 Services                   0     10,720 K
```

Figure 2.1.16

2.1.17. w32tm

- Used for configuring and monitoring Windows Time service.

```
C:\Users\AAFREEN ZAHRA KAZMI>w32tm/monitor
GetDcList failed with error code:  0x8007054B.
Exiting with error 0x8007054B
```

Figure 2.1.17

2.1.18. Start

- Starts a program or opens a new command prompt window.

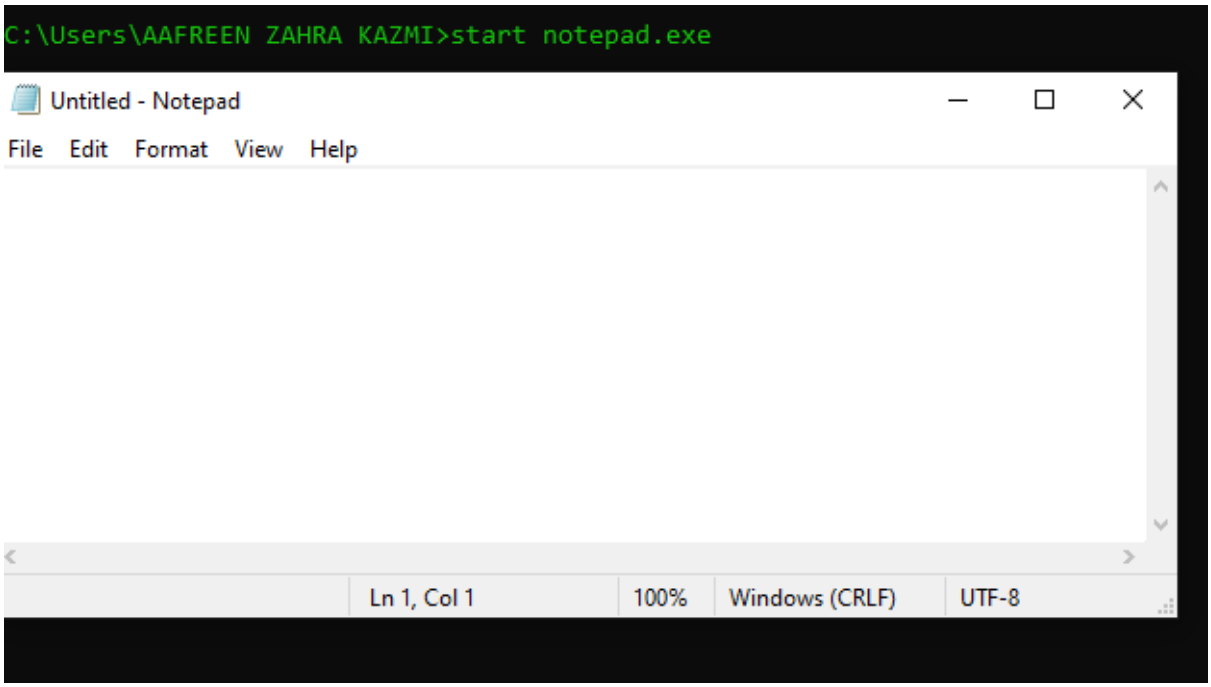


Figure 2.1.18

2.1.19. Timeout

- Pauses the command prompt for a specified amount of time.

```
C:\Users\AAFREEN ZAHRA KAZMI>timeout 20

Waiting for 15 seconds, press a key to continue ...
```

Figure 2.1.19

2.1.20. Pause

- Pauses the execution of a batch script and waits for user input.

```
C:\Users\AAFREEN ZAHRA KAZMI>pause
Press any key to continue . . .
```

Figure 2.1.20

2.1.21. Exit

- Exits the command prompt or a batch file.

Figure 2.1.21

2.1.22. shutdown

- Shuts down or restarts the computer.

```
C:\Users\AAFREEN ZAHRA KAZMI>shutdown /s /f /t 0
```

Figure 2.1.22

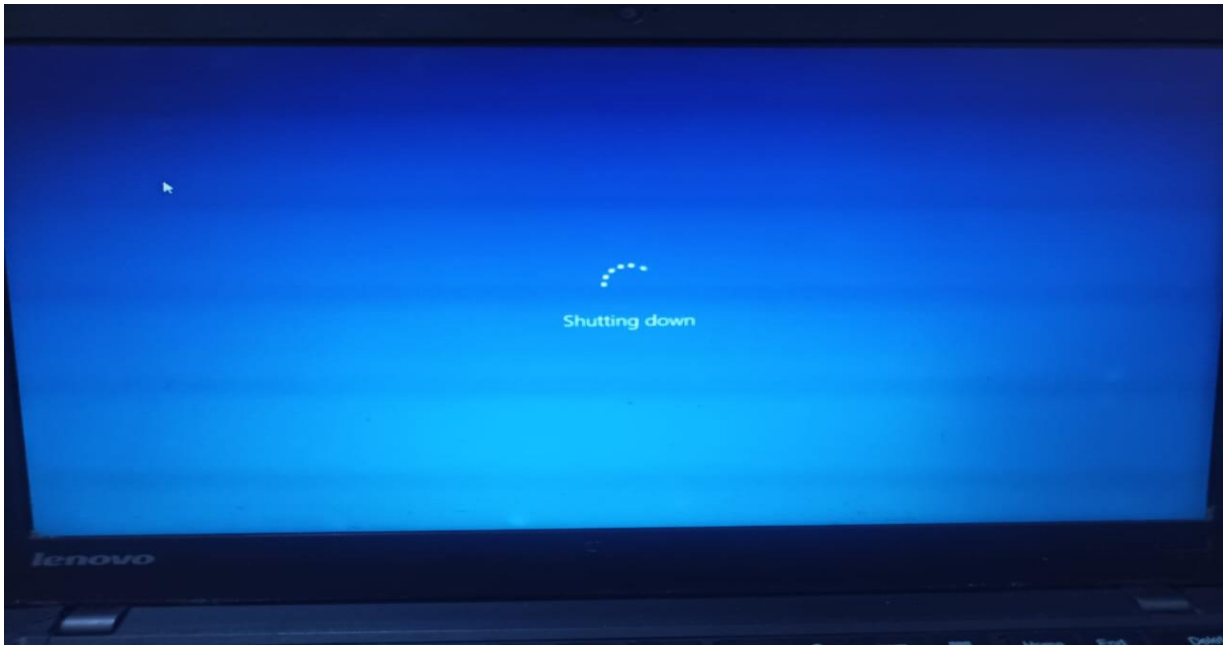


Figure 2.1.22

2.1.23. setfont

- Sets the console font.

Figure 2.1.23

2.1.24. ftp

- Transfers files to and from a remote network.

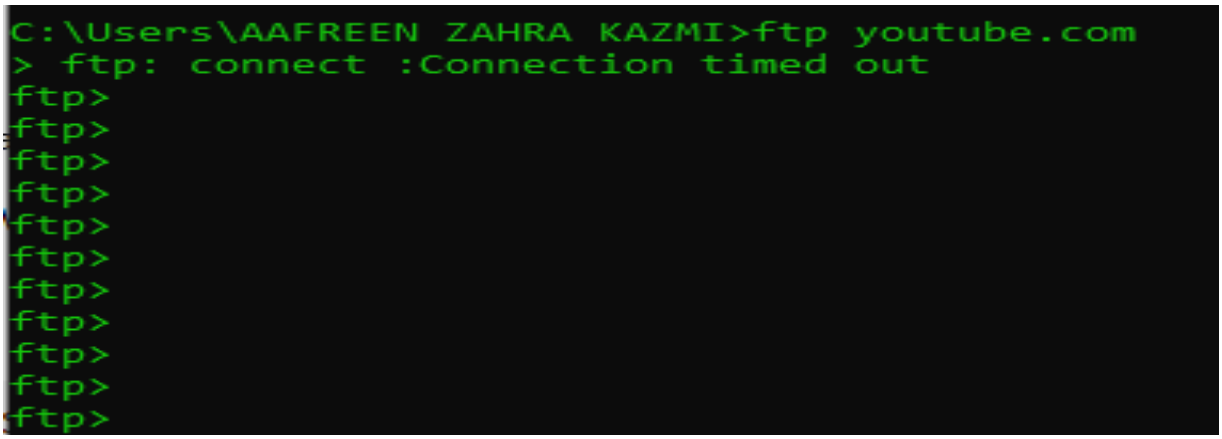


Figure 2.1.24

2.1.25. ftype

- Displays or modifies file types used in file extension associations.

Figure 2.1.25

2.1.26. getmac

- Displays the MAC address of network adapters.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>getmac

Physical Address    Transport Name
=================== ==========================================================
34-02-86-17-FE-76   \Device\Tcpip_{356A51F3-319A-42F0-A466-FB3B14307D34}
68-F7-28-7D-E3-A0   Media disconnected
34-02-86-17-FE-7A   Media disconnected
00-15-5D-3C-B0-D8   \Device\Tcpip_{C90B15F6-9655-45C5-A310-E3FA51B9420B}
0A-00-27-00-00-0E   \Device\Tcpip_{4CBD0FB5-E280-46BF-96A1-7FD651B3646C}
```

Figure 2.1.26

2.1.27. Ipconfig

- Displays the network configuration of the computer.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . : Home

Ethernet adapter Ethernet 6:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::8e17:8130:9253:2996%14
   IPv4 Address. . . . . . . . . . . : 192.168.56.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . : Home
   Link-local IPv6 Address . . . . . : fe80::b183:4753:421f:6e28%12
   IPv4 Address. . . . . . . . . . . : 192.168.10.6
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.10.1

Ethernet adapter Bluetooth Network Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```

Figure 2.1.27

2.1.28. Ping

- Tests the connection between your computer and a remote machine.

```
C:\Users\AAFREEN ZAHRA KAZMI>ping youtube.com

Pinging youtube.com [142.250.180.46] with 32 bytes of data:
Reply from 142.250.180.46: bytes=32 time=39ms TTL=56
Reply from 142.250.180.46: bytes=32 time=37ms TTL=56
Reply from 142.250.180.46: bytes=32 time=37ms TTL=56
Reply from 142.250.180.46: bytes=32 time=37ms TTL=56

Ping statistics for 142.250.180.46:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 37ms, Maximum = 39ms, Average = 37ms
```

Figure 2.1.28

2.1.29. route

- Manipulates network routing tables.

```
C:\Users\AAFREEN ZAHRA KAZMI>route print
===========================================================================
Interface List
 23...68 f7 28 7d e3 a0 ......Intel(R) Ethernet Connection (3) I218-LM
 14...0a 00 27 00 00 0e ......VirtualBox Host-Only Ethernet Adapter
 25...34 02 86 17 fe 77 ......Microsoft Wi-Fi Direct Virtual Adapter
  6...36 02 86 17 fe 76 ......Microsoft Wi-Fi Direct Virtual Adapter #2
 12...34 02 86 17 fe 76 ......Intel(R) Dual Band Wireless-AC 7265
 15...34 02 86 17 fe 7a ......Bluetooth Device (Personal Area Network)
  1...........................Software Loopback Interface 1
 59...00 15 5d 3c b0 d8 ......Hyper-V Virtual Ethernet Adapter
===========================================================================

IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0    192.168.10.1    192.168.10.6      60
        127.0.0.0        255.0.0.0         On-link         127.0.0.1     331
        127.0.0.1  255.255.255.255         On-link         127.0.0.1     331
  127.255.255.255  255.255.255.255         On-link         127.0.0.1     331
     172.22.192.0    255.255.240.0         On-link      172.22.192.1    5256
     172.22.192.1  255.255.255.255         On-link      172.22.192.1    5256
   172.22.207.255  255.255.255.255         On-link      172.22.192.1    5256
     192.168.10.0    255.255.255.0         On-link      192.168.10.6     316
     192.168.10.6  255.255.255.255         On-link      192.168.10.6     316
   192.168.10.255  255.255.255.255         On-link      192.168.10.6     316
     192.168.56.0    255.255.255.0         On-link      192.168.56.1     281
     192.168.56.1  255.255.255.255         On-link      192.168.56.1     281
   192.168.56.255  255.255.255.255         On-link      192.168.56.1     281
        224.0.0.0        240.0.0.0         On-link         127.0.0.1     331
        224.0.0.0        240.0.0.0         On-link      192.168.56.1     281
        224.0.0.0        240.0.0.0         On-link      192.168.10.6     316
        224.0.0.0        240.0.0.0         On-link      172.22.192.1    5256
  255.255.255.255  255.255.255.255         On-link         127.0.0.1     331
  255.255.255.255  255.255.255.255         On-link      192.168.56.1     281
  255.255.255.255  255.255.255.255         On-link      192.168.10.6     316
  255.255.255.255  255.255.255.255         On-link      172.22.192.1    5256
===========================================================================
Persistent Routes:
  None

IPv6 Route Table
===========================================================================
Active Routes:
 If Metric Network Destination      Gateway
  1    331 ::1/128                  On-link
 14    281 fe80::/64                On-link
 12    316 fe80::/64                On-link
 59   5256 fe80::/64                On-link
 14    281 fe80::8e17:8130:9253:2996/128
                                    On-link
 59   5256 fe80::ae88:38c2:4a7f:9798/128
                                    On-link
 12    316 fe80::b183:4753:421f:6e28/128
                                    On-link
  1    331 ff00::/8                 On-link
```

Figure 2.1.29

2.1.30. systeminfo

- Displays detailed configuration information about the computer.

```
C:\Users\AAFREEN ZAHRA KAZMI>systeminfo

Host Name:                 DESKTOP-46UPK5M
OS Name:                   Microsoft Windows 10 Pro
OS Version:                10.0.19045 N/A Build 19045
OS Manufacturer:           Microsoft Corporation
OS Configuration:          Standalone Workstation
OS Build Type:             Multiprocessor Free
Registered Owner:          AAFREEN ZAHRA KAZMI
Registered Organization:
Product ID:                00330-50000-00000-AAOEM
Original Install Date:     3/21/2024, 4:54:07 PM
System Boot Time:          10/26/2024, 10:10:31 AM
System Manufacturer:       LENOVO
System Model:              20CLS2KS0S
System Type:               x64-based PC
Processor(s):              1 Processor(s) Installed.
                           [01]: Intel64 Family 6 Model 61 Stepping 4 GenuineIntel ~2295 Mhz
BIOS Version:              LENOVO N10ET50W (1.29 ), 2/26/2018
Windows Directory:         C:\Windows
System Directory:          C:\Windows\system32
Boot Device:               \Device\HarddiskVolume1
System Locale:             en-gb;English (United Kingdom)
Input Locale:              en-us;English (United States)
Time Zone:                 (UTC+05:00) Islamabad, Karachi
Total Physical Memory:     8,071 MB
Available Physical Memory: 3,403 MB
Virtual Memory: Max Size:  9,351 MB
Virtual Memory: Available: 4,957 MB
Virtual Memory: In Use:    4,394 MB
Page File Location(s):     C:\pagefile.sys
Domain:                    WORKGROUP
Logon Server:              \\DESKTOP-46UPK5M
Hotfix(s):                 21 Hotfix(s) Installed.
                           [01]: KB5044029
                           [02]: KB5034468
                           [03]: KB4537759
                           [04]: KB4557968
                           [05]: KB4577586
                           [06]: KB5006120
                           [07]: KB5007115
                           [08]: KB5011048
                           [09]: KB5015684
                           [10]: KB5033052
```

Figure 2.1.30

2.1.31. netstat

- Displays network statistics and active connections.

```
C:\Users\AAFREEN ZAHRA KAZMI>netstat -a

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    0.0.0.0:135            DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:445            DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:2179           DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:5040           DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:5357           DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:7680           DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:49664          DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:49665          DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:49666          DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:49667          DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:49668          DESKTOP-46UPK5M:0      LISTENING
  TCP    0.0.0.0:53855          DESKTOP-46UPK5M:0      LISTENING
  TCP    172.22.192.1:139       DESKTOP-46UPK5M:0      LISTENING
  TCP    192.168.10.6:139       DESKTOP-46UPK5M:0      LISTENING
  TCP    192.168.10.6:51325     20.198.119.143:https   ESTABLISHED
```

Figure 2.1.31

2.1.32. telnet

- Connects to remote computers using the Telnet protocol.

```
C:\Users\AAFREEN ZAHRA KAZMI>telnet <DEXTOP-46UPK5M> [1234]
The system cannot find the file specified.
```

Figure 2.1.32

2.1.33. netview

- Displays a list of computers on the network.

```
C:\Users\AAFREEN ZAHRA KAZMI>net view
System error 6118 has occurred.

The list of servers for this workgroup is not currently available
```

Figure 2.1.33

2.1.34. Arp

- Displays or modifies the ARP (Address Resolution Protocol) cache.

```
C:\Users\AAFREEN ZAHRA KAZMI>arp -a

Interface: 192.168.10.6 --- 0xc
  Internet Address      Physical Address      Type
  192.168.10.1          40-9b-cd-6f-25-25     dynamic
  192.168.10.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.56.1 --- 0xe
  Internet Address      Physical Address      Type
  192.168.56.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 172.22.192.1 --- 0x3b
  Internet Address      Physical Address      Type
  172.22.207.255        ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Figure 2.1.34

2.1.35. nslookup

- Queries the DNS to find IP addresses associated with a domain or vice versa.

```
C:\Users\AAFREEN ZAHRA KAZMI>nslookup
Default Server:  Broadcom.Home
Address:  192.168.10.1
```

Figure 2.1.35

2.1.36. echo

- Displays messages or turns command echoing on/off.

```
C:\Users\AAFREEN ZAHRA KAZMI>echo Hello, World!
Hello, World!
```

Figure 2.1.36

2.1.37. attrib

- Displays or changes file attributes.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>attrib +r aafreen.txt
```

Figure 2.1.37

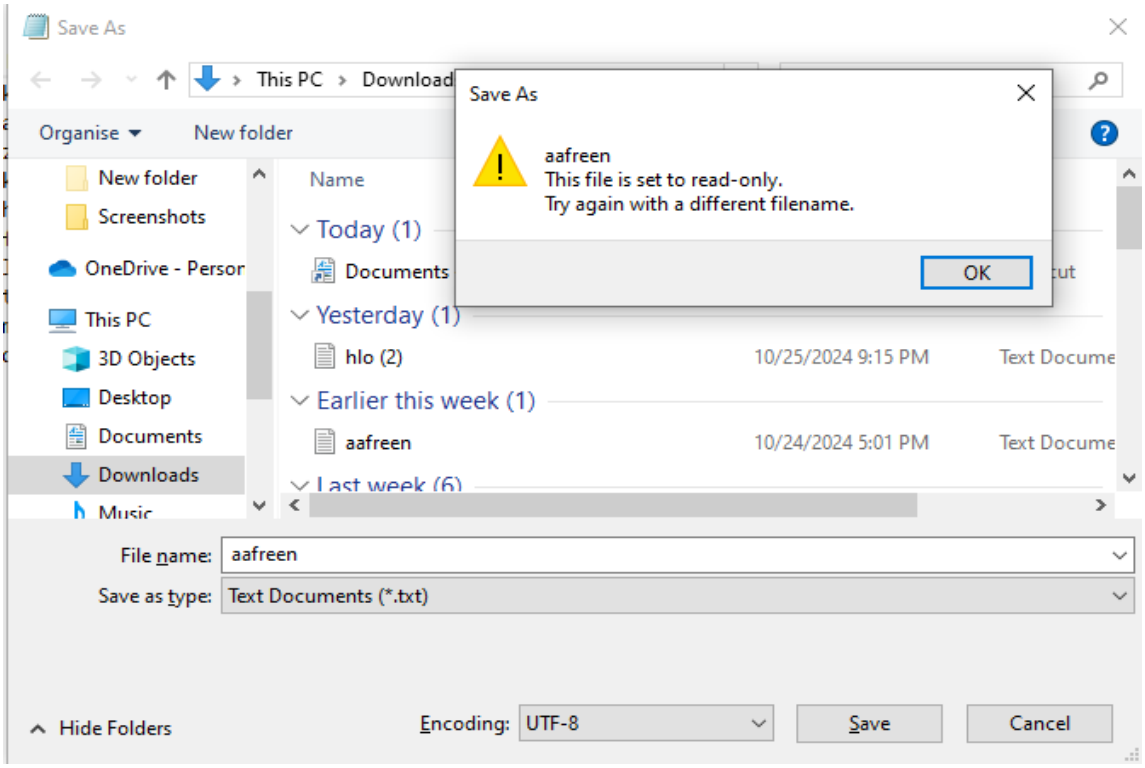


Figure 2.1.37

2.1.38. compact

- Displays or alters the compression of files on NTFS partitions.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>compact /c aafreen.txt

 Compressing files in C:\Users\AAFREEN ZAHRA KAZMI\Downloads\

aafreen.txt                72 :        72 = 1.0 to 1 [OK]

1 files within 1 directories were compressed.
72 total bytes of data are stored in 72 bytes.
The compression ratio is 1.0 to 1.
```

Figure 2.1.38

2.1.39. copy

- Copies files from one location to another.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>copy aafreen.txt D:\aafreen\
        1 file(s) copied.
```

Figure 2.1.39

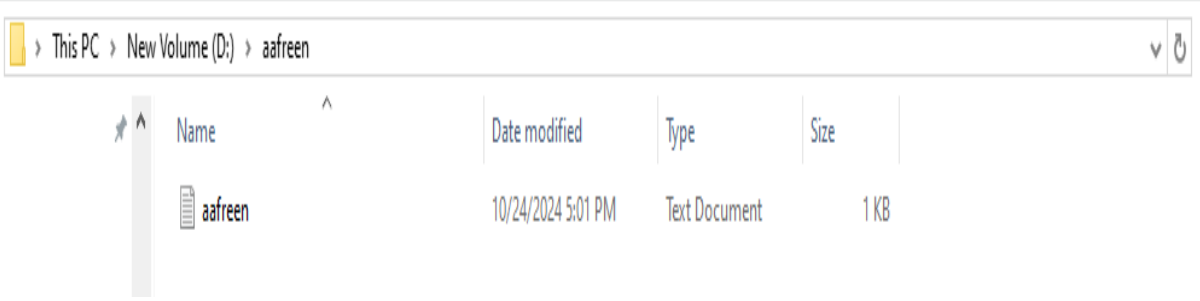


Figure 2.1.39

2.1.40. mkdir (or md)

- Creates a new directory. `

Figure 2.1.40

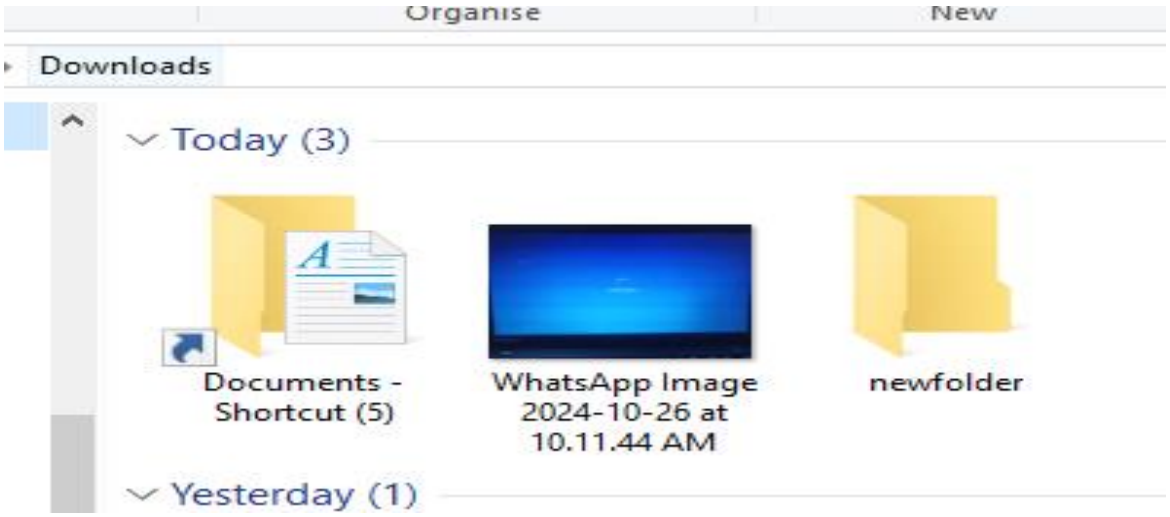


Figure 2.1.40

2.1.41. rename (or ren)

- Renames a file or directory.

Before execution

Figure 2.1.41

After execution

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>rename aafreen.txt fatima.txt
```

Figure 2.1.41

Figure 2.1.41

2.1.42. rmdir (or rd)

- Removes a directory.

Before execution

Figure 2.1.42

After execution

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>rmdir newfolder
```

Figure 2.1.42

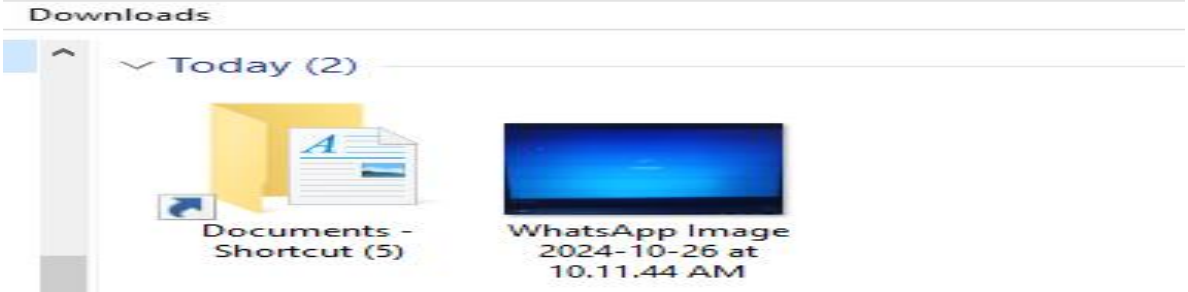


Figure 2.1.42

2.1.43. tree

- Displays a graphical representation of the directory structure.

