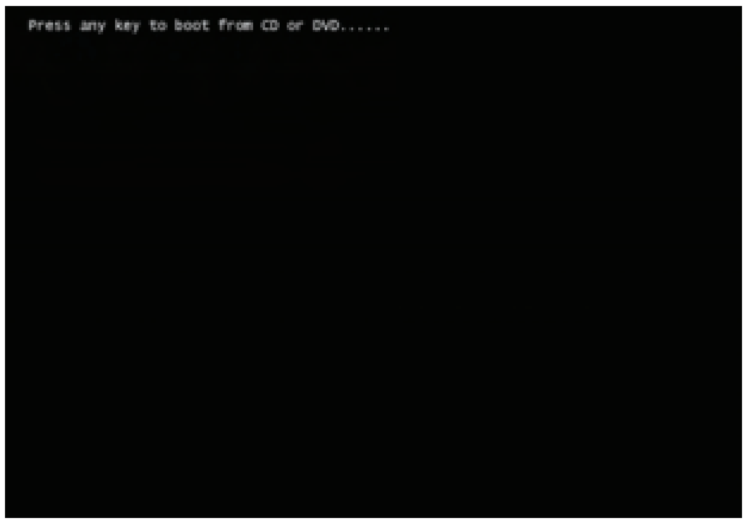
Ex.no 1 Installation of windows operating system

Aim:

To perform a clean installation of Windows 10

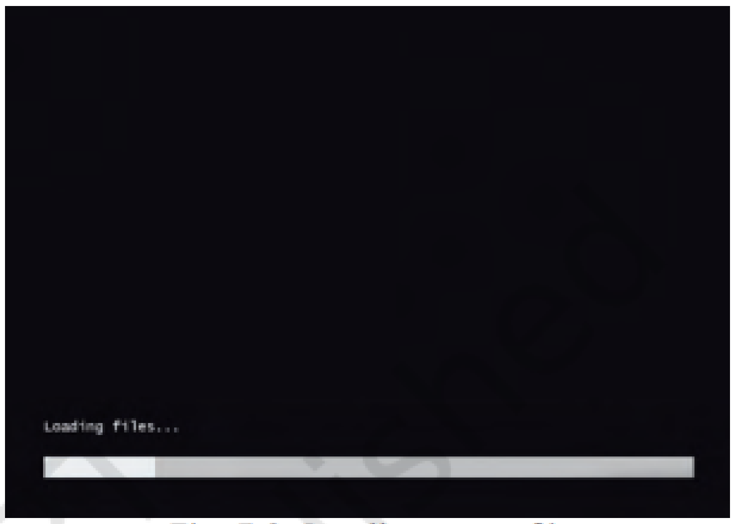
Procedure:

1) Insert a bootable media DVD or USB pen drive in your computer system, and press any key to boot from the bootable disk as shown in Figure 5.2. Let the disk allow the loading of the setup file as shown in Figure 5.3. Follow the steps below for clean installation of Windows 10.



```
Press any key to boot from CD or DVD......
```

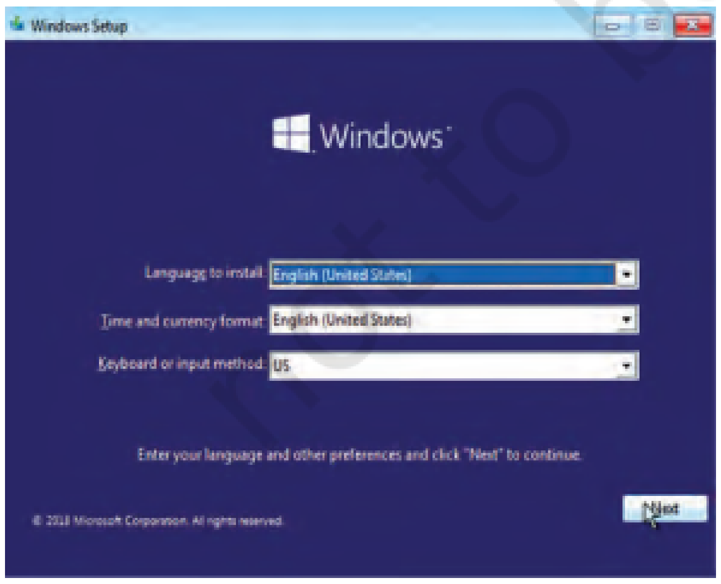
Fig. 5.2: Press any key for booting



```
Loading files...
```

Fig. 5.3: Loading setup file

2) Insert a bootable media DVD or USB pen drive in your computer system. Provide the details of language, time zone, and keyboard layout as shown in Figure 5.4. Then click on the 'Next' button.
3) Click the 'Install now' button as shown in Figure 5.5.



Windows Setup

Language to install: English (United States)

Time and currency format: English (United States)

Keyboard or input method: US

Enter your language and other preferences and click "Next" to continue.

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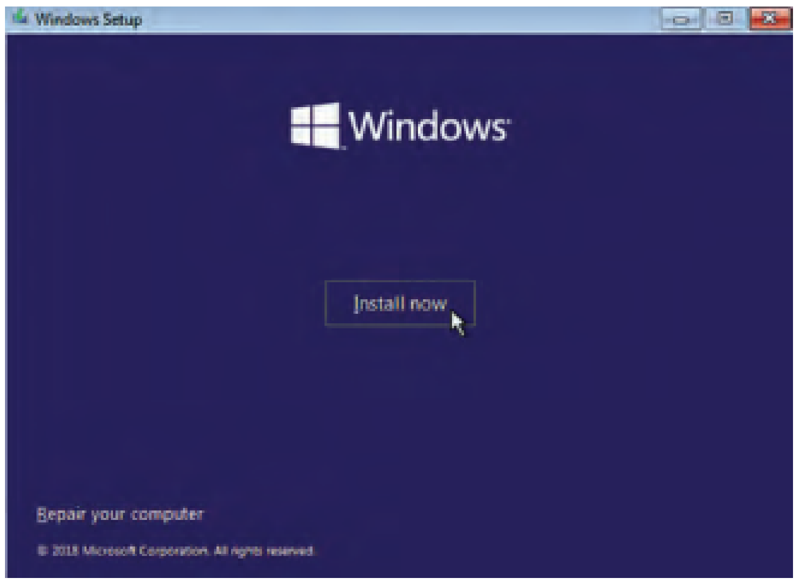
Fig. 5.4: Select language, time, and currency



Windows Setup

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Fig. 5.5: Installation window and input

4) In the next window, you will be asked to enter the product key. Enter it and click on the 'Next' button to proceed. In case you don't have the product key currently, then you can skip to enter the product key by clicking on the option 'I don't have a product key' to continue the installation as shown in Figure 5.7 below.

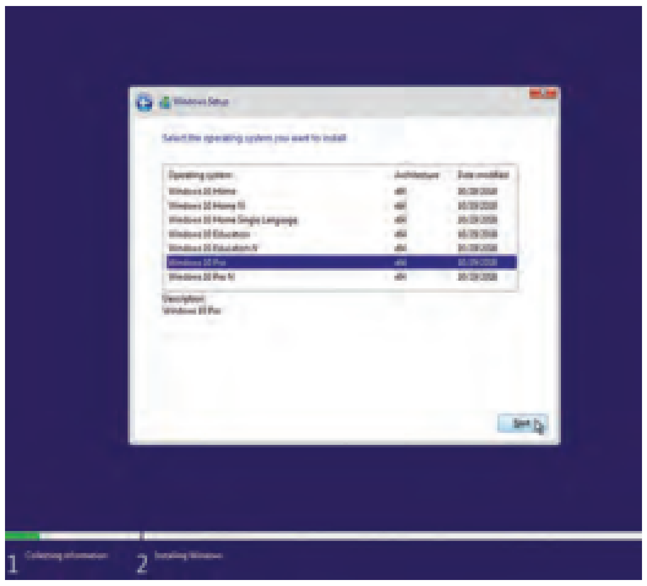


Fig. 5.6: Collecting information

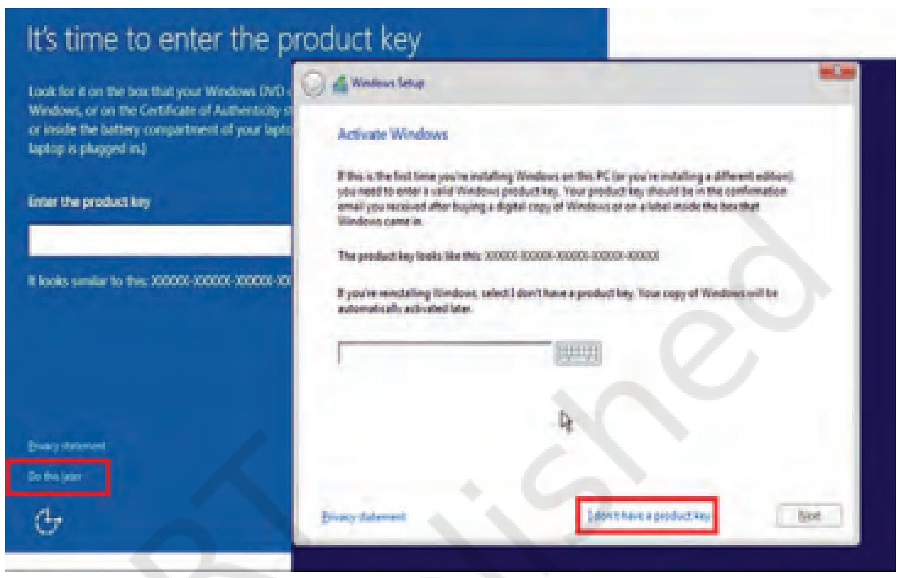


Fig. 5.7: Product key window

5) A new window as shown in Figure 5.8 will appear where you have to accept the licence terms by putting the tick ('I accept the license terms') on the checkbox
6) Click the 'Next' button as shown in Figure 5.8.
7) Click on the 'Custom: Install Windows only (advanced)' option as shown in Figure 5.9.

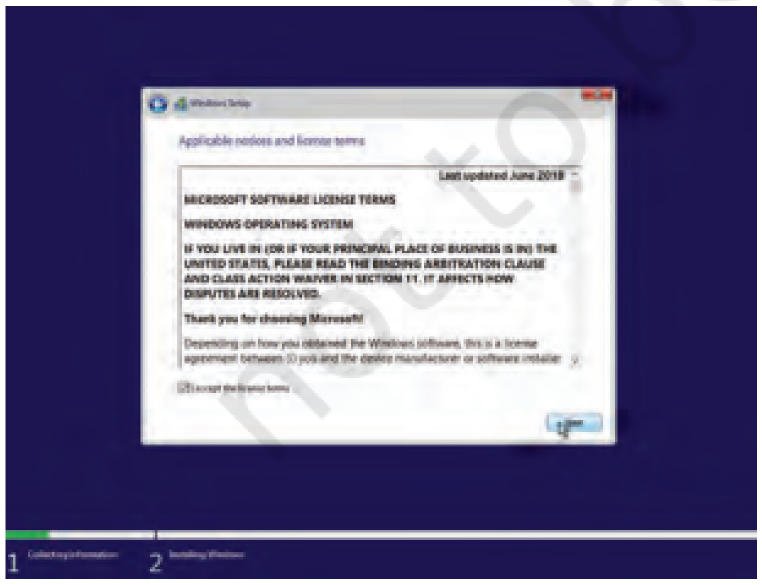

Windows Setup
Applicable notices and license terms
MICROSOFT SOFTWARE LICENSE TERMS
WINDOWS OPERATING SYSTEM
I accept the license terms
Next
1 Collecting information
2 Installing Windows

Fig. 5.8: License terms

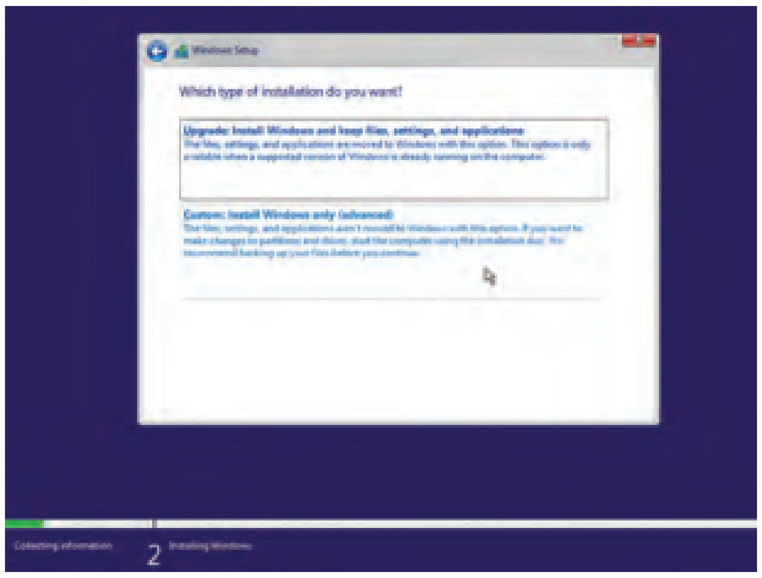
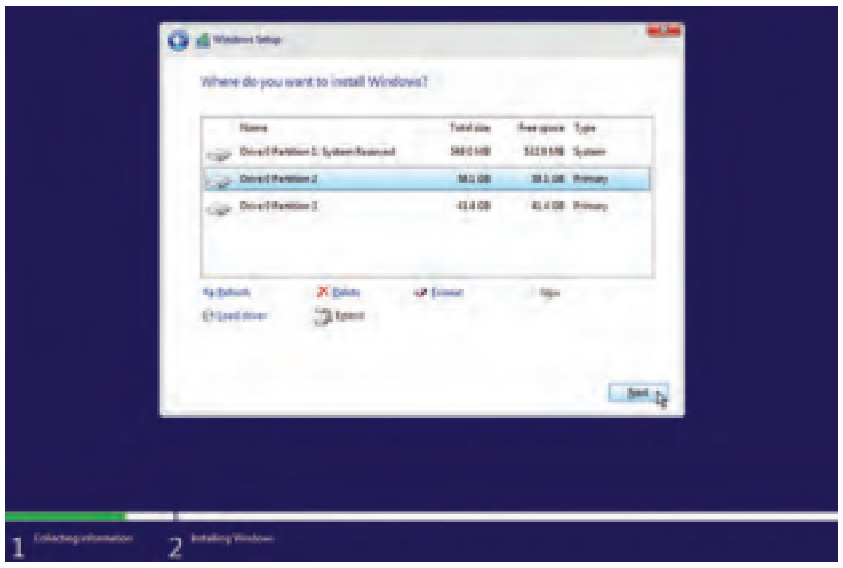

Windows Setup
Which type of installation do you want?
Upgrade: Install Windows and keep files, settings, and applications
Custom: Install Windows only (advanced)
Collecting information
2 Installing Windows

Fig. 5.9: Selecting installation setup window

8) Select the partition with the current installation of Windows (usually "Drive 0"), and click the 'Delete' button to remove it from the hard drive.
9) Click the 'Yes' button to confirm the deletion.
10) Select the empty drive ('Drive 0 Unallocated Space') and click on the 'Next' button as shown in Figure 5.11.
11) After completion of these steps, the set-up will proceed to install Windows 10 as shown in Figure 5.12.

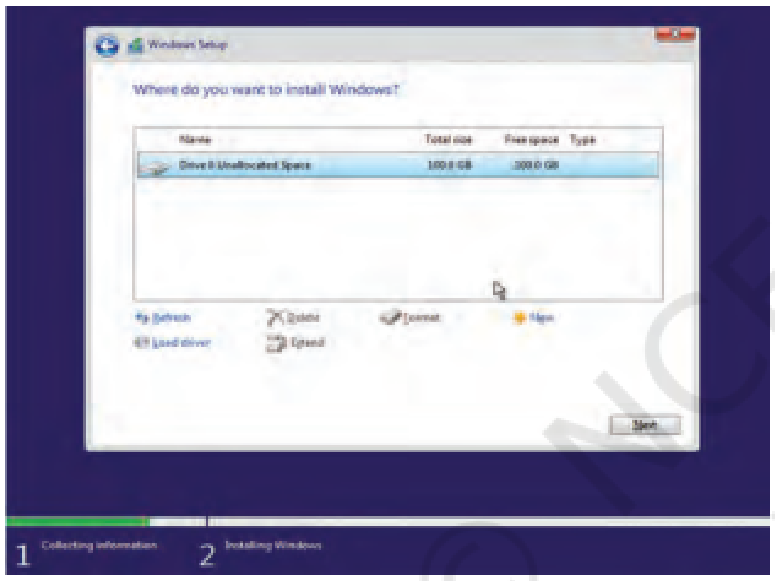


Windows Setup

Where do you want to install Windows?

	Name	Total size	Free space	Type
	Drive 0 Partition 1: System Reserved	500.0 MB	[illegible] MB	System
	Drive 0 Partition 2	[illegible] GB	[illegible] GB	Primary
	Drive 0 Partition 3	41.4 GB	41.4 GB	Primary

Fig. 5.10: Partition window

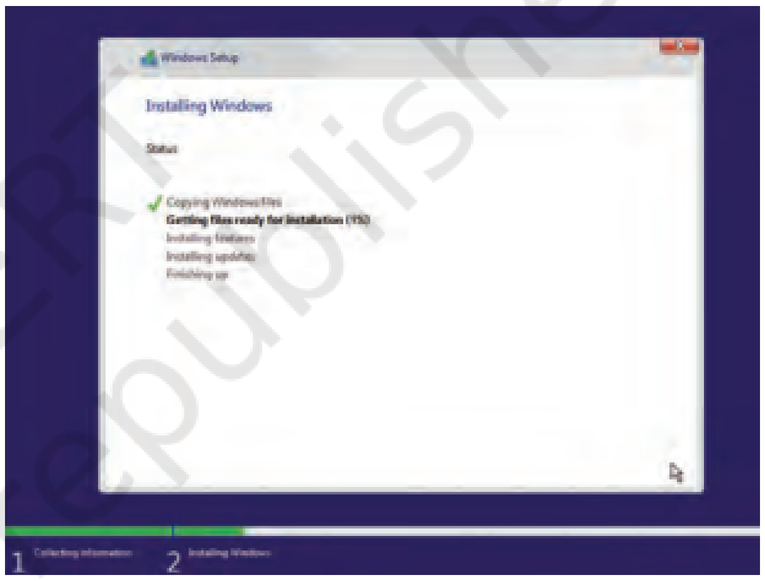


Windows Setup

Where do you want to install Windows?

	Name	Total size	Free space	Type
	Drive 0 Unallocated Space	100.0 GB	100.0 GB	

Fig. 5.11: Drive 0 unallocated Space



Windows Setup

Installing Windows

Status

✓ Copying Windows files
Getting files ready for installation (1%)
Installing features
Installing updates
Finishing up

Fig. 5.12: Installing Windows

12) After complete installation, the initial, window will appear on the computer screen as shown in Figure 5.13.

Fig. 5.13: Home window of Windows 10

Result:

Thus the Installation of windows operating system was done successfully.

Ex. No. 2.a **Basic Unix Commands**
Date :

Aim

To study and execute Unix commands.

Login

Type **telnet** *server_ipaddress* in **run** window.

User has to authenticate himself by providing *username* and *password*. Once verified, a greeting and **$** prompt appears. The shell is now ready to receive commands from the user. Options suffixed with a hyphen (–) and arguments are separated by space.

General commands

Command	Function
Date	Used to display the current system date and time.
date +%D	Displays date only
date +%T	Displays time only
date +%Y	Displays the year part of date
date +%H	Displays the hour part of time
Cal	Calendar of the current month
cal*year*	Displays calendar for all months of the specified year
cal*month year*	Displays calendar for the specified month of the year
Who	Login details of all users such as their IP, Terminal No, User name,
who am i	Used to display the login details of the user
Uname	Displays the Operating System
uname –r	Shows version number of the OS (kernel).
uname –n	Displays domain name of the server
echo$HOME	Displays the user's home directory
Bc	Basic calculator. Press Ctrl+dto quit
lp *file*	Allows the user to spool a job along with others in a print queue.
man*cmdname*	Manual for the given command. Press qto exit
history	To display the commands used by the user since log on.
exit	Exit from a process. If shell is the only process then logs out

Directory commands

Command	Function
Pwd	Path of the present working directory
mkdir*dir*	A directory is created in the given name under the current directory
mkdir*dir1 dir2*	A number of sub-directories can be created under one stroke
cd*subdir*	Change Directory. If the *subdir* starts with **/** then path starts from **root** (absolute) otherwise from current working directory.
cd	To switch to the home directory.
cd /	To switch to the root directory.
cd ..	To move back to the parent directory
rmdir*subdir*	Removes an empty sub-directory.

File commands

Command	**Function**
cat >*filename*	To create a file with some contents. To end typing press Ctrl+d. The **>** symbol means redirecting output to a file. (**<** for input)
cat*filename*	Displays the file contents.
cat>>*filename*	Used to append contents to a file
cp*src des*	Copy files to given location. If already exists, it will be overwritten
cp –i*src des*	Warns the user prior to overwriting the destination file
cp –r *src des*	Copies the entire directory, all its sub-directories and files.
mv *old new*	To rename an existing file or directory. –i option can also be used
mv *f1 f2 f3 dir*	To move a group of files to a directory.
mv –v *old new*	Display name of each file as it is moved.
rm *file*	Used to delete a file or group of files. –i option can also be used
rm *	To delete all the files in the directory.
rm –r *	Deletes all files and sub-directories
rm –f *	To forcibly remove even write-protected files
Ls	Lists all files and subdirectories (blue colored) in sorted manner.
ls*name*	To check whether a file or directory exists.
ls*name* *****	Short-hand notation to list out filenames of a specific pattern.
ls –a	Lists all files including hidden files (files beginning with **.**)
ls –x*dirname*	To have specific listing of a directory.
ls –R	Recursive listing of all files in the subdirectories
ls –l	Long listing showing file access rights (read/write/execute-**rwx** for user/group/others-**ugo**).
cmp *file1 file2*	Used to compare two files. Displays nothing if files are identical.
wc *file*	It produces a statistics of lines (**l**), words(**w**), and characters(**c**).
chmod *perm file*	Changes permission for the specified file. (r=4, w=2, x=1) chmod 740 *file* sets all rights for user, read only for groups and no rights for others

The commands can be combined using the pipeline (|) operator. For example, number of users logged in can be obtained as.

who | wc -l

Finally to terminate the unix session execute the command **exit** or **logout**.

