

Operating System

PORTFOLIO  
with

Lab Manual

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DEGREE: BS - CS

This document and all submission including codes are also available on

<https://github.com/miks98/OperatingSystems>

**IQRA UNIVERSITY**

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**Operating System**

# List of Labs

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* Introduction to OS and Fedora.
* Creation of Virtual Machine.

***Lab #2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Introduction to UNIX/LINUX Shell

***Lab # 3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

UNIX/LINUX Shell programming

* Variable
* Basic Variable

***Lab # 4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

UNIX/LINUX Shell programming

* Using Array
* Basic Operator

***Lab # 5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

UNIX/LINUX Shell programming

* Decision Making
* Shell Loop
* Loop Control
* Shell Function

***Lab # 6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

UNIX/LINUX Shell programming

* Shell Substitution
* Quoting Mechanisms
* I/O Redirection
* Man\_page Help

***Lab # 7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Linux File Management.

***Lab # 8\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Linux Directory Management

***Lab # 9\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Linux File Permission / Access Mode

***Lab # 10\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

CPU Scheduling Algorithms

***Lab # 11\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

File Allocation Strategies

***Lab # 12\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Memory Management Techniques

***Lab # 13\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Memory Management Techniques using Paging.

***Lab # 14\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Deadlock Management Techniques

***Lab # 15\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Page Replacement Algorithms

***Lab # 16\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Process Synchronization

# Lab Task:

## LAB # 01

### Task 01

Look for difference between VHD, VMDK and VDI

VDI is the format used by VIRTUALBOX.

VMDK is the format used by VMWare products.

VHD is the format used by Microsoft products.

VMDK is developed by and for VMWare, but VirtualBox and QEMU (another common virtualization software) also support it. This format might be the the best choice for you because you want wide compatibility with other virtualization software. VHD is the native format of Microsoft Virtual PC.

A virtual disk image (VDI) is the image of a virtual hard disk or the logical disk associated with a virtual machine. It is used in virtualization environments to create a replica of the disk space/drive assigned to one or more virtual machines.

### Task 02

Create a Fedora Virtual machine also create a text file using fedora terminal

**Already completed**

## LAB # 02

Write Linux bash Shell Script, which will ask and display all information required to Student admission in Engineering and Sciences University

#!/bin/sh

echo "Enter your name"

read -r name

echo "Enter your Date of Birth"

read -r dob

echo "Enter your CNIC Number"

read -r cnic

echo "Enter your last qualification"

read -r qualification

echo "Enter your intermediate grade"

read -r grade

echo "Attached all documents mention their also 4 passport sizes photograph"

echo "YOUR DETAIL"

echo "Name $name"

echo "Date of Birth $dob"

echo "CNIC number $cnic"

echo "Qualification $qualification"

echo "Inter grade $grade"

## LAB # 03

Use following variables to write your CV in Linux bash script.

|  |  |  |
| --- | --- | --- |
| Variable | Script | Output |
| $0 |  |  |
| $n |  |  |
| $# |  |  |
| $\* |  |  |
| $@ |  |  |
| $? |  |  |
| $$ |  |  |
| $! |  |  |

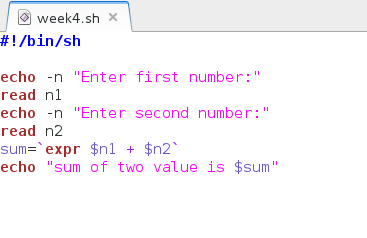
## LAB # 04

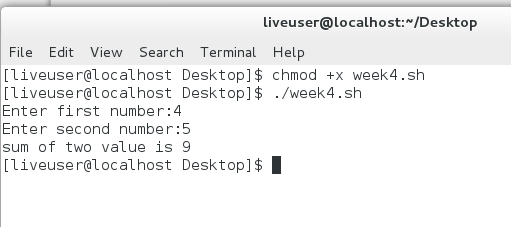
Write bash script to test all Athematic and logical operators in Linux

