Smt. Chandibai Himathmal Mansukhani College

Contents

USCS3PO1: USCS303 – Operating System (0S)- Practical -02

Shortest Job first Scheduling Algorithm (SJF) Algorithm

Practical Date: 23rd July ,2021 (Friday)

Practical Aim:

Implement SJF (with no preemption) scheduling algorithm in Java.

Shortest Job First(SJF) CPU scheduling algorithm is a CPU scheduling algorithm which is also called **as Shortest Job Next** .

It is Both Non Preemptive and Preemptive CPU Schedulin algorithm.

For Non Preemptive(with no preepmtive) approach, key idea is to allocate the CPU to the process with the smallest burst time so that the CPU seems to be more responsive.

Burst time is the amount of time required by a process for its execution on the CPU .

More appropriate term for this scheduling method would be the shortest next CPU burst algorithm, because scheduling depends on the length of the next CPU burst of a process rather than its total length.

Algorithm

Step 1: Input the number of processes required to be scheduled using SJF , burst time for each process .

s**tep 2:** Using enhanced bubble sort technique ,sort the all given process in ascending order according to burst time in a ready queue.

Step 3: Calculate the Finish Time ,Turn Around Time and Waiting Time for each process which in turn help to calculate Average Waiting Time and Average Turn Around Time required by CPU to schedule given set of process using SJF.

Step 3.1: for i= 0, Finish Time $T_0 =$ Arrival Time T_0 + Burst Time T_0

Step 3.2: for i >= 1, Finish Time $T_i =$ Arrival Time T_i + Burst Time T_{i-1}

Step 3.3: for i = 0, Turn Around Time T_0 =Finish Time T_0 – Arrival Time T_0

Step 3.4: for i > = 1, Turn Around Time T_i =Finish Time T_i – Arrival Time T_i

Step 3.5: for i = 0, Waiting Time T_0 =Turn Around Time T_0 – Burst Time T_0

Step 3.6: for i >=1, Waiting Time T_i =Turn Around Time T_i – Burst Time T_{i-1}

Step 4: Process with less arrival time comes first and gets schedule first by the CPU.

Step 5: Calculate the Average Waiting Time and Average Turn Around Time .

Step 6: Stop.

Solved Example

1. Consider following example containing five process arrive at same time.

Process ID	Burst Time
P0	6
P1	3
P2	8
P3	3
P4	4

Step 1: Processes get executed according to their lowest burst time first.

Process ID	Burst Time
P1	3
P3	3
P4	4
P0	6
P2	8

Step 2: Following shows the scheduling and execution of processes.

Step 2.1: At start P1 has shortest execution time which is 0-3 seconds.

System Time :0

Process Schedule :P1

Finish Time : 0 + 3 =3

Waiting Time :3 - 3 = 0

Turn Around Time :3 – 0 = 3

Step 2.2 : Next shortest exection time is process P3 for duration 3-6 seconds.

System Time :3

Process Schedule :P1, P3

Finish Time : 3 + 3 =6

Waiting Time :6 - 3 = 3

Turn Around Time :6 – 0=6

Step 2.3 : Next job with shortest execution time is P4 for a Duration 6-10 seconds.

System Time : 6

Process Schedule :P1,P3,P4

Finish Time : 6 + 4 =10

Waiting Time :10 - 4 = 6

Turn Around Time : 10 – 0=10

Step 2.4 : Next job with shortest execution time is P0 for duration of 10-16 seconds.

System Time :10

Process Schedule :P1,P3,P4,P0,P2

Finish Time : 16 + 8 =24

Waiting Time :24 – 8 = 16

Turn Around Time :24 – 0 =24

Step 2.5 : Similarly, next job with shortest execution time is P2 for duration of 16-24 seconds

Step 3: Calculate the Average Waiting Time and Average Turn Around Time.

Average Waiting Time =(0 + 3 + 6 + 10 + 16)/5

=35/5

=7

Average Turn Around Time =(3 + 6 + 10 + 16 + 24)/5

= 59/5

=11.8

Step 4: After scheduling of all provided processes:

Process ID	Burst Time	Arrival Time	Finish Time [Prev. Finish Time + Burst Time]	Turn Around Time [FinishTime-Arrival Time]	Waiting Time [TurnAround Time -Burst Time]
P1	3	0	(-+3=)3	(3-0=)6	(6-6=)0
P3	3	0	(3+3=)6	(9-0=)9	(9-3=)6
P4	4	0	(6+4=)10	(17-0=)17	(17-8=)9
P0	6	0	(10+6=)16	(20-0=)20	(20-3=)17
P2	8	0	(16+8=)24	(24-0=)24	(24-4=)20
Average				11.80000000	7.00000000