Output

```
$ date
Sat Apr    9 13:03:47 IST 2023

$ date +%D
04/09/23

$ date +%T
13:05:33

$ date +%Y
2023

$ date +%H
13

$ cal 08 1998
        JANUARY 2023
  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   2
                                 8
 29   30   31

$ who
root       :0              Apr   9 08:41
parvathy   pts/0           Apr   9 13:00 (scl-64)
cse4001    pts/3           Apr   9 13:18 (scl-41.smkfomra.com)

$ uname
Linux

$ uname -r
2.4.20-8smp

$ uname -n
localhost.localdomain

$ echo $HOME
/home/parvathy

$ echo $USER
Parvathy

$ bc
3+5
8
```

```
$ pwd
/home/parvathy/shellscripts/loops

$ mkdir filter
$ ls
filter      list.sh      regexpr    shellscripts

$ cd shellscripts/loops/
$

$ cd
$

$ cd /
[parvathy@localhost /]$

[parvathy @localhost /]$ cd /home/ parvathy /shellscripts/loops/
$ cd ..
[parvathy @localhost shellscripts]$

$ rmdir filter
$ ls
list.sh      regexpr    shellscripts

$ cat > greet
hi cse
wishing u the best

$ cat greet
hi cse-a
wishing u the best

$ cat >> greet
bye
$ cat greet
hi cse
wishing u the best bye

$ ls
greet    list.sh      regexpr    shellscripts

$ ls –a

.                .bash_logout    .canna   .gtkrc     regexpr        .viminfo.tmp
..               .bash_profile    .emacs    .kde          shellscripts     .xemacs
.bash_history    .bashrc           greet     list.sh        .viminfo
```

```
$ ls -l
-rw-rw-r--     1 parvathy    parvathy        32    Apr     11   14:52  greet
-rw-rw-r--     1 parvathy    parvathy        30    Apr      4   13:58  list.sh
drwxrwxr-x     2 parvathy    parvathy      4096    Apr      9   14:30  regexpr

$ cp greet ./regexpr/
$ ls
greet    list.sh      regexpr    shellscripts

$ ls ./regexpr
demo greet

$ cp -i greet ./regexpr/
cp: overwrite 'greet'? n

$ mv greet greet.txt

$ ls
greet.txt      list.sh      regexpr    shellscripts

$ mv greet.txt ./regexpr/
$ ls
list.sh        regexpr      shellscripts

$ rm -i *.sh
rm: remove regular file 'fact.sh'? y rm:
remove regular file 'prime.sh'?y
$ ls
list.sh        regexpr      shellscripts

$ wc list.sh
         4           9          30 list.sh
$ wc -l list.sh
         4 list.sh

$ cmp list.sh fact.sh
list.sh fact.sh differ: byte 1, line 1

$ ls -l list.sh
-rw-rw-r--     1 parvathy    parvathy        30 Apr    4 13:58 list.sh

$ chmod ug+x list.sh
$ ls -l list.sh
-rwxrwxr--        1 parvathy    parvathy          30 Apr    4 13:58 list.sh

$ chmod 740 list.sh

$ ls -l list.sh
-rwxr-----        1 parvathy    parvathy          30 Apr    4 13:58 list.sh
```

Result

Thus the study and execution of Unix commands has been completed successfully.

Ex. No. 2.b **Shell Programming**

Date:

Aim

To write simple shell scripts using shell programming fundamentals.

The activities of a shell are not restricted to command interpretation alone. The shell also has rudimentary programming features. Shell programs are stored in a file (with extension **.sh**). Shell programs run in interpretive mode. The original UNIX came with the Bourne shell (**sh**) and it is universal even today. C shell (**csh**) and Korn shell (**ksh**) are also widely used. Linux offers Bash shell (**bash**) as a superior alternative to Bourne shell.

Preliminaries

1. Comments in shell script start with **#**.
2. Shell variables are loosely typed i.e. not declared. Variables in an expression or output must be prefixed by **$**.
3. The **read** statement is shell's internal tool for making scriptsinteractive.
4. Output is displayed using **echo**statement.
5. Expressions are computed using the **expr**command. Arithmetic operators are + -
   * / %. Meta characters *** ( )** should be escaped with a \.
6. The shell scripts are executed
   $ sh *filename*

Decision-making

Shell supports decision-making using **if** statement. The **if** statement like its counterpart in programming languages has the following formats.

```
if [ condition ]
then
    statements
fi
```

```
if [ condition ]
then
    statements
else
    statements
fi
```

```
if [condition ]
then
    statements
elif [ condition ]
then
    statements
...
else
    statements
fi
```

The set of relational operators are –eq –ne –gt –ge –lt –le and logical operators used in conditional expression are –a –o !

Multi-way branching

The case statement is used to compare a variables value against a set of constants. If it matches a constant, then the set of statements followed after) is executed till a ;; is encountered. The optional *default* block is indicated by *****. Multiple constants can be specified in a single pattern separated by **|**.

```
case variable in
   constant1)
       statements ;;
   constant2)
       statements ;;
    ...
       *)
       statements
esac
```

Loops

Shell supports a set of loops such as **for**, **while** and **until** to execute a set of statements repeatedly. The body of the loop is contained between **do** and **done**

statement. The **for** loop doesn't test a condition, but uses a list

instead.

```
for variable in list
do
        statements
done
```

The **while** loop executes the *statements* as long as the condition remains true.

```
while [ condition ]
do
        statements
done
```

The **until** loop complements the while construct in the sense that the *statements* are executed as long as the condition remains false.

```
until [ condition ] do
        statements
done
```

i. Swapping values of two variables

```
# Swapping values – swap.sh
echo -n      "Enter value for A : " read a
echo -n      "Enter value for B : " read b
t=$a
a=$
b
b=$t
echo "Values after Swapping"
echo "A Value is $a and B Value is  $b"
```

Output

```
$ sh swap.sh
Enter value for A : 12 Enter
value for B : 23 Values after
Swapping
A Value is 23 and B Value is  12
```

ii. Farenheit to Centigrade Conversion

```
# Degree conversion – degconv.sh
echo -n "Enter Fahrenheit : "
read f
c=`expr \( $f - 32 \) \* 5 / 9`
echo "Centigrade is : $c"
```

Output

```
$ sh degconv.sh
Enter    Fahrenheit    :    213
Centigrade is : 100
```

iii. Biggest of 3 numbers

```
# Biggest – big3.sh
echo -n "Give value for A B and C: "
read a b c
if [ $a -gt $b -a $a -gt $c ] then
    echo "A is the Biggest number"
elif [ $b -gt $c ] then
    echo "B is the Biggest number"
else
    echo "C is the Biggest number"
fi
```

Output

```
$ sh big3.sh
Give value for A B and C: 4 3 4 C is the
Biggest number
```

iv. Grade Determination

```
  # Grade – grade.sh
  echo -n "Enter the mark : "
  read mark
  if [ $mark -gt 90 ] then
        echo "S Grade"
  elif [ $mark -gt 80 ] then
        echo "A Grade"
  elif [ $mark -gt 70 ] then
        echo "B Grade"
  elif [ $mark -gt 60 ] then
        echo "C Grade"
  elif [ $mark -gt 55 ] then
        echo "D Grade"
  elif [ $mark -ge 50 ] then
        echo "E Grade"
else
        echo "U Grade"
  fi
```

Output

```
$ sh grade.sh Enter
the mark : 65 C Grade
```

v. Vowel or Consonant

```
  # Vowel      - vowel.sh
  echo -n "Key in a lower case character : "
  read choice
  case $choice in a|e|i|o|u) echo "It's a Vowel";;
                         *)
                         echo "It's a Consonant"
  esac
```

Output

```
$ sh vowel.
Key in a lower case character : e It's a Vowel
```

vi. Simple Calculator

```
# Arithmetic operations — calc.sh
echo -n "Enter the two numbers : "
read a b
echo " 1. Addition"
echo " 2.  Subtraction"
echo " 3. Multiplication"
echo " 4. Division"
echo -n "Enter the option : "
read option
case $option in
        a.  c=`expr $a +  $b` echo
            "$a + $b =  $c";;
        b.  c=`expr $a -  $b` echo
            "$a - $b =  $c";;
        c.  c=`expr $a \* $b` echo
            "$a * $b =  $c";;
        d.  c=`expr $a /  $b` echo
            "$a / $b =  $c";;
    *) echo "Invalid Option" esac
```

Output

```
$ sh calc.sh
Enter the two numbers : 2 4
  1.   Addition
  2.   Subtraction
  3.   Multiplication
  4.   Division
Enter the option : 1 2 + 4 =
6
```

vii. Multiplication Table

```
# Multiplication table – multable.sh
clear
echo -n "Which multiplication table? : "
read n
for x in 1 2 3 4 5 6 7 8 9 10 do
    p=`expr $x \* $n`
    echo -n "$n X $x = $p" sleep
    1
done
```

Output

```
$ sh multable.sh
Which multiplication table? : 6 6 X 1 = 6
6 X 2 = 12
.....
```

viii. Number Reverse

```
# To reverse a number – reverse.sh
echo -n "Enter a number : "
read n rd=0
while [ $n -gt 0 ] do
      rem=` expr $n % 10`
      rd=`expr $rd \* 10 + $rem`
      n=` expr $n / 10`
done
echo "Reversed number is $rd"
```

Output

```
$ sh reverse.sh
Enter a number : 234
Reversed number is  432
```

ix. Prime Number

```
# Prime number – prime.sh
echo -n "Enter the number : "
read n
i=2
m=`expr $n / 2`
until [ $i -gt $m ] do
      q=`expr $n % $i`
      if [ $q -eq 0 ] then
            echo "Not a Prime number" exit
      fi
      i=`expr $i + 1` done
echo "Prime number"
```

Output

```
$ sh prime.sh
Enter the number : 17 Prime
number
```

x. Fibonacci series

```
echo "How many number of terms to be generated ?"
read n
function fibonacci
{
  x=0
  y=1
  i=2
  echo "Fibonacci Series up to $n terms :"
  echo "$x"
  echo "$y"
  # -lt stands for equal to
while [ $i -lt $n ]
 do
    i=`expr $i + 1 `
    z=`expr $x + $y `
    echo "$z"
    x=$y
    y=$z
 done
}
r=`fibonacci $n`
echo "$r"
```

Output

```
How many number of terms to be generated ?
10
Fibonacci Series up to 10 terms :
0
1
1
2
3
5
8
13
21
34
```

xi. ODD OR EVEN

```
echo "Enter a number:"
read num
# Check if the number is even or odd
        if (( num % 2 == 0 )); then
        echo "$num is even"
        else
        echo "$num is odd"
fi
```

OUTPUT:

```
Enter a number: 8
8 is even

Enter a number: 5
5 is odd
```

xii. Armstrong Number:

```
is_armstrong()
{
local num=$1
local sum=0
local temp=$num
local digits=0

# Count the number of digits in the number
while (( temp > 0 )); do
  temp=$((temp / 10))
  ((digits++))
done

temp=$num

 # Sum of digits raised to the power of the number of digits
while (( temp > 0 )); do
 digit=$((temp % 10))
 sum=$((sum + digit ** digits))
 temp=$((temp / 10))
done

# Check if the sum equals the original number
if (( sum == num )); then
  echo "$num is an Armstrong number"
else
  echo "$num is not an Armstrong number"
fi
}

# Input from the user
echo "Enter a number:"
read num

# Call the function to check for Armstrong number
is_armstrong $num
```

Output:

```
Enter a number:
153
153 is an Armstrong number

Enter a number:
123
123 is not an Armstrong number
```

xiii. Calculate the area and circumference

```
# Define the constant Pi
PI=3.14159

# Prompt the user to enter the radius
echo "Enter the radius of the circle:"
read radius

# Calculate the area and circumference
area=$(echo "$PI * $radius * $radius" | bc)
circumference=$(echo "2 * $PI * $radius" | bc)

# Output the results
echo "Area of the circle: $area"
echo "Circumference of the circle: $circumference"
```

Output:

```
Enter the radius of the circle:
5
Area of the circle: 78.53975
Circumference of the circle: 31.4159

Enter the radius of the circle:
10
Area of the circle: 314.159
Circumference of the circle: 62.8318
```

xiv) Calculate the area of triangle

```
echo "Enter the base of the triangle:"
read base

echo "Enter the height of the triangle:"
read height

area=$(echo "scale=2; 0.5 * $base * $height" | bc)

echo "Area of the triangle: $area"
```

Output:

```
Enter the base of the triangle:
5
Enter the height of the triangle:
10
Area of the triangle: 25.00

Enter the base of the triangle:
7
Enter the height of the triangle:
3
Area of the triangle: 10.50
```

xv) Factorial value:

```
factorial()
{
   local num=$1
   local result=1

   for ((i=1; i<=num; i++))
   do
      result=$((result * i))
   done

   echo "Factorial of $num is $result"
}
echo "Enter a number:"
read number
factorial $number
```

Output:

```
Enter a number: 5
Factorial of 5 is 120
```

xvi) Finding the positive or negative numbers:

```
echo "Enter a number:"
read number

# Check if the number is positive, negative or zero
if (( number > 0 )); then
   echo "$number is positive."
elif (( number < 0 )); then
   echo "$number is negative."
else
   echo "$number is zero."
fi
```

Output:

```
Enter a number:
5
5 is positive.

Enter a number:
-3
-3 is negative.

Enter a number:
0
0 is zero.
```

xvii) Display first 10 natural numbers:

```
# Loop to display first 10 natural numbers
echo "The first 10 natural numbers are:"
for (( i=1; i<=10; i++ ))
do
   echo $i
done
```

Output:

```
The first 10 natural numbers are:
1
2
3
4
5
6
7
8
9
10
```

xviii) Sum & Average of N numbers:

```
echo "Enter the number of elements:"
read n
sum=0
for (( i=1; i<=n; i++ ))
do
   echo "Enter number $i:"
   read num
   sum=$((sum + num))
done

average=$(echo "scale=2; $sum / $n" | bc)

echo "Sum of the $n numbers is: $sum"
echo "Average of the $n numbers is: $average"
```

Output:

```
Enter the number of elements:
3
Enter number 1:
4
Enter number 2:
5
Enter number 3:
6
Sum of the 3 numbers is: 15
Average of the 3 numbers is: 5.00
```

```
Enter the number of elements:
5
Enter number 1:
1
Enter number 2:
2
Enter number 3:
3
Enter number 4:
4
Enter number 5:
5
Sum of the 5 numbers is: 15
Average of the 5 numbers is: 3.00
```

xix) Check whether a given element is palindrome or not

```
echo "Enter a string or number to check if it's a palindrome:"
read input

reverse=$(echo $input | rev)

if [[ $input == $reverse ]]; then
   echo "$input is a palindrome."
else
   echo "$input is not a palindrome."
fi
```

Output:

```
Enter a string or number to check if it's a palindrome:
madam
madam is a palindrome.

Enter a string or number to check if it's a palindrome:
hello
hello is not a palindrome.

Enter a string or number to check if it's a palindrome:
121
121 is a palindrome.
```

xx) Display the first 10 even numbers

```
echo "The first 10 even numbers are:"
for (( i=1; i<=10; i++ ))
do
   even_number=$(( i * 2 ))
   echo $even_number
done
```

Output:

```
The first 10 even numbers are:
2
4
6
8
10
12
14
16
18
20
```

xxi) Calculate the Simple and Compound Interest

```
simple_interest()
{
   local principal=$1
   local rate=$2
   local time=$3
   simple=$(echo "scale=2; $principal * $rate * $time / 100" | bc)
   echo "Simple Interest: $simple"
}

compound_interest()
{
   local principal=$1
   local rate=$2
   local time=$3
compound=$(echo "scale=2; $principal * (1 + $rate / 100) ^ $time - $principal" | bc)
   echo "Compound Interest: $compound"
}
echo "Enter the principal amount:"
read principal
echo "Enter the rate of interest:"
read rate
echo "Enter the time period (in years):"
read time
simple_interest $principal $rate $time
compound_interest $principal $rate $time
```

Output:

```
Enter the principal amount:
1000
Enter the rate of interest:
5
Enter the time period (in years):
2
Simple Interest: 100.00
```

```
Compound Interest: 102.50


Enter the principal amount:
2000
Enter the rate of interest:
10
Enter the time period (in years):
3
Simple Interest: 600.00
Compound Interest: 662.00
```

xxii) Display the current date and time

```
echo "Current date and time: $(date)"
```

Output:

```
Current date and time: Sun Feb 18 14:35:50 UTC 2025
```

xxiii) Display the first 10 leap years

```
display_leap_years()
{
  echo "The first 10 leap years are:"
  count=0
  year=2024  # Start from a known leap year
  while [ $count -lt 10 ]; do
    if (( year % 4 == 0 && (year % 100 != 0 || year % 400 == 0) )); then
      echo $year
      ((count++))
    fi
    ((year++))
  done
}
# Call the function to display leap years
display_leap_years
```

Output:

```
The first 10 leap years are:
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
```

xxiv) Find the area of the Rectangle

```
echo "Enter the length of the rectangle:"
read length
echo "Enter the width of the rectangle:"
read width

# Calculate the area of the rectangle
area=$(echo "$length * $width" | bc)

# Display the area
echo "The area of the rectangle is: $area"
```

Output:

```
Enter the length of the rectangle:
5
Enter the width of the rectangle:
3
The area of the rectangle is: 15


Enter the length of the rectangle:
7
Enter the width of the rectangle:
4
The area of the rectangle is: 28
```

Result

Thus shell scripts were executed using different programming constructs

Ex.No: 3.a **fork,getpidsystem call**

Date:

Aim

To create a new child process using fork system call.

fork()

The fork system call is used to create a new process called *child* process.

- The return value is 0 for a child process.
- The return value is negative if process creation isunsuccessful.
- For the parent process, return value is positive

The child process is an exact copy of the parent process.
Both the child and parent continue to execute the instructions following fork call.
The child can start execution before the parent or vice-versa.

getpid() and getppid()

The getpid system call returns process ID of the callingprocess
The getppid system call returns parent process ID of the callingprocess

Algorithm

```
1. Declare a variable x to be shared by both child and parent.
2. Create a child process using fork system call.
3. If return value is -1 then
      Print "Process creation unsuccessfull"
      Terminate using exit system call.
4. If return value is 0 then
      Print "Child process"
      Print process id of the child using getpid system
      call Print value of x
      Print process id of the parent using getppid system call
5. Otherwise
      Print "Parent process"
      Print process id of the parent using getpid
      system call Print value of x
      Print process id of the shell using getppid system call.
6. Stop
```

Program

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

main()
{
    pid_t       pid; int
    x = 5; pid =
    fork(); x++;

    if (pid <  0)
    {
        printf("Process creation error");
        exit(-1);
    }
    else if (pid == 0)
    {
        printf("Child process:");
        printf("\nProcess id is %d", getpid());
        printf("\nValue of x is %d",  x);
        printf("\nProcess id of parent is %d\n",
        getppid());
    }
    else
    {
        printf("\nParent process:");
        printf("\nProcess id is %d", getpid());
        printf("\nValue of x is %d",  x);
        printf("\nProcess id of shell is %d\n",  getppid());
    }
}
```

Output

```
$ gcc fork.c

$ ./a.out Child
process:
Process id is 19499
Value of x is 6
Process id of parent is 19498

Parent process: Process
id is 19498 Value of x is 6
Process id of shell is 3266
```

Result

Thus a child process is created with copy of its parent's address space.

Ex.No: 3.b **exit, stat system call**

Date:

Aim

To display file status using stat system call.

exit()

The exit system call is used to terminate a process either normally or abnormally
Closes all standard I/O streams.

stat()

The stat system call is used to return information about a file as a structure.

Algorithm

1. Get *filename* as command line argument.
2. If *filename* does not exist then stop.
3. Call stat system call on the *filename* that returns a structure
4. Display members st_uid, st_gid, st_blksize, st_block, st_size, st_nlink, etc.,
5. Convert time members such as st_atime, st_mtime into time using ctime function
6. Compare st_mode with mode constants such as S_IRUSR, S_IWGRP, S_IXOTH and display file permissions.
7. Stop

Program

```
/* File status - stat.c */ #include
<stdio.h> #include <sys/stat.h>
#include <stdlib.h> #include
<time.h>

int main(int argc, char*argv[])
{
    struct stat file;
    int n;
    if (argc != 2)
    {
        printf("Usage: ./a.out <filename>\n");
        exit(-1);
    }
    if ((n = stat(argv[1], &file)) == -1)
    {
        perror(argv[1]);
        exit(-1);
}
```

```
    printf("User id : %d\n", file.st_uid);
    printf("Group id : %d\n", file.st_gid);
    printf("Block size : %d\n", file.st_blksize);
    printf("Blocks allocated : %d\n", file.st_blocks);
    printf("Inode no. : %d\n",  file.st_ino);
    printf("Last accessed : %s", ctime(&(file.st_atime)));
    printf("Last modified : %s", ctime(&(file.st_mtime)));
    printf("File size : %d bytes\n", file.st_size);
    printf("No. of links : %d\n",  file.st_nlink);

    printf("Permissions : ");
    printf( (S_ISDIR(file.st_mode)) ? "d" : "-");
    printf( (file.st_mode & S_IRUSR) ? "r" :  "-");
    printf( (file.st_mode & S_IWUSR) ? "w" :  "-");
    printf( (file.st_mode & S_IXUSR) ? "x" :  "-");
    printf( (file.st_mode & S_IRGRP) ? "r" :  "-");
    printf( (file.st_mode & S_IWGRP) ? "w" :  "-");
    printf( (file.st_mode & S_IXGRP) ? "x" :  "-");
    printf( (file.st_mode & S_IROTH) ? "r" :  "-");
    printf( (file.st_mode & S_IWOTH) ? "w" :  "-");
    printf( (file.st_mode & S_IXOTH) ? "x" : "-");
    printf("\n");

    if(file.st_mode & S_IFREG) printf("File type :
        Regular\n");
    if(file.st_mode & S_IFDIR) printf("File type :
        Directory\n");
}
```

Output

```
$ gcc stat.c

$ ./a.out fork.c User id :
0 Group id : 0 Block
size :  4096
Blocks allocated : 8 Inode no. :
16627
Last accessed : Fri Feb 22 21:57:09 2013
Last modified : Fri Feb 22 21:56:13 2013 File size : 591
bytes
No. of links : 1 Permissions :
-rw-r--r-- File type : Regular
```

Result

Thus attributes of a file is displayed using stat system call.

Ex.No: 3.c **waitsystem**

call Date:

Aim

To block a parent process until child completes using wait system call.

wait()

The wait system call causes the parent process to be blocked until a child terminates.
When a process terminates, the kernel notifies the parent by sending the SIGCHLD signal to the parent.
Without wait, the parent may finish first leaving a *zombie* child, to be adopted by init process

Algorithm

```
1. Create a child process using fork system call.
2. If return value is -1 then
   a. Print "Process creation unsuccessfull"
3. Terminate using exit system call.
4. If return value is > 0 then
   a. Suspend parent process until child completes using wait system call
   b. Print "Parent starts"
   c. Print even numbers from 0–10
   d. Print "Parent ends"
5. If return value is 0
   then
   a. Print "Child starts"
   b. Print odd numbers from 0–10
   c. Print "Child ends"
6. Stop
```

Program

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
main()
{
	int i, status; pid_t pid;

	pid = fork();
	if (pid <  0)
	{
		printf("\nProcess creation failure\n");
		exit(-1);
	}
	else if(pid > 0)
	{
		wait(NULL);
		printf ("\nParent starts\nEven Nos: ");
		for (i=2;i<=10;i+=2)
			printf  ("%3d",i);
		printf ("\nParent ends\n");
	}
	else if (pid == 0)
	{
		printf ("Child starts\nOdd Nos: ");
		for (i=1;i<10;i+=2)
			printf ("%3d",i); printf
		("\nChild  ends\n");
	}
}
```

Output

```
$ gcc wait.c

$ ./a.out Child
starts
Odd Nos:      1    3    5    7    9
Child ends

Parent starts
Even Nos:       2    4    6    8  10
Parent ends
```

Result

Thus using wait system call zombie child processes were avoided.