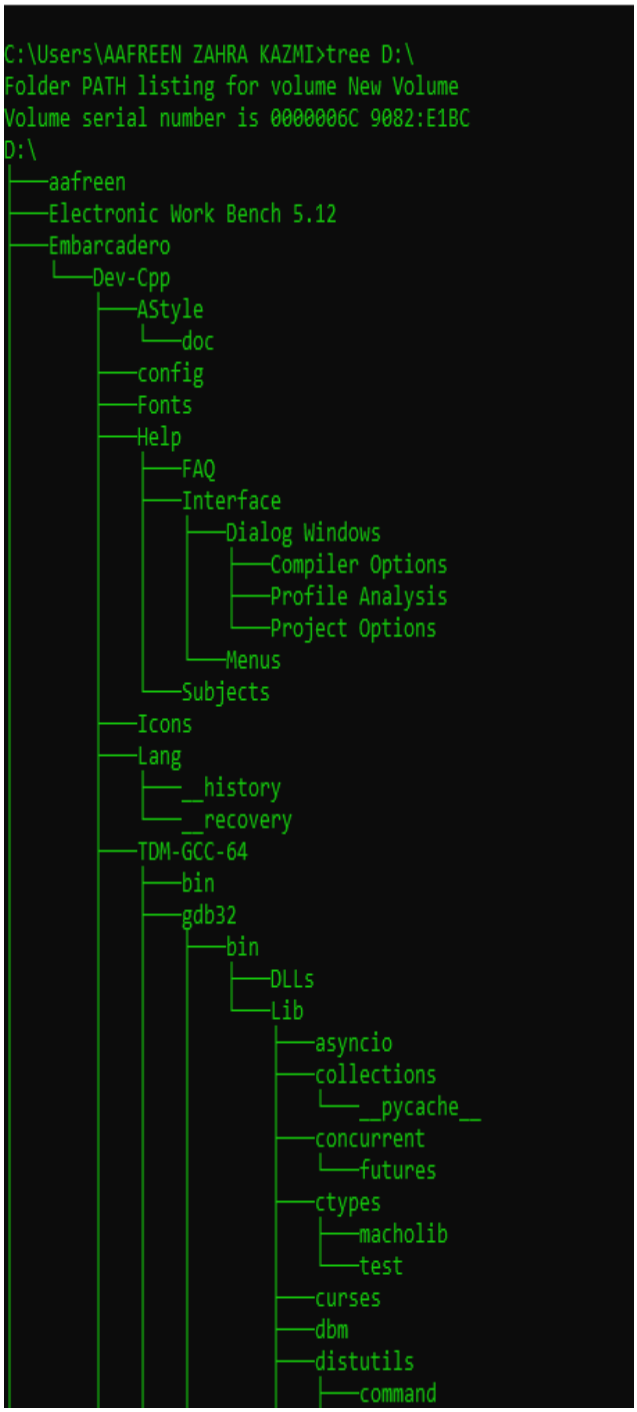


Figure 2.1.43

Figure 2.1.43

2.1.44. type

- Displays the contents of a text file.

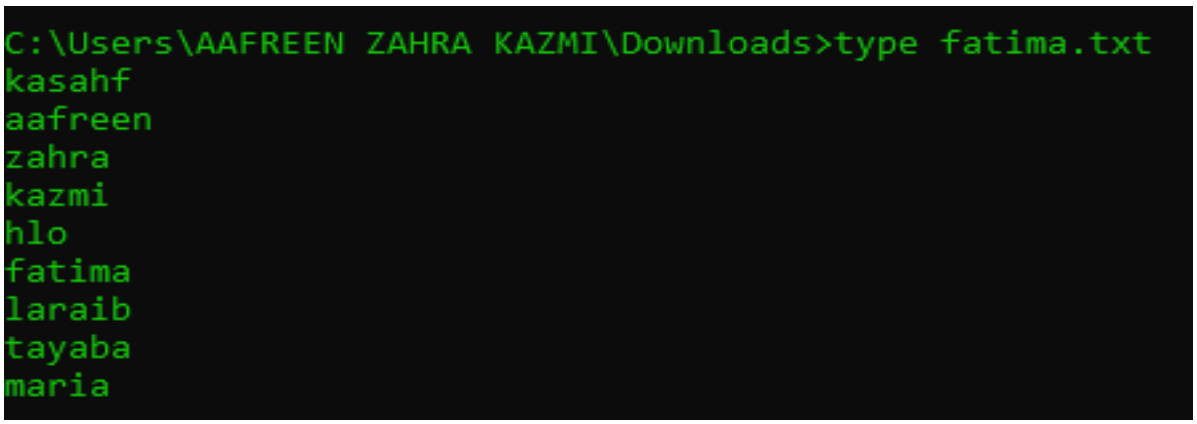


Figure 2.1.44

2.1.45. chkdsk

- Checks the file system and file system metadata of a volume for logical and physical errors.

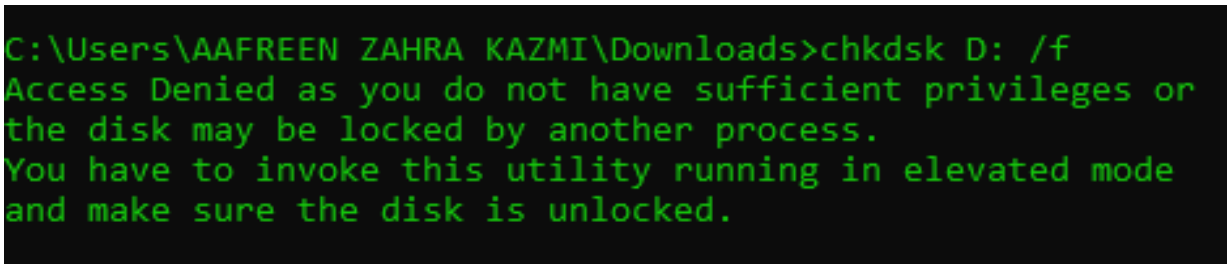


Figure 2.1.45

2.1.46. chkntfs

- Displays or modifies the automatic disk checking at startup.

Figure 2.1.46

2.1.47. defrag

- Locates and consolidates fragmented files on local volumes to improve system performance.

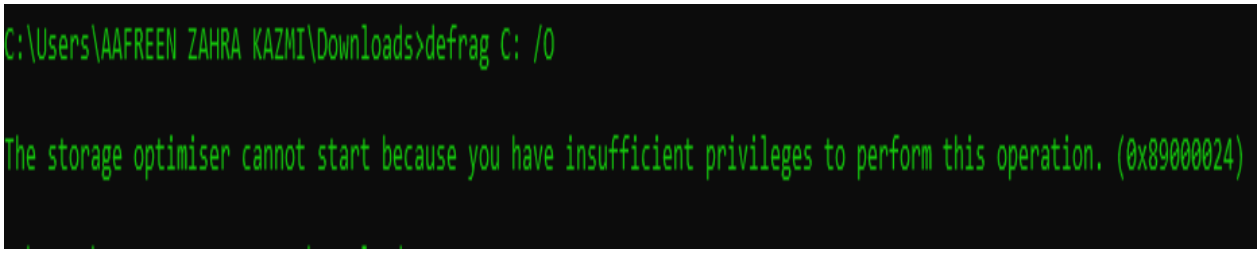


Figure 2.1.47

2.1.48. diskpart

- A command-line disk partitioning utility.

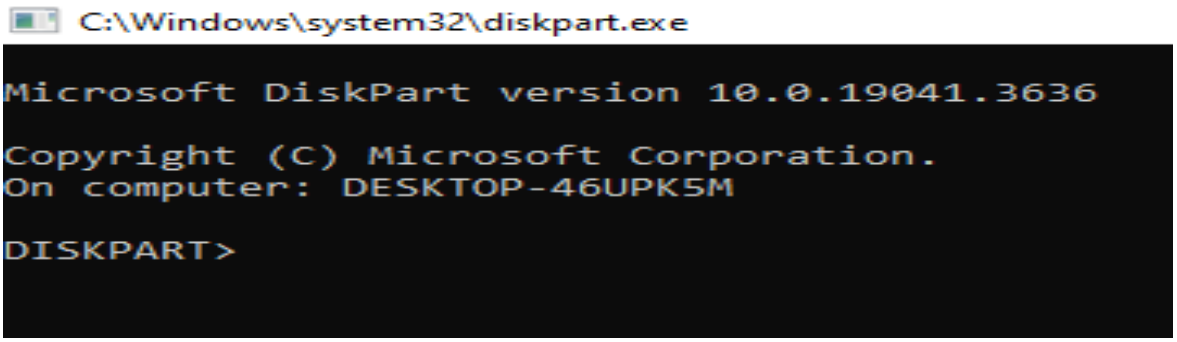


Figure 2.1.48

2.1.49. format

- Formats a disk for use with Windows.

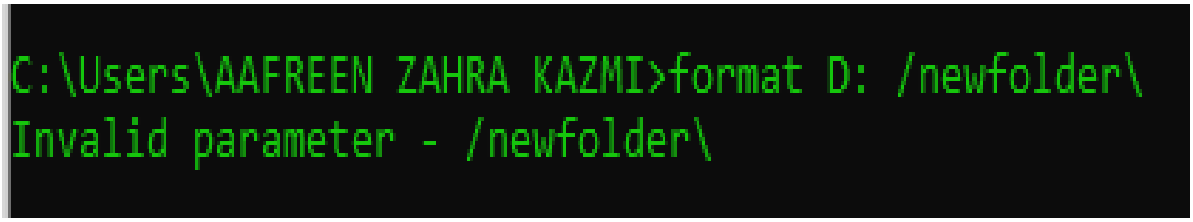


Figure 2.1.49

2.1.50. label

- Creates, changes, or deletes the volume label of a disk.

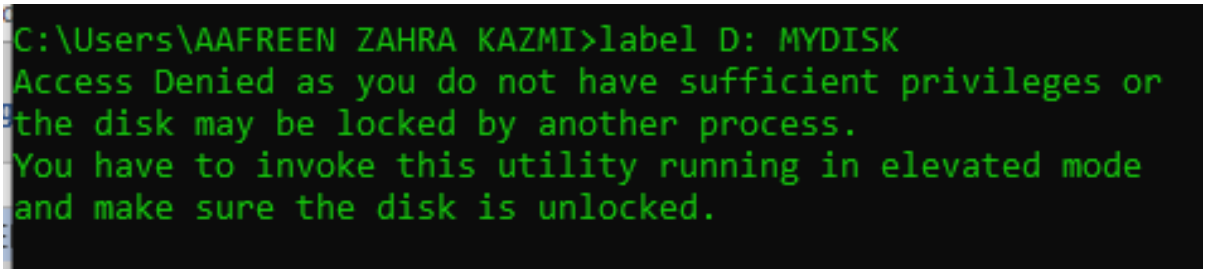


Figure 2.1.50

2.1.51. mode

- Configures system devices.

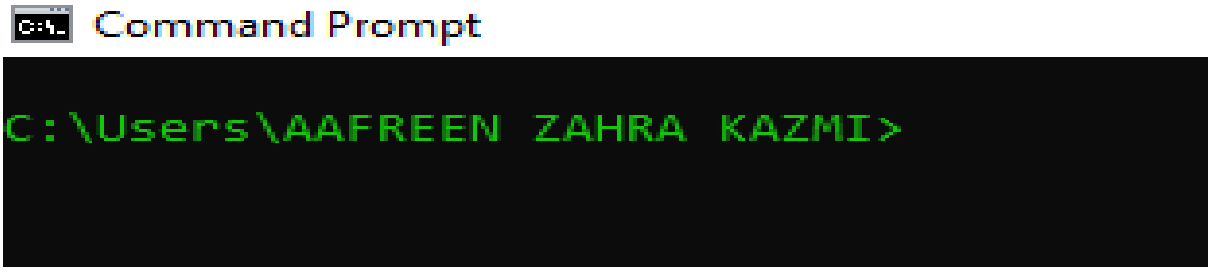


Figure 2.1.51

2.1.52. mountvol

- Creates, deletes, or lists a volume mount point.

Figure 2.1.52

2.1.53. verify

- Tells Windows whether to verify that your files are written correctly to a disk.

Figure 2.1.53

2.1.54. vol

- Displays the disk volume label and serial number, if they exist.

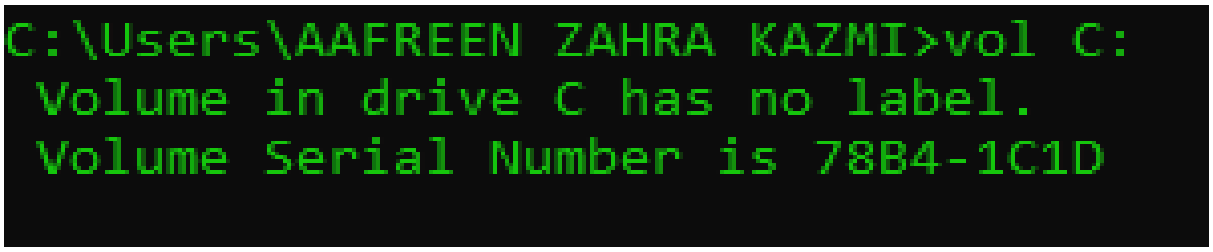


Figure 2.1.54

2.1.55. for

- Runs a specified command for each file in a set of files.

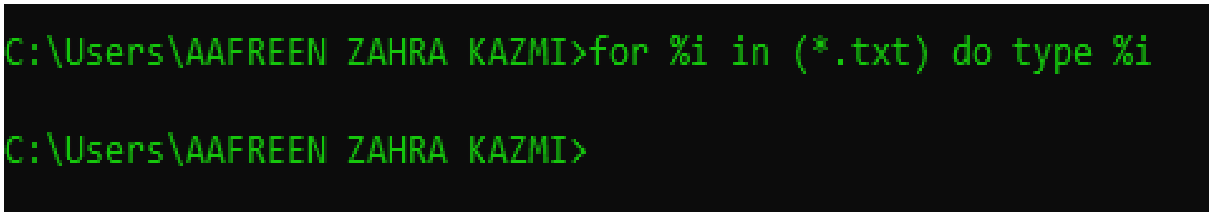


Figure 2.1.55

2.1.56. gpupdate

- Refreshes local and Active Directory-based Group Policy settings, including security settings.

```
C:\Users\AAFREEN ZAHRA KAZMI>gpupdate /force
Updating policy...

Computer Policy update has completed successfully.
```

Figure 2.1.56

2.1.57. gpresult

- Displays the Resultant Set of Policy (RSoP) information for a remote user and computer.

Displays RSoP summary data

```
Command Prompt
OS Configuration:              Standalone Workstation
OS Version:                    10.0.19045
Site Name:                     N/A
Roaming Profile:               N/A
Local Profile:                 C:\Users\AAFREEN ZAHRA KAZMI
Connected over a slow link?:   No

USER SETTINGS
--------------

    Last time Group Policy was applied:  10/26/2024 at 12:12:41 PM
    Group Policy was applied from:       N/A
    Group Policy slow link threshold:    500 kbps
    Domain Name:                         DESKTOP-46UPK5M
    Domain Type:                         <Local Computer>

    Applied Group Policy Objects
    -----------------------------
        N/A

    The following GPOs were not applied because they were filtered out
    -------------------------------------------------------------------
        Local Group Policy
            Filtering:  Not Applied (Empty)

    The user is a part of the following security groups
    ---------------------------------------------------
        High Mandatory Level
        Everyone
        Local account and member of Administrators group
        BUILTIN\Administrators
        Performance Log Users
        BUILTIN\Users
        NT AUTHORITY\INTERACTIVE
        CONSOLE LOGON
        NT AUTHORITY\Authenticated Users
        This Organization
        aafreenzk1214@gmail.com
        Local account
        LOCAL
        Cloud Account Authentication
```

Figure 2.1.57

Generates a report in HTML format

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>gpresult /h report.html
```

Figure 2.1.57

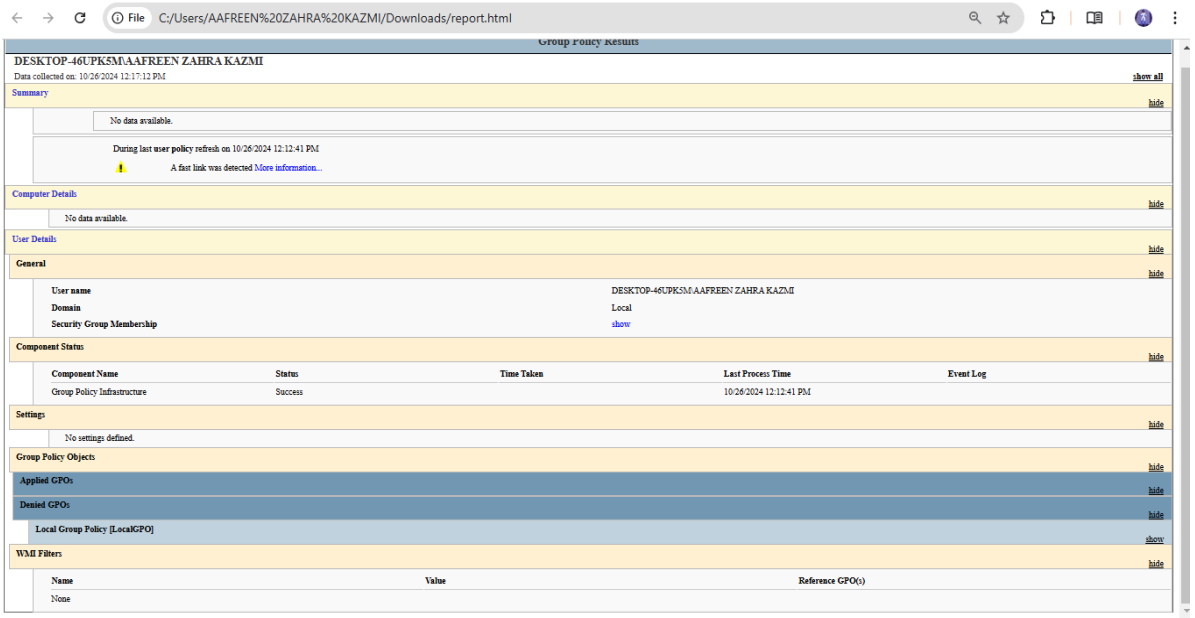


Figure 2.1.57

2.1.58. prompt

- Changes the command prompt.

```
C:\Users\AAFREEN ZAHRA KAZMI>prompt

C:\Users\AAFREEN ZAHRA KAZMI>prompt $P$G

C:\Users\AAFREEN ZAHRA KAZMI>
```

Figure 2.1.58

2.1.59. tracert

- Traces the route that packets take to reach a network host.

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads>tracert google.com

Tracing route to google.com [192.178.24.142]
over a maximum of 30 hops:

  1     2 ms     1 ms    10 ms  Broadcom.Home [192.168.10.1]
  2     7 ms     5 ms     5 ms  172.16.0.1
  3     6 ms    14 ms    32 ms  10.174.4.49
  4    29 ms     5 ms     6 ms  172.29.254.5
  5     5 ms     9 ms     7 ms  119.63.137.50
  6    34 ms    26 ms    25 ms  110.93.253.110
  7    27 ms    33 ms    25 ms  110.93.254.40
  8    43 ms    43 ms    43 ms  72.14.204.14
  9    46 ms    37 ms    38 ms  192.178.105.155
 10    63 ms    39 ms    39 ms  192.178.87.253
 11    39 ms     *       39 ms  google.com [192.178.24.142]

Trace complete.
```

Figure 2.1.59

WEEK # 2

3. UBUNTU

Ubuntu is a popular open-source Linux distribution based on Debian, known for its ease of use and robust performance. It features a user-friendly interface, regular updates, and a vast repository of software. Ubuntu is widely used for personal computers, servers, and cloud environments. It emphasizes security, with frequent updates and a strong focus on user privacy.

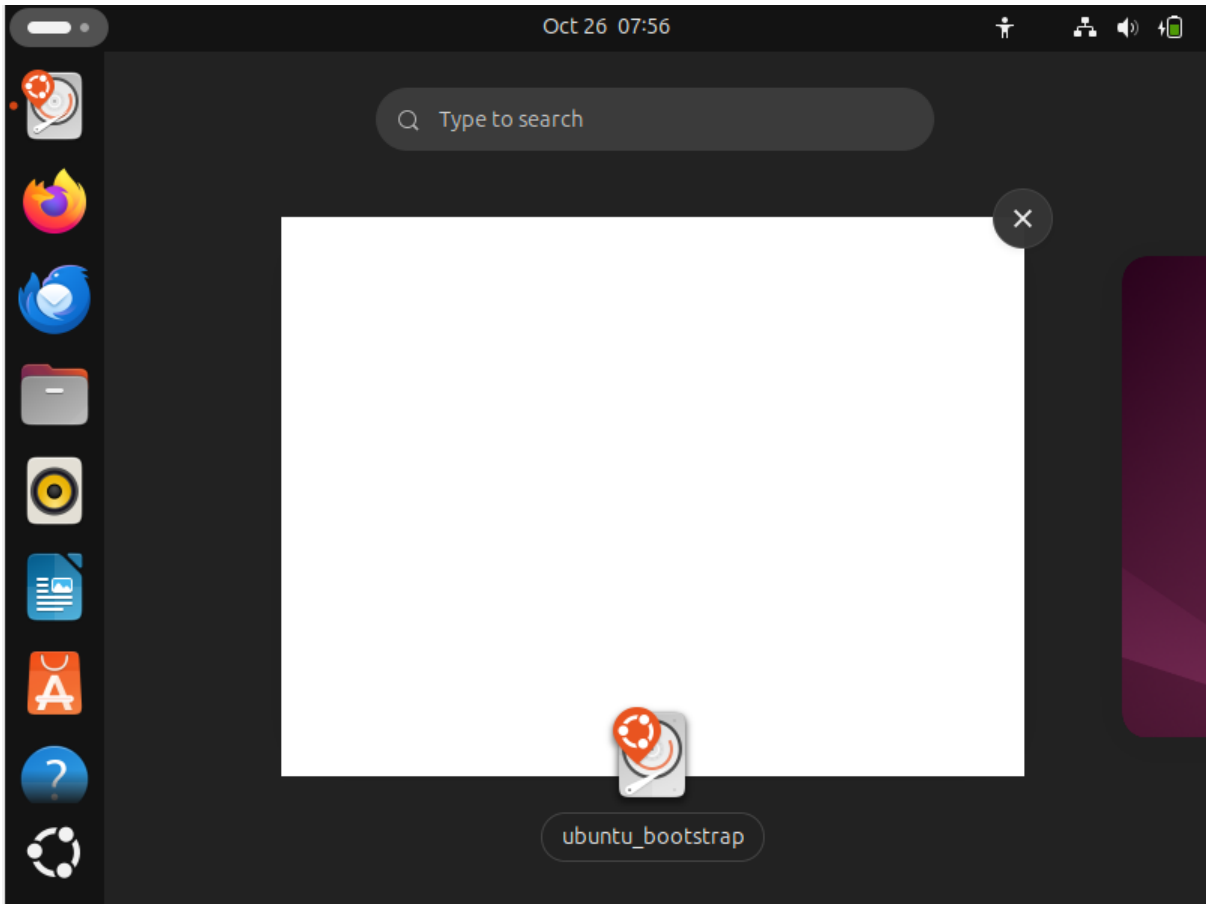


Figure 3

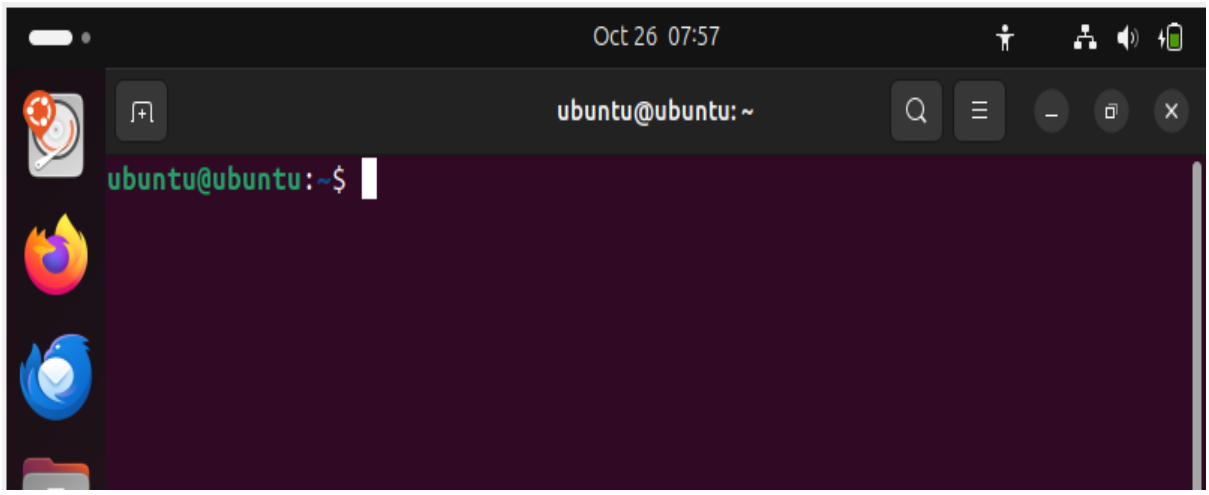


Figure 3

3.1. Files Command

3.1.1. ls

- Lists directory contents.

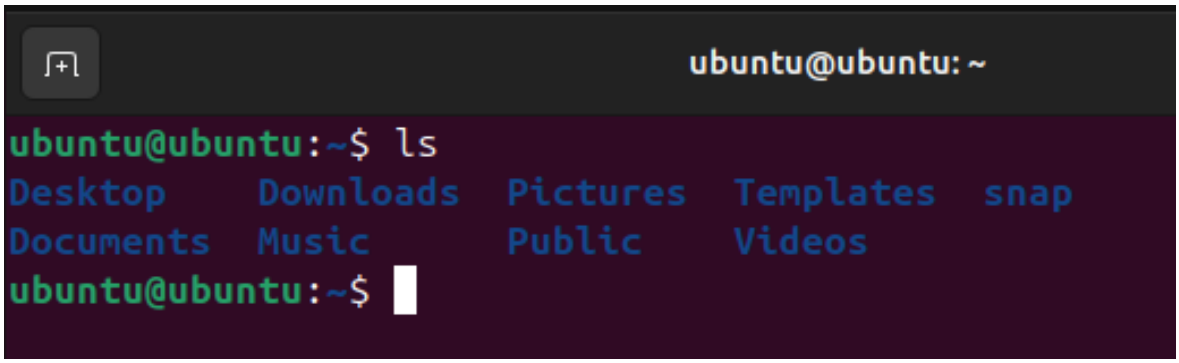


Figure 3.1.1

3.1.2. mkdir

- Creates a new directory.