Gnatt Chart

P1	**P3**	**P4**	**P0**	**P2**	
0	**3**	**6**	**10**	**16**	**24**

2. Consider following example containing three process arrive at same time

Process ID	Burst Time
P0	2
P1	1
P2	6

Process ID	Burst Time	Arrival Time	Finish Time [Prev. Finish Time + Burst Time]	Turn Around Time [FinishTime-Arrival Time]	Waiting Time [TurnAround Time -Burst Time]

P1	1	0	(-+1=)1	(1-0=)1	(1-1=)0
P0	2	0	(1+2=)3	(3-0=)3	(3-2=)1
P2	6	0	(3+6=)9	(9-0=)9	(9-6=)3
Average				4.33333334	1.33333334

Gnatt Chart

P1	P0	P2

0 1 3 9

3. Consider the following example containing five processes arrive at same time .

Process ID	Burst Time
P0	7
P1	3
P2	2
P3	10
P4	8

Process ID	Burst Time	Arrival Time	Finish Time [Prev. Finish Time + Burst Time]	Turn Around Time [FinishTime-Arrival Time]	Waiting Time [TurnAround Time -Burst Time]
P2	2	0	(-+2=)2	(2-0=)2	(2-2=)0
P1	3	0	(2+3=)5	(5-0=)5	(5-3=)2
P0	7	0	(5+7=)12	(12-0=)12	(12-7=)5
P4	8	0	(12+8=)20	(20-0=)20	(20-8=)12
P3	10	0	(20+10=)30	(30-0=)30	(30-10=)20
Average				13.80000000	7.80000000

Gnatt Chart:

P2	P1	P0	P4	P3

0 2 5 12 20 30

4. Consider the following example containing five processes arrive at same time.

Process ID	Burst Time
P0	25
P1	15
P2	10
P3	25
P4	10
P5	25

Process ID	Burst Time	Arrival Time	Finish Time [Prev. Finish Time + Burst Time]	Turn Around Time [FinishTime- Arrival Time]	Waiting Time [TurnAround Time -Burst Time]
P2	10	0	(-+10=)10	(10-0=)10	(10-10=)0
P4	10	0	(10+10=)20	(20-0=)20	(20-10=)10
P1	15	0	(20+15=)35	(35-0=)35	(35-15=)20
P0	25	0	(35+25=)60	(60-0=)60	(60-25=)35
P3	25	0	(60+25=)85	(85-0=)85	(85-25=)60
P5	25	0	(85+25=)110	(110-0=)110	(110-25=)85
Average				53.33333334	35.00000000