Ex.No: 3.d **close , write system call**

Date:

Aim

To append content to an existing file.

write()

Writes no. of bytes onto the file.
After a successful write, file's offset is incremented by the no. of bytes written.
If any error due to insufficient storage space, write fails.

close()

Closes a opened file.
When process terminates, files associated with the process are automatically closed.

Algorithm

```
1. Declare a character buffer buf to store 100 bytes.
2. Get exisiting filename as command line argument.
3. Create a file with the given name using open system call with O_APPEND
   option.
4. Check the file descriptor.
   a) If value is negative, then stop.
5. Get input from the console until user types Ctrl+D
   a) Read 100 bytes (max.) from console and store onto buf using read
      system call
   b) Write length of buf onto file using write systemcall.
6. Close the file using close system call.
7. Stop
```

Program

```
/*   File   append   -   fappend.c   */

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

main(int argc, char *argv[])
{
     int fd, n, len; char
     buf[100];

     if (argc != 2)
```

```
{
    printf("Usage: ./a.out <filename>\n"); exit(-1);
}
```

```
    fd = open(argv[1], O_APPEND|O_WRONLY|O_CREAT, 0644);
    if (fd < 0)
    {
        perror(argv[1]);
        exit(-1);
    }

    while((n = read(0, buf, sizeof(buf))) > 0)
    {
        len = strlen(buf);
        write(fd, buf,  len);
    }

    close(fd);
}
```

Output

```
$ gcc  fappend.c

$ ./a.out  hello
read system call is used to read from file or console write
system call is used to write to  file.
^D
```

Result

Thus contents have been written to end of the file. The process can be verified by using
cat command.

Ex. No. 4.a **FCFS Scheduling**

Date:

Aim

To schedule snapshot of processes queued according to FCFS scheduling.

Process Scheduling

CPU scheduling is used in multiprogrammed operating systems.
By switching CPU among processes, efficiency of the system can be improved.
Some scheduling algorithms are FCFS, SJF, Priority, Round-Robin, etc.
Gantt chart provides a way of visualizing CPU scheduling and enables to understand better.

First Come First Serve (FCFS)

Process that comes first is processed first
FCFS scheduling is non-preemptive
Not efficient as it results in long average waiting time.
Can result in starvation, if processes at beginning of the queue have long bursts.

Algorithm

1. Define an array of structure *process* with members *pid*, *btime*, *wtime* & *ttime*.
2. Get length of the ready queue, i.e., number of process (say *n*)
3. Obtain *btime* for each process.
4. The *wtime* for first process is 0.
5. Compute *wtime* and *ttime* for each process as:
   a. $wtime_{i+1} = wtime_i + btime_i$
   b. $ttime_i = wtime_i + btime_i$
6. Compute average waiting time *awat* and average turnaround time *atur*
7. Display the *btime*, *ttime* and *wtime* for each process.
8. Display GANTT chart for the above scheduling
9. Display *awat* time and *atur*
10. Stop

Program

```
/* FCFS Scheduling        - fcfs.c */

#include <stdio.h>

struct process
{
    int pid; int
    btime; int
    wtime; int
    ttime;
} p[10];

main()
{
    int i,j,k,n,ttur,twat; float
    awat,atur;

    printf("Enter no. of process : "); scanf("%d",
    &n);
    for(i=0; i<n; i++)
    {
        printf("Burst time for process P%d (in ms) : ",(i+1)); scanf("%d",
        &p[i].btime);
        p[i].pid =  i+1;
    }


    p[0].wtime = 0;
    for(i=0; i<n;  i++)
    {
        p[i+1].wtime = p[i].wtime + p[i].btime; p[i].ttime
        = p[i].wtime +  p[i].btime;
    }
    ttur = twat = 0;
    for(i=0; i<n;  i++)
    {
        ttur += p[i].ttime; twat
        +=  p[i].wtime;
    }
    awat = (float)twat / n; atur =
    (float)ttur /  n;

    printf("\n                    FCFS Scheduling\n\n");
    for(i=0; i<28; i++)
        printf("-");
    printf("\nProcess B-Time T-Time W-Time\n");
    for(i=0; i<28; i++)
        printf("-");
    for(i=0; i<n; i++)
        printf("\n  P%d\t%4d\t%3d\t%2d",
                        p[i].pid,p[i].btime,p[i].ttime,p[i].wtime);
    printf("\n"); for(i=0;
    i<28; i++)
        printf("-");

    printf("\n\nAverage waiting time                    : %5.2fms", awat);
    printf("\nAverage turn around time : %5.2fms\n", atur);

    printf("\n\nGANTT Chart\n");
    printf("-");
    for(i=0; i<(p[n-1].ttime + 2*n); i++)
        printf("-");
    printf("\n");
    printf("|"); for(i=0; i<n;
    i++)
    {
        k = p[i].btime/2;
        for(j=0; j<k; j++)
              printf(" ");
        printf("P%d",p[i].pid); for(j=k+1;
        j<p[i].btime; j++)
              printf(" ");
        printf("|");
    }
    printf("\n");
    printf("-");
    for(i=0; i<(p[n-1].ttime + 2*n); i++)
        printf("-");
    printf("\n");
    printf("0"); for(i=0;
    i<n; i++)
    {
        for(j=0; j<p[i].btime; j++) printf("
              ");
        printf("%2d",p[i].ttime);
    }
}
```

Output

```
Enter no. of process : 4
Burst time for process P1 (in ms) : 10 Burst time
for process P2 (in ms) : 4 Burst time for
process P3 (in ms) : 11 Burst time for process
P4 (in ms) :   6

          FCFS Scheduling

- - - - - - - - - - - - - - - - - - - -

Process B-Time T-Time W-Time

----------------------------
   P1        10       10       0
   P2         4       14      10
   P3        11       25      14
   P4         6       31      25
----------------------------

Average waiting time          : 12.25ms
Average turn around time :  20.00ms


GANT  Chart
T
----------------------------------------
|        P1        |    P2 |       P3         |     P4    |
----------------------------------------
0                  10       14                   25          31
```

Result

Thus waiting time & turnaround time for processes based on FCFS scheduling was computed and the average waiting time was determined.

Ex. No. 4)b) **SJF Scheduling**

Date:

Aim

To schedule snapshot of processes queued according to SJF scheduling.

Shortest Job First (SJF)

Process that requires smallest burst time is processed first.
SJF can be preemptive or non–preemptive
When two processes require same amount of CPU utilization, FCFS is used to break the tie.
Generally efficient as it results in minimal average waiting time.
Can result in starvation, since long critical processes may not be processed.

Algorithm

```
1.  Define an array of structure process with members pid, btime, wtime &
    ttime.
2.  Get length of the ready queue, i.e., number of process (say n)
3.  Obtain btime for each process.
4.  Sort the processes according to their btime in ascending order.
      a. If two process have same btime, then FCFS is used to resolve the tie.
5.  The wtime for first process is 0.
6.  Compute wtime and ttime for each process as:
      a. $wtime_{i+1} = wtime_i + btime_i$
      b. $ttime_i = wtime_i + btime_i$
7.  Compute average waiting time awat and average turn around time atur.
8.  Display btime, ttime and wtime for each process.
9.  Display GANTT chart for the above scheduling
10. Display awat and atur
11. Stop
```

Program

```
/* SJF Scheduling – sjf.c */ #include

<stdio.h>

struct process
{
    int pid; int
    btime; int
    wtime; int
    ttime;
} p[10], temp;

main()
{
    int i,j,k,n,ttur,twat; float
    awat,atur;

    printf("Enter no. of process : "); scanf("%d",
    &n);
    for(i=0; i<n; i++)
    {
        printf("Burst time for process P%d (in ms) : ",(i+1)); scanf("%d",
        &p[i].btime);
        p[i].pid = i+1;
    }


    for(i=0; i<n-1; i++)
    {
        for(j=i+1; j<n; j++)
        {
            if((p[i].btime > p[j].btime) ||
                (p[i].btime == p[j].btime && p[i].pid >   p[j].pid))
            {
                temp   =   p[i];
                p[i]  =  p[j]; p[j]
                = temp;
            }


        }
    }
    p[0].wtime = 0;
    for(i=0; i<n;  i++)
    {
        p[i+1].wtime = p[i].wtime + p[i].btime; p[i].ttime
        = p[i].wtime +  p[i].btime;
    }
    ttur = twat = 0;
```

```
        for(i=0; i<n; i++)
        {
              ttur += p[i].ttime; twat
              +=  p[i].wtime;
        }
        awat = (float)twat / n; atur =
        (float)ttur /  n;

        printf("\n                    SJF Scheduling\n\n");
        for(i=0; i<28; i++)
              printf("-");
        printf("\nProcess B-Time T-Time W-Time\n");
        for(i=0; i<28; i++)
              printf("-"); for(i=0;
        i<n;  i++)
              printf("\n   P%-4d\t%4d\t%3d\t%2d",
                             p[i].pid,p[i].btime,p[i].ttime,p[i].wtime);
        printf("\n"); for(i=0;
        i<28;  i++)
              printf("-");
        printf("\n\nAverage  waiting  time                    : %5.2fms", awat);
        printf("\nAverage turn around time : %5.2fms\n",  atur);

        printf("\n\nGANTT Chart\n");
        printf("-");
        for(i=0; i<(p[n-1].ttime + 2*n); i++)
              printf("-");
        printf("\n|"); for(i=0;
        i<n;  i++)
        {
              k = p[i].btime/2;
              for(j=0; j<k;  j++)
                    printf(" ");
              printf("P%d",p[i].pid); for(j=k+1;
              j<p[i].btime;  j++)
                    printf(" ");
              printf("|");
        }
        printf("\n-");
        for(i=0; i<(p[n-1].ttime + 2*n); i++)
              printf("-");
        printf("\n0"); for(i=0;
        i<n;  i++)
        {
              for(j=0; j<p[i].btime; j++) printf("
                    ");
              printf("%2d",p[i].ttime);
        }
}
```

Output

```
Enter no. of process  :         5
Burst time for  process         P1 (in ms) :        10
Burst time for  process         P2 (in ms) :        6
Burst time for  process         P3 (in ms) :        5
Burst time for  process         P4 (in ms) :        6
Burst time for  process         P5 (in ms) :        9

            SJF Scheduling

-------------------
Process B-Time T-Time W-Time
----------------------------
   P3         5       5       0
   P2         6      11       5
   P4         6      17      11
   P5         9      26      17
   P1        10      36      26
----------------------------

Average    waiting    time          :  11.80ms
Average turn around time : 19.00ms


GANT  Chart
T
--------------------------------------------------
|   P3   |    P2    |    P4   |     P5      |      P1      |
--------------------------------------------------
0        5          11        17            26              36
```

Result

Thus waiting time & turnaround time for processes based on SJF scheduling was computed and the average waiting time was determined.

Ex. No. 4)C) **Priority Scheduling**

Date:

Aim

To schedule snapshot of processes queued according to Priority scheduling.

Priority

Process that has higher priority is processed first.
Prioirty can be preemptive or non–preemptive
When two processes have same priority, FCFS is used to break the tie.
Can result in starvation, since low priority processes may not be processed.

Algorithm

1. Define an array of structure *process* with members *pid*, *btime*, *pri*, *wtime* & *ttime*.
2. Get length of the ready queue, i.e., number of process (say *n*)
3. Obtain *btime* and *pri* for each process.
4. *Sort* the processes according to their *pri* in ascending order.
   a. If two process have same *pri*, then FCFS is used to resolve the tie.
5. The *wtime* for first process is 0.
6. Compute *wtime* and *ttime* for each process as:
   a. $wtime_{i+1} = wtime_i + btime_i$
   b. $ttime_i = wtime_i + btime_i$
7. Compute average waiting time *awat* and average turn around time *atur*
8. Display the *btime*, *pri*, *ttime* and *wtime* for each process.
9. Display GANTT chart for the above scheduling
10. Display *awat* and *atur*
11. Stop

Program

```
/* Priority Scheduling            - pri.c */

#include <stdio.h>

struct process
{
     int pid; int
     btime; int
     pri; int
     wtime; int
     ttime;
} p[10], temp;

main()
{
     int i,j,k,n,ttur,twat; float
     awat,atur;

     printf("Enter no. of process : "); scanf("%d",
     &n);
     for(i=0; i<n; i++)
     {
          printf("Burst time for process P%d (in ms) : ", (i+1)); scanf("%d",
          &p[i].btime);
          printf("Priority for process P%d : ", (i+1)); scanf("%d", &p[i].pri);
          p[i].pid = i+1;
     }

     for(i=0; i<n-1; i++)
     {
          for(j=i+1; j<n; j++)
          {
               if((p[i].pri > p[j].pri) ||
                    (p[i].pri == p[j].pri && p[i].pid > p[j].pid)   )
               {
                    temp   =   p[i];
                    p[i] = p[j]; p[j]
                    = temp;
               }


          }
     }
     p[0].wtime = 0;
     for(i=0; i<n;  i++)
     {
          p[i+1].wtime = p[i].wtime + p[i].btime; p[i].ttime
          = p[i].wtime +  p[i].btime;
}
```

```
ttur = twat = 0;
for(i=0; i<n; i++)
{
      ttur += p[i].ttime; twat
      += p[i].wtime;
}
awat = (float)twat / n; atur =
(float)ttur / n;

printf("\n\t Priority Scheduling\n\n"); for(i=0; i<38;
i++)
      printf("-");
printf("\nProcess B-Time Priority T-Time              W-Time\n");
for(i=0; i<38; i++)
      printf("-"); for
(i=0; i<n; i++)
      printf("\n        P%-4d\t%4d\t%3d\t%4d\t%4d",
            p[i].pid,p[i].btime,p[i].pri,p[i].ttime,p[i].wtime);
printf("\n"); for(i=0;
i<38; i++)
      printf("-");

printf("\n\nAverage waiting time                   : %5.2fms", awat);
printf("\nAverage turn around time : %5.2fms\n", atur);

printf("\n\nGANTT Chart\n");
printf("-");
for(i=0; i<(p[n-1].ttime + 2*n); i++)
      printf("-");
printf("\n|"); for(i=0;
i<n; i++)
{
      k = p[i].btime/2;
      for(j=0; j<k; j++)
            printf(" ");
      printf("P%d",p[i].pid); for(j=k+1;
      j<p[i].btime; j++)
            printf(" ");
      printf("|");
}
printf("\n-");
for(i=0; i<(p[n-1].ttime + 2*n); i++)
      printf("-");
printf("\n0"); for(i=0;
i<n; i++)
{
      for(j=0; j<p[i].btime; j++) printf("
            ");
      printf("%2d",p[i].ttime);
```

```
        }
    }
```

Output

```
Enter no. of process :  5
Burst time for process  P1         (in      ms) :  10
Priority for process P1  :           3
Burst time for process  P2         (in      ms) :  7
Priority for process P2  :           1
Burst time for process  P3         (in      ms) :  6
Priority for process P3  :           3
Burst time for process  P4         (in      ms) :  13
Priority for process P4  :           4
Burst time for process  P5         (in      ms) :  5
Priority for process P5  :           2

                Priority Scheduling

– – – – – – – – – – – – – – – – – – – – – – – – – – –
Process B-Time  Priority T-Time           W-Time
– – – – – – – – – – – – – – – – – – – – – – – – – – –
   P2           7         1             7           0
   P5           5         2            12           7
   P1          10         3            22          12
   P3           6         3            28          22
   P4          13         4            41          28
– – – – – – – – – – – – – – – – – – – – – – – – – – –

Average waiting time               : 13.80ms
Average turn around time :   22.00ms

GANTT Chart

---------------------------------------------------------
|      P2      |    P5    |        P1        |     P3   |          P          |
                                                                   4
---------------------------------------------------------
0             7          12                22          28                    41
```

Result

Thus waiting time & turnaround time for processes based on Priority scheduling was
computed and the average waiting time was determined.

Ex. No. 4)d) Round Robin Scheduling

Date:

Aim

To schedule snapshot of processes queued according to Round robin scheduling.

Round Robin

All processes are processed one by one as they have arrived, but in rounds.
Each process cannot take more than the time slice per round.
Round robin is a fair preemptive scheduling algorithm.
A process that is yet to complete in a round is preempted after the time slice and put at the end of the queue.
When a process is completely processed, it is removed from the queue.

Algorithm

1. Get length of the ready queue, i.e., number of process (say *n*)
2. Obtain *Burst* time B_i for each processes P_i.
3. Get the *time slice* per round, say *TS*
4. Determine the number of rounds for each process.
5. The wait time for first process is 0.
6. If $B_i > TS$ then process takes more than one round. Therefore turnaround and waiting time should include the time spent for other remaining processes in the same round.
7. Calculate *average* waiting time and turn around time
8. Display the GANTT chart that includes
    a. order in which the processes were processed in progression of rounds
    b. Turnaround time T_i for each process in progression of rounds.
9. Display the *burst* time, *turnaround* time and *wait* time for each process (in order of rounds they were processed).
10. Display *average* wait time and turnaround time
11. Stop

Program

```
/* Round robin scheduling          - rr.c */

#include <stdio.h>

main()
{
    int i,x=-1,k[10],m=0,n,t,s=0;
    int a[50],temp,b[50],p[10],bur[10],bur1[10]; int
    wat[10],tur[10],ttur=0,twat=0,j=0; float awat,atur;

    printf("Enter no. of process : "); scanf("%d",
    &n);
    for(i=0; i<n; i++)
    {
        printf("Burst time for process P%d : ", (i+1)); scanf("%d",
        &bur[i]);
        bur1[i] = bur[i];
    }
    printf("Enter the time slice (in ms) : "); scanf("%d",
    &t);

    for(i=0; i<n; i++)
    {
        b[i] = bur[i] / t;
        if((bur[i]%t) != 0)
            b[i] += 1;
        m += b[i];
    }

    printf("\n\t\tRound Robin Scheduling\n");

    printf("\nGANTT Chart\n"); for(i=0;
    i<m; i++)
        printf("------------ ");
    printf("\n");

    a[0] = 0;
    while(j < m)
    {
        if(x == n-1) x =
            0;
        else
            x++;
        if(bur[x] >= t)
        {
            bur[x] -= t;
            a[j+1] = a[j] + t;
```

```
                if(b[x] == 1)
                {
                    p[s] = x;
                    k[s] = a[j+1];
                    s++;
                }
                j++;
                b[x] -= 1;
                printf("        P%d      |", x+1);
            }
            else if(bur[x] != 0)
            {
                a[j+1] = a[j] + bur[x]; bur[x] =
                0;
                if(b[x] == 1)
                {
                    p[s] = x;
                    k[s] = a[j+1];
                    s++;
                }
                j++;
                b[x] -= 1;
                printf("        P%d  |",x+1);
            }
        }

        printf("\n");
        for(i=0;i<m;i++)
            printf("____________ ");
        printf("\n");

        for(j=0; j<=m; j++)
            printf("%d\t",  a[j]);

        for(i=0; i<n; i++)
        {
            for(j=i+1; j<n; j++)
            {
                if(p[i] > p[j])
                {
                    temp   =   p[i];
                    p[i]  =  p[j]; p[j]
                    =  temp;

                    temp   =   k[i];
                    k[i]  =  k[j]; k[j]
                    =  temp;
                }
            }
```

```
}
```

```
        for(i=0; i<n; i++)
        {
            wat[i] = k[i] - bur1[i]; tur[i] = k[i];
        }
        for(i=0; i<n;  i++)
        {
            ttur += tur[i]; twat
            +=  wat[i];
        }

        printf("\n\n"); for(i=0;
        i<30;  i++)
            printf("-");
        printf("\nProcess\tBurst\tTrnd\tWait\n"); for(i=0;
        i<30; i++)
            printf("-");  for
        (i=0; i<n;  i++)
            printf("\nP%-4d\t%4d\t%4d\t%4d", p[i]+1, bur1[i], tur[i],wat[i]);
        printf("\n"); for(i=0;
        i<30;  i++)
            printf("-");

        awat = (float)twat / n; atur =
        (float)ttur /  n;
        printf("\n\nAverage  waiting  time                    : %.2f ms", awat);
        printf("\nAverage turn around time : %.2f ms\n",  atur);
    }
```

Output

```
Enter no. of process : 5
Burst time for process P1 : 10 Burst time
for process P2 : 29 Burst time for
process P3 : 3 Burst time for process P4 :
7 Burst time for process P5 : 12 Enter
the time slice (in ms) :  10

                      Round Robin Scheduling

GANTT Chart
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
P1      |   P2     |   P3   |   P4   |   P5   |   P2     |   P5     |     P2   |
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
0      10         20       23         30        40        50        52        61

- - - - - - - - - - - - - - - - - - - - -
Process Burst        Trnd       Wait
--------------------------------------
P1             10          10          0
P2             29          61         32
P3              3          23         20
P4              7          3          23
                           0
P5             12          52         40
--------------------------------------

Average waiting time            : 23.00 ms
Average turn around time : 35.20   ms
```

Result

Thus waiting time and turnaround time for processes based on Round robin scheduling was computed and the average waiting time was determined.

