SMT. CHANDIBAI HIMATHMAL MANUSUKHANI COLLEGE

USCSP301_USCS303_OS_B2_SS_01

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1) Algorithm

CPU scheduling algorithm are used for scheduling different process present in the ready queue with available resource in an optimal way so that each and every process get execute by CPU Scheduling algorithm are broadly classified into two main type namely preemptive and non-primitive.

FIRST COME FIRST OUT(FCFS) is also known as FIRST IN FIRST OUT (FIFO) SCHEDUAL algorithm is the and simplest CPU .

A process scheduling different process to be assigned to the CPU based on particular scheduling algorithm.

There are six popular process scheduling algorithm which we are going to discuss in this chapter FIRST COME FIRST OUT(FCFS) scheduling.

EXAMPLE 1: Consider the following example containing five processes arrive at same time.

Process ID	Times new
P0	6
P1	3
P2	8
P3	3
P4	4

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SOLVE:

Step 1: Process get execute according to their arrival time.

Step 2: Following show the scheduling and execute of process .

Step 2.2: At start P0 arrive and get execute for 6 second.

System Time	0
Process Scheduled	P0
Turn Around Time	6-0=6
Waiting Time	6-6=0

Step 2.2: P1 arrive after completion of P0, P1 is execute for 3.

System Time	6
Process Scheduled	P0, P1
Turn Around Time	9-0=9
Waiting Time	9-3=6

Step2.3: P2 arrive after complete execution of process P1 for 8.

System Time	9
Process Scheduled	P0, P1, P2
Turn Around Time	17-0=17
Waiting Time	17-8=9

Step 2.4: P3 arrive and gets execute for 3.

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 gets execute for 4.

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 :-(6+9+17+20+24)/5

=76/5

=15.2

Gantt Chart

Step 4: After Scheduling of all provided processes.

Process ID	Brust Time	Arrival Time	Finish Time	Turn Around Time	Waiting Time
P0	6	0	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

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AVERAGE				15.200000	10.400000

P0	P1	P2	P3	P4

0 6 9 17 20 24

EXAMPLE 2:

Consider the following example contain five with varied arrive time.

Process ID	Brust Time	Arrival Time
P0	6	2
P1	3	5
P2	8	1

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P3	3	0
P4	4	4

Step 1: Process get execute according to their arrival time.

Step 2: Following show the scheduling and execute of process.

Step 2.2: At start P3 arrive and get execute for 0-3 second.

System Time	0
Process Scheduled	P3
Turn Around Time	3-0=3
Waiting Time	3-3=0

Step 2.3: P0 arrives at time 4 sec but gets resource of CPU at 17 second for execution its execution period is 17-21 second.

System Time	11
Process Scheduled	P3, P2, P0
Turn Around Time	17-2=15

Waiting Time	15-6=13

Step 2.4: P4 arrives at time 4 sec but gets resource of CPU at 17 second for execution period is 17-21 second.

System Time	**17**
Process Schedule	P0, P1, P2, P3
Turn Around Time	20-0=20
Turn Around Time	20-3=17

Step 2.5: Similarly P1 arrives at time 5 sec but its execution gets started Turn Around time 21 second and last for a period 21-24 second.

System Time	**21**
Process Scheduled	P3, P2, P0, P4, P1
Turn Around Time	24-5=19
Waiting Time	19-5=19

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

Average Waiting Time = (0+2+9+13+16)/5

=40/5

=8

Average Turn Around Time :-(3+10+15+17+19)/5

=64/5

=12.8

Gantt Chart

Step 4: After Scheduling of all provided processes.

Process ID	Burst Time	Arrival Time	Finish Time	Turn Around Time	Waiting Time
P3	3	0	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	21-7=17	17-4=13
P1	3	2	21+3=24	24-5=19	19-3=16
AVERAGE				12.8000000	8.000000

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SOLVE:

Step 1: Process get execute according to their Arrival Time.

Step 2: Following show the Scheduling and execute of process.

