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USCSP301 – USCS303 : Operating system (OS) Practical – 01

Practical – 01 First Come First Serve (FCFS) Algorithm

Practical Date : 17 July 2021

Practical Aim : Implement FCFS scheduling Algorithm using Java

Algorithm :

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

Step 2: Using enhanced bubble sort technique, sort the all given processes in ascending order according to arrival 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 FCFS.

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

Step 3.2: for i >= 1, Finish Time Ti = Burst Time Ti + Finish Time T i-1

Step 3.3: for i=0, Turn Around Time To Finish Time To - Arrival Time To

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

Step 3.5: for i=0, Waiting Time To Turn Around Time To-Burst Time T_o

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

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

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

Step 6: Stop.

Solved Example

Example 01

Consider the following example containing five processes arrive at same time

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

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Step 1: Processes get executed according to their arrival time.

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

Step 2.1: At start PO arrives and get executed for 6 (i.e; 0-6) seconds.

System Time : 0

Process Scheduled : P0

Turn Around Time : 6 - 0 = 6

Waiting Time : 6 – 6 = 0

Step 2.2: P1 arrives after completion of P0, P1 is executed for 3 (i.e; 6-9) seconds.

System Time : 6

Process Scheduled : P0,P1

Turn Around Time : 9 - 0 = 9

Waiting Time : 9 – 3 = 6

Step 2.3: P2 arrives after complete execution of process P1, for 8 (i.e; 9-17) seconds

System Time : 9

Process Scheduled : P0,P1,P2

Turn Around Time : 17 - 0 = 17

Waiting Time : 17 – 8 = 9

Step 2.4: P3 arrives and gets executed for 3 (Le: 17-20) seconds.

System Time : 17

Process Scheduled : P0,P1,P2,P3

Turn Around Time : 20 - 0 = 20

Waiting Time : 20 – 3 = 17

Step 2.5: Similarly, P4 arrives and gets executed for 4 (i.e; 20-24) seconds.

System Time : 20

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

Turn Around Time :24 – 0 = 24

Waiting Time : 24 – 4 = 20

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

Average Waiting Time = (0 +6+9+17+20)/5

= 52/5

= 10.4

Average Turn Around Time = (0 +6+9+17+20)/5

= 76/5

= 15.2

Step 4 : After scheduling of all provided processes;

Process ID	Burst Time	Arrival Time	Finish Time (Prev.finish time+Burst time)	Turn Around Time (Finish time – Arrival Time)	Waiting Time (Turn Around Time – Burst Time
P0	6	0	(-+6=)6	(6-0=)6	(6-6=)0
P1	3	0	(6+3=)9	(9-0=)9	(9-3=)6
P2	8	0	(9+8=)17	(17-0=)17	(17-8=)9
P3	3	0	(17+3)20	(20-0=)20	(20-3=)17
P4	4	0	(20+4=)24	(24-0=)24	(24-4=)20
Average				15.200000	10.400000

Step 5 : Stop

Gnatt Chart

P0	P1	P2	P3	P4

Example 02

Process ID	Burst Time	Arrival Time
P0	6	2
P1	3	5
P2	8	1
P3	3	0
P4	4	4

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Process ID	Burst Time	Arrival Time	Finish Time (Prev.finish time+Burst time)	Turn Around Time (Finish time – Arrival Time)	Waiting Time (Turn Around Time – Burst Time
P3	3	0	(-+3=)3	(3-0=)3	(3-3=)0
P2	8	1	(3+8=)11	(11-1=)10	(10-8=)2
P0	6	2	(11+6=)17	(17-2=)15	(15-6=)9
P4	4	4	(17+4)21	(20-4=)17	(17-4=)13
P1	3	5	(21+3=)24	(24-5=)19	(19-3=)16
Average				12.800000	8.000000

Gnatt Chart

Example 03.

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 (Finish time – Arrival Time)	Waiting Time (Turn Around Time – Burst Time
P0	2	0	(-+2=)2	(2-0=)2	(2-2=)0
P1	1	0	(2+1=)3	(3-0=)3	(3-1=)2
P2	6	0	(3+6=)9	(9-0=)9	(9-6=)3
Average				4.66666667	1.66666667

Gnatt chart

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Example 04

Process ID	Burst Time	Arrival Time
P0	4	3
P1	3	5
P2	2	0
P3	1	5
P4	3	4

Process ID	Burst Time	Arrival Time	Finish Time (Prev.finish time+Burst time)	Turn Around Time (Finish time – Arrival Time)	Waiting Time (Turn Around Time – Burst Time
P2	2	0	(-+2=)2	(2-0=)2	(2-2=)0
P0	4	3	(2+4=)6	(6-3=)3	(3-4=)-1
P4	3	4	(6+3=)9	(9-4=)5	(5-3=)2
P1	3	5	(9+3)12	(12-5=)7	(7-3=)4
P3	1	5	(12+1=)13	(13-5=)8	(8-1=)7
Average				5.0000000	2.4000000