Ex. No. 5)a) **Fibonacci & Prime Number**

Date:

Aim

To generate 25 fibonacci numbers and determine prime amongst them using pipe.

Interprocess Communication

Inter-Process communication (IPC), is the mechanism whereby one process can communicate with another process, i.e exchange data.
IPC in linux can be implemented using pipe, shared memory, message queue, semaphore, signal or sockets.

Pipe

Pipes are unidirectional byte streams which connect the standard output from one process into the standard input of another process.
A pipe is created using the system call *pipe* that returns a pair of file descriptors.
The descriptor pfd[0] is used for reading and pfd[1] is used for writing.
Can be used only between parent and child processes.

Algorithm

```
1.  Declare a array to store fibonacci numbers
2.  Decalre a array pfd with two elements for pipe descriptors.
3.  Create pipe on pfd using pipe function call.
      a. If return value is -1 then stop
4.  Using fork system call, create a child process.
5.  Let the child process generate 25 fibonacci numbers and store them in a
    array.
6.  Write the array onto pipe using write systemcall.
7.  Block the parent till child completes using waitsystem call.
8.  Store fibonacci nos. written by child from the pipe in an array using read
    system call
9.  Inspect each element of the fibonacci array and check whether they are
    prime
      a. If prime then print the fibonacci term.
10. Stop
```

Program

```
/* Fibonacci and Prime using pipe - fibprime.c */ #include

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

```
#include  <sys/types.h>

main()
{
     pid_t pid;
```

```
int pfd[2];
int i,j,flg,f1,f2,f3;
static unsigned int ar[25],br[25];

if(pipe(pfd) == -1)
{
      printf("Error in pipe");
      exit(-1);
}


pid=fork(); if
(pid ==  0)
{
      printf("Child process generates Fibonacci series\n" ); f1 = -1;
      f2 = 1;
      for(i = 0;i < 25; i++)
      {
            f3 = f1 + f2;
            printf("%d\t",f3); f1 =
            f2;
            f2 = f3; ar[i] =
            f3;
      }
      write(pfd[1],ar,25*sizeof(int));
}
else if (pid > 0)
{
      wait(NULL);
      read(pfd[0], br, 25*sizeof(int));
      printf("\nParent prints Fibonacci that are  Prime\n");


      for(i = 0;i < 25; i++)
      {
            flg = 0;
            if (br[i] <= 1) flg = 1;
            for(j=2; j<=br[i]/2; j++)
            {
                  if (br[i]%j == 0)
                  {
                        flg=1;
                        break;
                  }
            }
            if (flg == 0) printf("%d\t",
                  br[i]);
      }
      printf("\n");
}
```

```
    else
    {
        printf("Process creation failed"); exit(-1);
    }
}
```

Output

```
$ gcc fibprime.c

$ ./a.out
Child process generates Fibonacci series
0       1       1       2       3       5       8       13
21      34      55      89      144     233     377     610
987     1597    2584    4181    6765    10946   17711   28657
46368
Parent   prints   Fibonacci   that   are Prime
2       3       5       13      89      233     1597    28657
```

Result

Thus fibonacci numbers that are prime is determined using IPC pipe.

Ex. No. 5)b) **who | wc -l**

Date:

Aim

To determine number of users logged in using pipe.

Algorithm

1. Decalre a array *pfd* with two elements for pipe descriptors.
2. Create pipe on *pfd* using pipe function call.
   a. If return value is -1 then stop
3. Using fork system call, create a child process.
4. Free the standard output (1) using close system call to redirect the output to pipe.
5. Make a copy of write end of the pipe using dup system call.
6. Execute who command using execlp system call.
7. Free the standard input (0) using close system call in the other process.
8. Make a close of read end of the pipe using dup system call.
9. Execute wc –l command using execlp system call.
10. Stop

Program

```
/* No. of users logged - cmdpipe.c */ #include

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

int main()
{
    int pfds[2];
    pipe(pfds);

    if (!fork())
    {
        close(1);
        dup(pfds[1]);
        close(pfds[0]); execlp("who",
        "who", NULL);
    }
```

```
        else
        {
            close(0);
            dup(pfds[0]);
            close(pfds[1]);
            execlp("wc", "wc", "-l", NULL);
        }
}
```

Output

```
$ gcc cmdpipe.c

$ ./a.out 15
```

Result

Thus standard output of who is connected to standard input of wc using pipe to compute number of users logged in.

Ex. No. 5)c) **Chat Messaging**

Date:

Aim

To exchange message between server and client using message queue.

Message Queue

A message queue is a linked list of messages stored within the kernel
A message queue is identified by a unique identifier
Every message has a positive long integer type field, a non-negative length, and the actual data bytes.
The messages need not be fetched on FCFS basis. It could be based on type field.

Algorithm

Server

```
1. Decalre a structure mesgq with type and text fields.
2. Initialize key to 2013 (some random value).
3. Create a message queue using msgget with key & IPC_CREAT as
   parameter.
   a. If message queue cannot be created then stop.
4. Initialize the message type member of mesgq to 1.
5. Do the following until user types Ctrl+D
   a. Get message from the user and store it in text member.
   b. Delete the newline character in text member.
   c. Place message on the queue using msgsend for the client to read.
   d. Retrieve the response message from the client using msgrcv function
   e. Display the text contents.
6. Remove message queue from the system using msgctl with IPC_RMID as
   parameter.
7. Stop
```

Client

```
1. Decalre a structure mesgq with type and text fields.
2. Initialize key to 2013 (same value as in server).
3. Open the message queue using msgget with key as parameter.
   a. If message queue cannot be opened then stop.
4. Do while the message queue exists
   a. Retrieve the response message from the server using msgrcv function
   b. Display the text contents.
```

   c. Get message from the user and store it in *text* member.
   d. Delete the newline character in *text* member.
   e. Place message on the queue using msgsend for the server to read.

5. Print "Server Disconnected".

6. Stop

Program

Server

```
/* Server chat process - srvmsg.c */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

struct mesgq
{
    long type;
    char text[200];
} mq;

main()
{
    int msqid, len; key_t
    key = 2013;

    if((msqid = msgget(key, 0644|IPC_CREAT)) == -1)
    {
        perror("msgget");
        exit(1);
    }

    printf("Enter text, ^D to quit:\n"); mq.type =
    1;

    while(fgets(mq.text, sizeof(mq.text), stdin) != NULL)
    {
        len = strlen(mq.text);
        if (mq.text[len-1] == '\n')
            mq.text[len-1] = '\0';
        msgsnd(msqid, &mq, len+1, 0);

        msgrcv(msqid, &mq, sizeof(mq.text), 0, 0); printf("From
        Client: \"%s\"\n", mq.text);
    }
    msgctl(msqid, IPC_RMID, NULL);
}
```

Client

```
/* Client chat process - climsg.c */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

struct mesgq
{
    long type;
    char text[200];
} mq;

main()
{
    int msqid, len; key_t
    key =  2013;

    if ((msqid = msgget(key, 0644)) == -1)
    {
        printf("Server not active\n"); exit(1);
    }

    printf("Client ready :\n");
    while (msgrcv(msqid, &mq, sizeof(mq.text), 0, 0) !=   -1)
    {
        printf("From Server: \"%s\"\n", mq.text);

        fgets(mq.text, sizeof(mq.text), stdin); len =
        strlen(mq.text);
        if (mq.text[len-1] == '\n')
            mq.text[len-1] = '\0';
        msgsnd(msqid, &mq, len+1,  0);
    }
    printf("Server   Disconnected\n");
}
```

Output

Server

```
$ gcc srvmsg.c -o srvmsg

$ ./srvmsg
Enter text, ^D to quit: hi
From Client: "hello" Where
r u?
From Client: "I'm where i am" bye
From Client: "ok"
^D
```

Client

```
$ gcc climsg.c -o climsg

$ ./climsg Client
ready:
From Server: "hi" hello
From Server: "Where r u?" I'm
where i am
From Server: "bye" ok
Server Disconnected
```

Result

Thus chat session between client and server was done using message queue.

Ex. No. 5)d) **Shared Memory**

Date:

Aim

To demonstrate communication between process using shared memory.

Shared memory

Two or more processes share a single chunk of memory to communicate randomly.
Semaphores are generally used to avoid race condition amongst processes.
Fastest amongst all IPCs as it does not require any system call.
It avoids copying data unnecessarily.

Algorithm

Server

1. Initialize size of shared memory *shmsize* to 27.
2. Initialize *key* to 2013 (some random value).
3. Create a shared memory segment using shmget with *key* & IPC_CREAT as parameter.
    a. If shared memory identifier *shmid* is -1, then stop.
4. Display *shmid*.
5. Attach server process to the shared memory using shmmat with *shmid* as parameter.
    a. If pointer to the shared memory is not obtained, then stop.
6. Clear contents of the shared region using memset function.
7. Write a–z onto the shared memory.
8. Wait till client reads the shared memory contents
9. Detatch process from the shared memory using shmdt system call.
10. Remove shared memory from the system using shmctl with IPC_RMID argument
11. Stop

Client

1. Initialize size of shared memory *shmsize* to 27.
2. Initialize *key* to 2013 (same value as in server).
3. Obtain access to the same shared memory segment using same *key*.
    a. If obtained then display the *shmid* else print "Server not started"
4. Attach client process to the shared memory using shmmat with *shmid* as parameter.
    a. If pointer to the shared memory is not obtained, then stop.

5. Read contents of shared memory and print it.
6. After reading, modify the first character of shared memory to '*'
7. Stop

Program

Server

```
/* Shared memory server - shms.c */

#include <stdio.h>
#include <stdlib.h>
#include <sys/un.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

#define shmsize 27

main()
{
    char c; int
    shmid;
    key_t key =       2013;
    char *shm, *s;

    if ((shmid = shmget(key, shmsize, IPC_CREAT|0666)) <  0)
    {
        perror("shmget");
        exit(1);
    }
    printf("Shared memory id : %d\n", shmid);

    if ((shm = shmat(shmid, NULL, 0)) == (char *)  -1)
    {
        perror("shmat");
        exit(1);
    }


    memset(shm, 0, shmsize); s
    = shm;
    printf("Writing (a-z) onto shared memory\n"); for (c =
    'a'; c <= 'z'; c++)
        *s++ = c;
    *s = '\0';

    while (*shm != '*');
    printf("Client finished reading\n");

    if(shmdt(shm) != 0)
        fprintf(stderr, "Could not close memory  segment.\n");

    shmctl(shmid, IPC_RMID, 0);
}
```

Client

```
/* Shared memory client - shmc.c */

#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

#define shmsize 27

main()
{
    int shmid;
    key_t key = 2013; char
    *shm, *s;

    if ((shmid = shmget(key, shmsize, 0666)) <  0)
    {
        printf("Server not started\n"); exit(1);
    }
    else
        printf("Accessing shared memory id :  %d\n",shmid);

    if ((shm = shmat(shmid, NULL, 0)) == (char *)  -1)
    {
        perror("shmat");
        exit(1);
    }

    printf("Shared memory contents:\n"); for (s
    = shm; *s != '\0';  s++)
        putchar(*s);
    putchar('\n');

    *shm = '*';
}
```

Output

Server

```
$ gcc shms.c -o shms

$ ./shms
Shared memory id : 196611 Writing
(a-z) onto shared memory Client
finished reading
```

Client

```
$ gcc shmc.c -o shmc

$ ./shmc
Accessing shared memory id : 196611 Shared
memory contents:
abcdefghijklmnopqrstuvwxyz
```

Result

Thus contents written onto shared memory by the server process is read by the client process.

Ex. No. 5)e) Producer-Consumer problem Date:

Aim

To synchronize producer and consumer processes using semaphore.

Semaphores

A semaphore is a counter used to synchronize access to a shared data amongst multiple processes.
To obtain a shared resource, the process should:
- o Test the semaphore that controls the resource.
- o If value is positive, it gains access and decrements value of semaphore.
- o If value is zero, the process goes to sleep and awakes when value is > 0.

When a process relinquishes resource, it increments the value of semaphore by 1.

Producer-Consumer problem

A producer process produces information to be consumed by a consumer process
A producer can produce one item while the consumer is consuming another one.
With bounded-buffer size, consumer must wait if buffer is empty, whereas producer must wait if buffer is full.
The buffer can be implemented using any IPC facility.

Algorithm

1. Create a shared memory segment *BUFSIZE* of size 1 and attach it.
2. Obtain semaphore id for variables *empty*, *mutex* and *full* using semget function.
3. Create semaphore for *empty*, *mutex* and *full* as follows:
   a. Declare *semun*, a union of specific commands.
   b. The initial values are: 1 for mutex, N for empty and 0 for full
   c. Use semctl function with SETVAL command
4. Create a child process using fork system call.
   a. Make the parent process to be the *producer*
   b. Make the child process to the *consumer*
5. The *producer* produces 5 items as follows:
   a. Call *wait* operation on semaphores *empty* and *mutex* using semop function.
   b. Gain access to buffer and produce data for consumption
   c. Call *signal* operation on semaphores *mutex* and *full* using semop function.

6. The *consumer* consumes 5 items as follows:
    a. Call *wait* operation on semaphores *full* and *mutex* using semop function.
    b. Gain access to buffer and consume the available data.
    c. Call *signal* operation on semaphores *mutex* and *empty* using semop function.
7. Remove shared memory from the system using shmctl with IPC_RMID argument
8. Stop

Program

```
/* Producer-Consumer problem using semaphore – pcsem.c */ #include

<stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>
#include <sys/sem.h>

#define N 5
#define BUFSIZE 1
#define PERMS 0666

int *buffer;
int nextp = 0, nextc = 0;
int mutex, full, empty;                    /* semaphore variables */

void producer()
{
    int data; if(nextp ==
    N)
        nextp = 0;
    printf("Enter data for producer to produce : "); scanf("%d",(buffer +
    nextp));
    nextp++;
}

void consumer()
{
    int g; if(nextc ==
    N)
        nextc = 0;
    g = *(buffer + nextc++); printf("\nConsumer
    consumes data %d",   g);
}

void sem_op(int id, int value)
{
    struct sembuf op; int v;
    op.sem_num = 0;
    op.sem_op = value;
    op.sem_flg =  SEM_UNDO;
    if((v = semop(id, &op, 1)) < 0)
        printf("\nError executing semop instruction");
}
```

```
void sem_create(int semid, int initval)
{
    int semval;
    union  semun
    {
        int  val;
        struct semid_ds *buf;
        unsigned short  *array;
    } s;

    s.val = initval;
    if((semval = semctl(semid, 0, SETVAL, s)) < 0) printf("\nError in
        executing semctl");
}

void sem_wait(int  id)
{
    int value = -1;
    sem_op(id,  value);
}

void sem_signal(int id)
{
    int value = 1;
    sem_op(id,  value);
}

main()
{
    int shmid, i; pid_t
    pid;

    if((shmid = shmget(1000, BUFSIZE, IPC_CREAT|PERMS)) <   0)
    {
        printf("\nUnable to create shared memory"); return;
    }
    if((buffer = (int*)shmat(shmid, (char*)0, 0)) ==   (int*)-1)
    {
        printf("\nShared memory allocation error\n"); exit(1);
    }

    if((mutex = semget(IPC_PRIVATE, 1, PERMS|IPC_CREAT)) == -1)
    {
        printf("\nCan't create mutex semaphore");
        exit(1);
    }
```

```
        if((empty = semget(IPC_PRIVATE, 1, PERMS|IPC_CREAT)) == -1)
        {
            printf("\nCan't create empty semaphore");
            exit(1);
        }
        if((full = semget(IPC_PRIVATE, 1, PERMS|IPC_CREAT)) ==   -1)
        {
            printf("\nCan't create full semaphore"); exit(1);
        }


        sem_create(mutex,       1);
        sem_create(empty,      N);
        sem_create(full, 0);

        if((pid = fork()) < 0)
        {
            printf("\nError in process creation"); exit(1);
        }
        else if(pid > 0)
        {
            for(i=0; i<N; i++)
            {
                sem_wait(empty);
                sem_wait(mutex); producer();
                sem_signal(mutex);
                sem_signal(full);
            }
        }
        else if(pid == 0)
        {
            for(i=0; i<N; i++)
            {
                sem_wait(full);
                sem_wait(mutex);
                consumer();
                sem_signal(mutex);
                sem_signal(empty);
            }
            printf("\n");
        }
    }
```

Output

```
$ gcc pcsem.c

$ ./a.out
Enter data for producer to produce : 5

Enter data for producer to produce : 8
Consumer consumes data 5
Enter data for producer to produce : 4
Consumer consumes data 8
Enter data for producer to produce : 2
Consumer consumes data 4
Enter data for producer to produce : 9
Consumer consumes data 2
Consumer consumes data  9
```

Result

Thus synchronization between producer and consumer process for access to a shared memory segment is implemented.

Ex. No. 6) Semaphore Implementation

Date:

Aim

To demonstrate the utility of semaphore in synchronization and multithreading.

Semaphore

The POSIX system in Linux has its own built-in semaphore library.
To use it, include semaphore.h.
Compile the code by linking with -lpthread -lrt.
To lock a semaphore or wait, use the **sem_wait** function.
To release or signal a semaphore, use the **sem_post** function.
A semaphore is initialised by using **sem_init**(for processes or threads)
To declare a semaphore, the data type is sem_t.

Algorithm

1. 2 threads are being created, one 2 seconds after the first one.
2. But the first thread will sleep for 4 seconds after acquiring the lock.
3. Thus the second thread will not enter immediately after it is called, it will enter 4 – 2
   = 2 secs after it is called.
4. *Stop*.

Program

```
/* C program to demonstrate working of Semaphores */

#include <stdio.h>
#include <pthread.h>
#include <semaphore.h>
#include <unistd.h>

sem_t mutex;

void* thread(void* arg)
{
    //wait sem_wait(&mutex);
    printf("\nEntered..\n");

    //critical section
    sleep(4);
    //signal
    printf("\nJust Exiting...\n");
    sem_post(&mutex);
}

int main()
{
    sem_init(&mutex, 0, 1); pthread_t
    t1,t2;
    pthread_create(&t1,NULL,thread,NULL);
    sleep(2);
    pthread_create(&t2,NULL,thread,NULL);
    pthread_join(t1,NULL);
    pthread_join(t2,NULL);
    sem_destroy(&mutex);
    return 0;
}
```

Output

```
$ gcc sem.c -lpthread

$ ./a.out Entered..
Just Exiting... Entered..
Just Exiting...
```

Result

Thus semaphore implementation has been demonstrated.

Ex.No:7) BANKERS ALGORITHM FOR DEAD LOCK AVOIDANCE

Date:

AIM

To implement deadlock avoidance by using Banker's Algorithm.

ALGORITHM

1. Start the program.
2. Get the values of resources and processes.
3. Get the avail value.
4. After allocation find the need value.
5. Check whether its possible to allocate.
6. If it is possible then the system is in safe state.
7. Else system is not in safety state.
8. If the new request comes then check that the system is in safety or not if we allow the request.
9. Stop.

PROGRAM

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

main()
{
     int r[1][10], av[1][10];
     int all[10][10], max[10][10], ne[10][10], w[10],safe[10]; int i=0, j=0,
     k=0, l=0, np=0, nr=0, count=0,  cnt=0;

     clrscr();
     printf("enter the number of processes in a system"); scanf("%d", &np);
     printf("enter the number of resources in a system"); scanf("%d",&nr);
     for(i=1; i<=nr; i++)
     {
          printf("Enter no. of instances of resource R%d " ,i); scanf("%d",
          &r[0][i]);
          av[0][i] = r[0][i];
     }

     for(i=1; i<=np; i++) for(j=1;
          j<=nr;  j++)
               all[i][j] = ne[i][j] = max[i][j] =  w[i] =0;
```

```
printf("Enter the allocation matrix"); for(i=1; i<=np;
i++)
{
      for(j=1; j<=nr; j++)
      {
              scanf("%d", &all[i][j]);
              av[0][j] = av[0][j] - all[i][j];
      }
}

printf("Enter the maximum matrix"); for(i=1;
i<=np; i++)
{
      for(j=1; j<=nr; j++)
      {
                  scanf("%d",&max[i][j]);
      }
}

for(i=1; i<=np; i++)
{
      for(j=1; j<=nr; j++)
      {
            ne[i][j] = max[i][j] - all[i][j];
      }
}

for(i=1; i<=np; i++)
{
      printf("pocess P%d", i); for(j=1;
      j<=nr; j++)
      {
            printf("\n allocated %d\t",all[i][j]);
            printf("maximum %d\t",max[i][j]);
            printf("need %d\t",ne[i][j]);
      }
      printf("\n_________________________________\n");
}

printf("\nAvailability "); for(i=1; i<=nr;
i++)
      printf("R%d %d\t", i, av[0][i]);
printf("\n__________________"); printf("\n
safe sequence");
```

```
    for(count=1; count<=np; count++)
    {
       for(i=1; i<=np; i++)
       {
             Cnt = 0;
             for(j=1; j<=nr; j++)
             {
                  if(ne[i][j] <= av[0][j] && w[i]==0) cnt++;
             }
             if(cnt == nr)
             {
                  k++;
                  safe[k] = i; for(l=1;
                  l<=nr;  l++)
                       av[0][l] = av[0][l] + all[i][l]; printf("\n
                  P%d ",safe[k]); printf("\t Availability ");
                  for(l=1; l<=nr; l++)
                       printf("R%d %d\t", l, av[0][l]); w[i]=1;
             }
        }
    }
    getch();
}
```

Output

```
enter the number of processes in a system 3 enter
the number of resources in a system   3

enter no. of instances of resource R1 10 enter no.
of instances of resource R2 7 enter no. of
instances of resource R3   7

Enter the allocation matrix 3 2 1
1 1 2
4 1 2

Enter the maximum matrix 4
4 4
3 4 5
5 2 4

pocess P1
  allocated 3            maximum 4              need 1
  allocated 2            maximum 4             need 2
  allocated 1            maximum 4             need 3
```

```
_________________________________
pocess P2
  allocated 1        maximum  3           need 2
  allocated 1        maximum  4           need 3
  allocated 2        maximum  5           need 3
_________________________________

pocess P3
  allocated 4        maximum  5           need 1
  allocated 1        maximum  2           need 1
  allocated 2        maximum  4           need 2
_________________________________

Availability R1 2                R2 3       R3 2
________________

  safe sequence
  P3            Availability R1 6            R2 4       R3 4
  P1            Availability R1 9            R2 6       R3 5
  P2            Availability R1 10           R2 7       R3 7
```

Result

Thus bankers algorithm for dead lock avoidance was executed successfully.