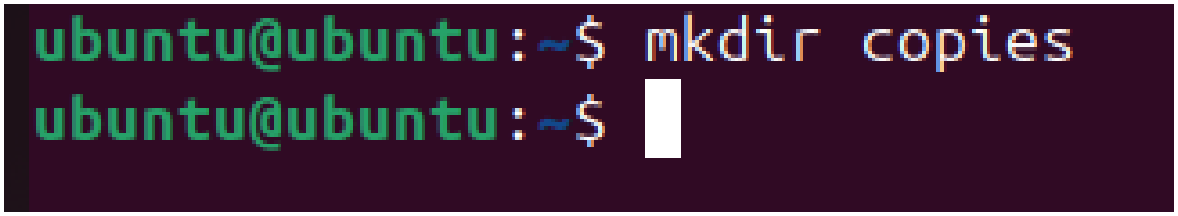


Figure 3.1.2

Figure 3.1.2

3.1.3. rmdir

- Removes empty directories.

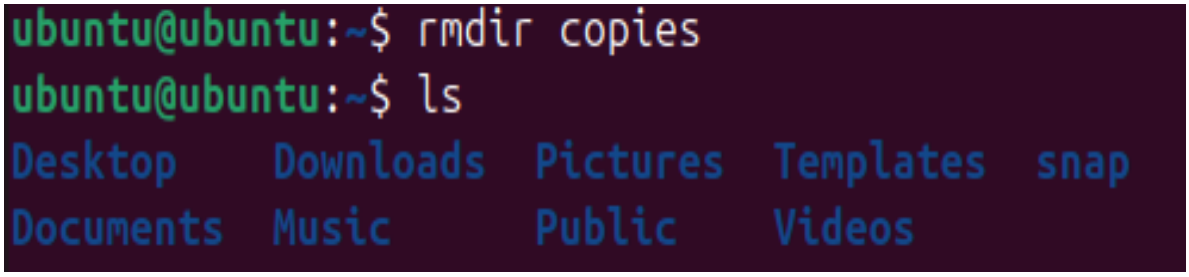


Figure 3.1.3

3.1.4. cd

- Changes the current directory.

Figure 3.1.4

3.1.5. sudo -i

- Opens a new shell with root privileges.

Figure 3.1.5

3.1.6. sudo apt install ncal

- Installs the ncal package using APT (Advanced Package Tool).

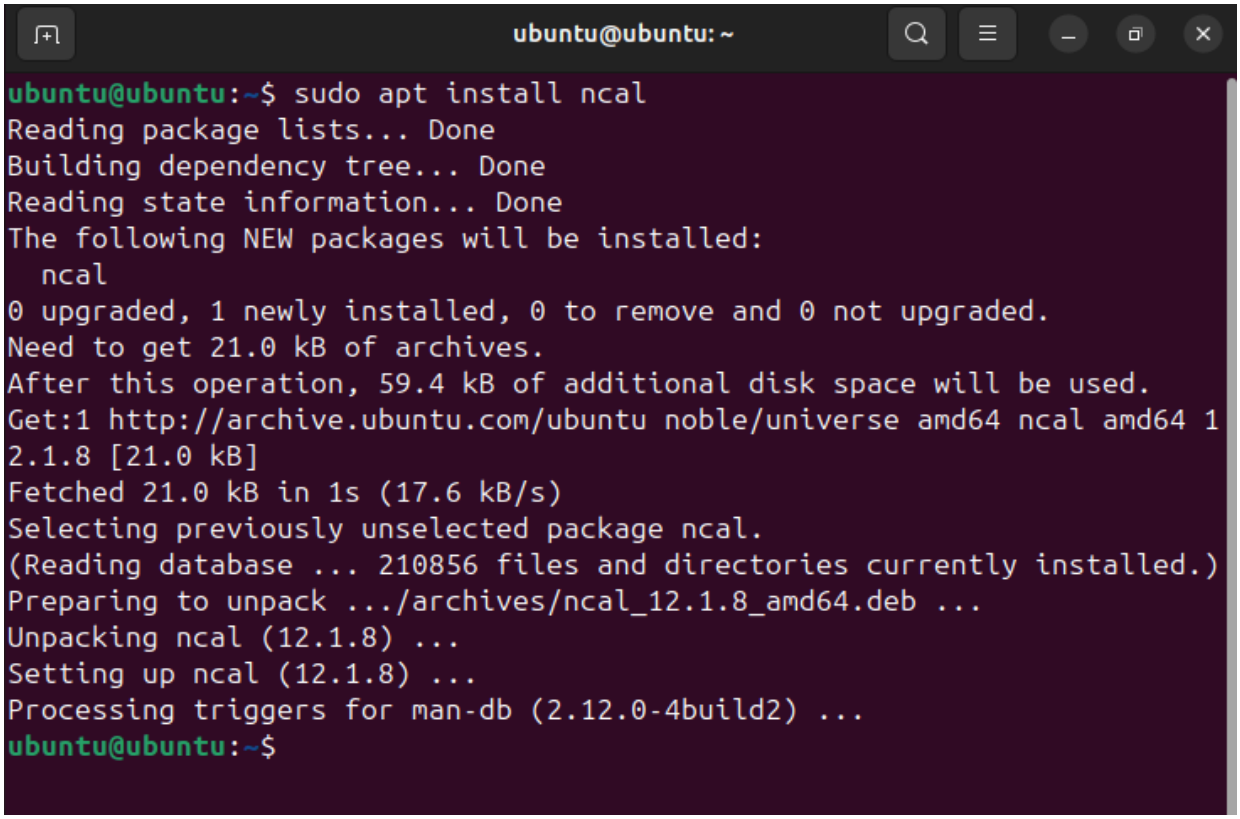


Figure 3.1.6

3.1.7. cal

- Displays a calendar.

Current month

```
ubuntu@ubuntu:~$ cal
      October 2024
Su Mo Tu We Th Fr Sa
       1  2  3  4  5
 6  7  8  9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31
```

Figure 3.1.7

Calendar for the year 2004

```
ubuntu@ubuntu:~$ cal 2004
                              2004

      January               February                March
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
                 1  2  3   1  2  3  4  5  6  7      1  2  3  4  5  6
 4  5  6  7  8  9 10   8  9 10 11 12 13 14   7  8  9 10 11 12 13
11 12 13 14 15 16 17  15 16 17 18 19 20 21  14 15 16 17 18 19 20
18 19 20 21 22 23 24  22 23 24 25 26 27 28  21 22 23 24 25 26 27
25 26 27 28 29 30 31  29                    28 29 30 31


      April                 May                   June
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
                 1  2  3                   1         1  2  3  4  5
 4  5  6  7  8  9 10   2  3  4  5  6  7  8   6  7  8  9 10 11 12
11 12 13 14 15 16 17   9 10 11 12 13 14 15  13 14 15 16 17 18 19
18 19 20 21 22 23 24  16 17 18 19 20 21 22  20 21 22 23 24 25 26
25 26 27 28 29 30     23 24 25 26 27 28 29  27 28 29 30
                      30 31


       July                  August              September
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
                 1  2  3   1  2  3  4  5  6  7            1  2  3  4
```

Figure 3.1.7

Calendar for any month 2004

```
ubuntu@ubuntu:~$ cal april 2004
      April 2004
Su Mo Tu We Th Fr Sa
                1  2  3
 4  5  6  7  8  9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30
```

Figure 3.1.7

Previous, current, and next month

```
ubuntu@ubuntu:~$ cal -3
   September 2024         October 2024          November 2024
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
 1  2  3  4  5  6  7         1  2  3  4  5                  1  2
 8  9 10 11 12 13 14   6  7  8  9 10 11 12   3  4  5  6  7  8  9
15 16 17 18 19 20 21  13 14 15 16 17 18 19  10 11 12 13 14 15 16
22 23 24 25 26 27 28  20 21 22 23 24 25 26  17 18 19 20 21 22 23
29 30                 27 28 29 30 31        24 25 26 27 28 29 30
```

Figure 3.1.7

Calendar for the year 2004

```
ubuntu@ubuntu:~$ cal -y 2004
                              2004

      January               February                March
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
             1  2  3   1  2  3  4  5  6  7      1  2  3  4  5  6
 4  5  6  7  8  9 10   8  9 10 11 12 13 14   7  8  9 10 11 12 13
11 12 13 14 15 16 17  15 16 17 18 19 20 21  14 15 16 17 18 19 20
18 19 20 21 22 23 24  22 23 24 25 26 27 28  21 22 23 24 25 26 27
25 26 27 28 29 30 31  29                    28 29 30 31


       April                  May                   June
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
             1  2  3                     1            1  2  3  4  5
 4  5  6  7  8  9 10   2  3  4  5  6  7  8   6  7  8  9 10 11 12
11 12 13 14 15 16 17   9 10 11 12 13 14 15  13 14 15 16 17 18 19
18 19 20 21 22 23 24  16 17 18 19 20 21 22  20 21 22 23 24 25 26
25 26 27 28 29 30     23 24 25 26 27 28 29  27 28 29 30
                      30 31


        July                  August               September
Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
             1  2  3   1  2  3  4  5  6  7            1  2  3  4
 4  5  6  7  8  9 10   8  9 10 11 12 13 14   5  6  7  8  9 10 11
```

Figure 3.1.7

3.1.8. clear

- Clears the terminal screen.

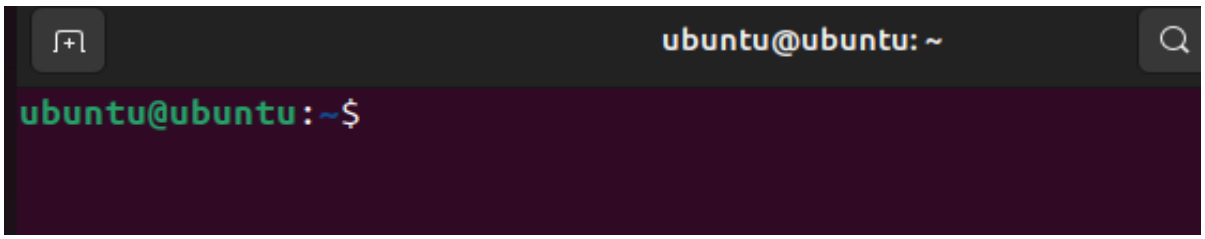


Figure 3.1.8

3.1.9. ncal -M

- Displays the current month with highlighted current date

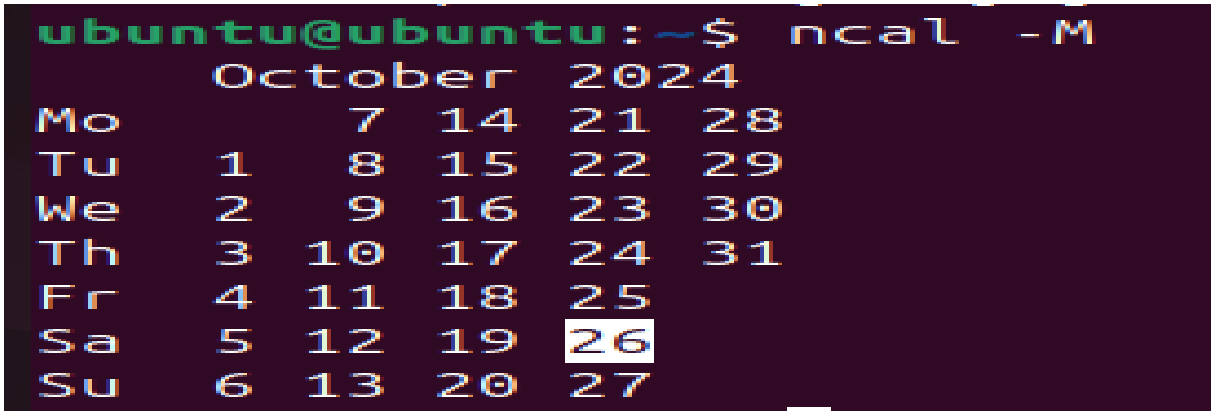


Figure 3.1.9

3.1.10. cal 9 1752

- Displays the calendar for September 1752 (special case in the Gregorian calendar).

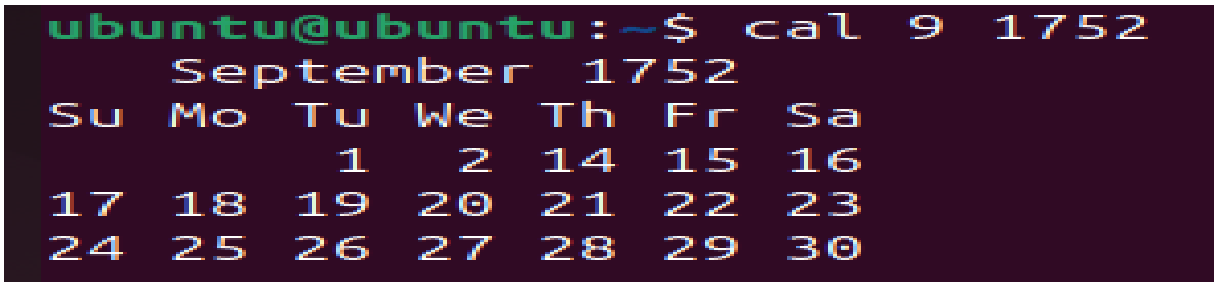


Figure 3.1.10

3.1.11. time

- Displays the current time.

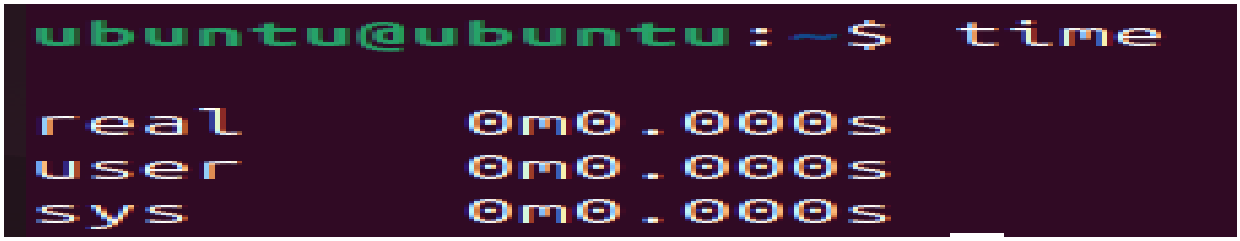


Figure 3.1.11

3.1.12. date

- Displays or sets the system date and time.

Figure 3.1.12

3.1.13. hostname

- Displays or sets the system's hostname.

Figure 3.1.13

3.1.14. sudo snap install chromium

- Installs the Chromium web browser using Snap.

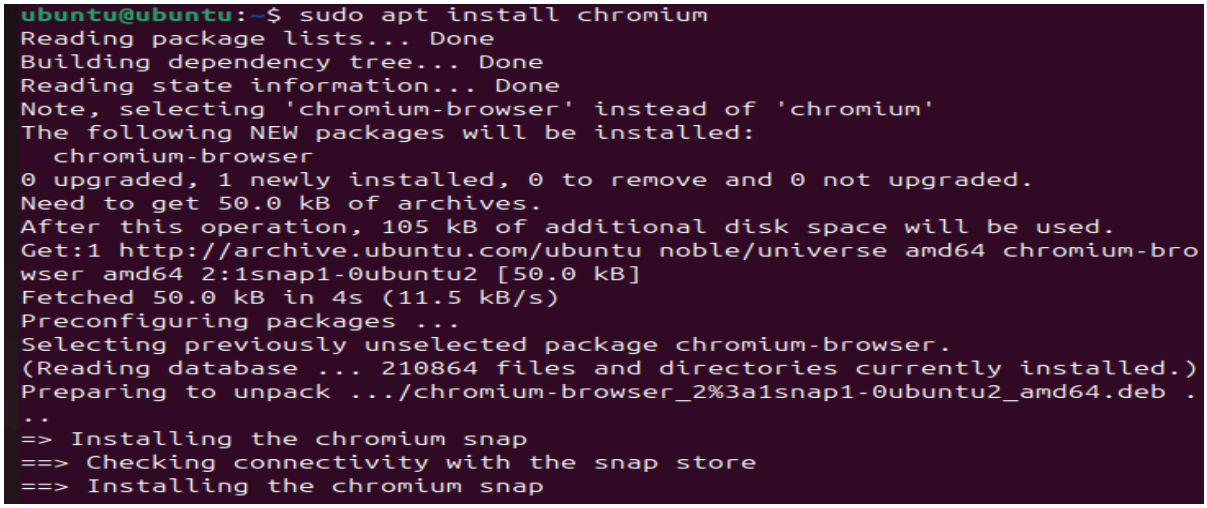


Figure 3.1.14

3.1.15. who

- Shows who is logged on.

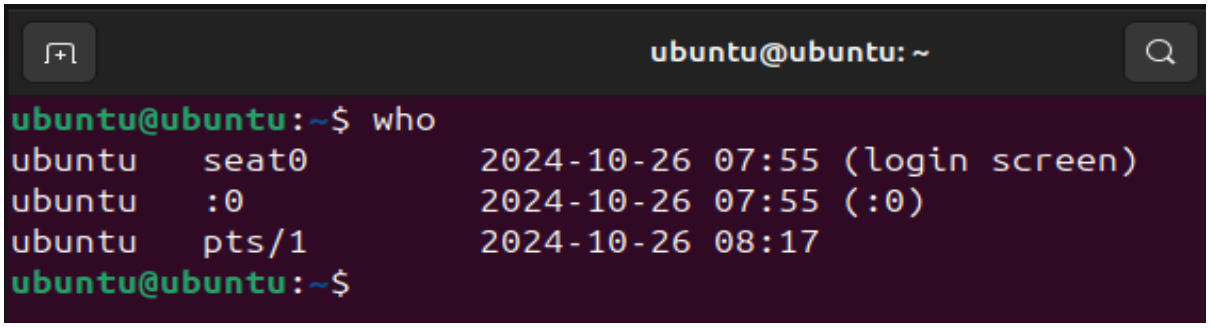


Figure 3.1.15

3.1.16. History

- Displays the command history.

Figure 3.1.16

3.1.17. sudo snap install vlc

- Installs the VLC media player using Snap.

Figure 3.1.17

3.1.18. cd /

- Changes to the root directory.

```
ubuntu@ubuntu:~$ cd /
ubuntu@ubuntu:/$
```

Figure 3.1.18

3.1.19. cat >> bar.txt

- Appends text to bar.txt file (press Ctrl+D to save and exit).

```
ubuntu@ubuntu:~$ sudo sh -c "cat >> bar.txt"
this is aafreen
ubuntu@ubuntu:~$ ls
Desktop    Downloads  Pictures  Templates  aafreen  snap
Documents  Music      Public    Videos     bar.txt
```

Figure 3.1.19

3.1.20. Permissions to make a file readable,writeable ,executable

- Symbolic Notation

  - r - read
  - w - write
  - x - execute
  - u - user (owner)
  - g - group
  - o - others
  - a - all (user, group, others)

Readable

```
ubuntu@ubuntu:~$ chmod a=r aafreen.txt
ubuntu@ubuntu:~$
```

Figure 3.1.20

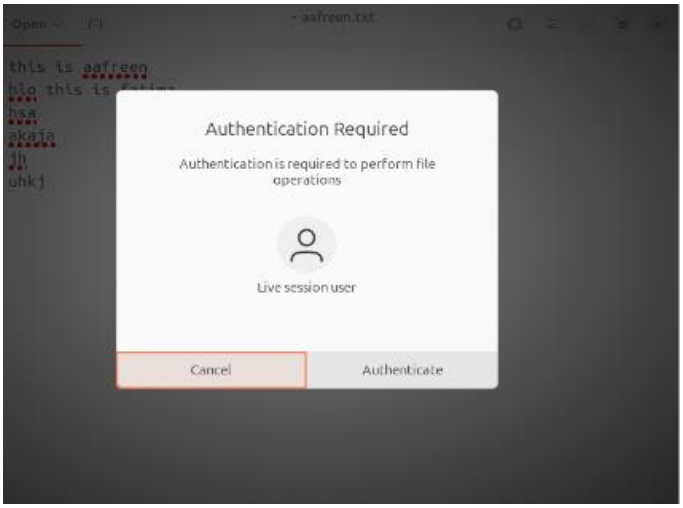


Figure 3.1.20

Writeable

```
ubuntu@ubuntu:~$ chmod a=w aafreen.txt
ubuntu@ubuntu:~$
```

Figure 3.1.20

Figure 3.1.20

Executable

```
ubuntu@ubuntu:~$ chmod a=x aafreen.txt
ubuntu@ubuntu:~$
```

Figure 3.1.20

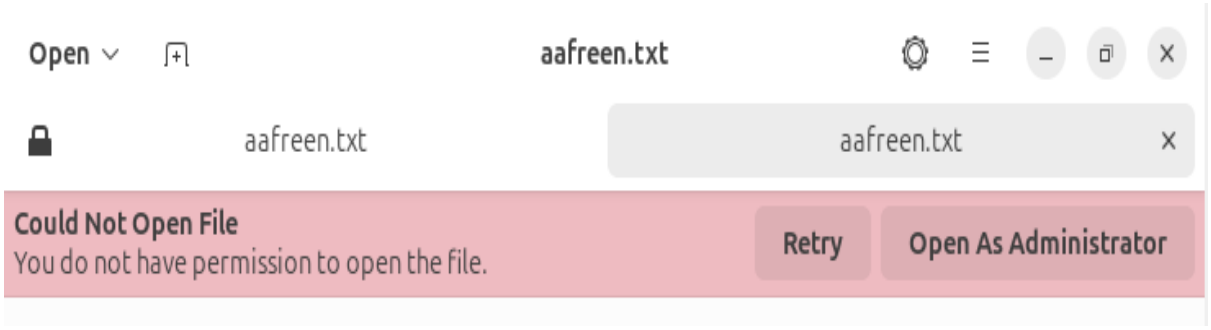


Figure 3.1.20

3.1.21. File

- Determines the type of a file

```
ubuntu@ubuntu:~$ file aafreen.txt
aafreen.txt: executable, regular file, no read permission
```

Figure 3.1.21

3.1.22. Head

- Outputs the first few lines of a file.

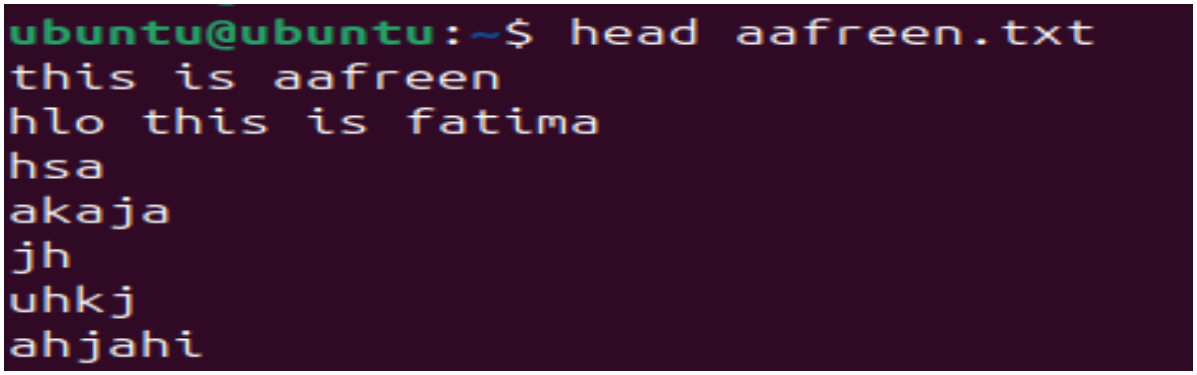


Figure 3.1.22

3.1.23. Which

- Displays the full path of the executable file for a command.

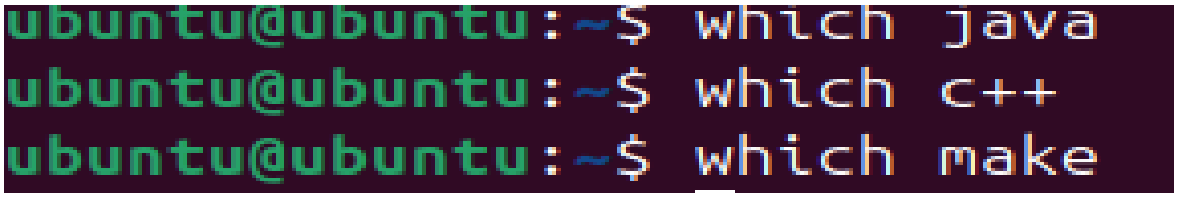


Figure 3.1.23

3.1.24. Whereis

- Locates the binary, source, and manual page files for a command.

Figure 3.1.24

3.1.25. Locate

- Quickly finds files and directories by name using a pre-built index.

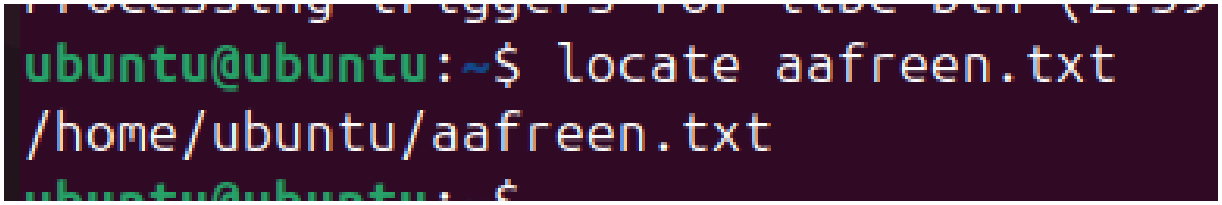


Figure 3.1.25

3.1.26. Find

- Searches for files and directories based on various criteria.

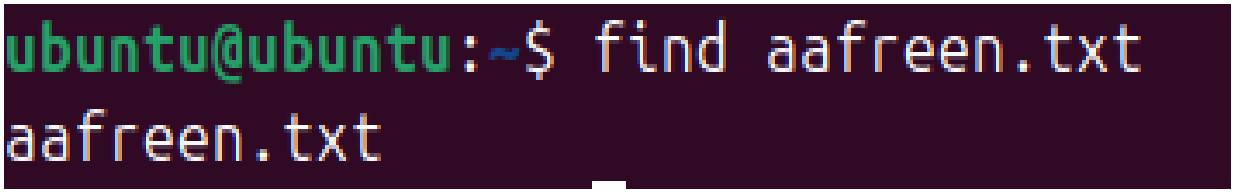


Figure 3.1.26

3.1.27. Ps

- Displays information about running processes.