Gnatt Chart

P2	P4	P1	P0	P3	P5

0 10 20 35 60 85 110

Implementation

```
//Name:Jadhav Sahil
//Batch: B2
//PRN :2020016400783091
//Date :23rd July ,2021
// Prac-02: SJF (with  no preemption)Algorithm

import java.util.Scanner;

public class P2_SJF_SJ
{
   //defining variables
   int burstTime[];
   int arrivalTime[]={0};
   String[] processId;
   int numberOfProcess;

void getProcessData(Scanner input){
   System.out.print("Enter the number of Process for Scheduling:");
   int inputNumberOfProcess = input.nextInt();
   numberOfProcess=inputNumberOfProcess;
   burstTime = new int[numberOfProcess];
   arrivalTime = new int[numberOfProcess];
   processId = new String[numberOfProcess];
   String st = "P";
   for(int i=0;i<numberOfProcess;i++){
         processId[i] = st.concat(Integer.toString(i));
         System.out.print("Enter the burst time for Process"+(i)+":");
      burstTime[i]=input.nextInt();}
}
void sortAccordingBurstTime(int[] at, int[] bt, String[] pid){
```

```
boolean swapped;
int temp;
String stemp;
        for(int i =0;i<numberOfProcess;i++){
           swapped=false;
       for(int j = 0;j<numberOfProcess-i-1;j++){
                    if(bt[j]>bt[j+1]){
                       temp = bt[j];
                       bt[j] =bt[j+1];
                       bt[j+1]=temp;



                temp = at[j];
                        at[j] =at[j+1];
                        at[j+1]=temp;



                stemp = pid[j];
                        pid[j]=pid[j+1];
                        pid[j+1]=stemp;


              swapped=true;
            }
          }
          if(swapped==false){
             break;
           }
      }
```

```
   }

void shortestJobFirstNPAlgorithm(){
   int finishTime[] = new int[numberOfProcess];
    int bt[] = burstTime.clone();
    int at[] = arrivalTime.clone();
    String pid[] = processId.clone();
    int waitingTime[] = new int[numberOfProcess];
    int turnAroundTime[] = new int[numberOfProcess];
    sortAccordingBurstTime(at, bt, pid);

    finishTime[0] = at[0] + bt[0];
    turnAroundTime[0]=finishTime[0] - at[0];
    waitingTime[0] = turnAroundTime[0] -bt[0];
    for(int i = 1;i<numberOfProcess;i++){
    finishTime[i] = bt[i] + finishTime[i-1];
    turnAroundTime[i]=finishTime[i] - at[i];
    waitingTime[i] = turnAroundTime[i] -bt[i];
      }

    float sum = 0;
    for(int n :waitingTime){
          sum += n;
      }
      float averageWaitingTime = sum/ numberOfProcess;

     sum = 0;
          for(int n :turnAroundTime){
          sum += n;
     }
    float averageTurnAroundTime = sum/ numberOfProcess;


        System.out.println("SJF(with no preemption) Schedulling Algorithm :");

        System.out.format("%20s%20s%20s%20s%20s%20s\n",          "ProcessId",
"BurstTime","ArrivalTime","FinishTime","TurnAroundTime", "WaitingTime");

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

            System.out.format("%20s%20d%20d%20d%20d%20d\n", pid[i], bt[i],
at[i],finishTime[i],turnAroundTime[i], waitingTime[i]);

                 }

         System.out.format("%80s%20f%20f\n","Average", averageTurnAroundTime,
averageWaitingTime);

       }
public static void main(String[] args){
   Scanner input= new Scanner(System.in);
        P2_SJF_SJ obj = new P2_SJF_SJ();
        obj.getProcessData(input);
        obj.shortestJobFirstNPAlgorithm();
     }
}
```

Input:

Enter the number of process for scheduling:5

Enter the burst time for Process0:6

Enter the burst time for Process1:3

Enter the burst time for Process2:8

Enter the burst time for Process3:3

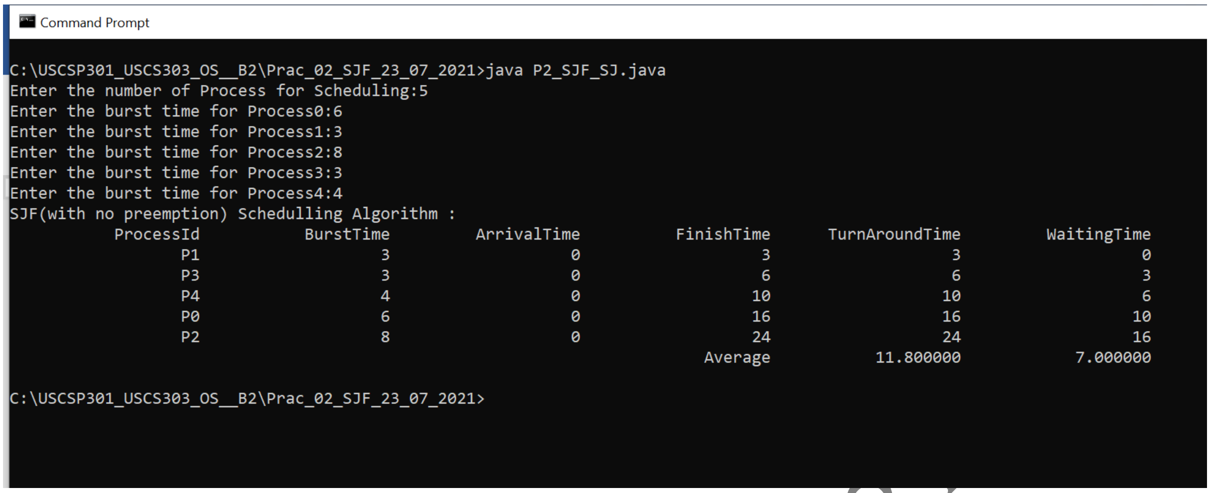
Enter the burst time for Process4:4

Output:

Process ID	Burst Time	Arrival Time	Finish Time [Prev. Finish Time + Burst Time]	Turn Around Time [FinishTime-Arrival Time]	Waiting Time [TurnAround Time -Burst Time]
P1	3	0	(-+3=)3	(3-0=)6	(6-6=)0
P3	3	0	(3+3=)6	(9-0=)9	(9-3=)6
P4	4	0	(6+4=)10	(17-0=)17	(17-8=)9
P0	6	0	(10+6=)16	(20-0=)20	(20-3=)17
P2	8	0	(16+8=)24	(24-0=)24	(24-4=)20
Average				11.80000000	7.00000000