|  |  |  |
| --- | --- | --- |
| Operator: Task | Script | Output |
| + : add two number |  |  |
| - : make decrement operator |  |  |
| \* : Mutiply negative and positive number |  |  |
| /: divide any number by zero |  |  |
| Less than: Compare two value |  |  |
| Greater than: Compare two value |  |  |
| EquUniversityty: Compare two value |  |  |
| Not equal: Compare two value |  |  |
| And: make two simple and gate |  |  |
| Or: make two input or gate |  |  |
| Not: make 1 input not |  |  |

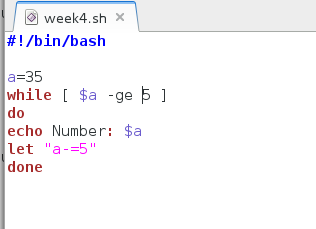
**Task: Write bash scrip to test all Athematic and logical operators in Linux**

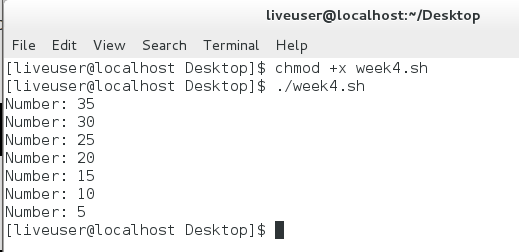
### + : add two number

****

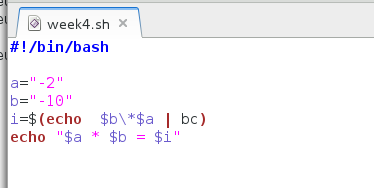