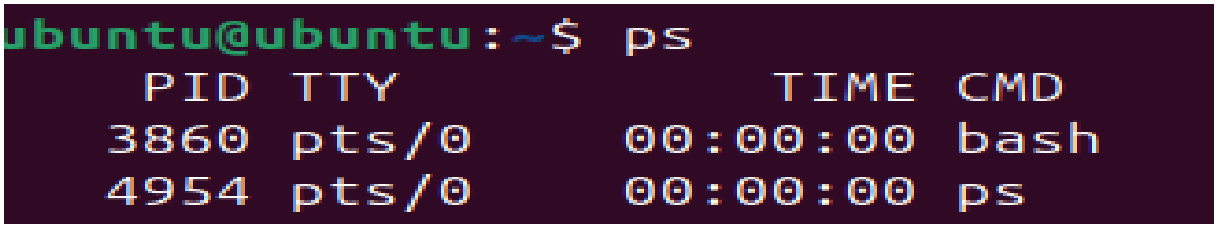


Figure 3.1.27

3.1.28. Tty

- Prints the file name of the terminal connected to the standard input.

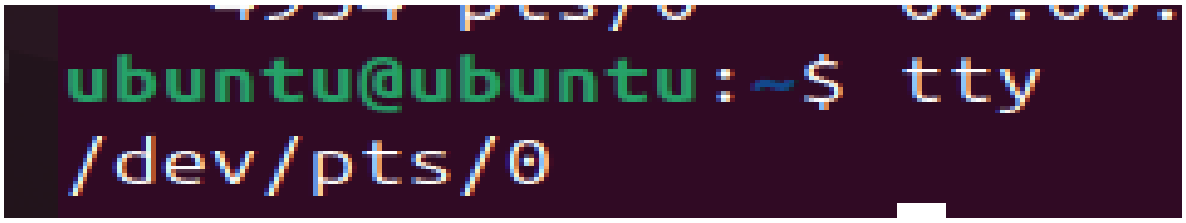


Figure 3.1.28

3.1.29. ps aux

- Displays a detailed list of all running processes for all users.

```
ubuntu@ubuntu:~$ ps aux
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMA
ND
root           1  0.3  0.6  23360 12928 ?        Ss   08:44   0:08 /sbin
root           2  0.0  0.0      0     0 ?        S    08:44   0:00 [kthr
root           3  0.0  0.0      0     0 ?        S    08:44   0:00 [pool
root           4  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root           5  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root           6  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root           7  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root          10  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root          11  0.0  0.0      0     0 ?        I    08:44   0:00 [kwor
root          12  0.0  0.0      0     0 ?        I<   08:44   0:00 [kwor
root          13  0.0  0.0      0     0 ?        I    08:44   0:00 [rcu_
root          14  0.0  0.0      0     0 ?        I    08:44   0:00 [rcu_
root          15  0.0  0.0      0     0 ?        I    08:44   0:00 [rcu_
root          16  0.2  0.0      0     0 ?        S    08:44   0:07 [ksof
root          17  0.2  0.0      0     0 ?        I    08:44   0:05 [rcu_
root          18  0.0  0.0      0     0 ?        S    08:44   0:00 [migr
root          19  0.0  0.0      0     0 ?        S    08:44   0:00 [idle
root          20  0.0  0.0      0     0 ?        S    08:44   0:00 [cpuh
root          21  0.0  0.0      0     0 ?        S    08:44   0:00 [cpuh
root          22  0.0  0.0      0     0 ?        S    08:44   0:00 [idle
```

Figure 3.1.29

3.1.30. Kill

- Sends a signal to terminate a process.

```
ubuntu@ubuntu:~$ kill 3860
ubuntu@ubuntu:~$ ps
    PID TTY          TIME CMD
   3860 pts/0    00:00:00 bash
   4987 pts/0    00:00:00 ps
```

Figure 3.1.30

3.1.31. Echo

- Displays a line of text or variable values.

```
ubuntu@ubuntu:~$ echo "hello ! aafreen ! how are you "
hello ! aafreen ! how are you
```

Figure 3.1.31

3.1.32. Rm

- Removes files or directories.

```
ubuntu@ubuntu:~$ rm aafreen.txt
rm: remove write-protected regular file 'aafreen.txt'? Y
ubuntu@ubuntu:~$ ls
Desktop    Downloads  Pictures  Templates  snap
Documents  Music      Public    Videos
```

Figure 3.1.32

3.1.33. Tail

- Outputs the last few lines of a file.

```
ubuntu@ubuntu:~$ tail fatima.txt
aafren
kahsa
fatima
laraib
laiba
hlo
karaci
```

Figure 3.1.33

3.1.34. Sort

- Arranges lines of text files in a specified order.

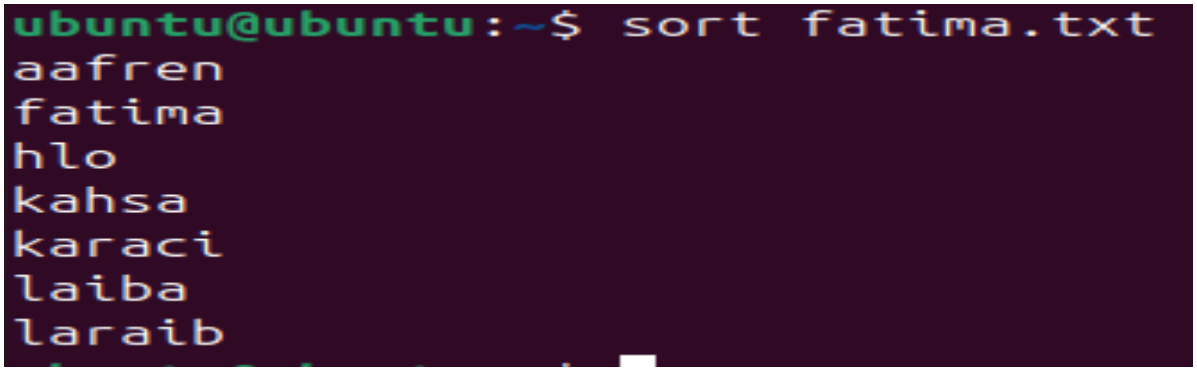


Figure 3.1.34

3.1.35. Grep

- Searches for a specified pattern in files.

Figure 3.1.35

3.1.36. Less

- Displays file contents one screen at a time, allowing for scrolling.

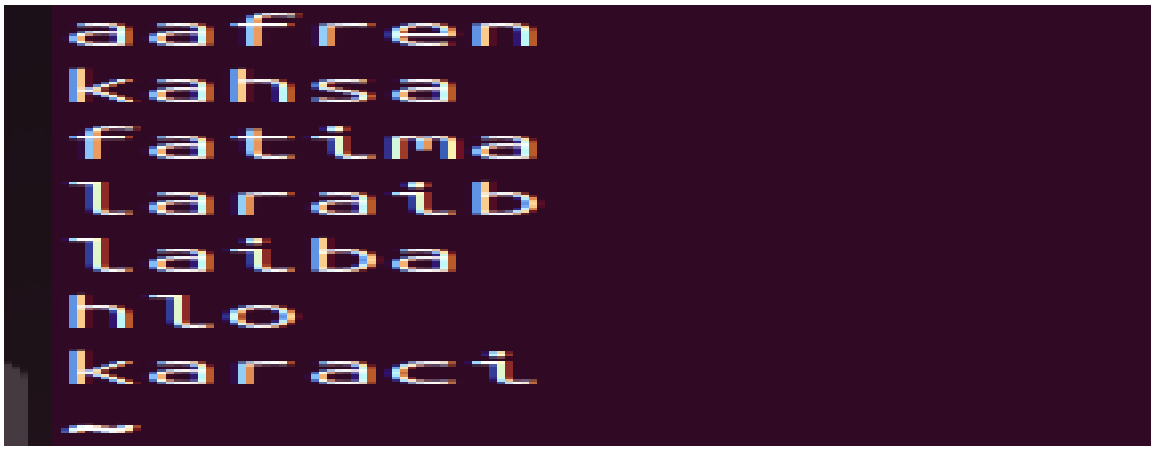


Figure 3.1.36

3.1.37. Man

- Displays the manual page for a command.

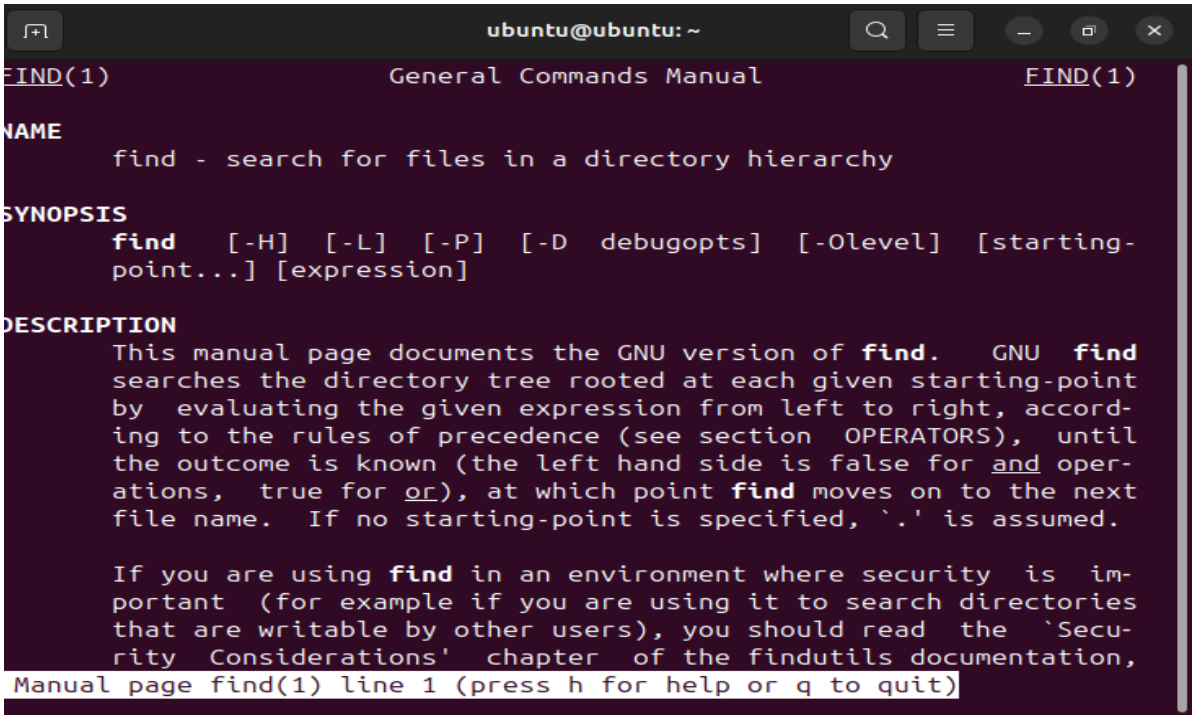


Figure 3.1.37

3.1.38. Output Redirection

- Redirects output from the command line to a file or another command.

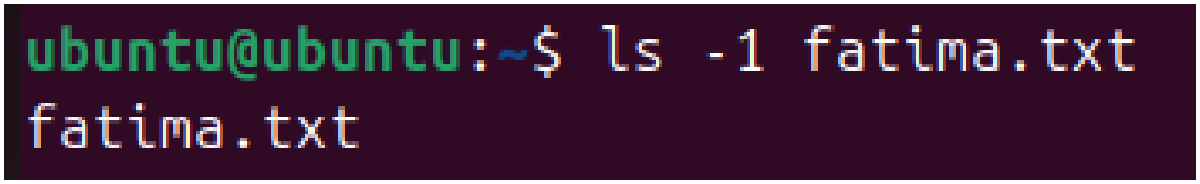


Figure 3.1.38

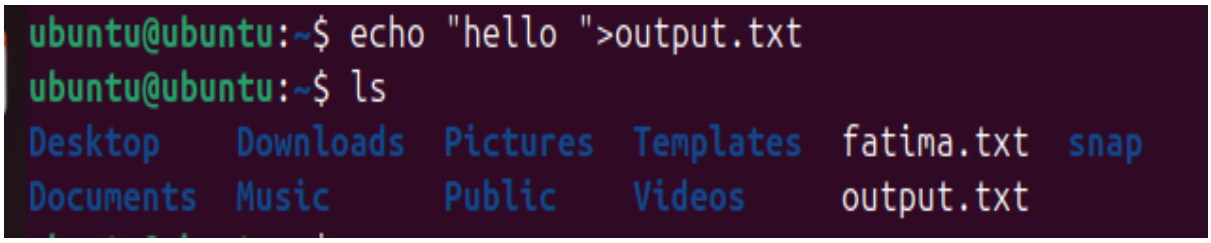


Figure 3.1.38

3.1.39. ls –l

- Displays detailed information about files and directories in a long format.

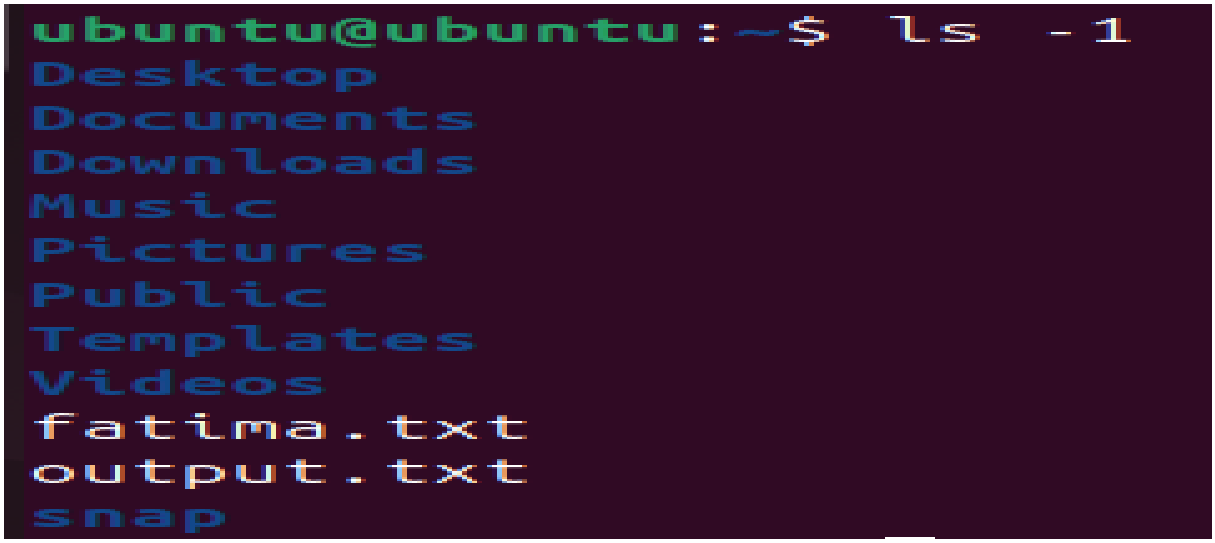


Figure 3.1.39

3.1.40. Pwd

- Prints the current working directory.

Figure 3.1.40

3.1.41. touch hello.cpp

- Creates an empty file or updates the timestamp of an existing file

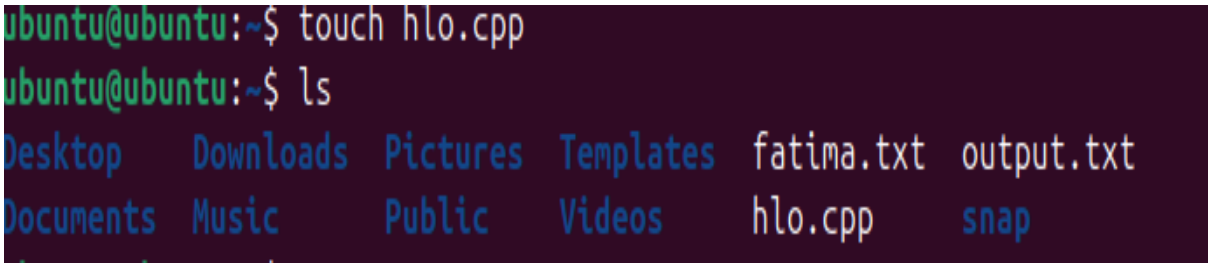


Figure 3.1.41

3.1.42. g++ hello.cpp -o test

- Compiles a C++ source file into an executable.

Figure 3.1.42

3.1.43. ./test

- Executes the compiled program.

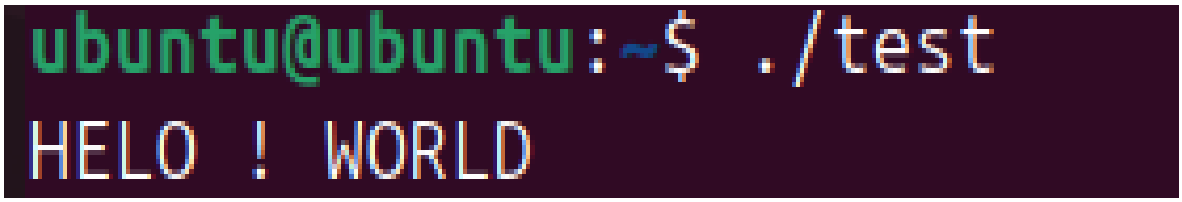


Figure 3.1.43

WEEK # 3

4. CODING IN UBUNTU WITH C++ PROGRAMMING LANGUAGE

4.1. SCENERIOS:

4.1.1. You are tasked with developing an interactive calculator that evaluates mathematical expressions while adhering to the BODMAS rule.

SOLUTION

Code

```
#include<iostream>
using namespace std;
int main ()
{
int a,b,c,d,result;
cout <<"Enter the value of a=";
cin>>a;
cout <<"Enter the value of b=";
cin>>b;
cout <<"Enter the value of c=";
cin>>c;
result=(a+b)/2*9+c+12*7;
cout<<"The result of an expression="<<result<<endl;
return 0;

}
```

Output

```
ubuntu@ubuntu:~$ g++ BODMAS.cpp -o test
ubuntu@ubuntu:~$ ./test
Enter the value of a=9
Enter the value of b=8
Enter the value of c=7
The result of an expression=163
ubuntu@ubuntu:~$
```

Figure 4.1.1

4.1.2. You are a teacher who wants to analyze the scores of students in a recent exam. You have collected the scores from all students, and now you want to find out: The highest score in the class (maximum).The lowest score in the class (minimum).

Solution

Code

```
#include<iostream>
using namespace std;
int main()
{
int n;
cout<<"Enter the Number of Students:";
cin>>n;
int arr[n];
for (int i=0;i<n;i++)
{
cout<<"Enter the marks of student  "<<i<<":";
cin>>arr[i];
}
int max=arr[0];
int min=arr[0];
for (int i=0;i<n;i++)
{
if (arr[i]>max)
```

```
if (arr[i]>max)
{
max=arr[i];
}
if(arr[i]<min)
{
min=arr[i];
}
}
cout<<"maximum number of marks are :"<<max<<endl;
cout<<"minimum number of marks are :"<<min<<endl;
}
```

Output

```
ubuntu@ubuntu:~$ g++ minmax.cpp -o test
ubuntu@ubuntu:~$ ./test
Enter the Number of Students:4
Enter the marks of student  0:12
Enter the marks of student  1:16
Enter the marks of student  2:19
Enter the marks of student  3:20
maximum number of marks are :20
minimum number of marks are :12
```

Figure 4.1.2

4.1.3. You are a data analyst working with a list of integers representing the daily sales of a product over a month. You need to perform the following tasks:
Calculate the sum of all even numbers in the list.
Calculate the result of subtracting all odd numbers in the list from an initial value of zero.

Code

```
#include<iostream>
using namespace std;
int main()
{
int n;
cout<<"Enter the Number:";
cin>>n;
int arr[n];
for (int i=0;i<n;i++)
{
cout<<"Enter the Value of  "<<i<<": number";
cin>>arr[i];
}
int sum=0;
int odd=0;
for (int i=0;i<n;i++)
{
if (arr[i]%2==0)
```

```
{
if (arr[i]%2==0)
{
sum=sum+arr[i];
}
}
cout<<"the sum of even number:"<<sum<<endl;
for (int i=0;i<n;i++)
{
if (arr[i]%2!=0)
{
odd=odd+arr[i];
}
}
cout<<"sum of odd number :"<<odd<<endl;
return 0;
}
```

Output

```
ubuntu@ubuntu:~$ g++ evenodd.cpp -o test
ubuntu@ubuntu:~$ ./test
Enter the Number:6
Enter the Value of  0: number 2
Enter the Value of  1: number 4
Enter the Value of  2: number7
Enter the Value of  3: number 3
Enter the Value of  4: number5
Enter the Value of  5: number9
the sum of even number:6
sum of odd number :24
```

Figure 4.1.3

WEEK # 4

5. CODING IN UBUNTU TERMINAL

5.1.1. DECLRAING VARIABLE

```
ubuntu@ubuntu:~$ myvar=hello
```

Figure 5.1.1

5.1.2. DIPLAYING THE VARIBALE VALUE

```
ubuntu@ubuntu:~$ echo $myvar
hello
```

Figure 5.1.2

5.1.3. DECLEARING A STRING

```
ubuntu@ubuntu:~$ myvar="i hate people"
```

Figure 5.1.3

5.1.4. DIPLAYING A STRING

```
ubuntu@ubuntu:~$ echo $myvar
i hate people
```

Figure 5.1.4

5.1.5. DECLEARING AN INTEGER

```
ubuntu@ubuntu:~$ myvar=8
```

Figure 5.1.5

5.1.6. DIPLAYING AN INTEGER

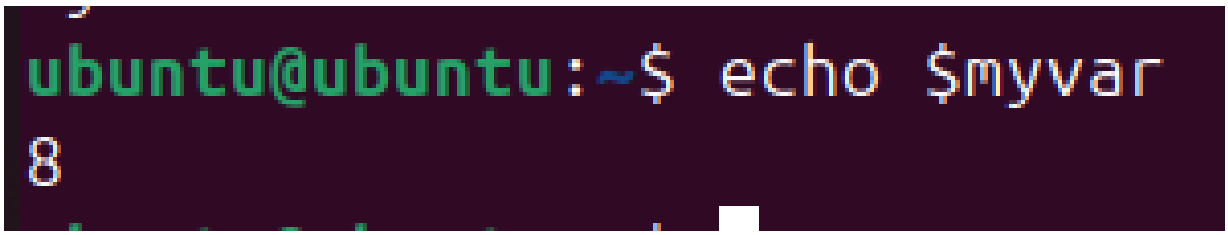


Figure 5.1.6

5.1.7. IF-THEN-ELSE STATEMENT

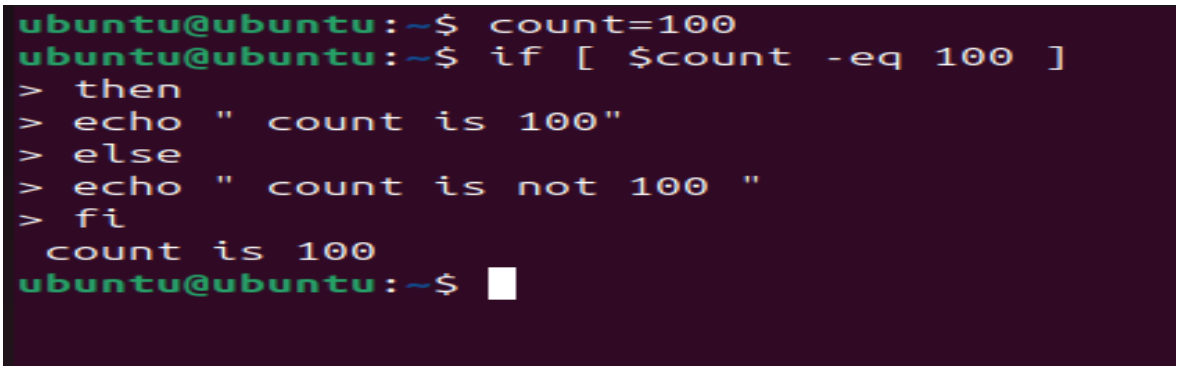


Figure 5.1.7

5.1.8. CASE STATEMENT

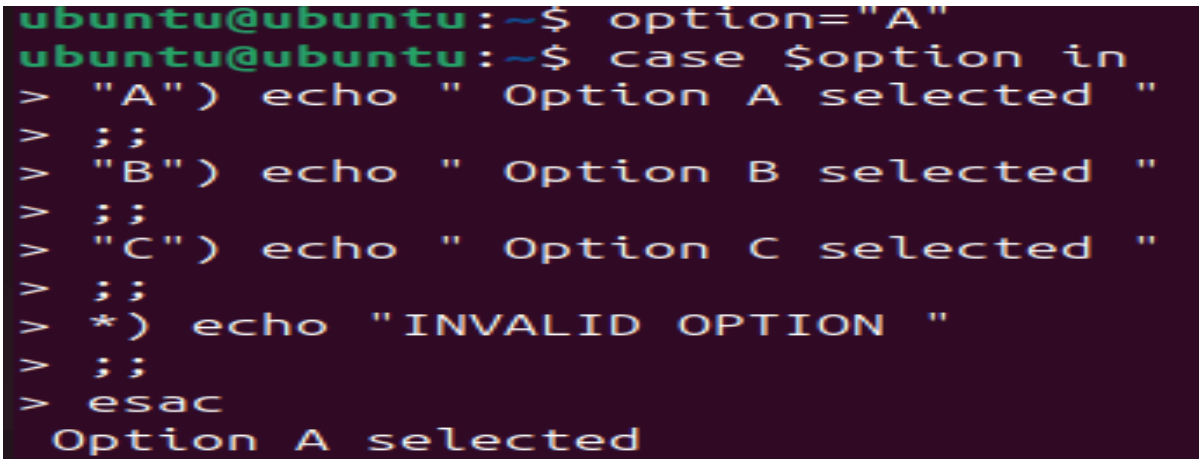


Figure 5.1.8

5.1.9. FOR LOOP

```
ubuntu@ubuntu:~$ for i in {1..7};do
> echo "i hate people $i"
> done
i hate people 1
i hate people 2
i hate people 3
i hate people 4
i hate people 5
i hate people 6
i hate people 7
ubuntu@ubuntu:~$
```

Figure 5.1.9

5.1.10. DO-WHILE LOOP

```
ubuntu@ubuntu:~$ count=0
ubuntu@ubuntu:~$ while true; do
> echo "count is $count"
> count=$((count+1))
> if [ $count -ge 5 ]; then
> break
> fi
> done
count is 0
count is 1
count is 2
count is 3
count is 4
```

Figure 5.1.10

5.1.11. WHILE LOOP

```
ubuntu@ubuntu:~$ count=1
ubuntu@ubuntu:~$ while [ $count -le 10 ]; do
> echo " i hate people $count"
> count=$((count+1))
> done
 i hate people 1
 i hate people 2
 i hate people 3
 i hate people 4
 i hate people 5
 i hate people 6
 i hate people 7
 i hate people 8
 i hate people 9
 i hate people 10
```

Figure 5.1.11

5.1.12. FILE COMPARING

```
ubuntu@ubuntu:~$ file1="aafreen.txt"
ubuntu@ubuntu:~$ file2="fatima.txt"
ubuntu@ubuntu:~$ if [ -f $file1 ] && [ -f $file2 ] ; then
> if cmp -s $file1 $file2 ; then
> echo "files are identical"
> else
> exho "files are different "
> fi
> else
> echo "one or both file do not exist"
> fi
one or both file do not exist
```

Figure 5.1.12

5.1.13. VARIABLE COMPARING

```
ubuntu@ubuntu:~$ count=10
ubuntu@ubuntu:~$ sum=10
ubuntu@ubuntu:~$ if [ $count -eq $sum ] ; then
> echo "they are same "
> else
> echo "they are different "
> fi
they are same
```

Figure 5.1.13

5.1.14. LOGICAL OPERATORS

```
ubuntu@ubuntu:~$ A=10
ubuntu@ubuntu:~$ B=20
ubuntu@ubuntu:~$ if [ $A -le 15 ] && [ $B -gt 15 ]; then
> echo "  A IS LESS THEN 15 AND B IS GREATER THEN 15 "
> else
> echo "ONE OR BOTH CONDITION ARE FALSE "
> fi
  A IS LESS THEN 15 AND B IS GREATER THEN 15
ubuntu@ubuntu:~$
```

Figure 5.1.14

WEEK # 5

6. SYSTEM CALLS

System calls provide an interface between user programs and the operating system. They allow user-level processes to request services from the kernel, such as file operations, process control, and communication. Here are some common system calls related to process management in Unix-like operating systems

6.1. fork ()

The fork () system call is used to create a new process by duplicating the calling process. The new process, referred to as the child process, is a copy of the parent process, except for the returned value. The fork () call returns:

- 0 to the child process.
- The child's PID (process ID) to the parent process.
- -1 if the creation of the child process fails.