Sample Output(Screenshots of all the examples) :

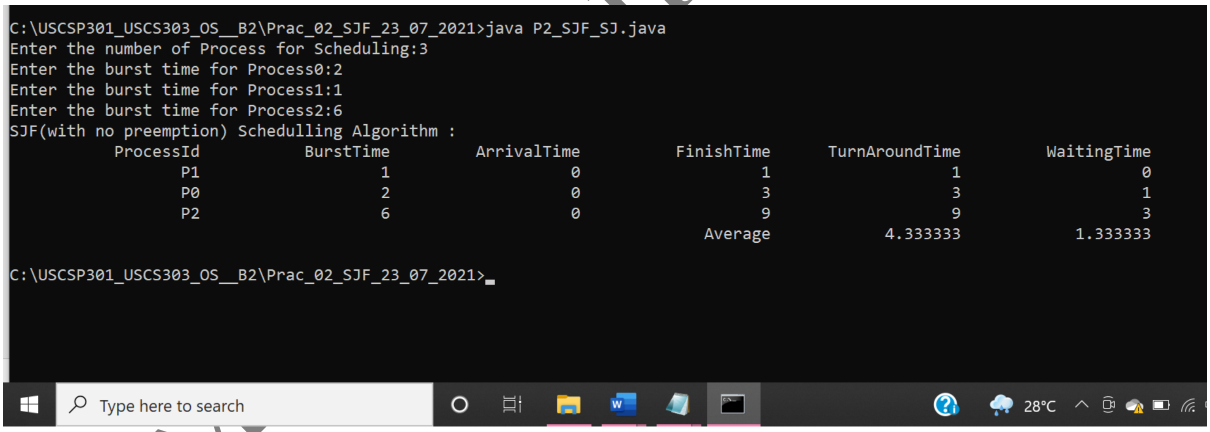
Question1:



```
C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>java P2_SJF_SJ.java
Enter the number of Process for Scheduling:5
Enter the burst time for Process0:6
Enter the burst time for Process1:3
Enter the burst time for Process2:8
Enter the burst time for Process3:3
Enter the burst time for Process4:4
SJF(with no preemption) Schedulling Algorithm :
           ProcessId           BurstTime         ArrivalTime          FinishTime      TurnAroundTime         WaitingTime
                  P1                   3                   0                   3                   3                   0
                  P3                   3                   0                   6                   6                   3
                  P4                   4                   0                  10                  10                   6
                  P0                   6                   0                  16                  16                  10
                  P2                   8                   0                  24                  24                  16
                                                                         Average           11.800000            7.000000

C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>
```

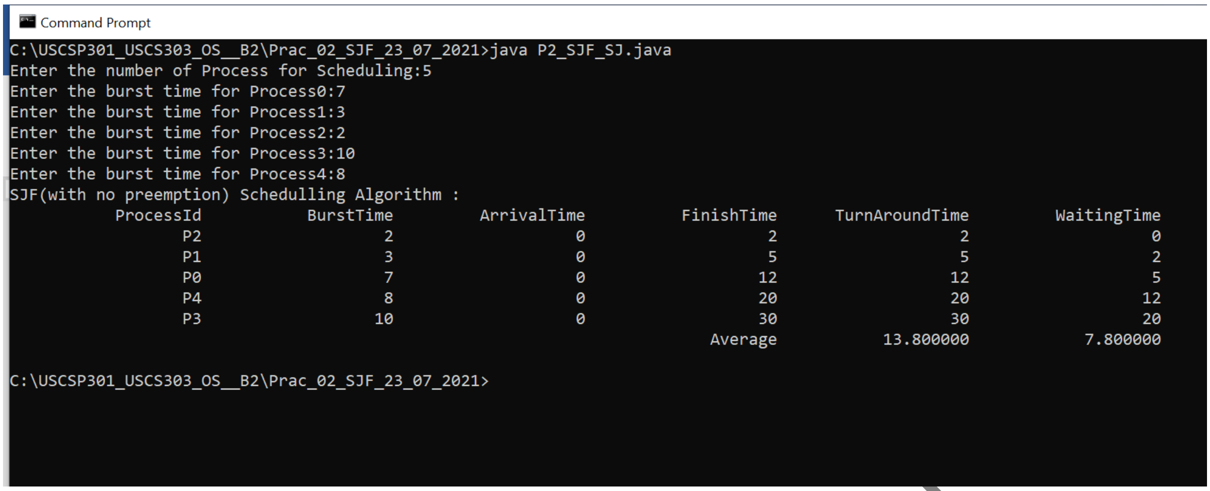
Question2:



```
C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>java P2_SJF_SJ.java
Enter the number of Process for Scheduling:3
Enter the burst time for Process0:2
Enter the burst time for Process1:1
Enter the burst time for Process2:6
SJF(with no preemption) Schedulling Algorithm :
           ProcessId           BurstTime         ArrivalTime          FinishTime      TurnAroundTime         WaitingTime
                  P1                   1                   0                   1                   1                   0
                  P0                   2                   0                   3                   3                   1
                  P2                   6                   0                   9                   9                   3
                                                                         Average            4.333333            1.333333

C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>_
```