****

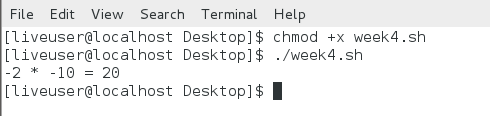
### - : make decrement operator

****

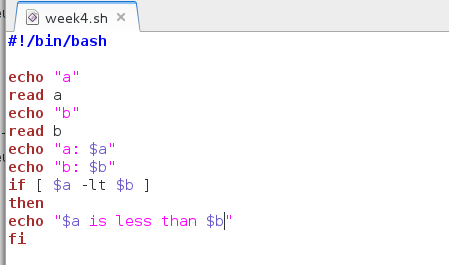
****

### \* : Mutiply negative and positive number

****

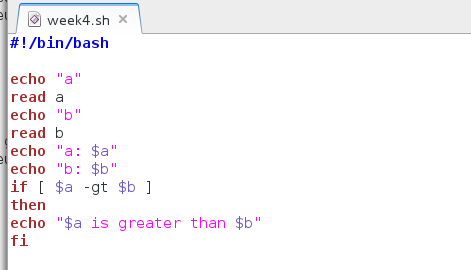
****

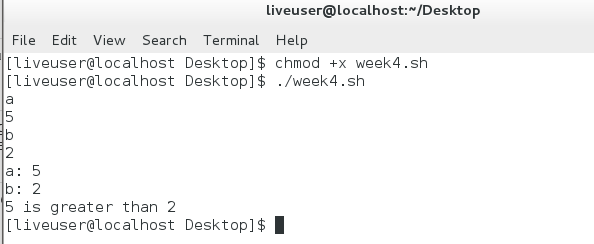
### Less than



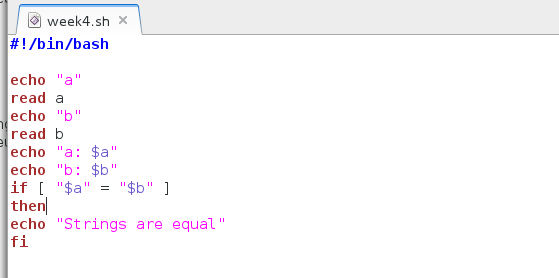


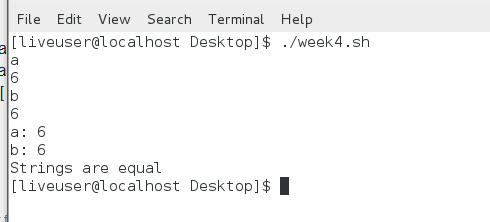
### Greater than



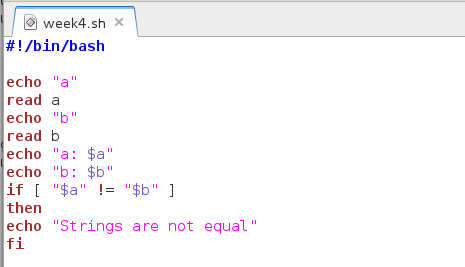


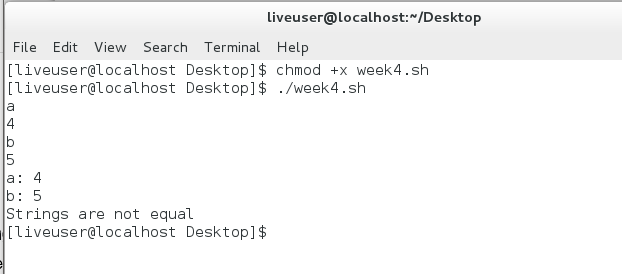
### Equals to:



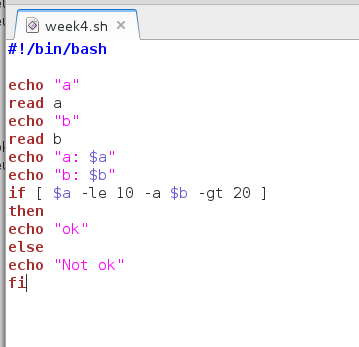


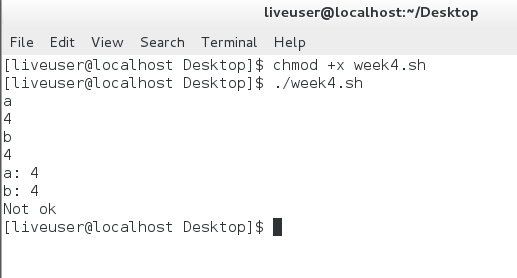
### Not equal



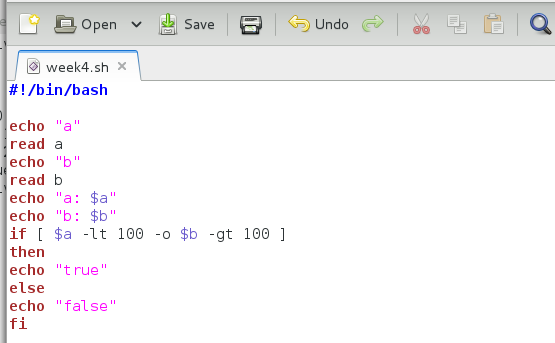


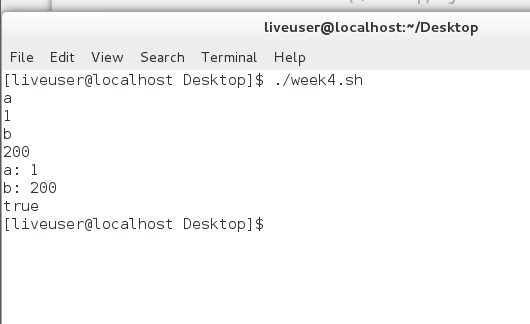
### AND operator:



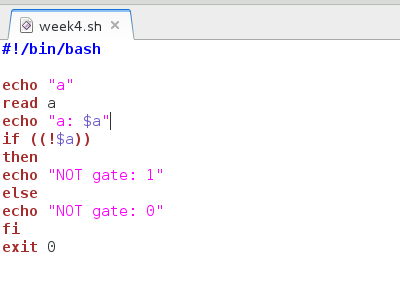


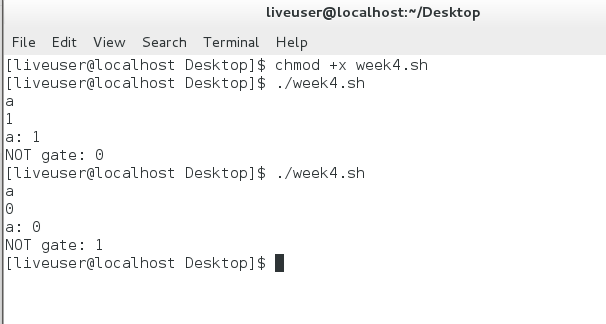
### **OR** operator**:**





### **NOT** operator**:**





## LAB # 05

Sort integer Array in ascending order.

### Code:

arr=(10 8 20 100 12)

echo "Array in original order"

echo "${arr[\*]}"

for ((i = 0; i<5; i++))

do

for((j = 0; j<5-i-1; j++))

do

if [ ${arr[j]} -gt ${arr[$((j+1))]} ]

then

# swap

temp=${arr[j]}

arr[$j]=${arr[$((j+1))]}

arr[$((j+1))]=$temp

fi

done

done

echo "Array in sorted order :"

echo "${arr[\*]}"

### Output:



Find shortest value in integer array.

### Code:

arrayName=(1 2 3 4 5 6 7)

min=${arrayName[0]}

# Loop through all elements in the array

for i in "${arrayName[@]}":

do

if [[ "$i" -lt "$min" ]]; then

min="$i"

fi

done

echo "Min is: $min"

Make shell function which can find out that input number is prime or not

### Code:

#!/bin/sh

Check\_prime () {

num=29

for((i=2; i<=num/2; i++))

do

if [ $((num%i)) -eq 0 ]

then

echo "$num is not a prime number."

exit

fi

done

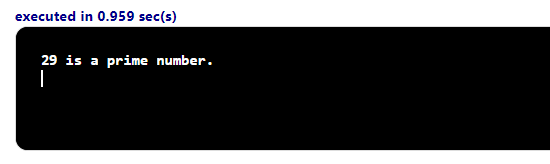
echo "$num is a prime number."

}

#function calling

Check\_prime

### Output:



Make shell function which can eliminate all odd numbers from integer array.

### Code:

### Output:

Make shell function which can find the last three prime number lesser than 100.

### Code:

### Output:

## LAB # 06 No Tasks

## LAB # 07 No Tasks

## LAB # 08 No Tasks

## LAB # 09 No Tasks

## LAB # 10 No Tasks

## LAB # 11 – Memory Management

* You are required to make changes in the above programs and introduce the use of compaction where required.
* Write code to simulate Worst-Fit Algorithm

### Code:

Also available on Github link

#include<stdio.h>

#include<conio.h>

#define max 25

void main()

{

int frag[max],b[max],f[max],i,j,nb,nf,temp;

static int bf[max],ff[max];

printf("\n\tMemory Management Scheme - First Fit");

printf("\nEnter the number of blocks:");

scanf("%d",&nb);

printf("Enter the number of files:");

scanf("%d",&nf);

printf("\nEnter the size of the blocks:-\n");

for(i=1;i<=nb;i++)

{

printf("Block %d:",i);

scanf("%d",&b[i]);

}

printf("Enter the size of the files :-\n");

for(i=1;i<=nf;i++)

{

printf("File %d:",i);

scanf("%d",&f[i]);

}

for(i=1;i<=nf;i++)

{

for(j=1;j<=nb;j++)

{

if(bf[j]!=1)

{

temp=b[j]-f[i];

if(temp>=0)

{

ff[i]=j;

break;

}

}

}

frag[i]=temp;

bf[ff[i]]=1;