6.1.1. SIMPLE PROGRAM

CODE

```
#include <iostream>
#include<unistd.h>
#include<sys/types.h>
using namespace std;
int main ()
{
pid_t pid=fork();
if (pid==0){
cout<<"This is Child process"<<pid<<endl;}
else if (pid>0)
{
cout<<"This is Parent process"<<pid<<endl;
}
else {
cout<<"fork failed";}
return 0;
}
```

Output

```
ubuntu@ubuntu:~$ g++ fork.cpp -o test
ubuntu@ubuntu:~$ ./test
This is Parent process8580
This is Child process0
```

E

Figure 6.1.1

6.1.2. Pedict the Output of the following program:

6.1.2.1. Program

```
#include <stdio.h>
#include<sys/types.h>
#include <unistd.h> int
main()
{
  // make two process which run same
// program after this instruction fork();
  printf("Hello world!\n");
  return 0;
}
```

Output

```
ubuntu@ubuntu:~$ g++ fork1.cpp -o test
./ubuntu@ubuntu:~$ ./test
hello world
hello world
ubuntu@ubuntu:~$
```

Figure 6.1.2.1

6.1.2.2. Program

```
#include <stdio.h>
#include <sys/types.h>
 #include <unistd.h>
 int main()
{   // make two process which run same
  // program after this instruction
fork();
fork();
   fork();
    printf("Hello world!\n");
    return 0;
}
```

Output

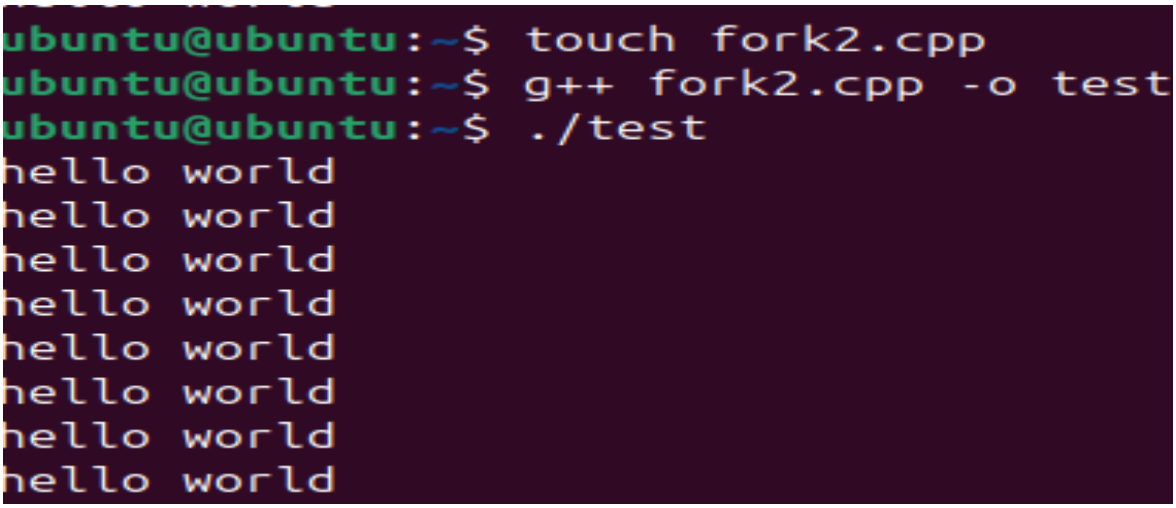


Figure 6.1.2.2

6.1.2.3. Program

```
#include <stdio.h>
 #include <unistd.h>
int main(int argc, char **argv)
{
   printf("--beginning of program\n");
   int counter = 0;     pid_t pid = fork();
   if (pid == 0)
   {
      // child process        int i = 0;        for (; i < 5; ++i)
      {
         printf("child process: counter=%d\n", ++counter);
      }    }
   else if (pid > 0)
   {
      // parent process        int j = 0;        for (; j < 5; ++j)
      {  printf("parent process: counter=%d\n", ++counter);
      }    }    else
   {
      // fork failed        printf("fork() failed!\n");        return 1;
   }    printf("--end of program--\n");
   return 0; }
```

Output

```
ubuntu@ubuntu:~$ g++ fork1.cpp -o test
ubuntu@ubuntu:~$ ./test
parent process:counter = 0
parent process:counter = 1
parent process:counter = 2
parent process:counter = 3
parent process:counter = 4
child process:counter = 0
child process:counter = 1
child process:counter = 2
child process:counter = 3
child process:counter = 4
```

Figure 6.1.2.3

6.1.2.4. Program

Open fork.cpp ~/

```
#include<iostream>
#include<stdio.h>
#include<sys/types.h>
#include<unistd.h>
using namespace std;

int main()
{
pid_t processid;
pid_t p_processid;
processid= getpid();
p_processid= getppid();
cout<<"the process id of this process is  "<<processid<<endl;
cout<<"the process id of parent process is  "<<p_processid<<endl;
return 0;
}
```

Output

```
ubuntu@ubuntu:~$ g++ fork.cpp -o test
ubuntu@ubuntu:~$ ./test
the process id of this process is  5401
the process id of parent process is  4170
ubuntu@ubuntu:~$
```

E

Figure 6.1.2.4

6.1.2.5. Write a program to find sum of even numbers in parent process and sum of odd numbers in child process.

CODE

Open aafreen.cpp ~/

```
#include<iostream>
#include<stdio.h>
#include<unistd.h>
#include<sys/types.h>
using namespace std;
int main ()
{
int arr[5],sum;
int id,childid,i;
for(i=0;i<5;i++)
{
cout<<"aaray="<<endl;
cin>>arr[i];
}
id=getpid();
if ((childid=fork())>0)
{
for(i =0;i<5;i++)
{
```

```
for(i =0;i<5;i++)
{
if(arr[i]%2==0)
{
sum=sum+arr[i];
cout<<"the sum  of even="<<sum<<endl;
}
}
}
else if ((childid=fork())==0)
{
for( i =0;i<5;i++)
{
if(arr[i]%2 !=0)
{
sum= sum+arr[i];
cout<<"the sum of  odd no ="<<sum<<endl;
}
}
}
```

OUTPUT

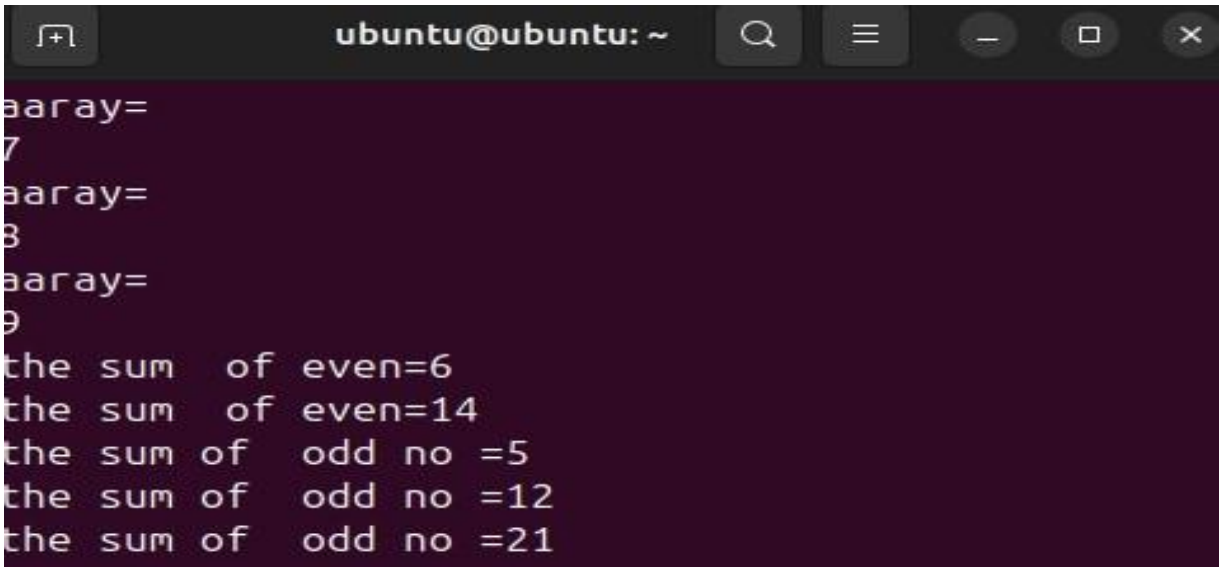


Figure 6.1.2.5

6.2. Exit()

The exit function is used to terminate a program. It performs cleanup operations, such as flushing output buffers and closing open files. The function is declared in the <stdlib.h> header.

6.3. Wait()

The wait function makes the parent process wait until all of its child processes have terminated. It is used for process synchronization. The function is declared in the <sys/wait.h> header.

6.4. Sleep()

The sleep function suspends the execution of the calling process for a specified number of seconds. It is useful for delaying program execution. The function is declared in the <unistd.h> header.

Code

```
#include <iostream>

#include <unistd.h>

#include <sys/types.h>

#include <sys/wait.h>

#include <cstdlib>

using namespace std;

int main() {

   pid_t pid = fork(); // Create a new process

   if (pid < 0) {

      // Fork failed

      cerr << "Fork failed!" << endl;

      return 1;

   }

   else if (pid == 0) {

      // Child process

      cout << "Child process (PID: " << getpid() << ") is sleeping for 3 seconds..." << endl;

      sleep(3); // Sleep for 3 seconds

      cout << "Child process (PID: " << getpid() << ") has finished sleeping." << endl;

      exit(0); // Exit child process

   }

   else {

      // Parent process

      cout << "Parent process (PID: " << getpid() << ") is waiting for child process (PID: " << pid <<
") to finish..." << endl;
```

```
    wait(NULL); // Wait for the child process to finish
    cout << "Child process has finished. Parent process (PID: " << getpid() << ") is continuing." << endl;
  }
  return 0;
}
```

Output

```
Output                                                    Clear
/tmp/dBxRhf1ntT.o
Parent process (PID: 1098) is waiting for child process (PID: 1099) to
    finish...
Child process (PID: 1099) is sleeping for 3 seconds...
Child process (PID: 1099) has finished sleeping.
Child process has finished. Parent process (PID: 1098) is continuing.


=== Code Execution Successful ===
```

Figure 6.4

WEEK # 6

7. FIRST COME FIRST SERVED (FCFS)

The **First Come First Served (FCFS)** scheduling algorithm is the simplest CPU scheduling method where processes are executed in the order of their arrival. It is non-preemptive, meaning once a process starts, it runs to completion without interruption. FCFS uses a First-In-First-Out (FIFO) queue structure, ensuring fairness since all processes are executed in the sequence they arrive. However, it suffers from drawbacks like the **convoy effect**, where a long process delays others, leading to inefficient CPU utilization and poor average turnaround time. Despite its simplicity and fairness, FCFS is rarely used in modern systems due to its limitations.

7.1. FCFS WITH SAME ARRIVAL TIME i.e. 0

Code

```
#include<iostream>

using namespace std;

// Function to find waiting time for all processes

void findWaitingTime(int processes[], int n, int bt[], int wt[]) {

    wt[0] = 0; // First process has no waiting time

    // Calculate waiting time for each process

    for (int i = 1; i < n; i++) {

        wt[i] = bt[i - 1] + wt[i - 1];

    }

}

// Function to calculate turnaround time for all processes

void findTurnaroundTime(int processes[], int n, int bt[], int wt[], int tat[]) {

    for (int i = 0; i < n; i++) {

        tat[i] = bt[i] + wt[i];

    }

}

// Function to calculate average time

void findAverageTime(int processes[], int n, int bt[]) {

    int wt[n], tat[n], total_wt = 0, total_tat = 0;

    findWaitingTime(processes, n, bt, wt);

    findTurnaroundTime(processes, n, bt, wt, tat);

    cout << "Processes  " << "Burst time  " << "Waiting time  " << "Turnaround time\n";

    for (int i = 0; i < n; i++) {
```

```
        total_wt += wt[i];
        total_tat += tat[i];
        cout << "   " << i + 1 << "\t\t" << bt[i] << "\t    " << wt[i] << "\t\t   " << tat[i] << endl;
    }
    cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
    cout << "\nAverage turnaround time = " << (float)total_tat / (float)n;
}
int main() {
    int n;
    // Taking input for number of processes
    cout << "Enter number of processes: ";
    cin >> n;
    int processes[n], burst_time[n];
    // Taking burst time for each process
    for (int i = 0; i < n; i++) {
        cout << "Enter burst time for process " << i + 1 << ": ";
        cin >> burst_time[i];
        processes[i] = i + 1; // Process number
    }
    findAverageTime(processes, n, burst_time);
    return 0;
}
```

Output

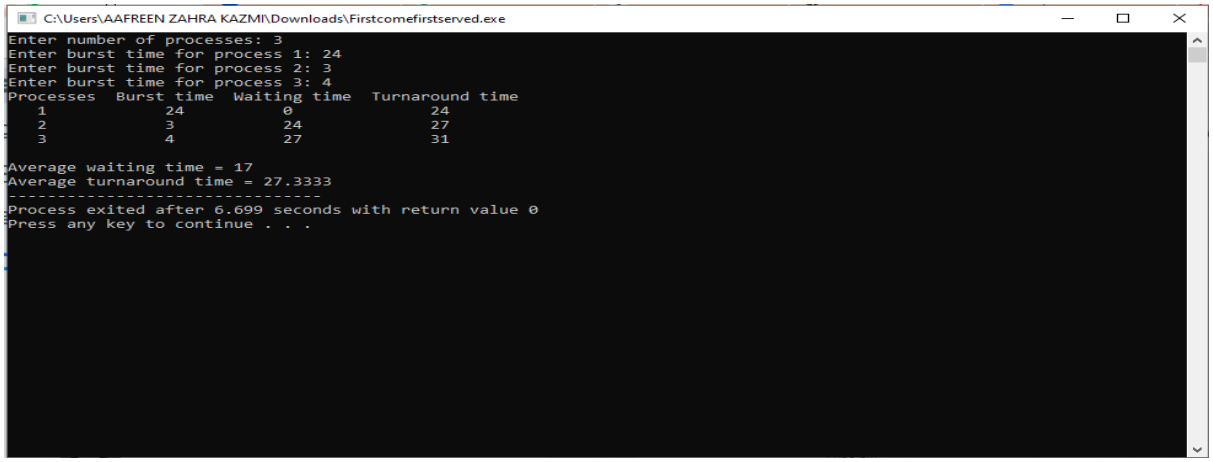


Figure 7.1

7.2. FCFS WITH DIFFERENT ARRIVAL TIME

Code

```
#include <iostream>
#include <algorithm>
using namespace std;
struct Process {
    int pid;
    int arrival_time;
    int burst_time;
    int completion_time;
    int waiting_time;
    int turnaround_time;
};
// Comparator function to sort processes based on arrival time
bool compare(Process a, Process b) {
    return a.arrival_time < b.arrival_time;
}
void calculateCompletionTime(Process proc[], int n) {
    proc[0].completion_time = proc[0].arrival_time + proc[0].burst_time;
    for (int i = 1; i < n; i++) {
        // If the CPU is idle, wait for the process to arrive
        if (proc[i].arrival_time > proc[i-1].completion_time) {
            proc[i].completion_time = proc[i].arrival_time + proc[i].burst_time;
        } else {
            proc[i].completion_time = proc[i-1].completion_time + proc[i].burst_time;
        }
    }
}
void calculateTurnaroundTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
```

```
        proc[i].turnaround_time = proc[i].completion_time - proc[i].arrival_time;
    }
}
void calculateWaitingTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
        proc[i].waiting_time = proc[i].turnaround_time - proc[i].burst_time;
    }
}
void fcfs(Process proc[], int n) {
    calculateCompletionTime(proc, n);
    calculateTurnaroundTime(proc, n);
    calculateWaitingTime(proc, n);
}
void printFcfs(Process proc[], int n) {
    cout << "\t\t\tFCFS SCHEDULING\t\t\t\n";
    cout << "PID\tArrival Time\tBurst Time\tCompletion Time\tTurnAround Time\tWaiting Time\n";
    for (int i = 0; i < n; i++) {
        cout << proc[i].pid << "\t\t" << proc[i].arrival_time << "\t\t" << proc[i].burst_time << "\t\t" << proc[i].completion_time << "\t\t" << proc[i].turnaround_time << "\t\t" << proc[i].waiting_time << "\n";
    }
}
int main() {
    int n = 5;
    Process proc[5] = {{1, 2, 6}, {2, 5, 2}, {3, 1, 8}, {4, 8, 3}, {5, 4, 4}};
    // Sort processes based on arrival time
    sort(proc, proc + n, compare);
    // Perform FCFS scheduling
    fcfs(proc, n);
   // Print the results
```

```
    printFcfs(proc, n);
    return 0;
}
```

Output

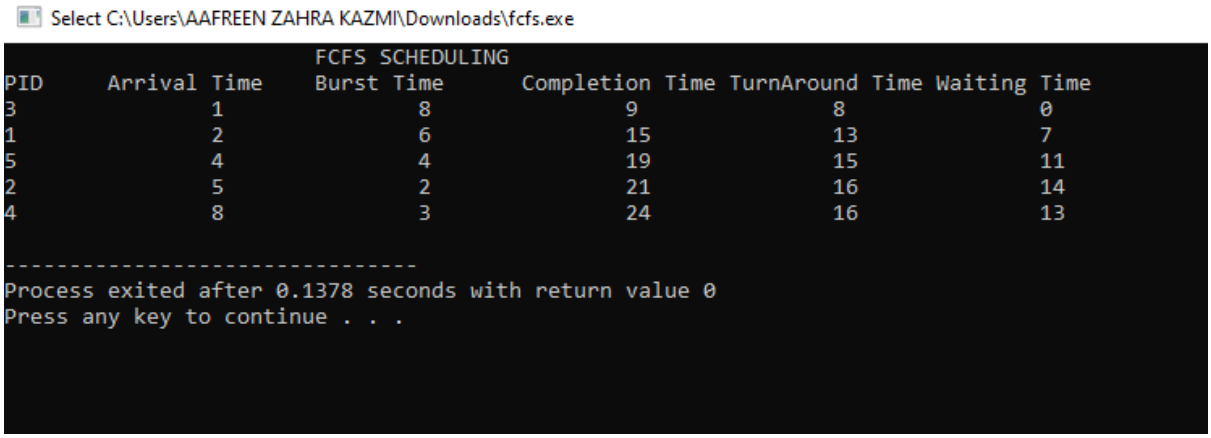


Figure 7.2

8. SHORTEST JOB FIRST (SJF)

The **Shortest Job First (SJF)** scheduling algorithm selects the process with the shortest burst time for execution, aiming to minimize the average waiting and turnaround times. It can be implemented as **non-preemptive**, where a process runs to completion once started, or **preemptive** (known as Shortest Remaining Time First, SRTF), where a new process with a shorter burst time can interrupt the current one. SJF is optimal in terms of reducing average waiting time but requires precise knowledge of process burst times, which can be difficult to predict. This limitation makes it less practical for real-time systems.

8.1. SJF WITH SAME ARRIVAL TIME i.e. 0

Code

```
#include <iostream>
#include <algorithm>
using namespace std;
// Structure for process
struct Process {
    int id;     // Process ID
    int bt;     // Burst Time
    int at;     // Arrival Time
};
// Function to find waiting time for all processes
void findWaitingTime(Process proc[], int n, int wt[]) {
    int service_time[n];
    service_time[0] = proc[0].at;
    wt[0] = 0;  // First process doesn't wait
    // Calculating waiting time
    for (int i = 1; i < n; i++) {
        service_time[i] = service_time[i - 1] + proc[i - 1].bt;
        wt[i] = service_time[i] - proc[i].at;
        // If waiting time for a process is negative, set it to zero
        if (wt[i] < 0) {
            wt[i] = 0;
        }
    }
```

```
}
// Function to calculate turnaround time for all processes
void findTurnaroundTime(Process proc[], int n, int wt[], int tat[]) {
    // Turnaround time = burst time + waiting time
    for (int i = 0; i < n; i++) {
        tat[i] = proc[i].bt + wt[i];
    }
}
// Function to calculate average time
void findAverageTime(Process proc[], int n) {
    int wt[n], tat[n], total_wt = 0, total_tat = 0;
    // Calculate waiting time for all processes
    findWaitingTime(proc, n, wt);
    // Calculate turnaround time for all processes
    findTurnaroundTime(proc, n, wt, tat);
    // Display processes along with burst time, waiting time, and turnaround time
    cout << "Processes  " << "Burst time  " << "Arrival time  " << "Waiting time  " << "Turnaround time\n";
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
        cout << "   " << proc[i].id << "\t\t" << proc[i].bt << "\t\t" << proc[i].at
             << "\t\t" << wt[i] << "\t\t  " << tat[i] << endl;
    }
    cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
    cout << "\nAverage turnaround time = " << (float)total_tat / (float)n;
}
// Function to implement SJF scheduling
void sjfScheduling(Process proc[], int n) {
    // Sort processes by burst time, if two processes have same burst time, sort by arrival time
    sort(proc, proc + n, [](Process a, Process b) {
        return (a.bt == b.bt) ? (a.at < b.at) : (a.bt < b.bt);
    });
```

```
    // Calculate average waiting and turnaround time
    findAverageTime(proc, n);}
int main() {
    int n;
    // Taking input for number of processes
    cout << "Enter number of processes: ";
    cin >> n;
    Process proc[n];
    // Taking burst time and arrival time for each process
    for (int i = 0; i < n; i++) {
        proc[i].id = i + 1;
        cout << "Enter burst time for process " << i + 1 << ": ";
        cin >> proc[i].bt;
        cout << "Enter arrival time for process " << i + 1 << ": ";
        cin >> proc[i].at;
    }
    // Perform SJF scheduling
    sjfScheduling(proc, n);
    return 0;
}
```