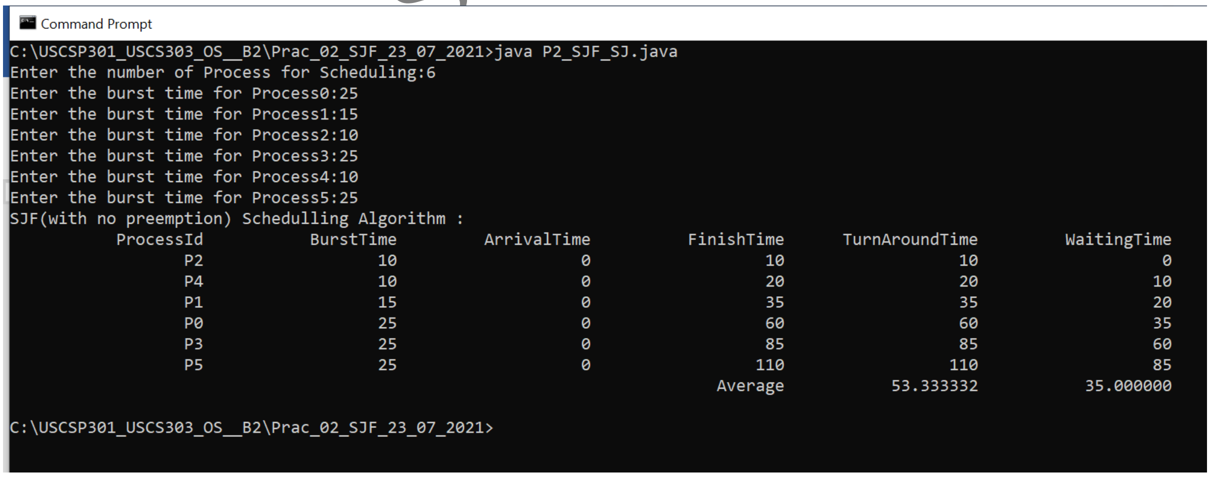
Question3:



```
C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>java P2_SJF_SJ.java
Enter the number of Process for Scheduling:5
Enter the burst time for Process0:7
Enter the burst time for Process1:3
Enter the burst time for Process2:2
Enter the burst time for Process3:10
Enter the burst time for Process4:8
SJF(with no preemption) Schedulling Algorithm :
           ProcessId           BurstTime         ArrivalTime           FinishTime      TurnAroundTime          WaitingTime
                  P2                   2                   0                    2                   2                    0
                  P1                   3                   0                    5                   5                    2
                  P0                   7                   0                   12                  12                    5
                  P4                   8                   0                   20                  20                   12
                  P3                  10                   0                   30                  30                   20
                                                                          Average           13.800000             7.800000

C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>
```

Question4:



```
C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>java P2_SJF_SJ.java
Enter the number of Process for Scheduling:6
Enter the burst time for Process0:25
Enter the burst time for Process1:15
Enter the burst time for Process2:10
Enter the burst time for Process3:25
Enter the burst time for Process4:10
Enter the burst time for Process5:25
SJF(with no preemption) Schedulling Algorithm :
           ProcessId           BurstTime         ArrivalTime           FinishTime      TurnAroundTime          WaitingTime
                  P2                  10                   0                   10                  10                    0
                  P4                  10                   0                   20                  20                   10
                  P1                  15                   0                   35                  35                   20
                  P0                  25                   0                   60                  60                   35
                  P3                  25                   0                   85                  85                   60
                  P5                  25                   0                  110                 110                   85
                                                                          Average           53.333332            35.000000

C:\USCSP301_USCS303_OS__B2\Prac_02_SJF_23_07_2021>
```