Step 2.1: At start P0 arrive and get execute for 2 second.

System Time	**0**
Process Scheduled	**P0**
Turn Around Time	**2-0=2**
Waiting Time	**2-2=0**

Step 2.2: P1 Arrive after completion of P0, P1 is execute for 1.

System Time	**2**
Process Scheduled	P0, P1
Turn Around time	3-0=3
Waiting Time	3-1=2

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Step2.3: P2 arrive after complete execution of process P1 for 6.

System Time	**3**
Process Scheduled	P0, P1, P2
Turn Around time	9-0=17
Waiting Time	9-6=3

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

Average Waiting Time = (0+2+3)/3

=5/3

=1.6666

Average Turn Around Time :-(2+3+9)/

=14/3

=4.6666

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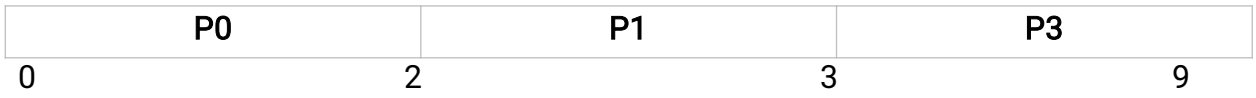
Gantt Chart

Step 4: After Scheduling of all provided processes.

Process ID	Burst Time	Arrival Time	Finish Time	Turn Around Time	Waiting Time
P0	2	0	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	9-6=3	9-6=3
AVERAGE				4.666	1.666



EXAMPLE 4: Consider the following example containing five process with varied Arrival Time.

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

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P3	1	5
P4	3	4

Step 3:

Calculate Average Waiting Time and Average Turn Around Time.

Average Waiting Time = (3+1+7+4+6)/5

=21/5

=4.2

Average Turn Around Time :-(1+2+9+5+9)/5

=26/5

=5.2

Gantt Chart

Step 4: After Scheduling of all provided processes.

Process ID	Burst Time	Arrival Time	Finish Time	Turn Around Time	Waiting Time
P0	4	3	6	3	1
P1	3	5	12	7	4

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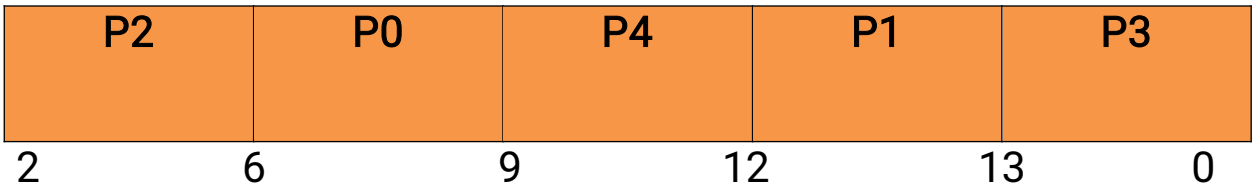
P2	2	0	2	2	0
P3	1	5	13	8	7
P4	3	4	9	5	92
AVERAGE				5.0000	2.40000



IMPLEMENATION:

import java.util.Scanner; public class
P1_FCFS_SS
{ int burstTime[]; int arrivalTime[]; String[]
processId; int numberOfProcess; void
getProcessData(Scanner input){
System.out.println("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 <