Output

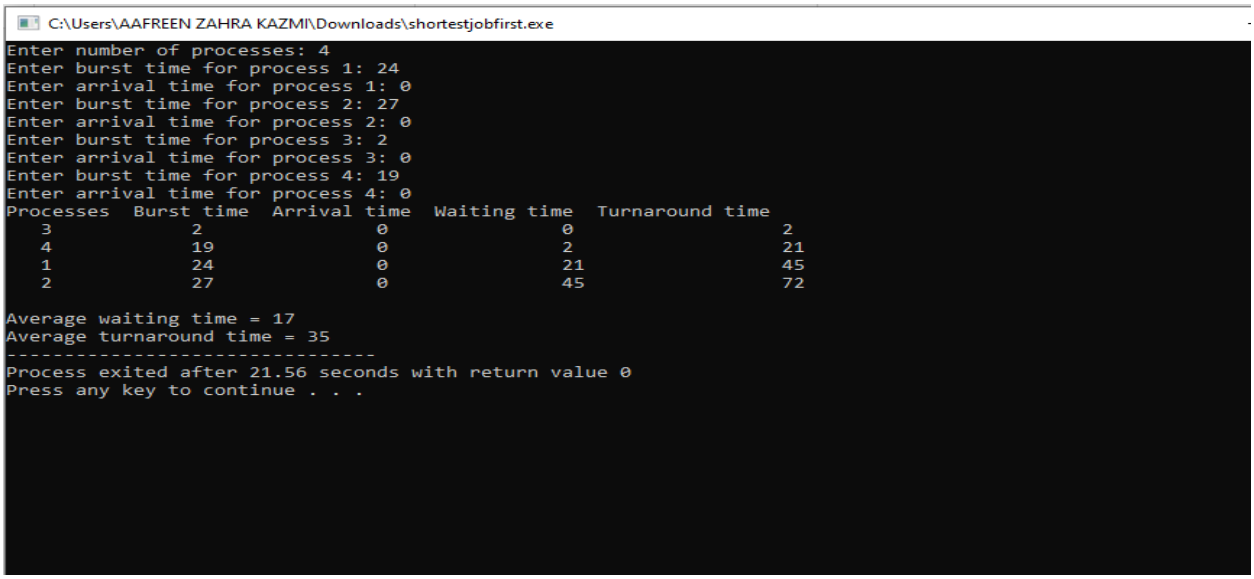


Figure 8.1

8.2. SJF WITH DIFFERENT ARRIVAL TIME

```
#include <iostream>
#include <algorithm>
using namespace std;
// Structure for process
struct Process {
    int id;     // Process ID
    int bt;     // Burst Time
    int at;     // Arrival Time
};
// Function to find waiting time for all processes
void findWaitingTime(Process proc[], int n, int wt[]) {
    int service_time[n];
    service_time[0] = proc[0].at;
    wt[0] = 0;  // First process doesn't wait
    // Calculating waiting time
    for (int i = 1; i < n; i++) {
        service_time[i] = service_time[i - 1] + proc[i - 1].bt;
        wt[i] = service_time[i] - proc[i].at;
        // If waiting time for a process is negative, set it to zero
        if (wt[i] < 0) {
            wt[i] = 0;
        }
    }
}
// Function to calculate turnaround time for all processes
void findTurnaroundTime(Process proc[], int n, int wt[], int tat[]) {
    // Turnaround time = burst time + waiting time
    for (int i = 0; i < n; i++) {
        tat[i] = proc[i].bt + wt[i];
    }
}
```

```
// Function to calculate average time
void findAverageTime(Process proc[], int n) {
    int wt[n], tat[n], total_wt = 0, total_tat = 0;
    // Calculate waiting time for all processes
    findWaitingTime(proc, n, wt);
    // Calculate turnaround time for all processes
    findTurnaroundTime(proc, n, wt, tat);
    // Display processes along with burst time, waiting time, and turnaround time
    cout << "Processes  " << "Burst time  " << "Arrival time  " << "Waiting time  " << "Turnaround time\n";
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
        cout << "   " << proc[i].id << "\t\t" << proc[i].bt << "\t\t" << proc[i].at
             << "\t\t" << wt[i] << "\t\t   " << tat[i] << endl;
    }
    cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
    cout << "\nAverage turnaround time = " << (float)total_tat / (float)n;
}
// Function to implement SJF scheduling
void sjfScheduling(Process proc[], int n) {
    // Sort processes by burst time, if two processes have same burst time, sort by arrival time
    sort(proc, proc + n, [](Process a, Process b) {
        return (a.bt == b.bt) ? (a.at < b.at) : (a.bt < b.bt);
    });
    // Calculate average waiting and turnaround time
    findAverageTime(proc, n);
}
int main() {
    int n;
    // Taking input for number of processes
    cout << "Enter number of processes: ";
    cin >> n;
```

```
    Process proc[n];
    // Taking burst time and arrival time for each process
    for (int i = 0; i < n; i++) {
        proc[i].id = i + 1;
        cout << "Enter burst time for process " << i + 1 << ": ";
        cin >> proc[i].bt;
        cout << "Enter arrival time for process " << i + 1 << ": ";
        cin >> proc[i].at;
    }
    // Perform SJF scheduling
    sjfScheduling(proc, n);
    return 0;
}
```

OUTPUT

```
Select C:\Users\AAFREEN ZAHRA KAZMI\Downloads\shortestjobfirst.exe
Enter number of processes: 4
Enter burst time for process 1: 34
Enter arrival time for process 1: 0
Enter burst time for process 2: 9
Enter arrival time for process 2: 3
Enter burst time for process 3: 9
Enter arrival time for process 3: 4
Enter burst time for process 4: 12
Enter arrival time for process 4: 7
Processes  Burst time  Arrival time  Waiting time  Turnaround time
   2           9              3              0                  9
   3           9              4              8                  17
   4           12             7              14                 26
   1           34             0              33                 67

Average waiting time = 13.75
Average turnaround time = 29.75
--------------------------------
Process exited after 25.36 seconds with return value 0
Press any key to continue . . .
```

Figure 8.2

WEEK # 7

9. PRIORITY SCHEDULLING (NON-PREMPTIVE)

Priority Scheduling (Non-Preemptive) is a CPU scheduling algorithm where each process is assigned a priority, and the process with the highest priority (lowest numerical value) is executed first. If two processes have the same priority, they are scheduled based on their arrival order. In this non-preemptive approach, once a process starts execution, it runs to completion before another process is selected. While it ensures that critical tasks are addressed first, it can lead to **starvation**, where low-priority processes are indefinitely delayed if high-priority processes keep arriving. Aging techniques can be used to mitigate this issue.

9.1. PS WITH DIFFERENT ARRIVAL TIME

CODE

```
#include <iostream>
#include <algorithm>
using namespace std;
struct Process {
    int pid;            // Process ID
    int arrival_time;   // Arrival Time
    int burst_time;     // Burst Time
    int completion_time; // Completion Time
    int waiting_time;   // Waiting Time
    int turnaround_time; // Turnaround Time
    int priority;       // Priority (1 is the highest priority)
};
// Comparator function to sort processes based on priority and arrival time
bool compare(Process a, Process b) {
    if (a.priority == b.priority) {
        return a.arrival_time < b.arrival_time; // If priorities are the same, sort by arrival time
    }
    return a.priority < b.priority; // Sort by priority
}
void calculateCompletionTime(Process proc[], int n) {
    proc[0].completion_time = proc[0].arrival_time + proc[0].burst_time;
    for (int i = 1; i < n; i++) {
```

```
        if (proc[i].arrival_time > proc[i-1].completion_time) {
            proc[i].completion_time = proc[i].arrival_time + proc[i].burst_time;
        } else {
            proc[i].completion_time = proc[i-1].completion_time + proc[i].burst_time;
        }
    }
}
void calculateTurnaroundTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
        proc[i].turnaround_time = proc[i].completion_time - proc[i].arrival_time;
    }
}
void calculateWaitingTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
        proc[i].waiting_time = proc[i].turnaround_time - proc[i].burst_time;
    }
}
void priorityScheduling(Process proc[], int n) {
    // Sort processes based on priority and arrival time
    sort(proc, proc + n, compare);
    calculateCompletionTime(proc, n);
    calculateTurnaroundTime(proc, n);
    calculateWaitingTime(proc, n);
}


void printPrioritySchedule(Process proc[], int n) {
    cout << "\t\t\tPRIORITY SCHEDULING\t\t\n";
    cout << "PID\tArrival Time\tBurst Time\tPriority\tCompletion Time\tTurnaround Time\tWaiting Time\n";
    for (int i = 0; i < n; i++) {
```

```
        cout << proc[i].pid << "\t\t" << proc[i].arrival_time << "\t\t" << proc[i].burst_time << "\t\t" << proc[i].priority << "\t\t" << proc[i].completion_time << "\t\t" << proc[i].turnaround_time << "\t\t" << proc[i].waiting_time << "\n";
    }
}
int main() {
    int n = 5;
    Process proc[5] = {
        {1, 0, 5, 0, 0, 0, 2}, // {PID, Arrival Time, Burst Time, Priority}
        {2, 1, 3, 0, 0, 0, 4},
        {3, 2, 8, 0, 0, 0, 3},
        {4, 3, 6, 0, 0, 0, 1},
        {5, 4, 2, 0, 0, 0, 3}
    };
    // Perform Priority Scheduling
    priorityScheduling(proc, n);
    // Print the results
    printPrioritySchedule(proc, n);
    return 0;
}
```

OUTPUT

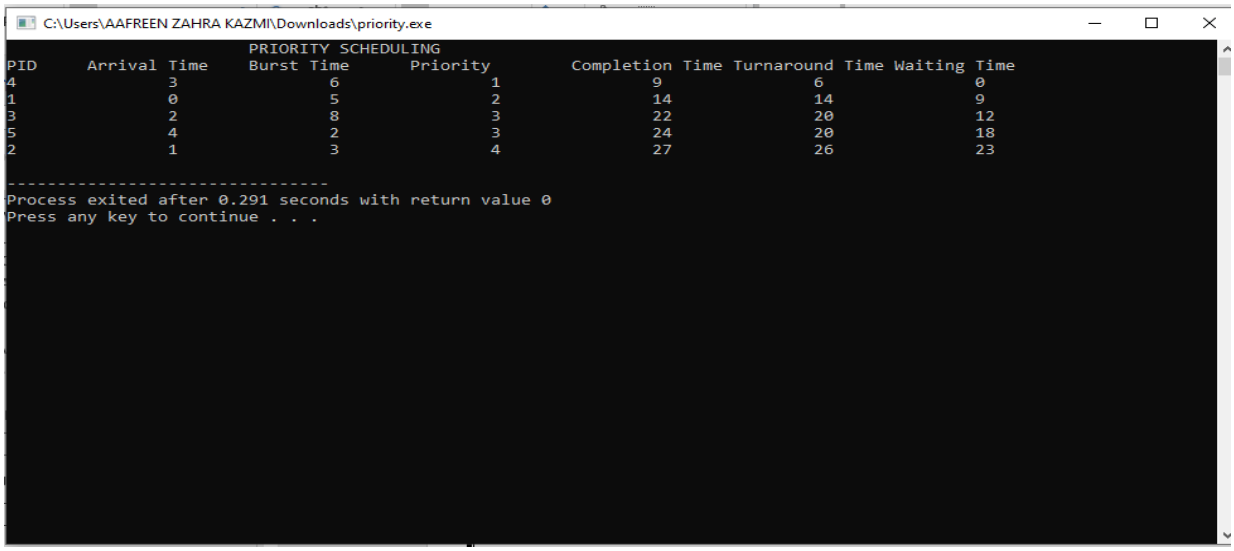


Figure 9.1

9.2. PS WITH SAME ARRIVAL TIME i.e. 0

Code

```
#include <iostream>
#include <algorithm>
using namespace std;
struct Process {
    int pid;            // Process ID
    int arrival_time;   // Arrival Time
    int burst_time;     // Burst Time
    int completion_time; // Completion Time
    int waiting_time;   // Waiting Time
    int turnaround_time; // Turnaround Time
    int priority;       // Priority (1 is the highest priority)
};
// Comparator function to sort processes based on priority and arrival time
bool compare(Process a, Process b) {
    if (a.priority == b.priority) {
        return a.arrival_time < b.arrival_time; // If priorities are the same, sort by arrival time
    }
    return a.priority < b.priority; // Sort by priority
}
void calculateCompletionTime(Process proc[], int n) {
    proc[0].completion_time = proc[0].arrival_time + proc[0].burst_time;
    for (int i = 1; i < n; i++) {
        if (proc[i].arrival_time > proc[i-1].completion_time) {
            proc[i].completion_time = proc[i].arrival_time + proc[i].burst_time;
        } else {
            proc[i].completion_time = proc[i-1].completion_time + proc[i].burst_time;
        }
    }}
```

```
void calculateTurnaroundTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
        proc[i].turnaround_time = proc[i].completion_time - proc[i].arrival_time;
    }
}
void calculateWaitingTime(Process proc[], int n) {
    for (int i = 0; i < n; i++) {
        proc[i].waiting_time = proc[i].turnaround_time - proc[i].burst_time;
    }
}
void priorityScheduling(Process proc[], int n) {
    // Sort processes based on priority and arrival time
    sort(proc, proc + n, compare);
    calculateCompletionTime(proc, n);
    calculateTurnaroundTime(proc, n);
    calculateWaitingTime(proc, n);
}
void printPrioritySchedule(Process proc[], int n) {
    cout << "\t\t\tPRIORITY SCHEDULING\t\t\t\n";
    cout << "PID\tArrival Time\tBurst Time\tPriority\tCompletion Time\tTurnaround Time\tWaiting Time\n";
    for (int i = 0; i < n; i++) {
        cout << proc[i].pid << "\t\t" << proc[i].arrival_time << "\t\t" << proc[i].burst_time << "\t\t" << proc[i].priority << "\t\t" << proc[i].completion_time << "\t\t" << proc[i].turnaround_time << "\t\t" << proc[i].waiting_time << "\n";
    }
}
int main() {
    int n = 5;
    Process proc[5] = {
        {1, 0, 5, 0, 0, 0, 2}, // {PID, Arrival Time, Burst Time, Priority}
```

```
        {2, 0, 3, 0, 0, 0, 4},
        {3, 0, 8, 0, 0, 0, 3},
        {4, 0, 6, 0, 0, 0, 1},
        {5, 0, 2, 0, 0, 0, 3}
    };
    // Perform Priority Scheduling
    priorityScheduling(proc, n);
    // Print the results
    printPriorityScheduleproc, n);
    return 0;
}
```

Output

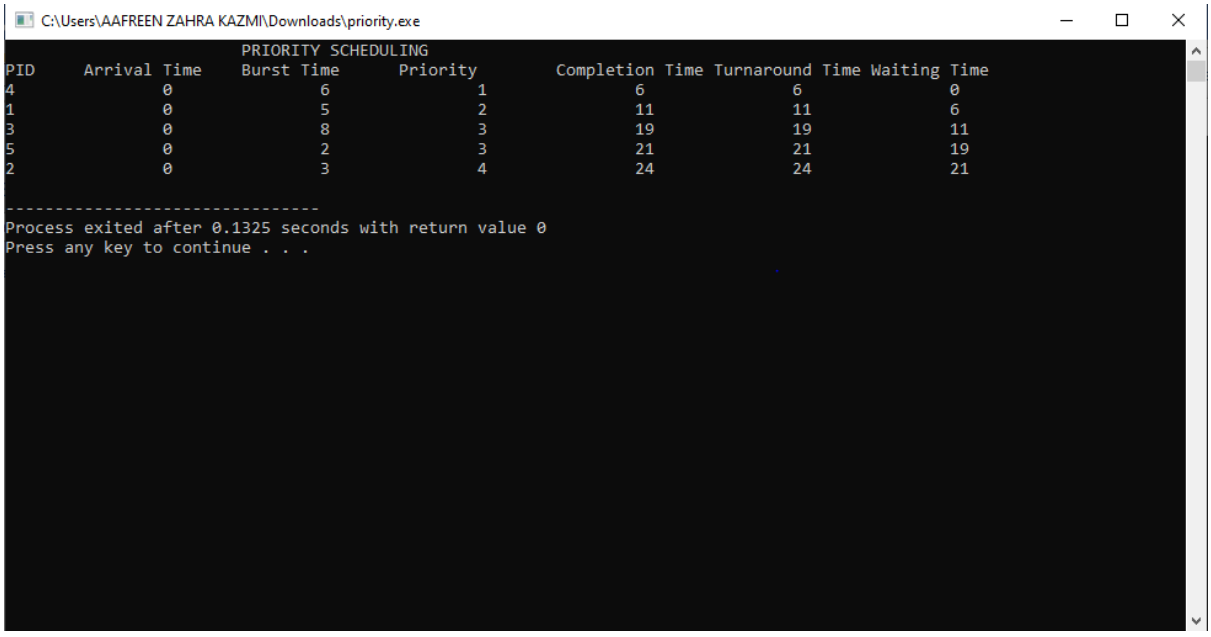


Figure 9.2

10. SHORTEST REMAINING TIME FIRST (PREMPTIVE) (SRTF)

Code

```
#include <iostream>
#include <climits>
using namespace std;
struct Process {
    int pid;            // Process ID
    int arrival_time;   // Arrival Time
    int burst_time;     // Burst Time
    int remaining_time; // Remaining Burst Time
    int completion_time; // Completion Time
    int waiting_time;   // Waiting Time
    int turnaround_time; // Turnaround Time
};
void calculateTimes(Process proc[], int n) {
    int time = 0; // Current time
    int completed = 0; // Number of processes completed
    int shortest_remaining_time;
    int idx;
    // Initialize remaining burst times
    for (int i = 0; i < n; i++) {
        proc[i].remaining_time = proc[i].burst_time;
    }
    while (completed != n) {
        idx = -1;
        shortest_remaining_time = INT_MAX;
        // Find the process with the shortest remaining burst time that has arrived
        for (int i = 0; i < n; i++) {
            if (proc[i].arrival_time <= time && proc[i].remaining_time > 0) {
                if (proc[i].remaining_time < shortest_remaining_time) {
                    shortest_remaining_time = proc[i].remaining_time;
                    idx = i;
```

```
            }
        }
    }
    if (idx != -1) {
        proc[idx].remaining_time--;
        time++;
        if (proc[idx].remaining_time == 0) {
            completed++;
            proc[idx].completion_time = time;
            proc[idx].turnaround_time = proc[idx].completion_time - proc[idx].arrival_time;
            proc[idx].waiting_time = proc[idx].turnaround_time - proc[idx].burst_time;
        }
    } else {
        time++;
    }
  }
}
void printSchedule(Process proc[], int n) {
  cout << "\t\t\tPREEMPTIVE SJF SCHEDULING\t\t\t\n";
  cout << "PID\tArrival Time\tBurst Time\tCompletion Time\tTurnaround Time\tWaiting Time\n";
  for (int i = 0; i < n; i++) {
    cout << proc[i].pid << "\t\t" << proc[i].arrival_time << "\t\t" << proc[i].burst_time << "\t\t" <<
proc[i].completion_time << "\t\t" << proc[i].turnaround_time << "\t\t" << proc[i].waiting_time <<
"\n";
  }
}
int main() {
  int n = 5;
  Process proc[5] = {
    {1, 0, 7, 0, 0, 0, 0}, // {PID, Arrival Time, Burst Time, Remaining Time, Completion Time,
Waiting Time, Turnaround Time}
    {2, 2, 4, 0, 0, 0, 0},
    {3, 4, 1, 0, 0, 0, 0},
```

```
        {4, 5, 4, 0, 0, 0, 0},
        {5, 6, 2, 0, 0, 0, 0}
    };
    // Calculate scheduling times
    calculateTimes(proc, n);
    // Print the schedule
    printSchedule(proc, n);
    return 0;
}
```

Output

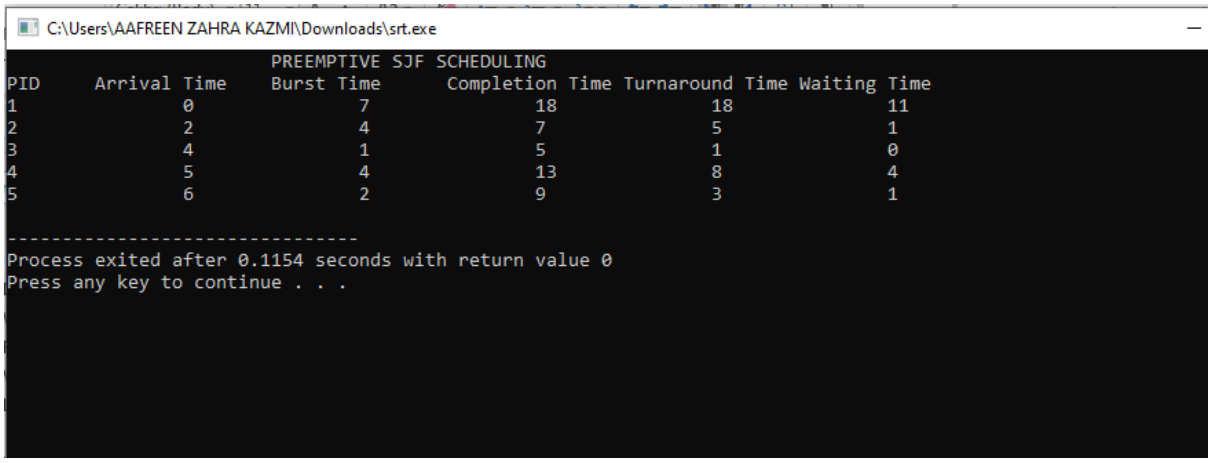


Figure 10

11. ROUND ROBIN (PREMPTIVE)

11.1. RR WITH SAME ARRIVAL TIME

Code

```
#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) {
    int rem_bt[n];
    for (int i = 0; i < n; i++)
        rem_bt[i] = bt[i];
    int t = 0; // Current time
    while (true) {
        bool done = true;
        // Traverse all processes one by one repeatedly
        for (int i = 0; i < n; i++) {
            if (rem_bt[i] > 0) {
                done = false; // There is a pending process
                if (rem_bt[i] > quantum) {
                    t += quantum;
                    rem_bt[i] -= quantum;
                } else {
                    t += rem_bt[i];
                    wt[i] = t - bt[i];
                    rem_bt[i] = 0;
                } }    }
        if (done) // If no process is left
            break;   }
}
// Function to calculate turn around time
void findTurnAroundTime(int processes[], int n, int bt[], int wt[], int tat[]) {
    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;
    findWaitingTime(processes, n, bt, wt, quantum);
    findTurnAroundTime(processes, n, bt, wt, tat);
    cout << "PN\tBT\tWT\tTAT\n";
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
        cout << " " << processes[i] << "\t" << bt[i] << "\t" << wt[i] << "\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() {
    int processes[] = {1, 2, 3};
    int n = sizeof(processes) / sizeof(processes[0]);

    int burst_time[] = {10, 5, 8};
    int quantum = 2;
    findavgTime(processes, n, burst_time, quantum);
    return 0;
}
```

Output

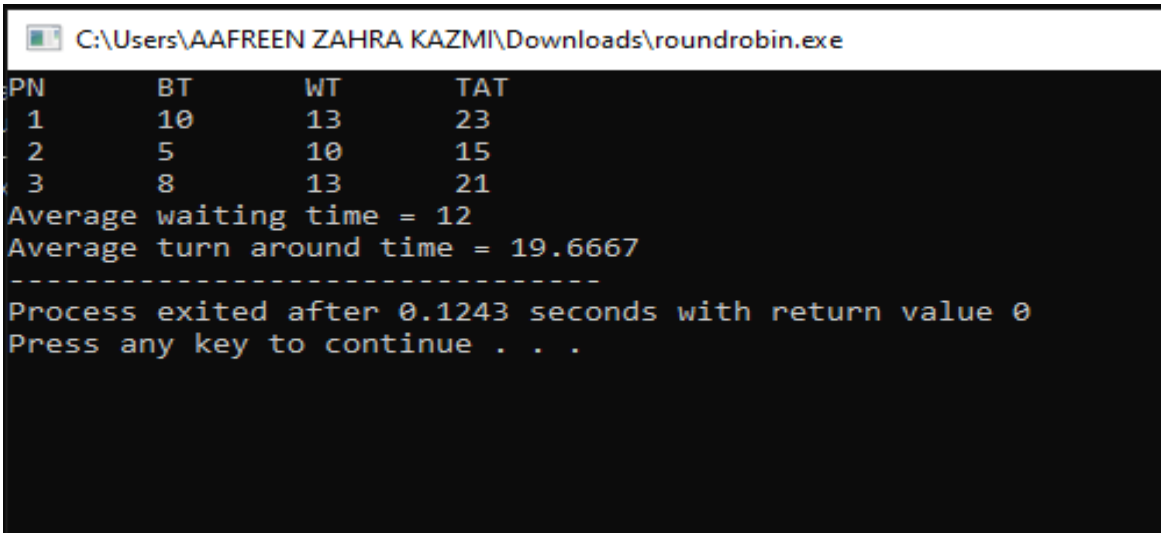


Figure 11.1

11.2. RR WITH DIFFERENT ARRIVAL TIME

Code

```
#include <iostream>
using namespace std;
struct Process {
    int pid;            // Process ID
    int arrival_time;   // Arrival Time
    int burst_time;     // Burst Time
    int remaining_time; // Remaining Burst Time
    int completion_time; // Completion Time
    int waiting_time;   // Waiting Time
    int turnaround_time; // Turnaround Time
};
// Function to find the waiting time for all processes
void findWaitingTime(Process proc[], int n, int quantum) {
    int t = 0; // Current time
    int rem_bt[n];
    int arrival[n];
    for (int i = 0; i < n; i++) {
        rem_bt[i] = proc[i].burst_time;
        arrival[i] = proc[i].arrival_time;
    }
    while (true) {
        bool done = true;
        for (int i = 0; i < n; i++) {
            if (arrival[i] <= t && rem_bt[i] > 0) {
                done = false;
                if (rem_bt[i] > quantum) {
                    t += quantum;
                    rem_bt[i] -= quantum;
                } else {
                    t += rem_bt[i];
```

```
                proc[i].waiting_time = t - proc[i].arrival_time - proc[i].burst_time;
                rem_bt[i] = 0;
            }
        }
    }
    if (done)
        break;
    bool all_arrived = true;
    for (int i = 0; i < n; i++) {
        if (arrival[i] > t) {
            all_arrived = false;
            break;
        }
    }
    if (!all_arrived) {
        t++;
    }
  }
}
// Function to calculate turn around time
void findTurnAroundTime(Process proc[], int n) {
  for (int i = 0; i < n; i++)
    proc[i].turnaround_time = proc[i].burst_time + proc[i].waiting_time;
}
// Function to calculate average time
void findavgTime(Process proc[], int n, int quantum) {
  findWaitingTime(proc, n, quantum);
  findTurnAroundTime(proc, n);
  cout << "PN\tArrival Time\tBurst Time\tWaiting Time\tTurnaround Time\n";
  int total_wt = 0, total_tat = 0;
  for (int i = 0; i < n; i++) {
    total_wt += proc[i].waiting_time;
```

```
        total_tat += proc[i].turnaround_time;
        cout << " " << proc[i].pid << "\t" << proc[i].arrival_time << "\t\t" << proc[i].burst_time << "\t\t"
<< proc[i].waiting_time << "\t\t" << proc[i].turnaround_time << endl;
    }
    cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
    cout << "\nAverage turnaround time = " << (float)total_tat / (float)n;
}
int main() {
    Process proc[] = {{1, 0, 10}, {2, 1, 5}, {3, 2, 8}};
    int n = sizeof(proc) / sizeof(proc[0]);
    int quantum = 2;
    findavgTime(proc, n, quantum);
    return 0;
}
```

Output

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads\roundrbindiffarrivaltime.exe
PN      Arrival Time    Burst Time      Waiting Time    Turnaround Time
 1      0               10              13              23
 2      1               5               9               14
 3      2               8               11              19

Average waiting time = 11
Average turnaround time = 18.6667
--------------------------------
Process exited after 0.2247 seconds with return value 0
Press any key to continue . . .
```

Figure 11.2

WEEK # 8

12. DEADLOCK DETECTION

12.1. SHOW IF THE SYSTEM IS IN DEADLOCK OR NOT?

CODE

```
#include <stdio.h>
int max[100][100];
int alloc[100][100];
int need[100][100];
int avail[100];
int n, r;
void input();
void show();
void cal();
int main() {
   printf("**Deadlock Detection Algorithm***\n");
   input();
   show();
   cal();
   return 0;
}
void input() {
   printf("Enter The No of processes: ");
   scanf("%d", &n);
   printf("Enter No of Resource Instances: ");
   scanf("%d", &r);
   printf("Enter The Max Matrix\n");
   for (int i = 0; i < n; i++) {
      for (int j = 0; j < r; j++) {
         scanf("%d", &max[i][j]);
      }
   }
   printf("Enter The Allocation Matrix\n");
   for (int i = 0; i < n; i++) {
      for (int j = 0; j < r; j++) {
```