Ex.No: 8) **DEAD LOCK PREVENTION**

Date:

Aim

To determine whether the process and their request for resources are in a deadlocked
state.

Algorithm

1. Mark each process that has a row in the Allocation matrix of all zeros.
2. Initialize a temporary vectorW to equal the Available vector.
3. Find an indexi such that processi is currently unmarked and thei th row ofQ
4. is less than or equal to W . That is,Q ik ... Wk, for 1 ... k ... m . If no such row is
5. found, terminate the algorithm.
5. If such a row is found, mark processi and add the corresponding row of the
6. allocation matrix to W . That is, setWk = Wk + Aik, for 1 ... k ... m . Return
7. to step 3.

Program

```
#include<stdio.h>
#include<conio.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();

main()
{
    int i,j;
    printf("Deadlock Detection Algo\n");
    input();
    show();
    cal();
    getch();
}

void input()
{
int i,j;
    printf("Enter the no of Processes\t");
    scanf("%d",&n);
```

```
printf("Enter the no of resource instances\t"); scanf("%d", &r);

printf("Enter the Max Matrix\n");
```

```
        for(i=0; i<n; i++) for(j=0;
            j<r;  j++)
                scanf("%d", &max[i][j]);

        printf("Enter the Allocation Matrix\n"); for(i=0; i<n;
        i++)
            for(j=0; j<r; j++) scanf("%d",
                &alloc[i][j]);
        printf("Enter the available Resources\n"); for(j=0;j<r;j++)
            scanf("%d",&avail[j]);
    }

    void show()
    {
        int i, j;
        printf("Process\t Allocation\t Max\t Available\t"); for(i=0; i<n; i++)
        {
            printf("\nP%d\t            ", i+1);
            for(j=0; j<r; j++)
            {
                printf("%d ", alloc[i][j]);
            }
            printf("\t"); for(j=0;
            j<r;  j++)
            {
                printf("%d ", max[i][j]);
            }
            printf("\t"); if(I
            == 0)
            {
                for(j=0; j<r; j++) printf("%d ",
                    avail[j]);
            }
        }
    }

    void cal()
    {
        int finish[100], temp, need[100][100], flag=1, k, c1=0; int dead[100];
        int safe[100]; int i, j;
        for(i=0; i<n; i++)
        {
            finish[i] = 0;
        }
```

```
/*find need matrix */ for(i=0; i<n;
i++)
{
    for(j=0; j<r; j++)
    {
        need[i][j]= max[i][j] - alloc[i][j];
    }
}

while(flag)
{
    flag=0;
    for(i=0;i<n;i++)
    {
        int c=0; for(j=0;j<r;j++)
        {
            if((finish[i]==0) && (need[i][j] <=  avail[j]))
            {
                c++;
                if(c == r)
                {
                        for(k=0; k<r; k++)
                        {
                                avail[k] += alloc[i][j]; finish[i]=1;
                                flag=1;
                        }
                        if(finish[i] == 1)
                        {
                                i=n;
                        }
                }
            }
        }
    }
}
J = 0;
Flag = 0;
for(i=0; i<n; i++)
{
    if(finish[i] == 0)
    {
        dead[j] = i; j++;
        flag = 1;
    }
}
```

```
      if(flag == 1)
      {
           printf("\n\nSystem       is    in    Deadlock    and    the    Deadlock
process are\n");
           for(i=0;i<n;i++)
           {
                printf("P%d\t", dead[i]);
           }
    }
    else
    {
           printf("\nNo Deadlock Occur");
    }
}
```

Output

```
********** Deadlock Detection Algo ************ Enter
the no of Processes                          3
Enter the no of  resource instances                    3
Enter the Max Matrix 3 6
0
4 3 3
3 4 4
Enter the Allocation Matrix 3 3 3
2 0 3
1 2 4
Enter the available Resources 1 2 0
Process     Allocation             Max         Available
P1               3 3 3               3 6 0       1 2 0
P2               2 0 3               4 3 3
P3               1 2 4               3 4 4

System is in Deadlock and the Deadlock process are P0    P1
              P2
```

Result

Thus using given state of information deadlocked process were determined.

Ex. No. 9) **Threading and Synchronization Date:**

Aim

To demonstrate threading and synchronization using mutex.

Description

- Thread synchronization is defined as a mechanism which ensures that two or more concurrent processes or threads do not simultaneously execute some particular program segment known as critical section.
- Processes' access to critical section is controlled by using synchronization techniques.
- When one thread starts executing the critical section (serialized segment of the program) the other thread should wait until the first thread finishes.
- If proper synchronization techniques are not applied, it may cause a race condition where the values of variables may be unpredictable
- A Mutex is a lock that we set before using a shared resource and release after using it.
- When the lock is set, no other thread can access the locked region of code. So this ensures a synchronized access of shared resources in the code.

Algorithm

1. Create two threads
2. Let the threads share a common resource, say counter
3. Even if thread2 si scheduled to start while thread was not done, access to shared resource is not done as it is locked by mutex
4. Once thread1 completes, thread2 starts execution
5. Stop

Program

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

pthread_t tid[2]; int
counter;
pthread_mutex_t lock;

void* trythis(void *arg)
{
    pthread_mutex_lock(&lock);

    unsigned long i = 0;
```

```
counter += 1;
printf("\n Job %d has started\n", counter); for(i=0;

i<(0xFFFFFFFF);i++);
```

```
        printf("\n Job %d has finished\n", counter);

        pthread_mutex_unlock(&lock);

        return NULL;
}

main()
{
        int i = 0; int
        error;

        if (pthread_mutex_init(&lock, NULL) != 0)
        {
                printf("\n mutex init has failed\n"); return 1;
        }

        while(i < 2)
        {
                err = pthread_create(&(tid[i]), NULL, &trythis, NULL); if (error !=
                0)
                        printf("\nThread          can't        be       created       :[%s]",
strerror(error));
                i++;
        }

        pthread_join(tid[0], NULL);
        pthread_join(tid[1], NULL);
        pthread_mutex_destroy(&lock);

        return 0;
}
```

Output

```
$ gcc filename.c -lpthread

$ ./a.out
Job 1 started
Job 1 finished
Job 2 started
Job 2 finished
```

Result

Thus concurrent threads were synchronized using mutex lock.

Ex. No. 10) **Paging**

Technique Date:

Aim

To determine physical address of a given page using page table.

Algorithm

1. Get process size
2. Compte no. of pages available and display it
3. Get relative address
4. Determine the corresponding page
5. Display page table
6. Display the physical address

Program

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

main()
{
    int size, m, n, pgno, pagetable[3]={5,6,7}, i, j, frameno; double m1;
    int ra=0, ofs;

    printf("Enter process size (in KB of max 12KB):"); scanf("%d", &size);
    m1 = size / 4; n =
    ceil(m1);
    printf("Total No. of pages: %d", n); printf("\nEnter relative
    address (in hexa) \n"); scanf("%d", &ra);


    pgno = ra / 1000; ofs =
    ra % 1000;
    printf("page no=%d\n", pgno);
    printf("page table"); for(i=0;i<n;i++)
        printf("\n %d [%d]", i, pagetable[i]); frameno =
    pagetable[pgno];
    printf("\nPhysical address: %d%d", frameno, ofs);

}
```

Output

```
Enter process size (in KB of max 12KB):12 Total
No. of pages: 3
Enter relative address (in hexa): 2643
page no=2
page table
  0 [5]
  1 [6]
  2 [7]
Physical address : 7643
```

Result

Thus physical address for the given logical address is determing using Paging technique.

Ex: 11)a) **First Fit Allocation**

Date:

Aim

To allocate memory requirements for processes using first fit allocation.

Memory Management

The first-fit, best-fit, or worst-fit strategy is used to select a free hole from the set of available holes.

First fit

Allocate the first hole that is big enough.
Searching starts from the beginning of set of holes.

Algorithm

```
1. Declare structures hole and process to hold information about set of holes
   and processes respectively.
2. Get number of holes, say nh.
3. Get the size of each hole
4. Get number of processes, say np.
5. Get the memory requirements for each process.
6. Allocate processes to holes, by examining each hole as follows:
   a. If hole size > process size then
      i. Mark process as allocated to that hole.
      ii. Decrement hole size by process size.
   b. Otherwise check the next from the set of hole
7. Print the list of process and their allocated holes or unallocated status.
8. Print the list of holes, their actual and current availability.
9. Stop
```

Program

```
/* First fit allocation - ffit.c */ #include

<stdio.h>

struct process
{
    int size; int
    flag; int
    holeid;
} p[10];
struct hole
{
    int size;
```

```
        int actual;
    } h[10];

    main()
    {
        int i, np, nh,  j;

        printf("Enter the number of Holes : "); scanf("%d",
        &nh);
        for(i=0; i<nh; i++)
        {
            printf("Enter size for hole H%d : ",i); scanf("%d",
            &h[i].size);
            h[i].actual =         h[i].size;
        }

        printf("\nEnter number of process : " );
        scanf("%d",&np);
        for(i=0;i<np;i++)
        {
            printf("enter the size of process P%d : ",i); scanf("%d",
            &p[i].size);
            p[i].flag = 0;
        }

        for(i=0; i<np; i++)
        {
            for(j=0; j<nh; j++)
            {
                if(p[i].flag != 1)
                {
                    if(p[i].size <=  h[j].size)
                    {
                        p[i].flag = 1; p[i].holeid = j;
                        h[j].size -=  p[i].size;
                    }
                }
            }
        }

        printf("\n\tFirst fit\n");
        printf("\nProcess\tPSize\tHole"); for(i=0;
        i<np; i++)
        {
            if(p[i].flag != 1)
                printf("\nP%d\t%d\tNot allocated", i, p[i].size); else
                printf("\nP%d\t%d\tH%d", i, p[i].size,  p[i].holeid);
        }
        printf("\n\nHole\tActual\tAvailable"); for(i=0;
        i<nh ;i++)
            printf("\nH%d\t%d\t%d", i, h[i].actual, h[i].size); printf("\n");
    }
```

Output

```
Enter  the  number of Holes : 5 hole
Enter   size   for  H0 : 100 hole H1 :
Enter   size   for  500 hole H2 : 200
Enter   size   for  hole H3 : 300 hole
Enter   size   for  H4 : 600
Enter size for
Enter number o  f process : 4
enter the size           of process P0 :  212
enter the size            of process P1 :  417
enter the size           of process P2 :  112
enter the size           of process P3 :  42
                                           6

           First   fit

Process PSize       Hole
P0         212      H1
P1         417      H4
P2         112      H1
P3         426      Not allocated
Hole       Actual   Available
H0         100      100
H1         500      176
H2         200      200
H3         300      300
H4         600      183
```

Result

Thus processes were allocated memory using first fit method.

Ex: 11)b) Best Fit

Allocation Date:

Aim

To allocate memory requirements for processes using best fit allocation.

Best fit

Allocate the smallest hole that is big enough.
The list of free holes is kept sorted according to size in ascending order.
This strategy produces smallest leftover holes

Algorithm

```
1. Declare structures hole and process to hold information about set of holes
   and processes respectively.
2. Get number of holes, say nh.
3. Get the size of each hole
4. Get number of processes, say np.
5. Get the memory requirements for each process.
6. Allocate processes to holes, by examining each hole as follows:
    a. Sort the holes according to their sizes in ascending order
    b. If hole size > process size then
        i. Mark process as allocated to that hole.
        ii. Decrement hole size by process size.
    c. Otherwise check the next from the set of sorted hole
7. Print the list of process and their allocated holes or unallocated status.
8. Print the list of holes, their actual and current availability.
9. Stop
```

Program

```
#include <stdio.h>

struct process
{
    int size; int
    flag; int
    holeid;
} p[10];

struct hole
{
    int hid; int
    size; int
```

```
        actual;
    } h[10];
```

```
main()
{
    int i, np, nh,  j;
    void bsort(struct hole[], int); printf("Enter the
    number of Holes : "); scanf("%d", &nh);
    for(i=0; i<nh; i++)
    {
        printf("Enter size for hole H%d : ",i); scanf("%d",
        &h[i].size);
        h[i].actual =        h[i].size;
        h[i].hid = i;
    }
    printf("\nEnter number of process : " );
    scanf("%d",&np);
    for(i=0;i<np;i++)
    {
        printf("enter the size of process P%d : ",i); scanf("%d",
        &p[i].size);
        p[i].flag = 0;
    }
    for(i=0; i<np; i++)
    {
        bsort(h, nh); for(j=0;
        j<nh;  j++)
        {
            if(p[i].flag != 1)
            {
                if(p[i].size <=  h[j].size)
                {
                    p[i].flag = 1; p[i].holeid =
                    h[j].hid;
                    h[j].size -=  p[i].size;
                }
            }
        }
    }
    printf("\n\tBest fit\n");
    printf("\nProcess\tPSize\tHole"); for(i=0;
    i<np; i++)
    {
        if(p[i].flag != 1)
            printf("\nP%d\t%d\tNot allocated", i, p[i].size); else
            printf("\nP%d\t%d\tH%d", i, p[i].size,  p[i].holeid);
    }
    printf("\n\nHole\tActual\tAvailable"); for(i=0;
    i<nh ;i++)
        printf("\nH%d\t%d\t%d", h[i].hid, h[i].actual, h[i].size);
    printf("\n");
}

void bsort(struct hole bh[], int n)
{
    struct hole temp; int i,j;
    for(i=0; i<n-1; i++)
    {
        for(j=i+1; j<n; j++)
        {
            if(bh[i].size > bh[j].size)
            {
                temp = bh[i];
                bh[i] = bh[j];
                bh[j] = temp;
            }
        }
    }
}
```

Output

```
Enter the number of Holes : 5 Enter
size for hole H0 : 100 Enter size for
hole H1 : 500 Enter size for hole H2 :
200 Enter size for hole H3 : 300 Enter
size for hole H4 : 600 Enter number of
process : 4
enter the size of process P0 : 212 enter
the size of process P1 : 417 enter the size
of process P2 : 112 enter the size of
process P3 : 426
           Best fit
Process    PSize     Hole
P0         212       H3
P1         417       H1
P2         112       H2
P3         426       H4

Hole       Actual    Available
H1         500       83
H3         300       88
H2         200       88
H0         100       100
H4         600       174
```

Result

Thus processes were allocated memory using best fit method.

Ex. No. 12)a) FIFO Page Replacement Date:

Aim

To implement demand paging for a reference string using FIFO method.

FIFO

Page replacement is based on when the page was brought into memory.
When a page should be replaced, the oldest one is chosen.
Generally, implemented using a FIFO queue.
Simple to implement, but not efficient.
Results in more page faults.
The page-fault may increase, even if frame size is increased (Belady's anomaly)

Algorithm

```
1. Get length of the reference string, say l.
2. Get reference string and store it in an array, say rs.
3. Get number of frames, say nf.
4. Initalize frame array upto length nf to -1.
5. Initialize position of the oldest page, say j to 0.
6. Initialize no. of page faults, say count to 0.
7. For each page in reference string in the given order, examine:
    a. Check whether page exist in the frame array
    b. If it does not exist then
        i. Replace page in position j.
        ii. Compute page replacement position as (j+1) modulus nf.
        iii. Increment count by 1.
        iv. Display pages in frame array.
8. Print count.
9. Stop
```

Program

```
#include <stdio.h>

main()
{
    int i,j,l,rs[50],frame[10],nf,k,avail,count=0;

    printf("Enter length of ref. string : "); scanf("%d", &l);
    printf("Enter reference string :\n"); for(i=1; i<=l; i++)
        scanf("%d", &rs[i]); printf("Enter
    number of frames : "); scanf("%d", &nf);
```

```
	for(i=0; i<nf; i++)
		frame[i] = -1;
	j = 0;
	printf("\nRef. str            Page frames");
	for(i=1; i<=l; i++)
	{
		printf("\n%4d\t", rs[i]); avail = 0;
		for(k=0; k<nf; k++)
			if(frame[k] ==  rs[i])
				avail = 1;
		if(avail == 0)
		{
			frame[j] = rs[i]; j =
			(j+1) % nf; count++;
			for(k=0; k<nf; k++)
				printf("%4d",  frame[k]);
		}
	}
	printf("\n\nTotal no. of page faults :  %d\n",count);
}
```

Output

```
Enter length of ref. string : 20 Enter
reference string :
1 2 3 4 2 1 5 6 2 1 2 3 7 6  3
Enter number of frames : 5 Ref.

str           Page frames
   1            1    -1    -1    -1    -1
   2            1     2    -1    -1    -1
   3            1     2     3    -1    -1
   4            1     2     3     4    -1
   2
   1
   5            1     2     3     4     5
   6            6     2     3     4     5
   2
   1            6     1     3     4     5
   2            6     1     2     4     5
   3            6     1     2     3     5
   7            6     1     2     3     7
   6
   3
Total no. of page faults : 10
```

Result

Thus page replacement was implemented using FIFO algorithm.

Ex. No. 12)b) LRU Page Replacement

Aim

To implement demand paging for a reference string using LRU method.

LRU

Pages used in the recent past are used as an approximation of future usage.
The page that has not been used for a longer period of time is replaced.
LRU is efficient but not optimal.
Implementation of LRU requires hardware support, such as counters/stack.

Algorithm

```
1.  Get length of the reference string, say len.
2.  Get reference string and store it in an array, say rs.
3.  Get number of frames, say nf.
4.  Create access array to store counter that indicates a measure of recent
    usage.
5.  Create a function arrmin that returns position of minimum of the given
    array.
6.  Initalize frame array upto length nf to -1.
7.  Initialize position of the page replacement, say j to 0.
8.  Initialize freq to 0 to track page frequency
9.  Initialize no. of page faults, say count to 0.
10. For each page in reference string in the given order, examine:
      a. Check whether page exist in the frame array.
      b. If page exist in memory then
            i. Store incremented freq for that page position in access array.
      c. If page does not exist in memory
                                              then
         i. Check for any empty frames.
            ii. If there is an empty frame,
                    Assign that frame to the page
                    Store incremented freq for that page position in access
                    array.
                    Increment count.
            iii. If there is no free frame then
                    Determine page to be replaced using arrmin function.
                    Store incremented freq for that page position in access
                    array.
                    Increment count.
            iv. Display pages in frame array.
11. Print count.
```

12. Stop

Program

```
/* LRU page replacement - lrupr.c */ #include

<stdio.h>

int arrmin(int[], int);

main()
{
      int i,j,len,rs[50],frame[10],nf,k,avail,count=0; int
      access[10], freq=0, dm;

      printf("Length of Reference string : "); scanf("%d",
      &len);
      printf("Enter reference string :\n"); for(i=1; i<=len;
      i++)
            scanf("%d", &rs[i]); printf("Enter no.
      of frames : "); scanf("%d", &nf);

      for(i=0; i<nf; i++)
            frame[i] = -1;
      j = 0;

      printf("\nRef. str            Page frames");
      for(i=1; i<=len; i++)
      {
            printf("\n%4d\t", rs[i]); avail = 0;
            for(k=0; k<nf; k++)
            {
                  if(frame[k] == rs[i])
                  {
                        avail = 1; access[k] =
                        ++freq; break;
                  }
            }
            if(avail == 0)
            {
                  dm = 0;
```

```
                for(k=0; k<nf; k++)
                {
                    if(frame[k] == -1)
                        dm = 1;
                        break;
                }







                if(dm == 1)
                {
                    frame[k] = rs[i]; access[k]
                    = ++freq; count++;
                }
                else
                {
                    j = arrmin(access, nf);
                    frame[j] = rs[i]; access[j] =
                    ++freq; count++;
                }
                for(k=0; k<nf; k++)
                    printf("%4d", frame[k]);
            }
        }
        printf("\n\nTotal no. of page faults : %d\n", count);
}

int arrmin(int a[], int n)
{
  int i, min = a[0]; for(i=1;
    i<n; i++) if (min > a[i])
                min = a[i];
        for(i=0; i<n; i++)
            if (min == a[i])
                return i;
}
```

Output

```
Length of Reference string : 15 Enter
reference string :
1 2 3 4 2     1 5 6 2 1 2       3 7   6 3
Enter no.     of frames :       5
Ref. str      Page frames
    1          1   -1   -1   -1   -1
    2          1    2   -1   -1   -1
    3          1    2    3   -1   -1
    4          1    2    3    4   -1
    2
    1
    5          1    2    3    4    5
    6          1    2    6    4    5
    2
    1
    2
    3          1    2    6    3    5
    7          1    2    6    3    7
    6
    3
Total no. of page faults : 8
```

Result

Thus page replacement was implemented using LRU algorithm.