}

printf("\nFile\_no:\tFile\_size :\tBlock\_no:\tBlock\_size:\tFragement");

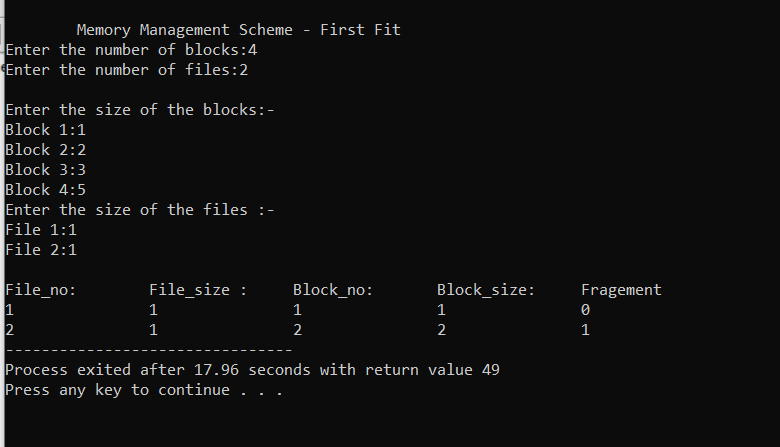
for(i=1;i<=nf;i++)

printf("\n%d\t\t%d\t\t%d\t\t%d\t\t%d",i,f[i],ff[i],b[ff[i]],frag[i]);

getch();

}

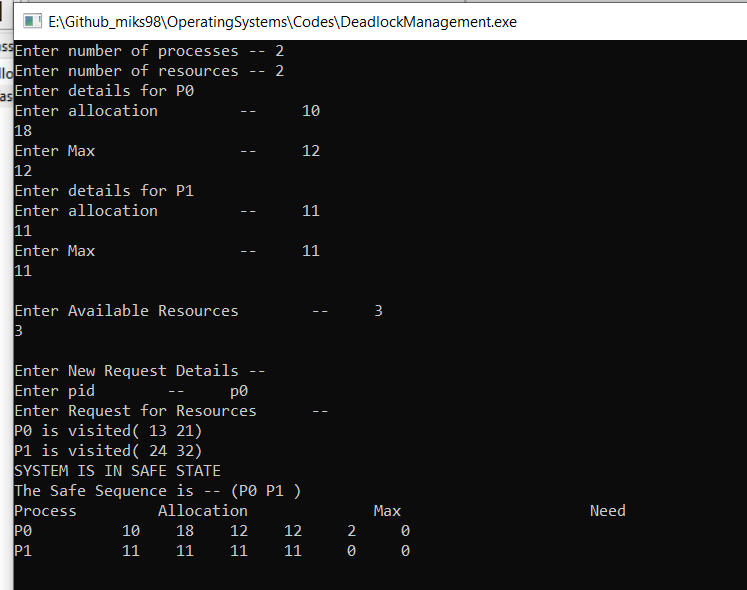
### Output:



## LAB # 12 No Tasks

## LAB # 13

### Output 1:



# Activities

Already Submitted & can be accessed at

<https://github.com/miks98/OperatingSystems/tree/master/Submitted%20Activities>

# Quiz

## Answer 01:

Code:

#!/bin/bash

echo "Input the string without space"

read str

for i in $(seq 0 ${#str}) ; do

revstr=${str:$i:1}$revstr

done

echo "The given string is " $str

if [ "$str" = "$revstr" ]; then

echo "It is a palindrome."

else

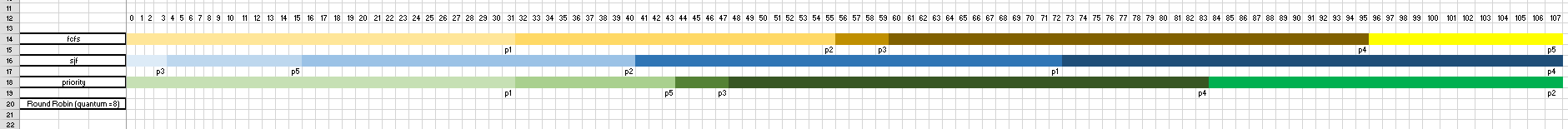
echo "It is not a palindrome."