```
            scanf("%d", &alloc[i][j]);
        }
    }
    printf("Enter The Available Resources\n");
    for (int j = 0; j < r; j++) {
        scanf("%d", &avail[j]);
    }
}
void show() {
    printf("Process\tAllocation\t\t Max\t\t\tAvailable\n");
    for (int i = 0; i < n; i++) {
        printf("%d\t", i + 1);
        for (int j = 0; j < r; j++) {
            printf("%d\t ", alloc[i][j]);
        }
        printf("\t");
        for (int j = 0; j < r; j++) {
            printf("%d \t", max[i][j]);
        }
        printf("\t");
        if (i == 0) {
            for (int j = 0; j < r; j++) {
                printf("%d \t", avail[j]);
            }
        }
        printf("\n");
    }
}
void cal() {
    int finish[100], dead[100];
    int flag = 1;
    int j = 0;
    // Initialize finish array to 0
    for (int i = 0; i < n; i++) {
```

```
    finish[i] = 0;
  }
  // Calculate the Need matrix
  for (int i = 0; i < n; i++) {
    for (int j = 0; j < r; j++) {
      need[i][j] = max[i][j] - alloc[i][j];
    }
  }
  // Deadlock detection algorithm
  while (flag) {
    flag = 0;
    for (int i = 0; i < n; i++) {
      int c = 0;
      for (int j = 0; j < r; j++) {
        if (finish[i] == 0 && need[i][j] <= avail[j]) {
          c++;
        }
      }
      if (c == r) {
        for (int k = 0; k < r; k++) {
          avail[k] += alloc[i][k];
        }
        finish[i] = 1;
        flag = 1;
      }
    }
  }
  // Check if there are any unfinished processes (deadlocked)
  for (int i = 0; i < n; i++) {
    if (finish[i] == 0) {
      dead[j] = i + 1; // Store the deadlocked process index
      j++;
    }
  }
```

```
    // Output the result
    if (j > 0) {
        printf("\n\nSystem Is In Deadlock. Processes Are:\n");
        for (int i = 0; i < j; i++) {
            printf("Process %d is deadlocked.\n", dead[i]);
        }
    } else {

printf("\nNo Deadlock Occurred.\n");
    }
}
```

OUTPUT

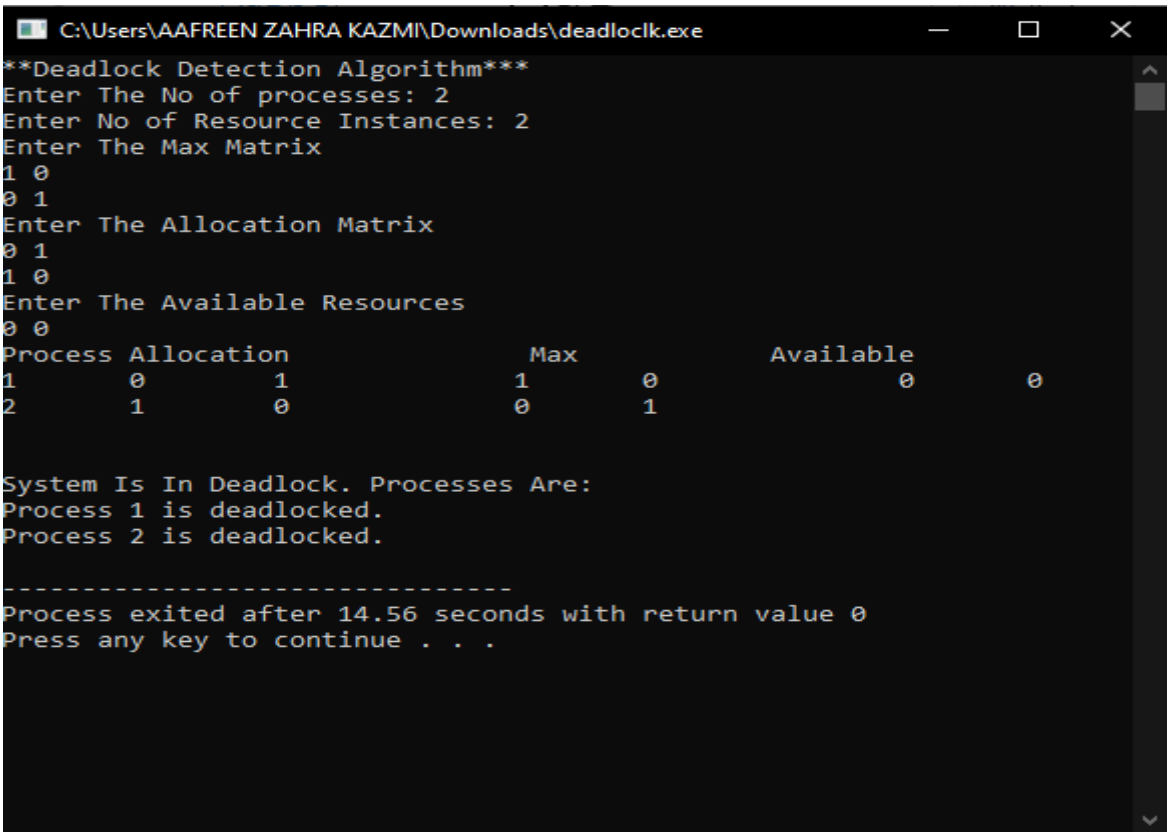


Figure 12.1

12.2. SHOW THE SYSTEM IS IN SAFE STATE AND PROCESS THE SEQUENCE OF THE PROCESS?

CODE

```
#include <stdio.h>
int max[100][100];
int alloc[100][100];
int need[100][100];
int avail[100];
int n, r;
void input();
void show();
void cal();
int main() {
   printf("**Deadlock Detection Algorithm***\n");
   input();
   show();
   cal();
   return 0;
}
void input() {
   printf("Enter The Number of Processes: ");
   scanf("%d", &n);
   printf("Enter Number of Resource Types: ");
   scanf("%d", &r);
   printf("Enter The Max Matrix:\n");
   for (int i = 0; i < n; i++) {
      for (int j = 0; j < r; j++) {
         scanf("%d", &max[i][j]);
      }
   }
   printf("Enter The Allocation Matrix:\n");
   for (int i = 0; i < n; i++) {
      for (int j = 0; j < r; j++) {
         scanf("%d", &alloc[i][j]);
```

```
        }
    }
    printf("Enter The Available Resources:\n");
    for (int j = 0; j < r; j++) {
        scanf("%d", &avail[j]);
    }
}
void show() {
    printf("Process\tAllocation\t\t Max\t\t\tAvailable\n");
    for (int i = 0; i < n; i++) {
        printf("P%d\t", i + 1);
        for (int j = 0; j < r; j++) {
            printf("%d ", alloc[i][j]);
        }
        printf("\t\t");
        for (int j = 0; j < r; j++) {
            printf("%d ", max[i][j]);
        }
        printf("\t\t");
        if (i == 0) {
            for (int j = 0; j < r; j++) {
                printf("%d ", avail[j]);
            }
        }
        printf("\n");
    }
}
void cal() {
    int finish[100] = {0};
    int safeSeq[100];
    int work[100];
    int index = 0;
  // Copy available resources to work array
    for (int i = 0; i < r; i++) {
```

```
    work[i] = avail[i];
  }
  // Calculate the Need matrix
  for (int i = 0; i < n; i++) {
    for (int j = 0; j < r; j++) {
      need[i][j] = max[i][j] - alloc[i][j];
    }
  }
  // Safety algorithm
  int count = 0;
  while (count < n) {
    int found = 0;
    for (int i = 0; i < n; i++) {
      if (!finish[i]) {
        int j;
        for (j = 0; j < r; j++) {
          if (need[i][j] > work[j]) {
            break;
          }
        }
        if (j == r) { // If all needs are satisfied
          for (int k = 0; k < r; k++) {
            work[k] += alloc[i][k];
          }
          safeSeq[index++] = i;
          finish[i] = 1;
          found = 1;
          count++;
        }
      }
    }

    if (!found) {
      printf("\nSystem is in Deadlock.\n");
```

```
            return;
        }
    }
    // If all processes are finished, output the safe sequence
    printf("\nSystem is in a Safe State.\nSafe Sequence: ");
    for (int i = 0; i < n; i++) {
        printf("P%d", safeSeq[i] + 1);
        if (i < n - 1) {
            printf(" -> ");
        }
    }
    printf("\n");
}
```

OUTPUT

```
C:\Users\AAFREEN ZAHRA KAZMI\Downloads\safestate.exe
**Deadlock Detection Algorithm***
Enter The Number of Processes: 5
Enter Number of Resource Types: 3
Enter The Max Matrix:
7 5 3
3 2 2
9 0 2
4 2 2
5 3 3
Enter The Allocation Matrix:
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter The Available Resources:
3 3 2
Process Allocation              Max                     Available
P1      0 1 0           7 5 3           3 3 2
P2      2 0 0           3 2 2
P3      3 0 2           9 0 2
P4      2 1 1           4 2 2
P5      0 0 2           5 3 3

System is in a Safe State.
Safe Sequence: P2 -> P4 -> P5 -> P1 -> P3

--------------------------------
Process exited after 42.61 seconds with return value 0
Press any key to continue . . .
```

Figure 12.2

WEEK # 9

13. THREADS

13.1. Write a C++ program to demonstrate basic single threading

CODE

```
#include <iostream>
#include <chrono>
#include <thread> // Used for simulating task duration
using namespace std;
void task1() {
    cout << "Task 1: Starting..." << endl;
    this_thread::sleep_for(chrono::seconds(2)); // Simulate a 2-second task
    cout << "Task 1: Completed!" << endl;
}
void task2() {
    cout << "Task 2: Starting..." << endl;
    this_thread::sleep_for(chrono::seconds(3)); // Simulate a 3-second task
    cout << "Task 2: Completed!" << endl;
}
int main() {
    cout << "Single-threaded program starting...\n" << endl;
    task1(); // Execute Task 1
    task2(); // Execute Task 2
    cout << "\nAll tasks completed in a single thread!" << endl;
    return 0;
}
```

OUTPUT

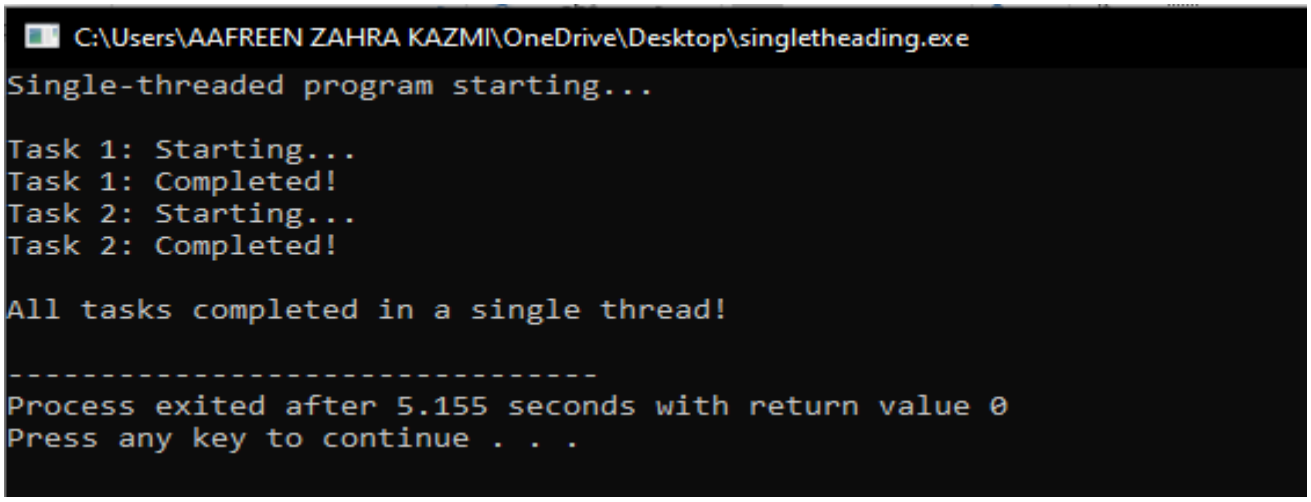


Figure 13.1.

13.2. Write a C++ program to demonstrate basic multi-threading.

CODE

```
#include <iostream>
#include <thread>
#include <chrono>
using namespace std;
void postUpdate(string username, string message) {
    cout << username << " is posting: " << message << endl;
    this_thread::sleep_for(chrono::seconds(2)); // Simulate time taken to post
    cout << username << " finished posting: " << message << endl;
}
int main() {
    cout << "Multi-threaded social media updates simulation starting...\n" << endl;
    // Create threads for different users posting updates
    thread user1(postUpdate, "Alice", "Hello, world!");
    thread user2(postUpdate, "Bob", "Loving the weather today!");
    thread user3(postUpdate, "Charlie", "Check out my latest photo!");
    // Wait for all threads to finish
    user1.join();
    user2.join();
    user3.join();
    cout << "\nAll users have finished posting their updates!" << endl;
```

```
    return 0;
}
```

OUTPUT

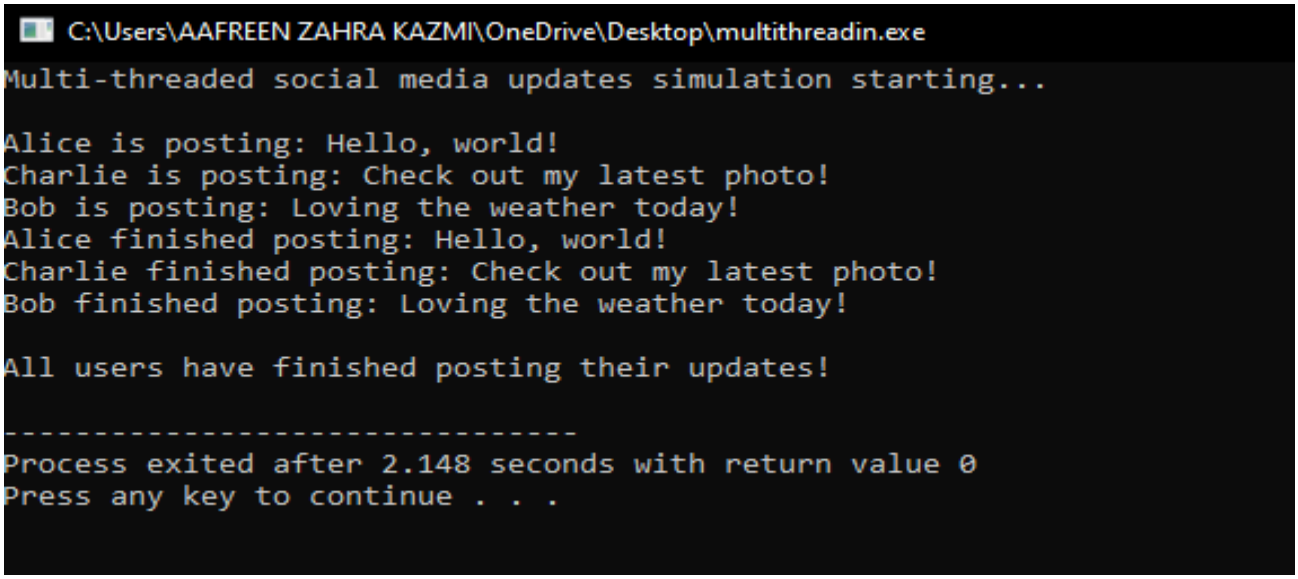


Figure 13.2

14. POSIX-THREAD

14.1. Write a C++ program to demonstrate basic single threading using P-Thread

CODE

```
#include <iostream>
#include <pthread.h>
#include <unistd.h> // For sleep function
using namespace std;
// Function to be executed by the thread
void* task(void* arg) {
    const char* taskName = (const char*)arg;
    cout << taskName << " is starting..." << endl;
    sleep(2); // Simulate task delay
    cout << taskName << " is completed!" << endl;
    return nullptr;
}
int main() {
    pthread_t thread; // Declare a thread identifier
    const char* taskName = "Task 1";
    cout << "Main thread: Creating a single thread for Task 1.\n";
    // Create a thread to execute the task function
    if (pthread_create(&thread, nullptr, task, (void*)taskName) != 0) {
        cerr << "Error: Failed to create the thread." << endl;
        return 1;
    }
    // Wait for the created thread to complete
    pthread_join(thread, nullptr);
    cout << "Main thread: Task 1 completed, exiting program." << endl;
    return 0;
}
```

OUTPUT

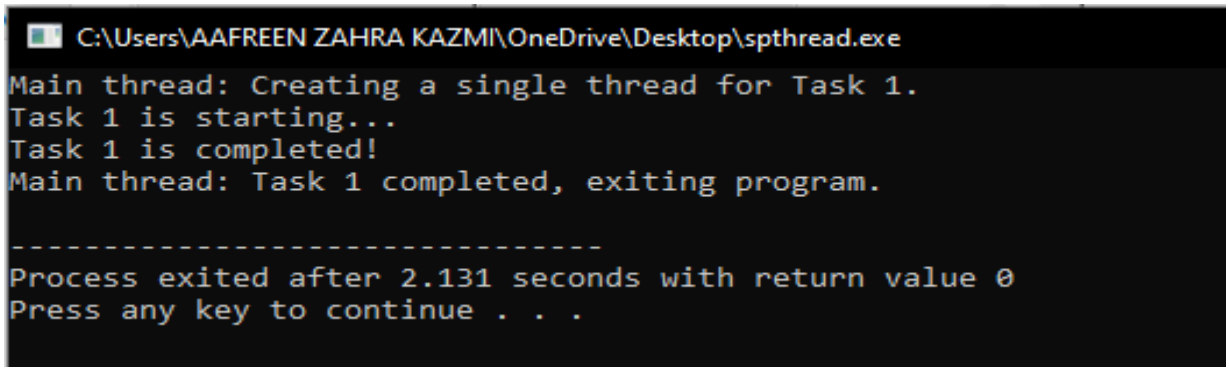


Figure 14.1

14.2. Write a C++ program to demonstrate basic multi-threading using P-Thread.

CODE

```
#include <iostream>
#include <pthread.h>
#include <unistd.h> // For sleep function
using namespace std;
// Function to simulate sending a message
void* sendMessage(void* arg) {
    const char* user = (const char*)arg;
    cout << user << " is sending a message..." << endl;
    sleep(2); // Simulate sending delay
    cout << user << " has sent the message!" << endl;
    return nullptr;
}
int main() {
    pthread_t threads[3]; // Array to hold thread identifiers
    const char* users[] = {"Alice", "Bob", "Charlie"};
    cout << "Simulating multi-threaded message sending...\n" << endl;
    // Create a thread for each user
    for (int i = 0; i < 3; i++) {
        if (pthread_create(&threads[i], nullptr, sendMessage, (void*)users[i]) != 0) {
            cerr << "Error: Failed to create thread for " << users[i] << endl;
            return 1;
        }
```

```
    }
    // Wait for all threads to complete
    for (int i = 0; i < 3; i++) {
        pthread_join(threads[i], nullptr);
    }
    cout << "\nAll users have completed sending their messages!" << endl;
    return 0;
}
```

OUTPUT

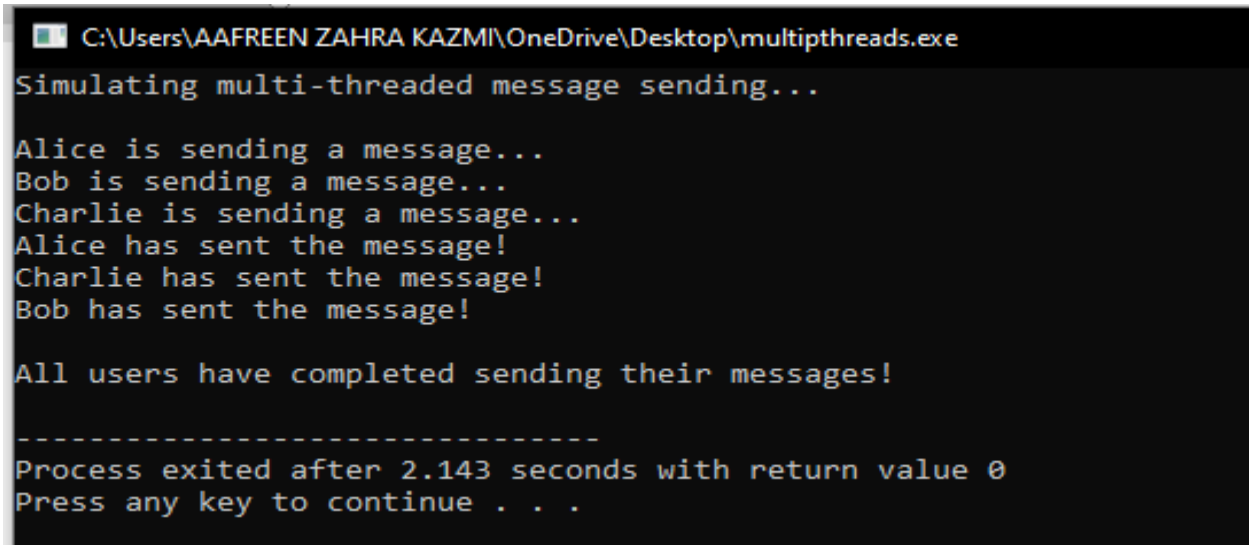


Figure 14.2

WEEK # 10

15. PAGE REPLACEMENT ALGORITHM

15.1. FIFO (FIRST IN FIRST OUT)

Code

```
#include <iostream>
#include <queue> // For FIFO management
using namespace std;
void fifoPageReplacement(int pages[], int n, int capacity) {
    int frames[capacity]; // Array to hold the pages in memory
    int currentSize = 0;  // Current size of the frames array
    int pageFaults = 0;   // Count of page faults
    int index = 0;        // Pointer for FIFO replacement
    // Initialize frames to -1 to indicate they are empty
    for (int i = 0; i < capacity; i++) {
        frames[i] = -1;
    }
    cout << "Page Reference | Frames Content | Page Fault" << endl;
    for (int i = 0; i < n; i++) {
        bool pageFound = false;
        // Check if the page is already in frames
        for (int j = 0; j < currentSize; j++) {
            if (frames[j] == pages[i]) {
                pageFound = true;
                break;
            }
        }
        // If the page is not found, replace using FIFO
        if (!pageFound) {
            frames[index] = pages[i]; // Replace the oldest page
```

```
            index = (index + 1) % capacity; // Move FIFO pointer
            pageFaults++;
            // Increment currentSize until frames are full
            if (currentSize < capacity) {
                currentSize++;
            }
            // Print page fault info
            cout << "    " << pages[i] << "          | ";
            for (int k = 0; k < currentSize; k++) {
                cout << frames[k] << " ";
            }
            for (int k = currentSize; k < capacity; k++) {
                cout << "- ";
            }
            cout << " | Yes" << endl;
        } else {
            // Print no page fault info
            cout << "    " << pages[i] << "          | ";
            for (int k = 0; k < currentSize; k++) {
                cout << frames[k] << " ";
            }
            for (int k = currentSize; k < capacity; k++) {
                cout << "- ";
            }
            cout << " | No" << endl;
        }
    }
    cout << "\nTotal Page Faults: " << pageFaults << endl;
```

```
}
int main() {
    int pages[] = {7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2}; // Page reference string
    int n = sizeof(pages) / sizeof(pages[0]); // Number of pages
    int capacity = 3; // Number of frames
    fifoPageReplacement(pages, n, capacity);
    return 0;
}
```

OUTPUT

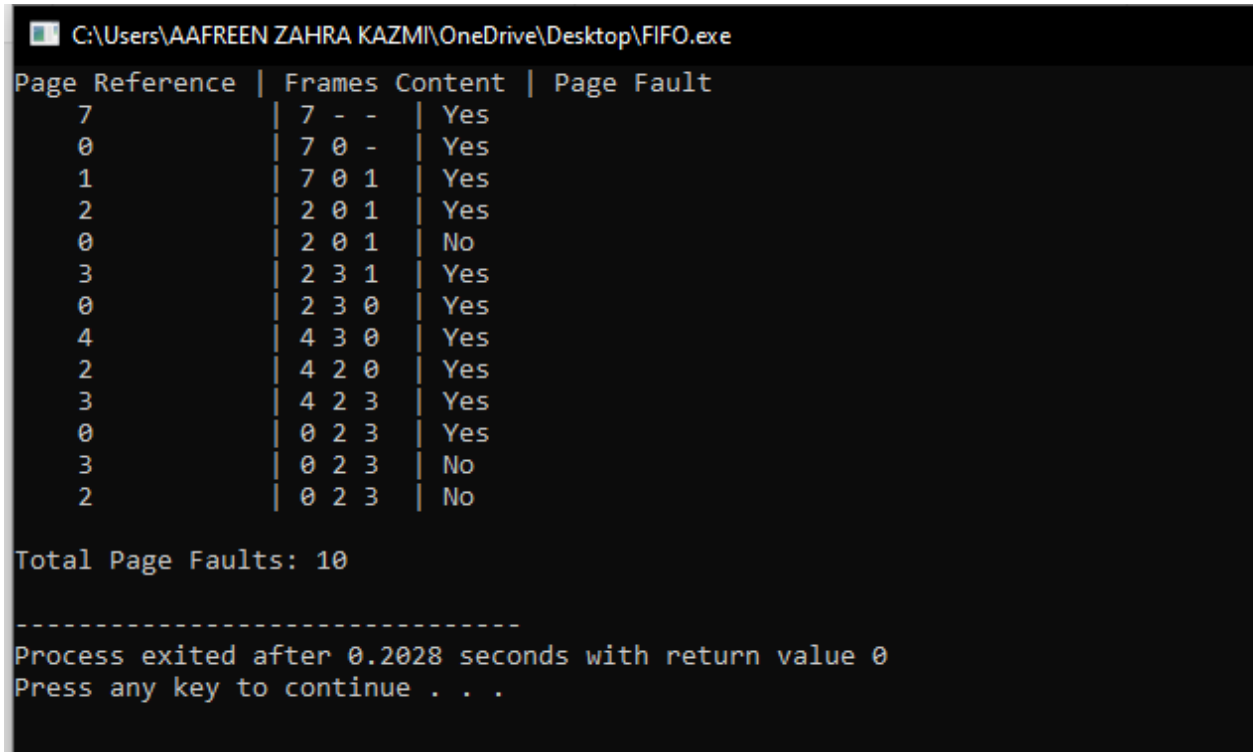


Figure 15.1

15.2. LRU (LEAST REACENTLY USED)

CODE