Ex. No. 12.C Optimal Page Replacement

Aim

To implement optimal page replacement technique.

Algorithm:

1. Start the program
2. Read number of pages and frames
3. Read each page value
4. Search for page in the frames
5. If not available allocate free frame
6. If no frames is free replace the page with the page that is leastly used
7. Print page number of page faults.
8. Stop process

Program:

```
#include <stdio.h>

int findOptimal(int pages[], int n, int frame[], int frameSize, int index)
{
int farthest = index;
int replaceIndex = -1;

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

```
            if (frame[i] == pages[j])
                  {
              if (j > farthest)
                           {
                farthest = j;
                replaceIndex = i;
              }
              break;
            }
          }
          // If page is never referenced again, replace this page
          if (j == n) return i;
        }

        return (replaceIndex == -1) ? 0 : replaceIndex;
      }

      void optimalPageReplacement(int pages[], int n, int frameSize)
      {
        int frame[frameSize];
        int count = 0, pageFaults = 0;

        for (int i = 0; i < frameSize; i++) frame[i] = -1; // Initialize frame with -1






        for (int i = 0; i < n; i++)
        {
          int page = pages[i];
          int found = 0;


          // Check if the page is already in frame
          for (int j = 0; j < frameSize; j++)
               {
            if (frame[j] == page)
               {
              found = 1;
              break;
          }
          }

          // If page is not found, replace a page
          if (!found)
               {
            if (count < frameSize)
                  {
              frame[count++] = page;
            }
```

```
                else
                {
            int replaceIndex = findOptimal(pages, n, frame, frameSize, i + 1);
            frame[replaceIndex] = page;
        }
        pageFaults++;

        // Print frame contents
        printf("Step %d: ", i + 1);
        for (int j = 0; j < frameSize; j++)
                {
            if (frame[j] != -1)
                printf("%d ", frame[j]);
            else
                printf("- ");
        }
        printf("\n");
    }
  }

  printf("Total Page Faults: %d\n", pageFaults);
}

int main()
{
  int n, frameSize;

  printf("Enter number of pages: ");
  scanf("%d", &n);

  int pages[n];
  printf("Enter page reference sequence: ");
  for (int i = 0; i < n; i++)
  {
    scanf("%d", &pages[i]);
  }



  printf("Enter number of frames: ");
  scanf("%d", &frameSize);

  printf("\nOptimal Page Replacement Steps:\n");
  optimalPageReplacement(pages, n, frameSize);

  return 0;
}
```

Output

```
Enter number of pages: 12
Enter page reference sequence: 7 0 1 2 0 3 4 2 3 0 3 2
Enter number of frames: 3

Optimal Page Replacement Steps:
Step 1: 7 - -
Step 2: 7 0 -
Step 3: 7 0 1
Step 4: 2 0 1
Step 6: 2 3 1
Step 7: 2 3 4
Step 10: 0 3 4
Step 11: 0 2 4
Step 12: 0 2 3
Total Page Faults: 9
```

Ex. No. 13)a) File Oraganization - Single-Level Directory

Date:

Aim

To organize files in a single level directory structure, I,e., without sub-directories.

Algorithm

```
1.  Get name of directory for the user to store all the files
2.  Display menu
3.  Accept choice
4.  If choice =1 then
        Accept filename without any
        collission Store it in the directory
5.  If choice =2 then
        Accept filename
        Remove filename from the directory array
6.  If choice =3 then
        Accept filename
        Check for existence of file in the directory array
7.  If choice =4 then
        List all files in the directory array
8.  If choice =5
        then Stop
```

Program

```
#include <stdio.h>
@include <stdlib.h>
#include <conio.h>

struct
{
    char dname[10]; char
    fname[25][10]; int
    fcnt;
}dir;

main()
{
    int i, ch; char
    f[30]; clrscr();
    dir.fcnt = 0;
    printf("\nEnter name of directory -- "); scanf("%s",
    dir.dname);

    while(1)
    {
        printf("\n\n 1. Create File\t2. Delete File\t3. Search File \n4. Display
        Files\t5. Exit\nEnter your choice--"); scanf("%d",&ch);
```

```
switch(ch)
{
     case 1:
          printf("\n Enter the name of the file -- "); scanf("%s",
          dir.fname[dir.fcnt]); dir.fcnt++;
          break;

     case 2:
          printf("\n Enter the name of the file -- "); scanf("%s", f);
          for(i=0; i<dir.fcnt; i++)
          {
               if(strcmp(f, dir.fname[i]) == 0)
               {
                    printf("File %s is deleted ",f); strcpy(dir.fname[i],
                    dir.fname[dir.fcnt-1]); break;
               }
          }
          if(I == dir.fcnt)
               printf("File %s not found", f); else
               dir.fcnt--; break;

     case 3:
          printf("\n Enter the name of the file -- "); scanf("%s", f);
          for(i=0; i<dir.fcnt; i++)
          {
               if(strcmp(f, dir.fname[i]) == 0)
               {
                         printf("File %s is found ", f); break;
               }
          }
          if(I == dir.fcnt)
               printf("File %s not found", f); break;

     case 4:
          if(dir.fcnt == 0)
               printf("\n Directory Empty"); else
          {
               printf("\n The Files are -- "); for(i=0;
               i<dir.fcnt; i++)
                         printf("\t%s", dir.fname[i]);
          }
          break;
```

```
            default:
                exit(0);
        }
    }
    getch();
}
```

Output

```
Enter name of directory -- CSE

 1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 1
 Enter the name of the file -- fcfs

 1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 1
 Enter the name of the file -- sjf

 1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 1
 Enter the name of the file -- lru

1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 3
 Enter the name of the file --
sjf File sjf is found

 1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 3
 Enter the name of the file --
bank File bank is not found

 1. Create File 2. Delete File 3. Search File
 4. Display Files     5. Exit
Enter your choice -- 4
 The Files are --     fcfs   sjf     lru     bank

 1. Create File 2. Delete File   3. Search File
 4.Display Files      5. Exit
Enter your choice -- 2
 Enter the name of the file --
lru File lru is deleted
```

Result

Thus files were organized into a single level directory.

Ex. No. 13)b) File Oraganization - Two-Level Directory

Date:

Aim

To organize files as two-level directory with each user having his own user file directory (UFD).

Algorithm

```
1. Display menu
2. Accept choice
3. If choice =1 then
       Accept directory name
       Create an entry for that directory
4. If choice =2 then
       Get directory name
       If directory exist then accept filename without collision else report error
5. If choice =3 then
       Get directory name
       If directory exist then Get filename
           If file exist in that directory then delete entry else report error
6. If choice =4 then
       Get directory name
       If directory exist then Get filename
           If file exist in that directory then Display filename else report error
7. If choice =5 then Display files directory-wise
8. If choice =6 then Stop
```

Program

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

struct
{
    char dname[10], fname[10][10]; int
    fcnt;
}dir[10];

main()
{
    int i, ch, dcnt, k; char
    f[30], d[30]; clrscr();
    dcnt=0;
    while(1)
    {
        printf("\n\n 1. Create Directory\t 2. Create File\t  3.
Delete File");
        printf("\n 4. Search File \t \t 5. Display \t 6. Exit \n Enter your choice --
        ");
```

```
scanf("%d", &ch); switch(ch)
{
    case 1:
        printf("\n Enter name of directory -- ");
        scanf("%s", dir[dcnt].dname); dir[dcnt].fcnt = 0;
        dcnt++;
        printf("Directory created"); break;

    case 2:
        printf("\n Enter name of the directory -- "); scanf("%s", d);
        for(i=0; i<dcnt; i++)
        if(strcmp(d,dir[i].dname) ==  0)
        {
            printf("Enter name of the file -- "); scanf("%s",
            dir[i].fname[dir[i].fcnt]); dir[i].fcnt++;
            printf("File created"); break;
        }
        if(i == dcnt)
            printf("Directory %s not found",d); break;

    case 3:
        printf("\nEnter name of the directory -- "); scanf("%s", d);
        for(i=0; i<dcnt; i++)
        {
            if(strcmp(d,dir[i].dname) == 0)
            {
                    printf("Enter name of the file -- "); scanf("%s", f);
                    for(k=0; k<dir[i].fcnt; k++)
                    {
                            if(strcmp(f, dir[i].fname[k]) ==  0)
                            {
                                    printf("File %s is deleted ", f);
                                     dir[i].fcnt--;
                                     strcpy(dir[i].fname[k],
                                             dir[i].fname[dir[i].fcnt]);
                                     goto jmp;
                            }
                    }
                    printf("File %s not found",f); goto jmp;
            }
        }
```

```
                printf("Directory %s not found",d); jmp :
        break;

            case 4:
                printf("\nEnter name of the directory -- "); scanf("%s", d);
                for(i=0; i<dcnt; i++)
                {
                    if(strcmp(d,dir[i].dname) == 0)
                    {
                            printf("Enter the name of the file -- "); scanf("%s", f);
                            for(k=0; k<dir[i].fcnt; k++)
                            {
                                    if(strcmp(f, dir[i].fname[k]) ==  0)
                                    {
                                            printf("File %s is found ", f); goto jmp1;
                                    }
                            }
                            printf("File %s not found", f); goto jmp1;
                    }
                }
                printf("Directory %s not found", d); jmp1:
        break;

        case 5:
            if(dcnt == 0)
                printf("\nNo Directory's "); else
            {
                printf("\nDirectory\tFiles");
                for(i=0;i<dcnt;i++)
                {
                    printf("\n%s\t\t",dir[i].dname); for(k=0;k<dir[i].fcnt;k++)
                            printf("\t%s",dir[i].fname[k]);
                }
            }
            break;

        default:
            exit(0);
        }
    }
    getch();
}
```

Output

```
1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 1
Enter name of directory -- CSE
Directory created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 1
Enter name of directory -- ECE
Directory created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 2
Enter name of the directory --
ECE Enter name of the file --
amruth File created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 2
Enter name of the directory --
CSE Enter name of the file --
kowshik File created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 2
Enter name of the directory --
CSE Enter name of the file --
pranesh File created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 2
 Enter name of the directory --
ECE Enter name of the file -- ajith
File created

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 5
Directory      Files
CSE                kowshik pranesh
ECE                 amruth ajith

1. Create Directory   2. Create File  3. Delete File  4. Search File  5. Display  6.
Exit Enter your choice -- 3
Enter name of the directory --
ECE Enter name of the file --
ajith
File ajith is deleted
```

Result

Thus user files have been stored in their respective directories and retrieved easily.

Ex. No. 14)a) File Allocation using Contiguous Allocation

Aim

To implement file allocation on free disk space in a contiguous manner.

File Allocation

The three methods of allocating disk space are:

1. Contiguous allocation
2. Linked allocation
3. Indexed allocation

Contiguous

Each file occupies a set of contiguous block on the disk.
The number of disk seeks required is minimal.
The directory contains address of starting block and number of contiguous block (length) occupied.
Supports both sequential and direct access.
First / best fit is commonly used for selecting a hole.

Algorithm

```
1. Assume no. of blocks in the disk as 20 and all are free.
2. Display the status of disk blocks before allocation.
3. For each file to be allocated:
    a. Get the filename, start address and file length
    b. If start + length > 20, then goto step 2.
    c. Check to see whether any block in the range (start, start + length-1)
       is allocated. If so, then go to step 2.
    d. Allocate blocks to the file contiguously from start block to start +
       length – 1.
4. Display directory entries.
5. Display status of disk blocks after allocation
6. Stop
```

Program

```
/* Contiguous Allocation - cntalloc.c */ #include

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

int num=0, length[10], start[10]; char
fid[20][4], a[20][4];

void directory()
{
```

```
int i;
printf("\nFile Start Length\n");
```

```
    for(i=0; i<num; i++)
        printf("%-4s %3d %6d\n",fid[i],start[i],length[i]);
}

void display()
{
    int i;
    for(i=0; i<20; i++) printf("%4d",i);
    printf("\n"); for(i=0;
    i<20;  i++)
        printf("%4s", a[i]);
}

main()
{
    int i,n,k,temp,st,nb,ch,flag; char
    id[4];

    for(i=0; i<20; i++) strcpy(a[i], "");
    printf("Disk space before allocation:\n"); display();
    do
    {
        printf("\nEnter File name (max 3 char) : "); scanf("%s", id);
        printf("Enter start block : ");
        scanf("%d", &st);
        printf("Enter no. of blocks : ");
        scanf("%d", &nb); strcpy(fid[num], id);
        length[num] = nb; flag
        = 0;

        if((st+nb) > 20)
        {
            printf("Requirement exceeds range\n");
            continue;
        }

        for(i=st; i<(st+nb); i++)
            if(strcmp(a[i], "") !=  0)
                flag = 1;
        if(flag == 1)
        {
            printf("Contiguous allocation not possible.\n"); continue;
        }
        start[num] = st; for(i=st;
        i<(st+nb);  i++)
```

```
                strcpy(a[i], id);;
            printf("Allocation done\n");
            num++;

            printf("\nAny more allocation (1. yes / 2. no)? : "); scanf("%d", &ch);
        } while (ch == 1); printf("\n\t\t\tContiguous
        Allocation\n"); printf("Directory:");
        directory();
        printf("\nDisk space after allocation:\n"); display();
}
```

Output

```
Disk space before allocation:
  0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19

Enter File name (max 3 char) :
cp Enter start block : 14
Enter no. of blocks : 3
Allocation done
Any more allocation (1. yes / 2. no)? : 1

Enter File name (max 3 char) :
tr Enter start block : 18
Enter no. of blocks : 3
Requirement exceeds
range

Enter File name (max 3 char) :
tr Enter start block : 10
Enter no. of blocks : 3
Allocation done
Any more allocation (1. yes / 2. no)? : 1

Enter File name (max 3 char) :
mv Enter start block : 0
Enter no. of blocks : 2
Allocation done
Any more allocation (1. yes / 2. no)? : 1

Enter File name (max 3 char) :
ps Enter start block : 12
Enter no. of blocks : 3
Contiguous allocation not possible.
Any more allocation (1. yes / 2. no)? :2




                    Contiguous Allocation
Directory:
```

```
File Start
Length cp     14
       3
tr     10     3
mv      0     2

Disk space after allocation:
  0   1   2   3   4   5   6   7   8   9   1   11  12  13  1   1   1   17  18  1
                                          0                   4   5   6           9
  m   m                                   tr  tr  tr          c   c   c
  v   v                                                       p   p   p
```

Result

Thus contiguous allocation is done for files with the available free blocks.

Ex. No. 14)b) File Allocation using linked file strategy

Date:

Aim

To implement linked file allocation strategy.

Linked

Each file is a linked list of disk blocks.
The directory contains a pointer to first and last blocks of the file.
The first block contains a pointer to the second one, second to third and so on.
File size need not be known in advance, as in contiguous allocation.
No external fragmentation.
Supports sequential access only.

Algorithm

1. Get no. of files
2. Accept filenames and no. of blocks fo each file
3. Obtrain start block for each file
4. Obtain other blocks for each file
5. Check block availability before allocation
6. If block is unavailable then report error
7. Accept file name
8. Display linked file allocation blocks for that file
9. Stop

Program

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


main()
{
    static int b[20], i, j, blocks[20][20]; char
    F[20][20], S[20], ch;
    int sb[20], eb[20], x, n; clrscr();
    printf("\n Enter no. of Files ::");
    scanf("%d",&n);
```

```
        for(i=0;i<n;i++)
        {
            printf("\n Enter file %d name ::", i+1); scanf("%s",
            &F[i]);
            printf("\n Enter No. of blocks::", i+1); scanf("%d",&b[i]);
        }

        for(i=0;i<n;i++)
        {
            printf("\n Enter Starting block of file%d::",i+1); scanf("%d", &sb[i]);
            printf("\nEnter blocks for file%d::\n", i+1); for(j=0;
            j<b[i]-1;)
            {
                printf("\n Enter the %dblock ::", j+2); scanf("%d",
                &x);
                if(b[i] != 0)
                {
                    blocks[i][j] = x; j++;
                }
                else
                    printf("\n Invalid block::");
            }
        }

        printf("\nEnter the Filename :"); scanf("%s",
        &S);
        for(i=0; i<n; i++)
        {
            if(strcmp(F[i],S) == 0)
            {
                printf("\nFname\tBsize\tStart\tBlocks\n");   printf("\n____\n");
                printf("\n%s\t%d\t%d\t", F[i], b[i], sb[i]); printf("%d->",sb[i]);
                for(j=0; j<b[i];  j++)
                {
                    if(b[i] != 0)
                        printf("%d->", blocks[i][j]);
                }
            }
        }
        printf("\n______________________________________________________________\n");
        getch();
    }
```

Output

```
 Enter no. of Files ::2

 Enter file 1 name ::fcfs
 Enter No. of blocks::3

 Enter file 2 name ::
 sjf Enter No. of
 blocks::2

 Enter Starting block of
file1::8 Enter blocks for
file1::
 Enter the 2block ::
 3 Enter the
 3block ::5

 Enter Starting block of
file2::2 Enter blocks for
file2::
 Enter the 2block ::6

Enter the Filename ::

fcfs

Fname Bsize Start Blocks
------------------------------------------
fcfs      3          8      8->3->5
------------------------------------------
```

Result

Thus blocks for file were allocation using linked allocation method.

Ex. No. 14)c) File Allocation using Indexed file strategy

Date:

Aim

To implement linked file allocation strategy.

Indexed

In indexed allocation, all pointers are put in a single block known as index block.
The directory contains address of the index block.
The i^{th} entry in the index block points to i^{th} block of the file.
Indexed allocation supports direct access.
It suffers from pointer overhead, i.e wastage of space in storing pointers.

Algorithm

```
Step 1: Start.
Step 2: Let n be the size of the buffer
Step 3: check if there are any producer
Step 4: if yes check whether the buffer is full
Step 5: If no the producer item is stored in the buffer
Step 6: If the buffer is full the producer has to wait
Step 7: Check there is any consumer.If yes check whether the buffer is empty
Step 8: If no the consumer consumes them from the buffer
Step 9: If the buffer is empty, the consumer has to wait.
Step 10: Repeat checking for the producer and consumer till required
Step 11: Terminate the process.
```

Program

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
void main()
{
int f[50], index[50],i, n, st, len, j, c, k, ind,count=0;
clrscr();
for(i=0;i<50;i++)
f[i]=0;
x:printf("Enter the index block: ");
scanf("%d",&ind);
if(f[ind]!=1)
{
printf("Enter no of blocks needed and no of files for the index %d on the
disk : \n", ind);
scanf("%d",&n);
}
else
{
printf("%d index is already allocated \n",ind);
goto x;
}
y: count=0;
for(i=0;i<n;i++)
{
scanf("%d", &index[i]);
if(f[index[i]]==0)
count++;
}
if(count==n)
{
for(j=0;j<n;j++)
f[index[j]]=1;
printf("Allocated\n");
printf("File Indexed\n");
for(k=0;k<n;k++)
printf("%d-------->%d : %d\n",ind,index[k],f[index[k]]);
}
else
{
printf("File in the index is already allocated \n");
printf("Enter another file indexed");
goto y;
}
printf("Do you want to enter more file(Yes - 1/No - 0)");
scanf("%d", &c);
if(c==1)
goto x;
else
exit(0);
getch();
}
```

Output:

```
Enter the index
block: 5
Enter no of blocks
needed and no of
files for the index 5
on the disk :
```

```
4
1 2 3 4
Allocated
File Indexed
5-------->1 : 1
5-------->2 : 1
5-------->3 : 1
5-------->4 : 1
Do you want to
enter more
file(Yes - 1/No -
0)1
Enter the index
block: 4
4 index is already
allocated
Enter the index
block: 6


Enter no of blocks
needed and no of
files for the index
6 on the disk :
2
7 8
A5llocated
File Indexed
6-------->7 : 1
6-------->8 : 1
Do you want to enter more file(Yes - 1/No
- 0)0
```

Result

Thus blocks for file were allocation using indexed allocation method.

Ex. No. 15.a Disk Scheduling Algorithm:FCFS

Date:

Aim

To implement FCFS disk scheduling algorithm.

FCFS

FCFS is the simplest disk scheduling algorithm. As the name suggests, this algorithm entertains requests in the order they arrive in the disk queue. The algorithm looks very fair and there is no starvation (all requests are serviced sequentially) but generally, it does not provide the fastest service.

Algorithm:

1. Let Request array represents an array storing indexes of tracks that have been requested in ascending order of their time of arrival. 'head' is the position of disk head.
2. Let us one by one take the tracks in default order and calculate the absolute distance of the track from the head.
3. Increment the total seek count with this distance.
4. Currently serviced track position now becomes the new head position.
5. Go to step 2 until all tracks in request array have not been serviced.