fi

## Answer 02:

Gantt Charts:





Codes

FCFS

// Java program for implementation of FCFS scheduling

import java.text.ParseException;

class GFG {

// Function to find the waiting time for all processes

static void findWaitingTime(int processes[], int n,

int bt[], int wt[]) {

// waiting time for first process is 0

wt[0] = 0;

// calculating waiting time

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

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

}

}

// Function to calculate turn around time

static void findTurnAroundTime(int processes[], int n,

int bt[], int wt[], int tat[]) {

// calculating turnaround time by adding

// bt[i] + wt[i]

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

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

}

}

//Function to calculate average time

static void findavgTime(int processes[], int n, int bt[]) {

int wt[] = new int[n], tat[] = new int[n];

int total\_wt = 0, total\_tat = 0;

//Function to find waiting time of all processes

findWaitingTime(processes, n, bt, wt);

//Function to find turn around time for all processes

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

//Display processes along with all details

System.out.printf("Processes Burst time Waiting"

+" time Turn around time\n");

// Calculate total waiting time and total turn around time

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

total\_wt = total\_wt + wt[i];

total\_tat = total\_tat + tat[i];

System.out.printf(" %d ", (i + 1));

System.out.printf(" %d ", bt[i]);

System.out.printf(" %d", wt[i]);

System.out.printf(" %d\n", tat[i]);

}

float s = (float)total\_wt /(float) n;

int t = total\_tat / n;

System.out.printf("Average waiting time = %f", s);

System.out.printf("\n");

System.out.printf("Average turn around time = %d ", t);

}

// Driver code

public static void main(String[] args) throws ParseException {

//process id's

int processes[] = {1, 2, 3};

int n = processes.length;

//Burst time of all processes

int burst\_time[] = {10, 5, 8};

findavgTime(processes, n, burst\_time);

}

}

SJF

// Java program to implement Shortest Job first with Arrival Time

import java.util.\*;

class GFG {

static int[][] mat = new int[10][6];

static void arrangeArrival(int num, int[][] mat) {

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

for (int j = 0; j < num - i - 1; j++) {

if (mat[j][1] > mat[j + 1][1]) {

for (int k = 0; k < 5; k++) {

int temp = mat[j][k];

mat[j][k] = mat[j + 1][k];

mat[j + 1][k] = temp;

}

}

}

}

}

static void completionTime(int num, int[][] mat) {

int temp, val = -1;

mat[0][3] = mat[0][1] + mat[0][2];

mat[0][5] = mat[0][3] - mat[0][1];

mat[0][4] = mat[0][5] - mat[0][2];

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

temp = mat[i - 1][3];

int low = mat[i][2];

for (int j = i; j < num; j++) {

if (temp >= mat[j][1] && low >= mat[j][2]) {

low = mat[j][2];

val = j;

}

}

mat[val][3] = temp + mat[val][2];

mat[val][5] = mat[val][3] - mat[val][1];

mat[val][4] = mat[val][5] - mat[val][2];

for (int k = 0; k < 6; k++) {

int tem = mat[val][k];

mat[val][k] = mat[i][k];

mat[i][k] = tem;

}

}

}

// Driver Code

public static void main(String[] args) {

int num;

Scanner sc = new Scanner(System.in);

System.out.println("Enter number of Process: ");

num = sc.nextInt();

System.out.println("...Enter the process ID...");

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

System.out.println("...Process " + (i + 1) + "...");

System.out.println("Enter Process Id: ");

mat[i][0] = sc.nextInt();

System.out.println("Enter Arrival Time: ");

mat[i][1] = sc.nextInt();