```
#include <iostream>
#include <unordered_map>
using namespace std;
int findLRU(int time[], int n) {
    int min_time = time[0], pos = 0;
    for (int i = 1; i < n; i++) {
        if (time[i] < min_time) {
            min_time = time[i];
            pos = i;
        }
    }
    return pos;
}
void lruPageReplacement(int pages[], int n, int capacity) {
    int frames[10], time[10];
    int page_faults = 0, count = 0;
    unordered_map<int, int> page_map; // To store page and its index
    for (int i = 0; i < capacity; i++) {
        frames[i] = -1; // Initialize frame slots to -1
    }
    cout << "Page Frames Status:\n";
    for (int i = 0; i < n; i++) {
        int found = 0;
        // Check if the page is already in the frames
        for (int j = 0; j < capacity; j++) {
            if (frames[j] == pages[i]) {
```

```
            found = 1;
            time[j] = count++; // Update access time
            break;
        }
    }
    if (!found) {
        // Find position to replace
        int replace_idx = (i < capacity) ? i : findLRU(time, capacity);
        page_map.erase(frames[replace_idx]); // Remove old page from map
        frames[replace_idx] = pages[i];     // Replace with the new page
        time[replace_idx] = count++;        // Update access time
        page_map[pages[i]] = replace_idx;   // Add new page to map
        page_faults++;
    }

    // Display current frame state
    for (int j = 0; j < capacity; j++) {
        if (frames[j] == -1)
            cout << "- ";
        else
            cout << frames[j] << " ";
    }
    cout << endl;
  }

  cout << "\nTotal Page Faults: " << page_faults << endl;
}
int main() {
```

```
    int pages[] = {7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0};
    int n = sizeof(pages) / sizeof(pages[0]);
    int capacity;
    cout << "Enter the number of frames: ";
    cin >> capacity;
    lruPageReplacement(pages, n, capacity);
    return 0;
}
```

OUTPUT

```
C:\Users\AAFREEN ZAHRA KAZMI\OneDrive\Desktop\LRU.exe
Enter the number of frames: 4
Page Frames Status:
7 - - -
7 0 - -
7 0 1 -
7 0 1 2
7 0 1 2
3 0 1 2
3 0 1 2
3 0 4 2
3 0 4 2
3 0 4 2
3 0 4 2
3 0 4 2
3 0 4 2
3 0 1 2
3 0 1 2
3 0 1 2

Total Page Faults: 7

--------------------------------
Process exited after 1.558 seconds with return value 0
Press any key to continue . . .
```

Figure 15.2

15.3. OPTIMAL PAGE REPLACEMENT

CODE

```
#include <iostream>
using namespace std;
int predict(int pages[], int frames[], int n, int frame_count, int current_index) {
    int farthest = current_index, pos = -1;
    for (int i = 0; i < frame_count; i++) {
        int j;
        for (j = current_index; j < n; j++) {
            if (frames[i] == pages[j]) {
                if (j > farthest) {
                    farthest = j;
                    pos = i;
                }
                break;
            }
        }
        if (j == n) return i; // If not found in future
    }
    return (pos == -1) ? 0 : pos;
}

void optimalPageReplacement(int pages[], int n, int frame_count) {
    int frames[10], page_faults = 0;
    for (int i = 0; i < frame_count; i++) frames[i] = -1;

    cout << "Page Frames Status:\n";
    for (int i = 0; i < n; i++) {
```

```
        int found = 0;
        // Check if the page is already in the frames
        for (int j = 0; j < frame_count; j++) {
            if (frames[j] == pages[i]) {
                found = 1;
                break;
            }
        }
        if (!found) {
            // Find the frame to replace
            int replace_idx = (i < frame_count) ? i : predict(pages, frames, n, frame_count, i);
            frames[replace_idx] = pages[i];
            page_faults++;
        }
        // Display the current state of the frames
        for (int j = 0; j < frame_count; j++) {
            if (frames[j] == -1) cout << "- ";
            else cout << frames[j] << " ";
        }
        cout << endl;
    }
    cout << "\nTotal Page Faults: " << page_faults << endl;
}
int main() {
    int pages[] = {7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0};
    int n = sizeof(pages) / sizeof(pages[0]);
    int frame_count;
```

```
    cout << "Enter the number of frames: ";
    cin >> frame_count;
    optimalPageReplacement(pages, n, frame_count);
    return 0;
}
```

OUTPUT

Figure 15.3

WEEK # 11

16. FRAGMENTATION

16.1. FIRST-FIT

CODE

```
#include <iostream>
using namespace std;
void firstFit(int blockSizes[], int m, int processSizes[], int n) {
    int allocation[n]; // To store block assigned to each process
    for (int i = 0; i < n; i++) allocation[i] = -1; // Initialize all allocations to -1
    for (int i = 0; i < n; i++) { // Iterate over each process
        for (int j = 0; j < m; j++) { // Find the first suitable block
            if (blockSizes[j] >= processSizes[i]) {
                allocation[i] = j; // Assign block to process
                blockSizes[j] -= processSizes[i]; // Reduce available size of block
                break;
            }
        }
    }
    // Output results
    cout << "Process No.\tProcess Size\tBlock No.\n";
    for (int i = 0; i < n; i++) {
        cout << i + 1 << "\t\t" << processSizes[i] << "\t\t";
        if (allocation[i] != -1)
            cout << allocation[i] + 1 << endl;
        else
            cout << "Not Allocated" << endl;
    }
}
```

```
int main() {
    int blockSizes[] = {100, 500, 200, 300, 600};
    int processSizes[] = {212, 417, 112, 426};
    int m = sizeof(blockSizes) / sizeof(blockSizes[0]);
    int n = sizeof(processSizes) / sizeof(processSizes[0]);

    firstFit(blockSizes, m, processSizes, n);
    return 0;
}
```

OUTPUT

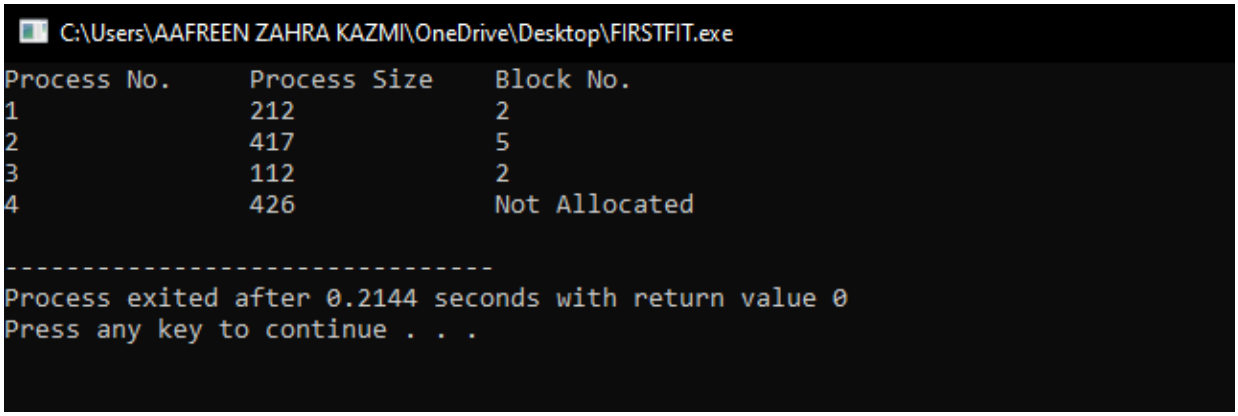


Figure 16.1

16.2. WORST-FIT

CODE

```
#include <iostream>
using namespace std;
void worstFit(int blockSizes[], int m, int processSizes[], int n) {
    int allocation[n]; // To store block assigned to each process
    for (int i = 0; i < n; i++) allocation[i] = -1; // Initialize all allocations to -1

    for (int i = 0; i < n; i++) { // Iterate over each process
        int worstIndex = -1;
```

```
        // Find the worst-fit block
        for (int j = 0; j < m; j++) {
            if (blockSizes[j] >= processSizes[i]) {
                if (worstIndex == -1 || blockSizes[j] > blockSizes[worstIndex]) {
                    worstIndex = j;
                }
            }
        }
        // If a suitable block was found, allocate it
        if (worstIndex != -1) {
            allocation[i] = worstIndex;
            blockSizes[worstIndex] -= processSizes[i];
        }
    }

    // Output results
    cout << "Process No.\tProcess Size\tBlock No.\n";
    for (int i = 0; i < n; i++) {
        cout << i + 1 << "\t\t" << processSizes[i] << "\t\t";
        if (allocation[i] != -1)
            cout << allocation[i] + 1 << endl;
        else
            cout << "Not Allocated" << endl;
    }
}
int main() {
    int blockSizes[] = {100, 500, 200, 300, 600};
    int processSizes[] = {212, 417, 112, 426};
```

```
    int m = sizeof(blockSizes) / sizeof(blockSizes[0]);
    int n = sizeof(processSizes) / sizeof(processSizes[0]);
    worstFit(blockSizes, m, processSizes, n);
    return 0;
}
```

OUTPUT

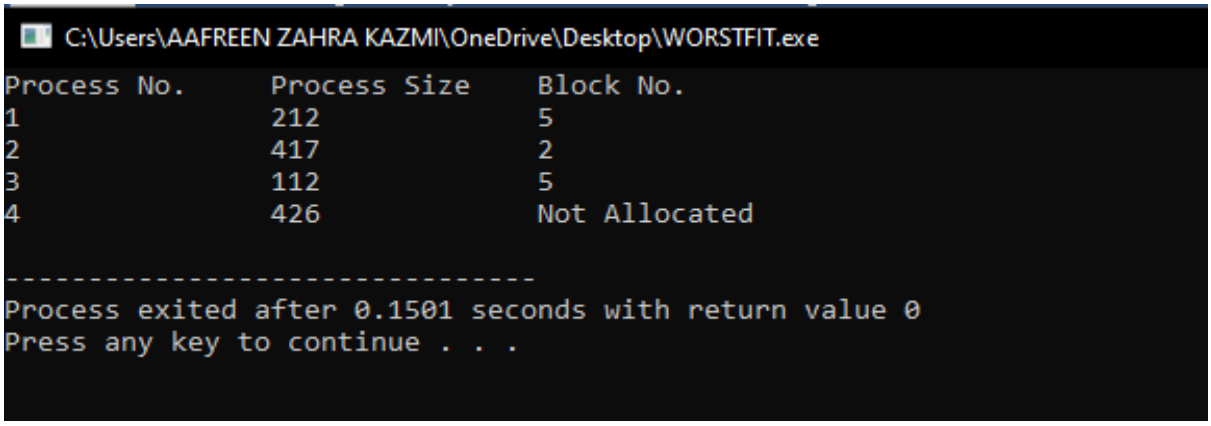


Figure 16.2

16.3. BEST-FIT

CODE

```
#include <iostream>
using namespace std;
void bestFit(int blockSizes[], int m, int processSizes[], int n) {
    int allocation[n]; // To store block assigned to each process
    for (int i = 0; i < n; i++) allocation[i] = -1; // Initialize all allocations to -1
    for (int i = 0; i < n; i++) { // Iterate over each process
        int bestIndex = -1;
        // Find the best-fit block
        for (int j = 0; j < m; j++) {
            if (blockSizes[j] >= processSizes[i]) {
                if (bestIndex == -1 || blockSizes[j] < blockSizes[bestIndex]) {
                    bestIndex = j;
                }
```

```
            }
        }
        // If a suitable block was found, allocate it
        if (bestIndex != -1) {
            allocation[i] = bestIndex;
            blockSizes[bestIndex] -= processSizes[i];
        }
    }
    // Output results
    cout << "Process No.\tProcess Size\tBlock No.\n";
    for (int i = 0; i < n; i++) {
        cout << i + 1 << "\t\t" << processSizes[i] << "\t\t";
        if (allocation[i] != -1)
            cout << allocation[i] + 1 << endl;
        else
            cout << "Not Allocated" << endl;
    }
}
int main() {
    int blockSizes[] = {100, 500, 200, 300, 600};
    int processSizes[] = {212, 417, 112, 426};
    int m = sizeof(blockSizes) / sizeof(blockSizes[0]);
    int n = sizeof(processSizes) / sizeof(processSizes[0]);
    bestFit(blockSizes, m, processSizes, n);
    return 0;}
```

OUTPUT

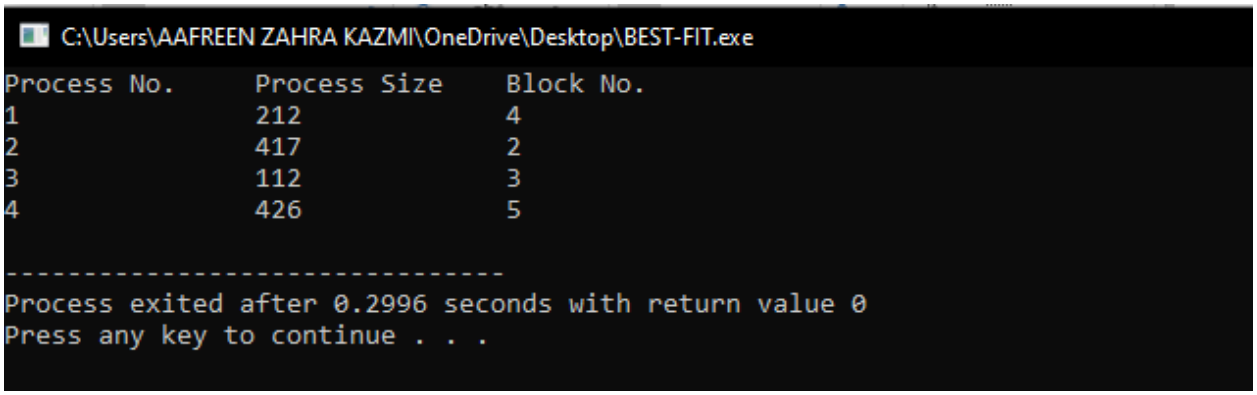


Figure 11.3

WEEK # 12

17. IPC(INTER PROCESS COMMUNICATION)

17.1. WRITER PROCESS

CODE

```
#include <iostream>
#include <sys/ipc.h>
#include <sys/msg.h>
#include <cstring>
#include <cstdio>
using namespace std;
// Structure for message queue
struct mesg_buffer {
    long mesg_type;
    char mesg_text[100];
};
int main() {
    key_t key;
    int msgid;
    // Generate unique key using ftok
    key = ftok("progfile", 65);
    // Create or access the message queue
    msgid = msgget(key, 0666 | IPC_CREAT);
    if (msgid == -1) {
        perror("msgget failed");
        return 1;
    }
    mesg_buffer message;
    message.mesg_type = 1;
    // Input data to send
```

```
    cout << "Write Data: ";
    cin.getline(message.mesg_text, sizeof(message.mesg_text));
    // Send message using msgsnd
    if (msgsnd(msgid, &message, sizeof(message), 0) == -1) {
        perror("msgsnd failed");
        return 1;
    }
    cout << "Data sent: " << message.mesg_text << endl;
    return 0;
}
```

OUTPUT

```
Output
Write Data: HLO I AM AAFREEN
Data sent: HLO I AM AAFREEN


=== Code Execution Successful ===
```

Figure 17.1

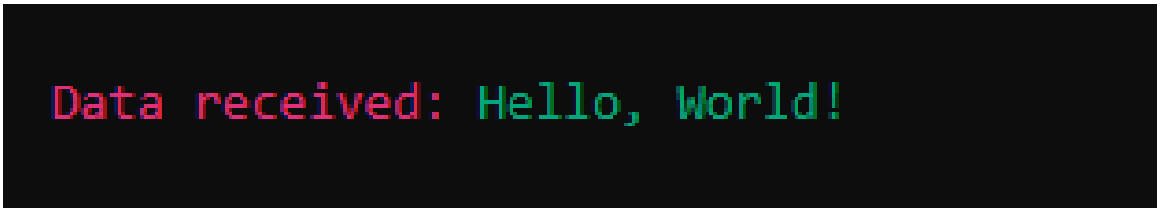
17.2. READER PROCESS

CODE

```
#include <iostream>
#include <sys/ipc.h>
#include <sys/msg.h>
#include <cstring>
#include <cstdio>
using namespace std;
// Structure for message queue
struct mesg_buffer {
    long mesg_type;
    char mesg_text[100];
};
int main() {
    key_t key;
    int msgid;
    // Generate unique key using ftok
    key = ftok("progfile", 65);
    // Get the message queue identifier
    msgid = msgget(key, 0666 | IPC_CREAT);
    if (msgid == -1) {
        perror("msgget failed");
        return 1;
    }
    mesg_buffer message;
   // Receive the message from the queue
    if (msgrcv(msgid, &message, sizeof(message), 1, 0) == -1) {
        perror("msgrcv failed");
```

```
        return 1;
    }
    cout << "Data received: " << message.mesg_text << endl;
    // Remove the message queue
    if (msgctl(msgid, IPC_RMID, NULL) == -1) {
        perror("msgctl failed to remove queue");
        return 1;
    }
    return 0;
}
```

OUTPUT



WEEK # 13

18. DINING PHILOSOPHER PROBLEM

CODE

```
#include <iostream>
#include <thread>
#include <mutex>
#include <condition_variable>
#define N 5
#define THINKING 2
#define HUNGRY 1
#define EATING 0
#define LEFT (phnum + 4) % N
#define RIGHT (phnum + 1) % N

int state[N];
int phil[N] = { 0, 1, 2, 3, 4 };

std::mutex mutex;
std::condition_variable S[N];

void test(int phnum)
{
   if (state[phnum] == HUNGRY
      && state[LEFT] != EATING
      && state[RIGHT] != EATING) {
      // state that eating
      state[phnum] = EATING;

      std::this_thread::sleep_for(std::chrono::milliseconds(2000));
```

```
        std::cout << "Philosopher " << phnum + 1 << " takes fork " << LEFT + 1 << " and " << phnum + 1
<< std::endl;
        std::cout << "Philosopher " << phnum + 1 << " is Eating" << std::endl;

        // notify the philosopher that he can start eating
        S[phnum].notify_all();
    }
}

// take up chopsticks
void take_fork(int phnum)
{
    std::unique_lock<std::mutex> lock(mutex);

    // state that hungry
    state[phnum] = HUNGRY;

    std::cout << "Philosopher " << phnum + 1 << " is Hungry" << std::endl;

    // eat if neighbours are not eating
    test(phnum);

    // if unable to eat wait to be signalled
    S[phnum].wait(lock);

    std::this_thread::sleep_for(std::chrono::milliseconds(1000));
}

// put down chopsticks
void put_fork(int phnum)
{
```

```
    std::unique_lock<std::mutex> lock(mutex);

    // state that thinking
    state[phnum] = THINKING;

    std::cout << "Philosopher " << phnum + 1 << " putting fork " << LEFT + 1 << " and " << phnum + 1
<< " down" << std::endl;
    std::cout << "Philosopher " << phnum + 1 << " is thinking" << std::endl;
    test(LEFT);
    test(RIGHT);
}
void philosopher(int num)
{
    while (true) {
        take_fork(num);
        put_fork(num);
    }
}
int main()
{
    std::thread threads[N];

    for (int i = 0; i < N; i++) {
        threads[i] = std::thread(philosopher, i);
        std::cout << "Philosopher " << i + 1 << " is thinking" << std::endl;
    }
    for (int i = 0; i < N; i++)
        threads[i].join();
    return 0;
}
```

OUTPUT

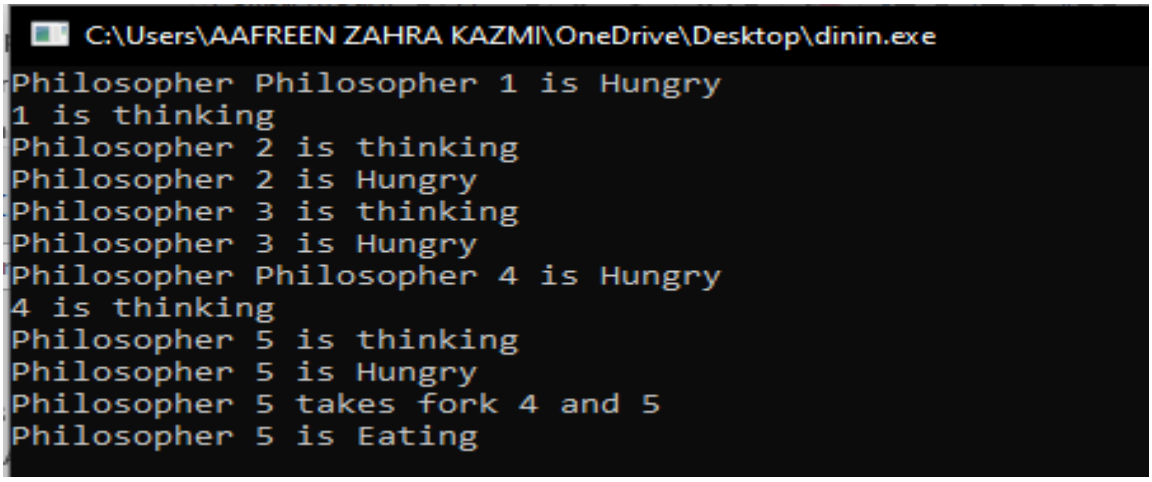


Figure 18

WEEK # 14

19. ZOMBIE PROCESS

CODE

```
#include <iostream>
#include <windows.h> // For Windows API functions
using namespace std;
int main() {
    // Create a child process
    PROCESS_INFORMATION processInfo;
    STARTUPINFO startupInfo;
    ZeroMemory(&startupInfo, sizeof(startupInfo));
    startupInfo.cb = sizeof(startupInfo);
    ZeroMemory(&processInfo, sizeof(processInfo));
    // Simulate creating a child process
    if (CreateProcess(NULL, (LPSTR)"notepad.exe", NULL, NULL, FALSE, 0, NULL,
NULL, &startupInfo, &processInfo)) {
        cout << "Parent process (PID: " << GetCurrentProcessId() << ") created a child process
(PID: " << processInfo.dwProcessId << ")." << endl;


        // Simulate not cleaning up the child immediately (zombie-like state)
        cout << "Parent process is sleeping for 5 seconds..." << endl;
        Sleep(5000);
        // Now parent cleans up the child process
        cout << "Parent process cleaning up child process." << endl;
        CloseHandle(processInfo.hProcess);
        CloseHandle(processInfo.hThread);
    } else {
        cerr << "Failed to create child process." << endl;
    }
    return 0;
}
```

OUTPUT

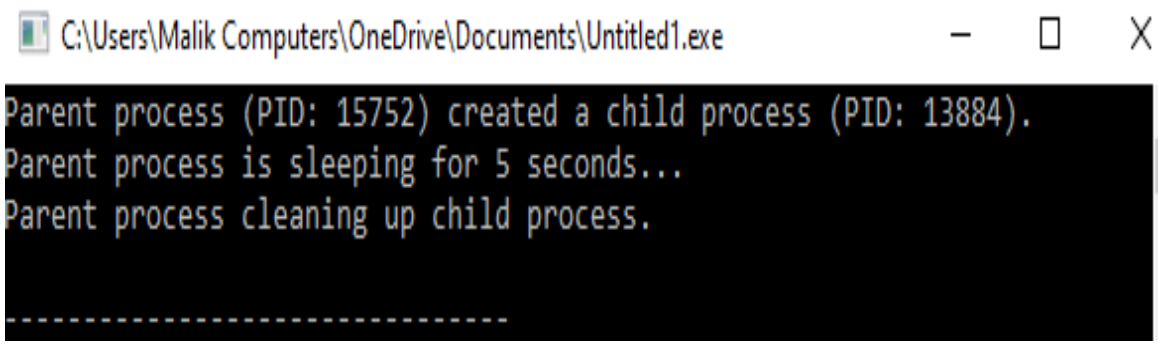


Figure 19

20. ORPHAN PROCESS

CODE

```
#include <iostream>
#include <windows.h> // For Windows API functions
using namespace std;


int main() {
    // Create a child process
    PROCESS_INFORMATION processInfo;
    STARTUPINFO startupInfo;
    ZeroMemory(&startupInfo, sizeof(startupInfo));
    startupInfo.cb = sizeof(startupInfo);
    ZeroMemory(&processInfo, sizeof(processInfo));


    // Simulate creating a child process
    if (CreateProcess(NULL, (LPSTR)"notepad.exe", NULL, NULL, FALSE, 0, NULL,
NULL, &startupInfo, &processInfo)) {
        cout << "Parent process (PID: " << GetCurrentProcessId() << ") created a child process
(PID: " << processInfo.dwProcessId << ")." << endl;


        // Simulate parent exiting immediately (orphan-like behavior)
        cout << "Parent process exiting now, leaving the child process running." << endl;
        ExitProcess(0); // Parent exits
    } else {
        cerr << "Failed to create child process." << endl;
    }
    return 0;
}
```

OUTPUT

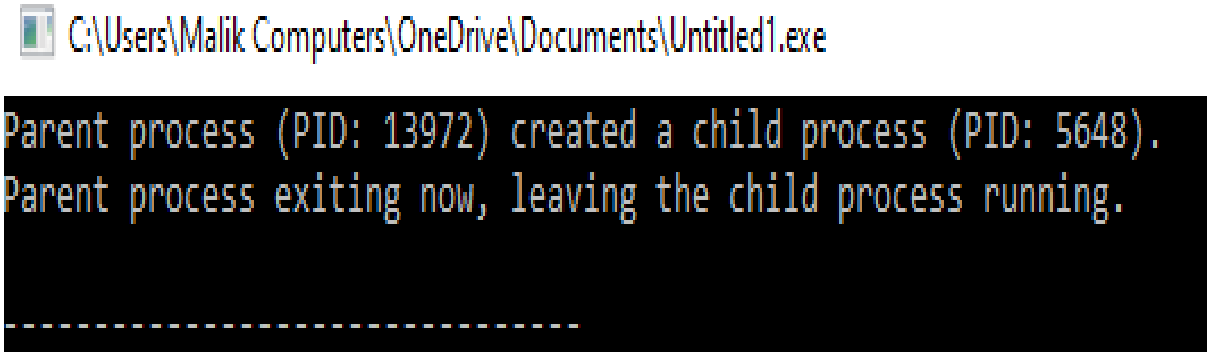


Figure 20

****