Gnatt Chart

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Implementation

Java Program:

```
import java.util.Scanner;


public class P1_FCFS_YP{



   int burstTime[];     int arrivalTime[];     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();

         System.out.print("Enter the arrival time for Process"+(i)+" :");
arrivalTime[i]=input.nextInt();

     }

   }

void sortAccordingArrivalTime(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(at[j]>at[j+1]){                    temp = at[j];                         at[j] =at[j+1];
           at[j+1]=temp;


               temp = bt[j];
```

```
                bt[j] =bt[j+1];                 bt[j+1]=temp;


              stemp = pid[j];
                    pid[j]=pid[j+1];            pid[j+1]=stemp;
             swapped=true;
            }
           }
         if(swapped==false){          break;
             }
        }
   }
void firstComeFirstServeAlgorithm(){
    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];    sortAccordingArrivalTime(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("FCFS 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);

        P1_FCFS_YP obj = new P1_FCFS_YP();     obj.getProcessData(input);
obj.firstComeFirstServeAlgorithm();

     }

}
```

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Input

```
C:\USCSP301_USCSP303_OS_Batch B1\Prac_01_YashParab_17_07_2021>java P1_FCFS_YP
Enter the number of process for Scheduling:5
Enter the burst time for Process0:6
Enter the arrival time for Process0 :0
Enter the burst time for Process1:3
Enter the arrival time for Process1 :0
Enter the burst time for Process2:8
Enter the arrival time for Process2 :0
Enter the burst time for Process3:3
Enter the arrival time for Process3 :0
Enter the burst time for Process4:4
Enter the arrival time for Process4 :0
```

Output :-

```
FCFS Schedulling Algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime        WaitingTime
                 P0                  6                  0                  6                  6                  0
                 P1                  3                  0                  9                  9                  6
                 P2                  8                  0                 17                 17                  9
                 P3                  3                  0                 20                 20                 17
                 P4                  4                  0                 24                 24                 20
                                                                    Average          15.200000          10.400000
```

Batch: B1 Name: Yash Anand Parab

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Sample output 01

```
C:\USCSP301_USCSP303_OS_Batch B1\Prac_01_YashParab_17_07_2021>javac P1_FCFS_YP.java

C:\USCSP301_USCSP303_OS_Batch B1\Prac_01_YashParab_17_07_2021>java P1_FCFS_YP
Enter the number of process for Scheduling:5
Enter the burst time for Process0:6
Enter the arrival time for Process0 :0
Enter the burst time for Process1:3
Enter the arrival time for Process1 :0
Enter the burst time for Process2:8
Enter the arrival time for Process2 :0
Enter the burst time for Process3:3
Enter the arrival time for Process3 :0
Enter the burst time for Process4:4
Enter the arrival time for Process4 :0
FCFS Schedulling Algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime        WaitingTime
                P0                  6                  0                  6                  6                  0
                P1                  3                  0                  9                  9                  6
                P2                  8                  0                 17                 17                  9
                P3                  3                  0                 20                 20                 17
                P4                  4                  0                 24                 24                 20
                                                                    Average          15.200000          10.400000
```

Sample output 02

```
C:\USCSP301_USCSP303_OS_B1\Prac_01_YashParab_17_07_2021>java P1_FCFS_YP
Enter the number of process for Scheduling:5
Enter the burst time for Process0:3
Enter the arrival time for Process0 :0
Enter the burst time for Process1:8
Enter the arrival time for Process1 :1
Enter the burst time for Process2:6
Enter the arrival time for Process2 :2
Enter the burst time for Process3:4
Enter the arrival time for Process3 :4
Enter the burst time for Process4:3
Enter the arrival time for Process4 :5
FCFS Schedulling Algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime        WaitingTime
                P0                  3                  0                  3                  3                  0
                P1                  8                  1                 11                 10                  2
                P2                  6                  2                 17                 15                  9
                P3                  4                  4                 21                 17                 13
                P4                  3                  5                 24                 19                 16
                                                                    Average          12.800000          8.000000
```

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Sample output 03

```
C:\USCSP301_USCSP303_OS_B1\Prac_01_YashParab_17_07_2021>java P1_FCFS_YP
Enter the number of process for Scheduling:3
Enter the burst time for Process0:2
Enter the arrival time for Process0 :0
Enter the burst time for Process1:1
Enter the arrival time for Process1 :0
Enter the burst time for Process2:6
Enter the arrival time for Process2 :0
FCFS Schedulling Algorithm :
          ProcessId          BurstTime         ArrivalTime         FinishTime      TurnAroundTime         WaitingTime
                P0                  2                   0                  2                   2                   0
                P1                  1                   0                  3                   3                   2
                P2                  6                   0                  9                   9                   3
                                                                     Average           4.666667            1.666667
```

Sample output 04

```
C:\USCSP301_USCSP303_OS_B1\Prac_01_YashParab_17_07_2021>java P1_FCFS_YP
Enter the number of process for Scheduling:5
Enter the burst time for Process0:2
Enter the arrival time for Process0 :0
Enter the burst time for Process1:4
Enter the arrival time for Process1 :3
Enter the burst time for Process2:3
Enter the arrival time for Process2 :4
Enter the burst time for Process3:3
Enter the arrival time for Process3 :5
Enter the burst time for Process4:1
Enter the arrival time for Process4 :5
FCFS Schedulling Algorithm :
          ProcessId          BurstTime         ArrivalTime         FinishTime      TurnAroundTime         WaitingTime
                P0                  2                   0                  2                   2                   0
                P1                  4                   3                  6                   3                  -1
                P2                  3                   4                  9                   5                   2
                P3                  3                   5                 12                   7                   4
                P4                  1                   5                 13                   8                   7
                                                                     Average           5.000000            2.400000
```