System.out.println("Enter Burst Time: ");

mat[i][2] = sc.nextInt();

}

System.out.println("Before Arrange...");

System.out.println("Process ID\tArrival Time\tBurst Time");

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

System.out.printf("%d\t\t%d\t\t%d\n",

mat[i][0], mat[i][1], mat[i][2]);

}

arrangeArrival(num, mat);

completionTime(num, mat);

System.out.println("Final Result...");

System.out.println("Process ID\tArrival Time\tBurst" +

" Time\tWaiting Time\tTurnaround Time");

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

System.out.printf("%d\t\t%d\t\t%d\t\t%d\t\t%d\n",

mat[i][0], mat[i][1], mat[i][2], mat[i][4], mat[i][5]);

}

sc.close();

}

}

Priority

import java.util.\*;

// Data Structure

class Process {

int at, bt, pri, pno;

Process(int pno, int at, int bt, int pri)

{

this.pno = pno;

this.pri = pri;

this.at = at;

this.bt = bt;

}

}

/// Gantt chart structure

class GChart {

// process number, start time, complete time, turn around time, waiting time

int pno, stime, ctime, wtime, ttime;

}

// user define comparative method (first arrival first serve,

// if arrival time same then heigh priority first)

class MyComparator implements Comparator {

public int compare(Object o1, Object o2)

{

Process p1 = (Process)o1;

Process p2 = (Process)o2;

if (p1.at < p2.at)

return (-1);

else if (p1.at == p2.at && p1.pri > p2.pri)

return (-1);

else

return (1);

}

}

// class to find Gantt chart

class FindGantChart {

void findGc(LinkedList queue)

{

// initial time = 0

int time = 0;

// priority Queue sort data according

// to arrival time or priority (ready queue)

TreeSet prique = new TreeSet(new MyComparator());

// link list for store processes data

LinkedList result = new LinkedList();

// process in ready queue from new state queue

while (queue.size() > 0)

prique.add((Process)queue.removeFirst());

Iterator it = prique.iterator();

// time set to according to first process

time = ((Process)prique.first()).at;

// scheduling process

while (it.hasNext()) {

// dispatcher dispatch the

// process ready to running state

Process obj = (Process)it.next();

GChart gc1 = new GChart();

gc1.pno = obj.pno;

gc1.stime = time;

time += obj.bt;

gc1.ctime = time;

gc1.ttime = gc1.ctime - obj.at;

gc1.wtime = gc1.ttime - obj.bt;

/// store the exxtreted process

result.add(gc1);

}

// create object of output class and call method

new ResultOutput(result);

}

}

Round Robin

// Java program for implementation of RR scheduling

public class GFG

{

// Method to find the waiting time for all

// processes

static void findWaitingTime(int processes[], int n,

int bt[], int wt[], int quantum)

{

// Make a copy of burst times bt[] to store remaining

// burst times.

int rem\_bt[] = new int[n];

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

rem\_bt[i] = bt[i];

int t = 0; // Current time

// Keep traversing processes in round robin manner

// until all of them are not done.

while(true)

{

boolean done = true;

// Traverse all processes one by one repeatedly

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

{

// If burst time of a process is greater than 0

// then only need to process further

if (rem\_bt[i] > 0)

{

done = false; // There is a pending process

if (rem\_bt[i] > quantum)

{

// Increase the value of t i.e. shows

// how much time a process has been processed

t += quantum;

// Decrease the burst\_time of current process

// by quantum

rem\_bt[i] -= quantum;

}

// If burst time is smaller than or equal to

// quantum. Last cycle for this process

else

{

// Increase the value of t i.e. shows

// how much time a process has been processed

t = t + rem\_bt[i];

// Waiting time is current time minus time

// used by this process

wt[i] = t - bt[i];

// As the process gets fully executed

// make its remaining burst time = 0

rem\_bt[i] = 0;