Program:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
  int RQ[100],i,n,TotalHeadMoment=0,initial;
  printf("Enter the number of Requests\n");
  scanf("%d",&n);
  printf("Enter the Requests sequence\n");
  for(i=0;i<n;i++)
   scanf("%d",&RQ[i]);
  printf("Enter initial head position\n");
  scanf("%d",&initial);

  // logic for FCFS disk scheduling

  for(i=0;i<n;i++)
  {
    TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
    initial=RQ[i];
  }

  printf("Total head moment is %d",TotalHeadMoment);
  return 0;

}
```

Output:

```
Enter the number of Request
8
Enter the Requests Sequence
95 180 34 119 11 123 62 64
Enter initial head position
50
Total head movement is 644
```

Result

Thus the program for FCFS disk scheduling algorithm was created and executed successfully.

Ex. No. 15)b) Disk Scheduling Algorithm: C-SCAN

Date:

Aim

To implement C-SCAN disk scheduling algorithm.

C-SCAN

The **Circular SCAN (C-SCAN) Scheduling Algorithm** is a modified version of the SCAN Disk Scheduling Algorithm that deals with the inefficiency of the SCAN algorithm by servicing the requests more uniformly.

Algorithm:

Step 1: Let the Request array represents an array storing indexes of tracks that have been requested in ascending order of their time of arrival. 'head' is the position of the disk head.
Step 2: The head services only in the right direction from 0 to the disk size.
Step 3: While moving in the left direction do not service any of the tracks.
Step 4: When we reach the beginning(left end) reverse the direction.
Step 5: While moving in the right direction it services all tracks one by one.
Step 6: While moving in the right direction calculate the absolute distance of the track from the head.
Step 7: Increment the total seek count with this distance.
Step 8: Currently serviced track position now becomes the new head position.
Step 9: Go to step 6 until we reach the right end of the disk.
Step 9: If we reach the right end of the disk reverse the direction and go to step 3 until all tracks in the request array have not been serviced.

Program:

```
#include<stdio.h>
  #include<stdlib.h>
  int main()
  {
    int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
    printf("Enter the number of Requests\n");
    scanf("%d",&n);
    printf("Enter the Requests sequence\n");
    for(i=0;i<n;i++)
     scanf("%d",&RQ[i]);
    printf("Enter initial head position\n");
    scanf("%d",&initial);
    printf("Enter total disk size\n");
    scanf("%d",&size);
    printf("Enter the head movement direction for high 1 and for low 0\n");
    scanf("%d",&move);

    // logic for C-Scan disk scheduling

      /*logic for sort the request array */
    for(i=0;i<n;i++)
    {
      for( j=0;j<n-i-1;j++)
      {
        if(RQ[j]>RQ[j+1])
        {

          int temp;
          temp=RQ[j];
          RQ[j]=RQ[j+1];
          RQ[j+1]=temp;
        }

      }
    }

    int index;
    for(i=0;i<n;i++)
    {
      if(initial<RQ[i])
      {
        index=i;
        break;
      }
    }

    // if movement is towards high value
    if(move==1)
    {
      for(i=index;i<n;i++)
      {
        TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
        initial=RQ[i];
      }
      //  last movement for max size
      TotalHeadMoment=TotalHeadMoment+abs(size-RQ[i-1]-1);
      /*movement max to min disk */
      TotalHeadMoment=TotalHeadMoment+abs(size-1-0);
      initial=0;
      for( i=0;i<index;i++)
      {
         TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
         initial=RQ[i];

      }
    }
    // if movement is towards low value
    else
    {
      for(i=index-1;i>=0;i--)
      {
        TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
        initial=RQ[i];
      }
```

```
            // last movement for min size
            TotalHeadMoment=TotalHeadMoment+abs(RQ[i+1]-0);
            /*movement min to max disk */
            TotalHeadMoment=TotalHeadMoment+abs(size-1-0);
            initial =size-1;
            for(i=n-1;i>=index;i--)

            {

                TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
                initial=RQ[i];

            }
        }

        printf("Total head movement is %d",TotalHeadMoment);
        return 0;
    }
```

Output:

```
Enter the number of Request
8
Enter the Requests Sequence
95 180 34 119 11 123 62 64
Enter initial head position
50
Enter total disk size
200
Enter the head movement direction for high 1 and for low 0
1
Total head movement is 382
```

Result

Thus the program for C-SCAN disk scheduling algorithm was created and executed successfully.

Ex. No. 15)c) Disk Scheduling Algorithm: SSTF

Date:

Aim

To implement SSTF disk scheduling algorithm.

SSTF

- Given an array of disk track numbers and initial head position, our task is to find the total number of seek operations done to access all the requested tracks if **Shortest Seek Time First (SSTF)** is a disk scheduling algorithm is used.

Algorithm:

Step 1: Let the Request array represents an array storing indexes of tracks that have been requested. 'head' is the position of the disk head.
Step 2: Find the positive distance of all tracks in the request array from the head.
Step 3: Find a track from the requested array which has not been accessed/serviced yet and has a minimum distance from the head.
Step 4: Increment the total seek count with this distance.
Step 5: Currently serviced track position now becomes the new head position.
Step 6: Go to step 2 until all tracks in the request array have not been serviced.

Program:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
   int RQ[100],i,n,TotalHeadMoment=0,initial,count=0;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);

   // logic for sstf disk scheduling

      /* loop will execute until all process is completed*/
   while(count!=n)
   {
      int min=1000,d,index;
      for(i=0;i<n;i++)
      {
        d=abs(RQ[i]-initial);
        if(min>d)
        {
           min=d;
           index=i;
```

```
          }

        }
        TotalHeadMoment=TotalHeadMoment+min;
        initial=RQ[index];


              // 1000 is for max
      // you can use any number
        RQ[index]=1000;
        count++;
    }

    printf("Total head movement is %d",TotalHeadMoment);
    return 0;
}
```

Output:

```
Enter the number of Request
8
Enter Request Sequence
95 180 34 119 11 123 62 64
Enter initial head Position
50
Total head movement is 236
```

Result

Thus the program for SSTF disk scheduling algorithm was created and executed successfully.

Ex. No. 15)d) Disk Scheduling Algorithm: LOOK

Date:

Aim

To implement LOOK disk scheduling algorithm.

LOOK

- The LOOK algorithm operates by scanning the disk in a specific direction, but instead of going all the way to the end of the disk before reversing direction like the SCAN algorithm, it reverses direction as soon as it reaches the last request in the current direction.

Algorithm:

Step 1: Let the Request array represents an array storing indexes of tracks that have been requested in ascending order of their time of arrival. 'head' is the position of the disk head.
Step 2: The initial direction in which the head is moving is given and it services in the same direction.
Step 3: The head services all the requests one by one in the direction head is moving.
Step 4: The head continues to move in the same direction until all the requests in this direction are finished.
Step 5: While moving in this direction calculate the absolute distance of the track from the head.
Step 6: Increment the total seek count with this distance.
Step 7: Currently serviced track position now becomes the new head position.
Step 8: Go to step 5 until we reach at last request in this direction.
Step 9: If we reach where no requests are needed to be serviced in this direction reverse the direction and go to step 3 until all tracks in the request array have not been serviced.

Program:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
   int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);
   printf("Enter total disk size\n");
   scanf("%d",&size);
   printf("Enter the head movement direction for high 1 and for low 0\n");
   scanf("%d",&move);

   // logic for look disk scheduling
```

```
        /*logic for sort the request array */
    for(i=0;i<n;i++)

    {
        for(j=0;j<n-i-1;j++)
        {
            if(RQ[j]>RQ[j+1])
            {
                int temp;
                temp=RQ[j];
                RQ[j]=RQ[j+1];
                RQ[j+1]=temp;
            }

        }
    }

    int index;
    for(i=0;i<n;i++)
    {
        if(initial<RQ[i])
        {
            index=i;
            break;
        }
    }

    // if movement is towards high value
    if(move==1)
    {
        for(i=index;i<n;i++)
        {
            TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
            initial=RQ[i];
        }

        for(i=index-1;i>=0;i--)
        {
             TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
             initial=RQ[i];

        }
    }
    // if movement is towards low value
    else
    {
        for(i=index-1;i>=0;i--)
        {
            TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
            initial=RQ[i];
        }
        for(i=index;i<n;i++)
        {
            TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
            initial=RQ[i];

        }
    }

    printf("Total head movement is %d",TotalHeadMoment);
    return 0;
}
```

Output:

```
Enter the number of Request
8
Enter the Requests Sequence
95 180 34 119 11 123 62 64
Enter initial head position
50
Enter the head movement direction for high 1 and for low 0
1
Total head movement is 299
```

Result

Thus the program for LOOK disk scheduling algorithm was created and executed successfully.

Ex. No. 16) **Installation of LINUX inside Windows using VMWare**

Date:

Aim

To Install of a Guest OS using VMWare.

Definition

Your actual operating system is called host OS and the operating system you install in the virtual machine is called guest OS. The virtual machines use your host OS's system resources. Ubuntu GNOME requires 4 GB of RAM to function properly, your system should have 8 GB to allocate 4 GB to the guest OS (Ubuntu) and keep 4 GB for the host OS (Windows).

Procedure:

Step 1: Download and install VMWare Player

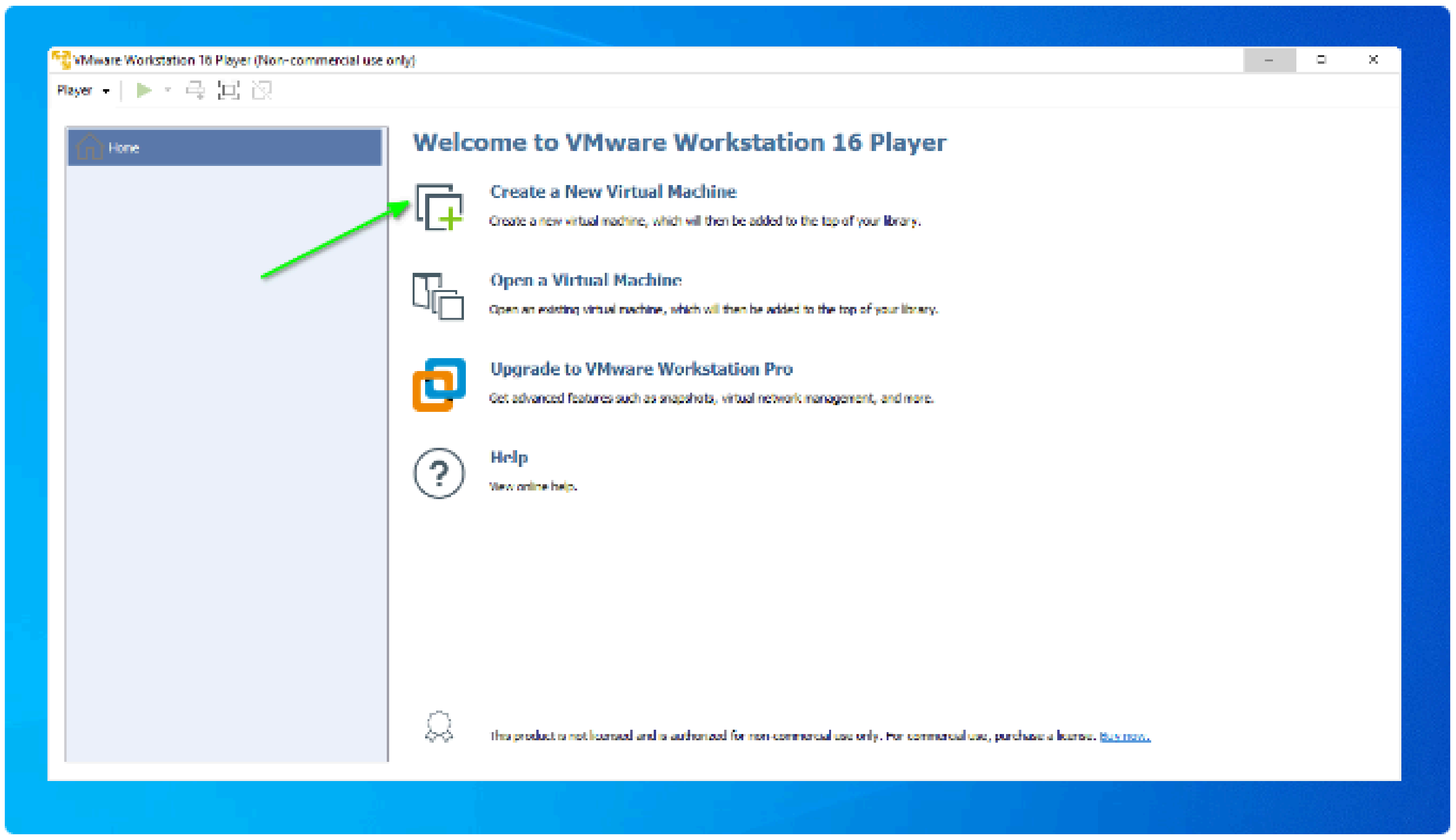
Go to VMWare website and download the .exe file of VMWare Player. Once downloaded, double-click the exe file and follow the on-screen instructions to install VMWare.

Step 2: Download the Linux ISO

Next, you need to download the ISO file of the Linux distribution. You can get this image from the official website of the Linux distribution you are trying to use.

Step 3: Install Linux using VMWare

You have installed VMWare and you have downloaded the ISO for Linux. You are now set to install Linux in VMware. Now, start VMWare and click on **Create New Virtual Machine**.


VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
Create a New Virtual Machine
Open a Virtual Machine
Upgrade to VMware Workstation Pro
Help

Create a new virtual machine, which will then be added to the top of your library.

Open an existing virtual machine, which will then be added to the top of your library.

Get advanced features such as snapshots, virtual network management, and more.

View online help.

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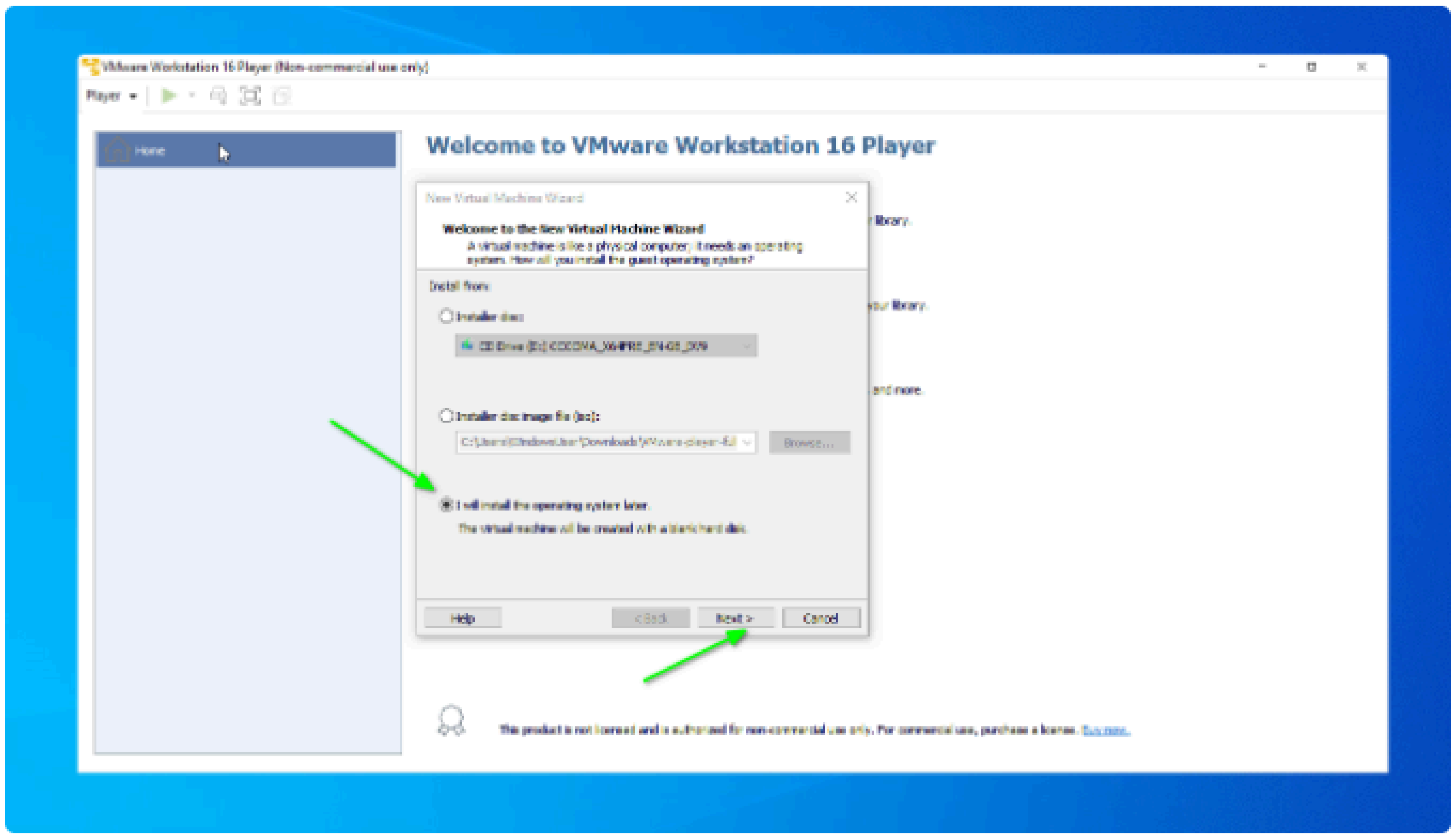
Create new virtual machine in VMWare

Select "I will install operating system later" option and press next.



VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
New Virtual Machine Wizard
Help
< Back
Next >
Cancel
Browse...

Welcome to the New Virtual Machine Wizard

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

○ Installer disc:

CD Drive (E:) CCCOMA_X64FRE_EN-GB_DV9

○ Installer disc image file (iso):

C:\Users\WindowsUser\Downloads\VMware-player-full

[✓ I will install the operating system later.]

The virtual machine will be created with a blank hard disk.

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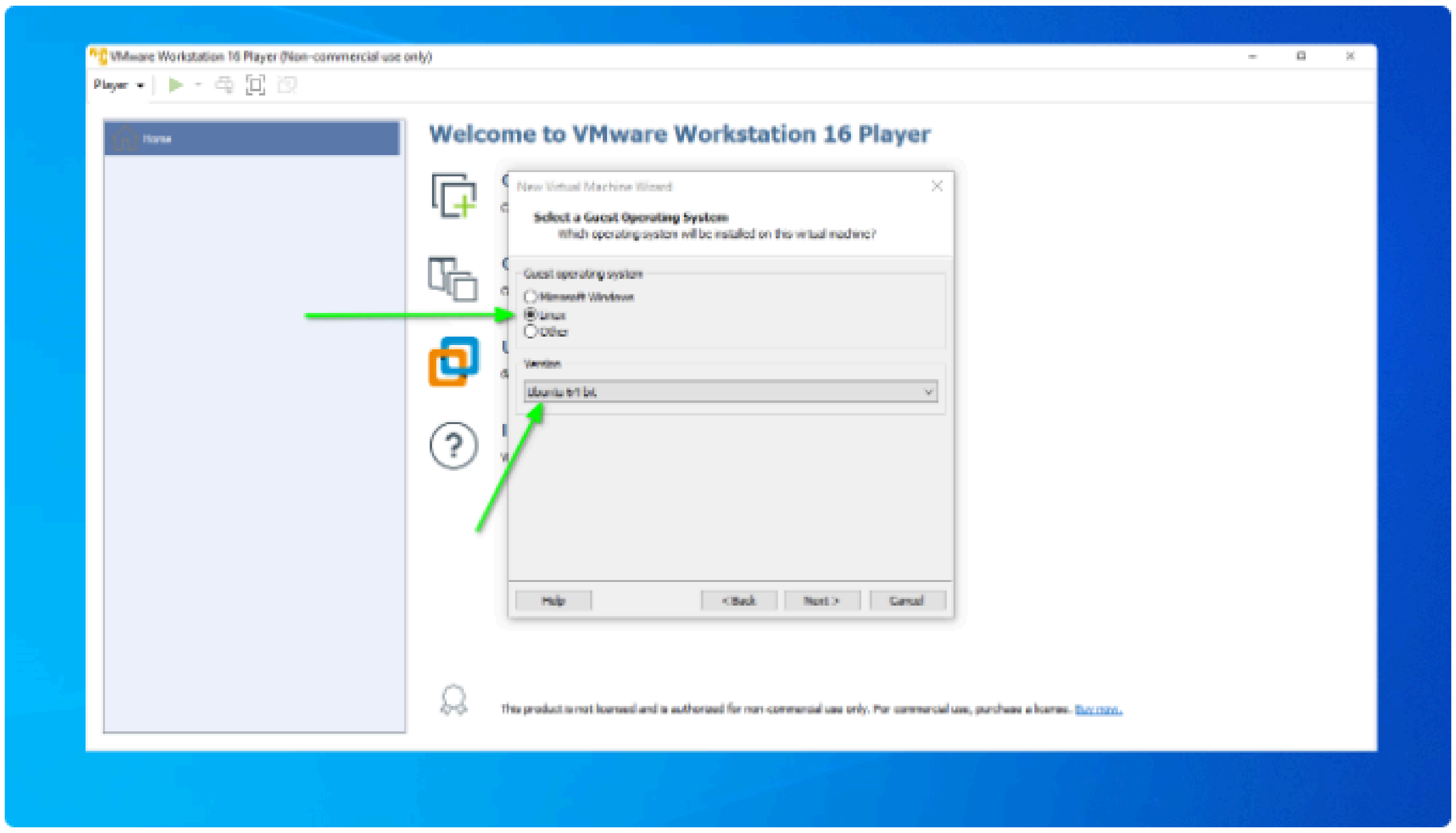
Select install operating system later button
On the next screen, set the Operating system to Linux and the version to Ubuntu 64bit.



VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
New Virtual Machine Wizard
Help
< Back
Next >
Cancel

Select a Guest Operating System

Which operating system will be installed on this virtual machine?

Guest operating system

○ Microsoft Windows

[✓ Linux]

○ Other

Version

Ubuntu 64-bit

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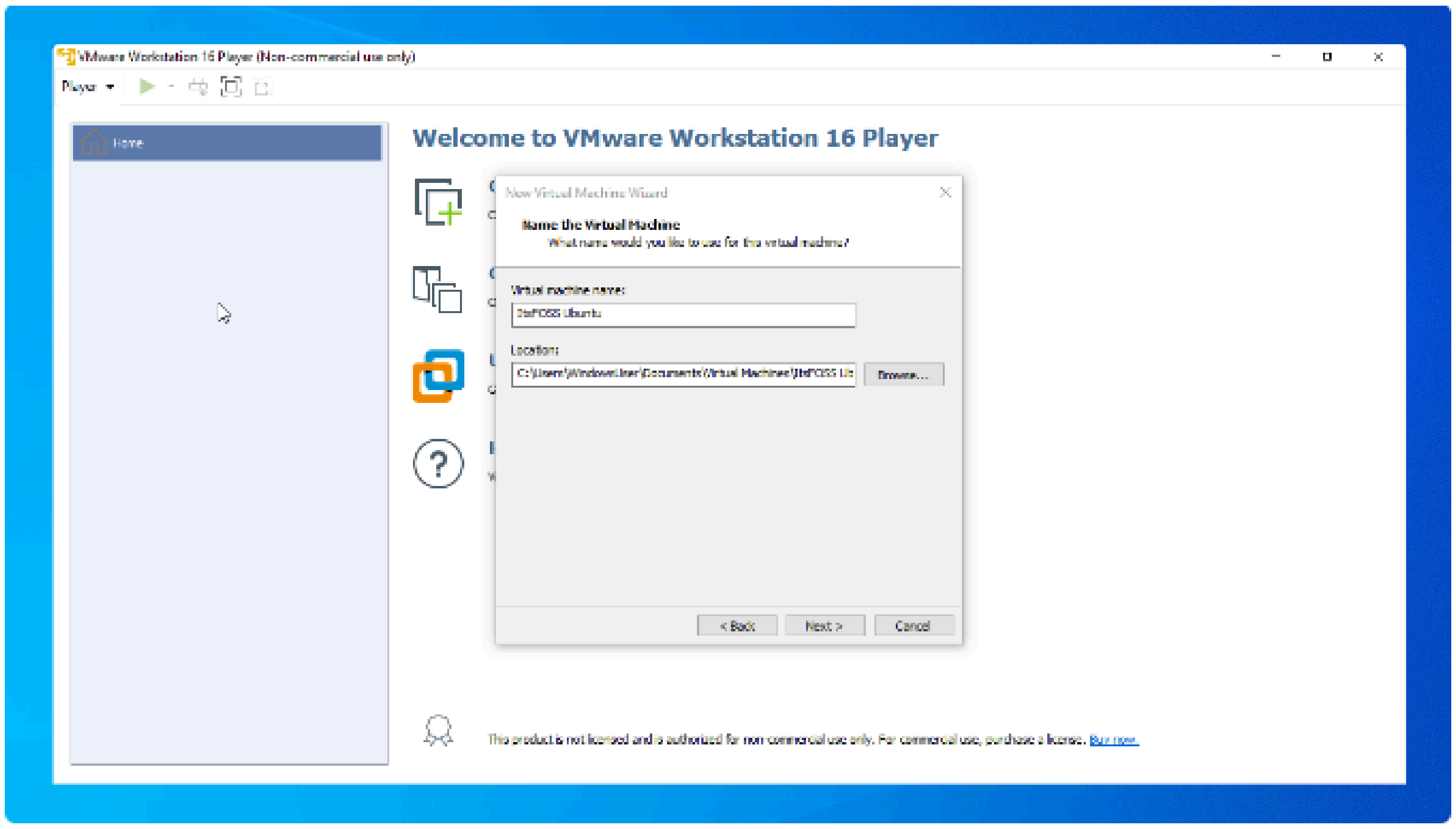
Select Linux type and ubuntu 64 type
Give the virtual machine a name and press Next.


VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
New Virtual Machine Wizard
< Back
Next >
Cancel
Browse...

Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name:
ItsFOSS Ubuntu

Location:
C:\Users\WindowsUser\Documents\Virtual Machines\ItsFOSS Ub

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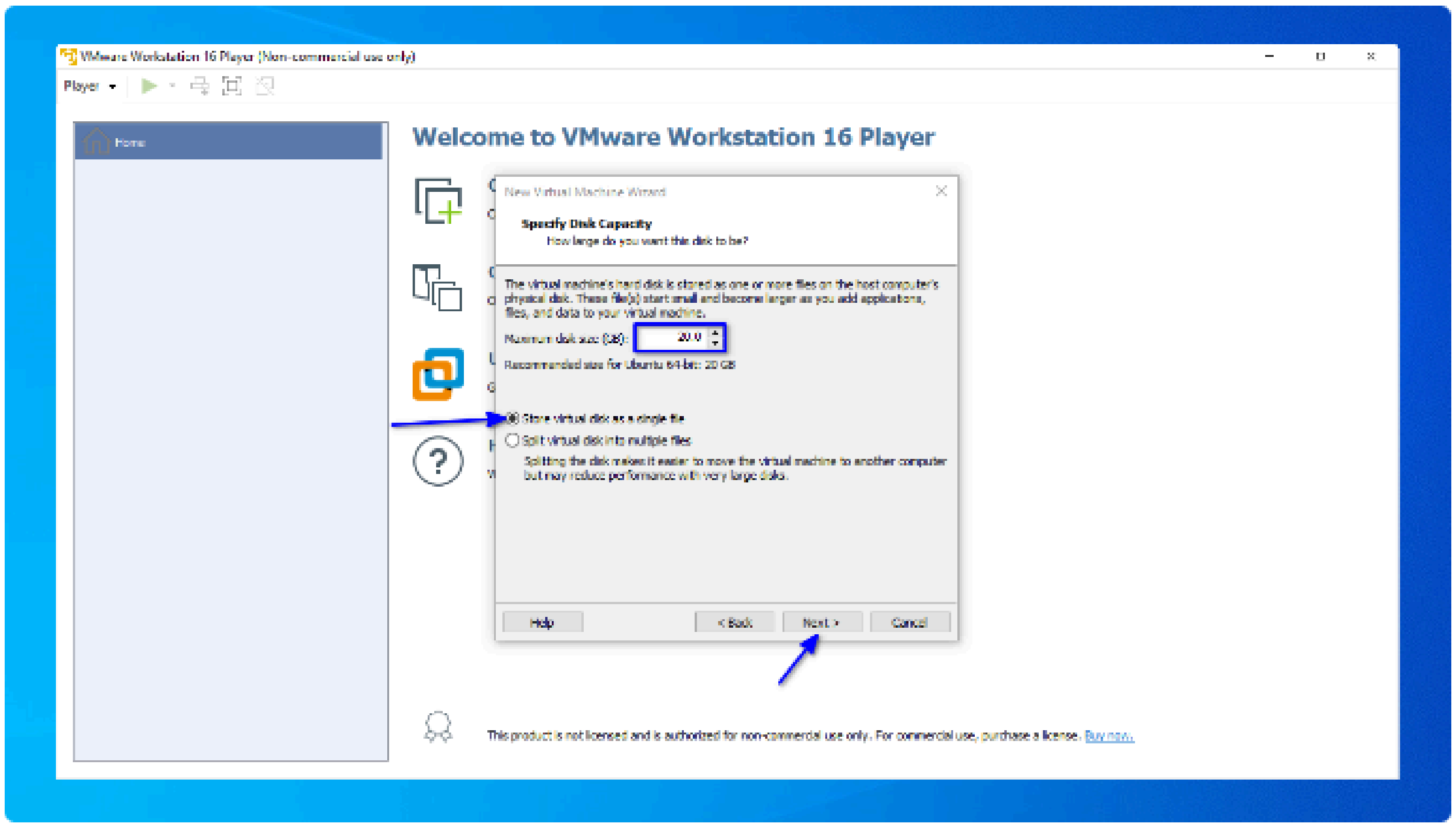
Name the virtual machine
In the next screen, set the disk size to a minimum of 20 GB and also select “Store Virtual Disk as a single file” option.


VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
New Virtual Machine Wizard
Help
< Back
Next >
Cancel

Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB): 20.0

Recommended size for Ubuntu 64-bit: 20 GB

[✓ Store virtual disk as a single file]
Split virtual disk into multiple files
Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

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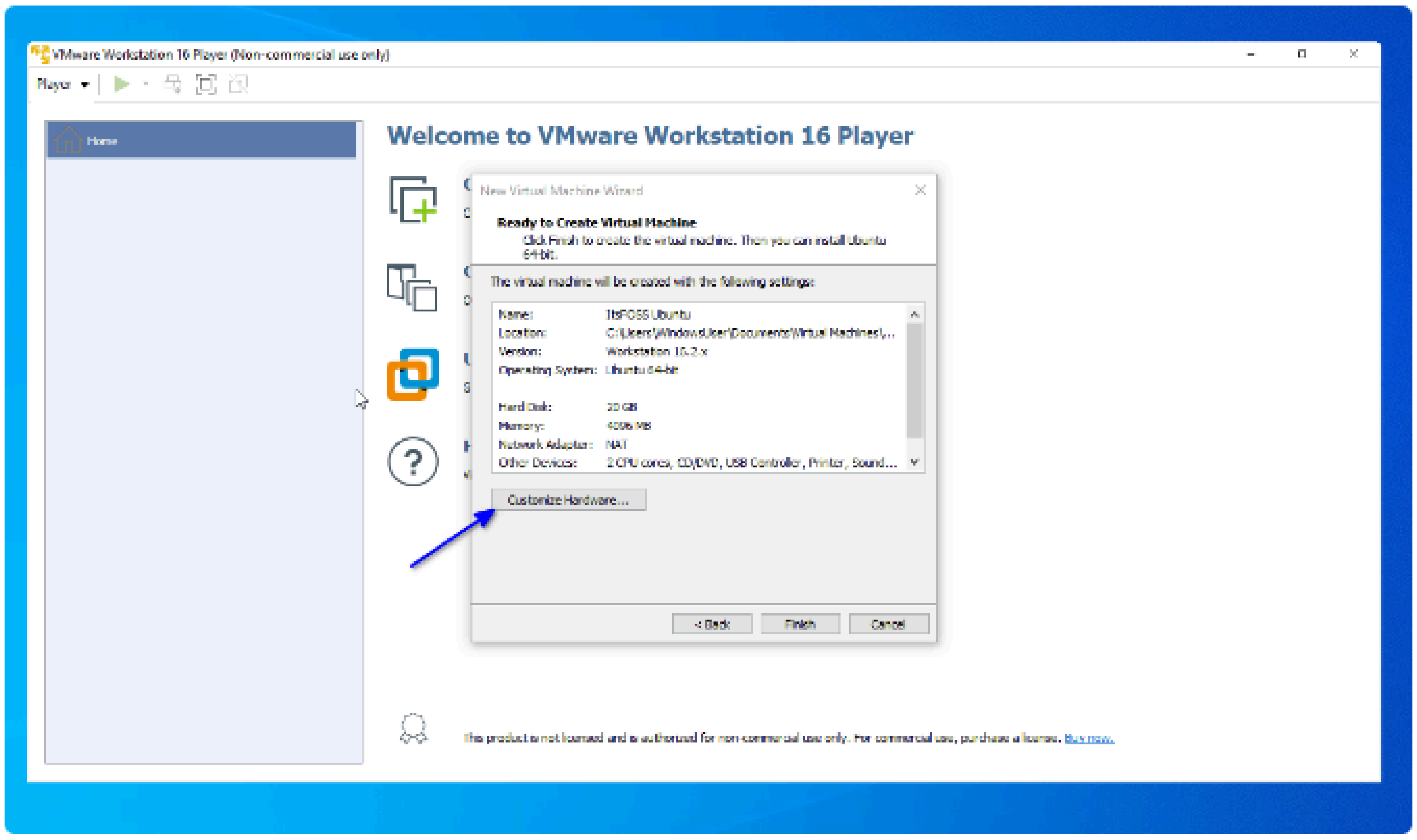
Select disk size and store as single file
From the next screen, you can either press Finish and set ISO file later by right-clicking and Settings. Or you can select the ISO file on the go. For this, press “Customize Hardware” button.


VMware Workstation 16 Player (Non-commercial use only)
Player
Home
Welcome to VMware Workstation 16 Player
New Virtual Machine Wizard
Customize Hardware...
< Back
Finish
Cancel

Ready to Create Virtual Machine
Click Finish to create the virtual machine. Then you can install Ubuntu 64-bit.

The virtual machine will be created with the following settings:

```
Name:              ItsFOSS Ubuntu
Location:          C:\Users\WindowsUser\Documents\Virtual Machines\...
Version:           Workstation 16.2.x
Operating System:  Ubuntu 64-bit

Hard Disk:         20 GB
Memory:            4096 MB
Network Adapter:   NAT
Other Devices:     2 CPU cores, CD/DVD, USB Controller, Printer, Sound...
```

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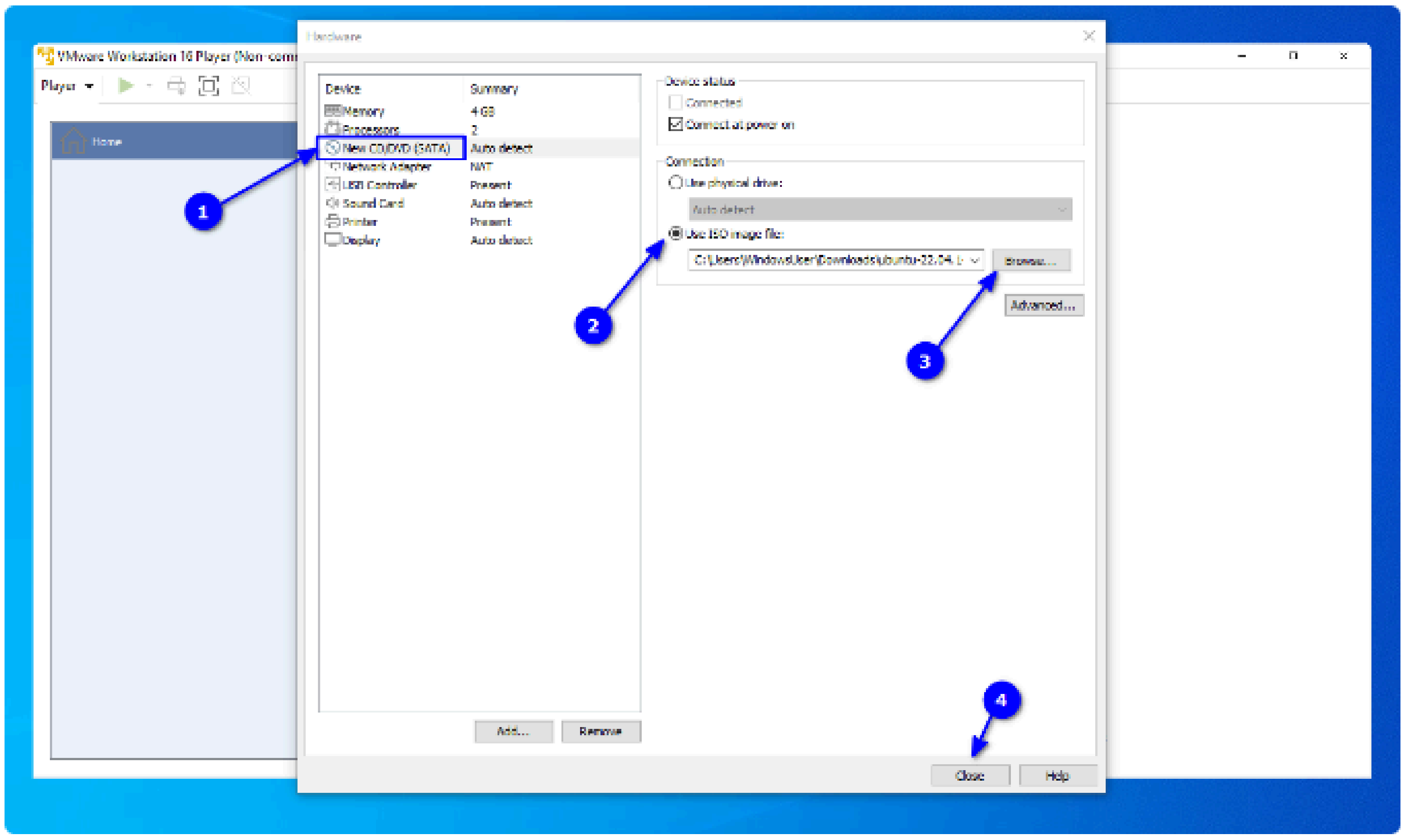
Press Customise Hardware button
On this screen, you can tweak memory, processors, etc. But you need to select "New CD/DVD" button and add the Ubuntu ISO as shown in the screenshot:

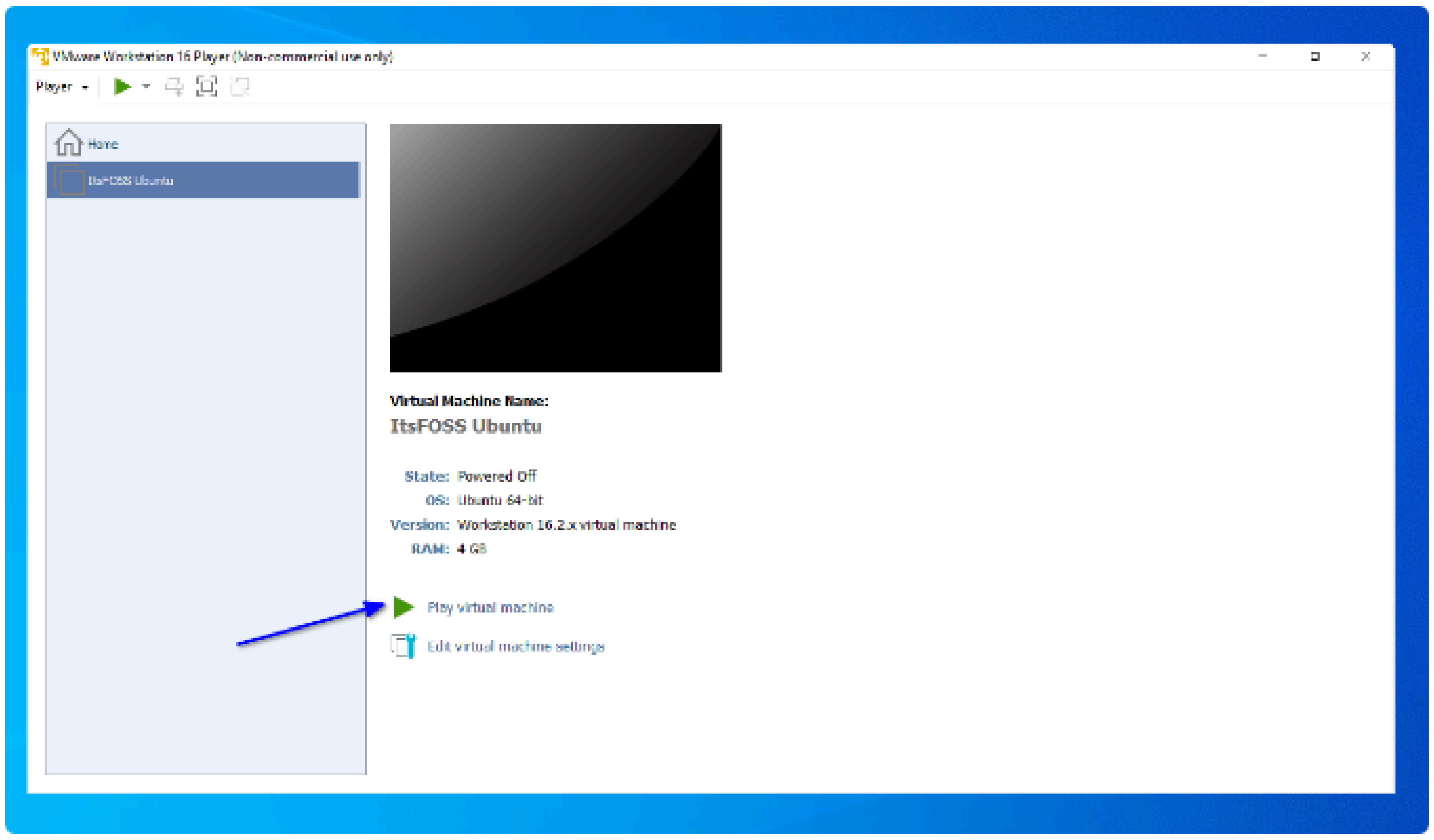


Device	Summary
Memory	4 GB
Processors	2
New CD/DVD (SATA)	Auto detect
Network Adapter	NAT
USB Controller	Present
Sound Card	Auto detect
Printer	Present
Display	Auto detect

Device status
- [ ] Connected
- [✓] Connect at power on

Connection
- ○ Use physical drive: Auto detect
- ● Use ISO image file: C:\Users\WindowsUser\Downloads\ubuntu-22.04.1

Set ISO image file from customize hardware dialog box


VMware Workstation 16 Player (Non-commercial use only)
Player
Home
ItsFOSS Ubuntu
Play virtual machine
Edit virtual machine settings

Virtual Machine Name:
ItsFOSS Ubuntu

State: Powered Off
OS: Ubuntu 64-bit
Version: Workstation 16.2.x virtual machine
RAM: 4 GB

Now, you can close this and press the finish button. Once done, you can now start the VMWare virtual machine and start the installation of Ubuntu.

Result:

Thus the Guest OS has been successfully installed using VMWare.