}

}

}

// If all processes are done

if (done == true)

break;

}

}

// Method to calculate turn around time

static void findTurnAroundTime(int processes[], int n,

int bt[], int wt[], int tat[])

{

// calculating turnaround time by adding

// bt[i] + wt[i]

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

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

}

// Method to calculate average time

static void findavgTime(int processes[], int n, int bt[],

int quantum)

{

int wt[] = new int[n], tat[] = new int[n];

int total\_wt = 0, total\_tat = 0;

// Function to find waiting time of all processes

findWaitingTime(processes, n, bt, wt, quantum);

// Function to find turn around time for all processes

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

// Display processes along with all details

System.out.println("Processes " + " Burst time " +

" Waiting time " + " Turn around time");

// Calculate total waiting time and total turn around time

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

{

total\_wt = total\_wt + wt[i];

total\_tat = total\_tat + tat[i];

System.out.println(" " + (i+1) + "\t\t" + bt[i] +"\t " +

wt[i] +"\t\t " + tat[i]);

}

System.out.println("Average waiting time = " +

(float)total\_wt / (float)n);

System.out.println("Average turn around time = " +

(float)total\_tat / (float)n);

}

// Driver Method

public static void main(String[] args)

{

// process id's

int processes[] = { 1, 2, 3};

int n = processes.length;

// Burst time of all processes

int burst\_time[] = {10, 5, 8};

// Time quantum

int quantum = 2;

findavgTime(processes, n, burst\_time, quantum);

}

}

# Extra Links

|  |  |
| --- | --- |
| Serial | Link |
|  | [Program for Worst Fit algorithm in Memory Management - GeeksforGeeks](https://www.geeksforgeeks.org/program-worst-fit-algorithm-memory-management/) |
|  | [Part 6.5 Fixed size partitioning | FIRST | BEST | WORST | Memory management | OS | Operating System - YouTube](https://www.youtube.com/watch?v=YcX-awpW9yc) |
|  | [Test Bash Script Online - Online Bash Script Tester - Shell Scripting online](https://www.jdoodle.com/test-bash-shell-script-online/) |
|  | [ShellCheck – shell script analysis tool](https://www.shellcheck.net/) |
|  | [UNIX / LINUX Tutorial - Tutorialspoint](https://www.tutorialspoint.com/unix/index.htm) |
|  | <https://docs.google.com/a/nu.edu.pk/viewer?a=v&pid=sites&srcid=bnUuZWR1LnBrfG5vbWFuLWlzbGFtfGd4OjE3N2NkZGVjYTAyNTRmNjQ> |
|  | <https://docs.google.com/a/nu.edu.pk/viewer?a=v&pid=sites&srcid=bnUuZWR1LnBrfG5vbWFuLWlzbGFtfGd4OjQzNGRmOTVmMjE4NGJlOWY> |
|  | <https://docs.google.com/a/nu.edu.pk/viewer?a=v&pid=sites&srcid=bnUuZWR1LnBrfG5vbWFuLWlzbGFtfGd4OjFjMDc5YzU0MWY3NDgxZjY> |
|  | <http://sites.google.com/a/nu.edu.pk/noman-islam> |
|  | <https://docs.google.com/a/nu.edu.pk/viewer?a=v&pid=sites&srcid=bnUuZWR1LnBrfG5vbWFuLWlzbGFtfGd4OjRjNThjZDUxYWQxMjA5NzA> |
|  | [**Operating system Tutorial in Hindi (OS)**](https://www.youtube.com/watch?v=RTAJDuXrN8M&list=PL0s3O6GgLL5csKdIeV-Z7fZXohZUMAAsG)  Last moment Tuitions  <https://www.youtube.com/watch?v=RTAJDuXrN8M&list=PL0s3O6GgLL5csKdIeV-Z7fZXohZUMAAsG> |
|  | [**Operating System**](https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O)  Neso Academy  <https://youtube.com/playlist?list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O> |