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```
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.println("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){ bre
ak; }
} } 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;
```

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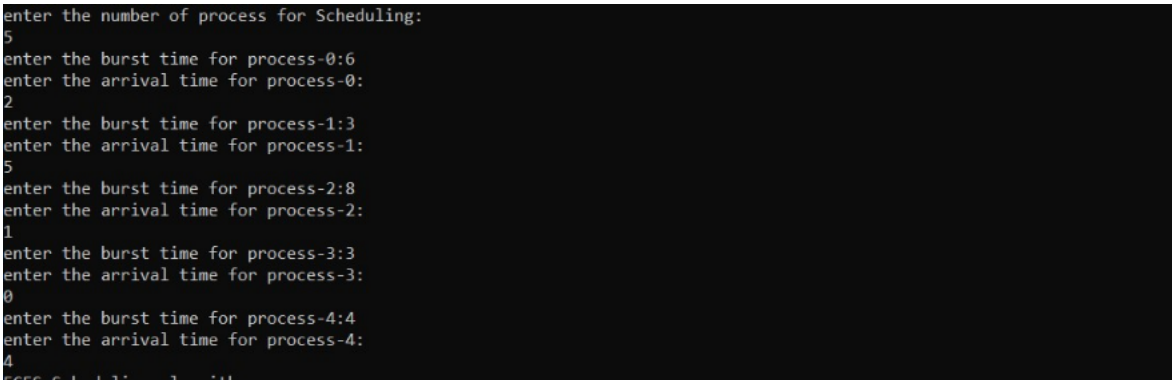
```
System.out.println("FCFS Scheduling algorithm :");
System.out.format("%20s%20s%20s%20s%20s%20s\n","ProcessId","B urstTime"
,"ArrivalTime","FinishTime","TurnAroundTime","WatingTime"); for(int
i=0;i<numberOfProcess;i++){
System.out.format("%20s%20d%20d%20d%20d%20d\n",pid[i],bt[i],at[i
]
,finishTime[i],turnAroundTime[i],waitingTime[i]);
}
System.out.format("%80s%20f%20f\n",
"Average",averageTurnAroundTime,averageWaitingTime);
}
public static void main(String[] args){ Scanner input=new
Scanner(System.in); P1_FCFS_SS obj=new
P1_FCFS_SS();
obj.getProcessData(input);obj.firstComeFirstServeAlgorithm();
}
}
```

INPUT:-



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OUTPUT:-

```
FCFS Scheduling algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime         WatingTime
                 p3                  3                  0                  3                  3                  0
                 p2                  8                  1                 11                 10                  2
                 p0                  6                  2                 17                 15                  9
                 p4                  4                  4                 21                 17                 13
                 p1                  3                  5                 24                 19                 16
                                                                    Average          12.800000          8.000000
```

SAMPLE OUTPUT- 01:-

```
enter the number of process for Scheduling:
5
enter the burst time for process-0:6
enter the arrival time for process-0:
2
enter the burst time for process-1:3
enter the arrival time for process-1:
5
enter the burst time for process-2:8
enter the arrival time for process-2:
1
enter the burst time for process-3:3
enter the arrival time for process-3:
0
enter the burst time for process-4:4
enter the arrival time for process-4:
4
FCFS Scheduling algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime         WatingTime
                 p3                  3                  0                  3                  3                  0
                 p2                  8                  1                 11                 10                  2
                 p0                  6                  2                 17                 15                  9
                 p4                  4                  4                 21                 17                 13
                 p1                  3                  5                 24                 19                 16
                                                                    Average          12.800000          8.000000
```


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INPUT:-

```
enter the number of process for Scheduling:
3
enter the burst time for process-0:2
enter the arrival time for process-0:
0
enter the burst time for process-1:1
enter the arrival time for process-1:
0
enter the burst time for process-2:6
enter the arrival time for process-2:
0
```

OUTPUT:-

```
enter the arrival time for process-2:
0
FCFS Scheduling algorithm :
          ProcessId          BurstTime         ArrivalTime         FinishTime      TurnAroundTime          WatingTime
                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- 02:-

```
enter the number of process for Scheduling:
3
enter the burst time for process-0:2
enter the arrival time for process-0:
0
enter the burst time for process-1:1
enter the arrival time for process-1:
0
enter the burst time for process-2:6
enter the arrival time for process-2:
0
FCFS Scheduling algorithm :
          ProcessId          BurstTime         ArrivalTime         FinishTime      TurnAroundTime          WatingTime
                p0                  2                   0                  2                   2                   0
                p1                  1                   0                  3                   3                   2
                p2                  6                   0                  9                   9                   3
                                                                     Average           4.666667            1.666667
```

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INPUT:-

```
enter the number of process for Scheduling:
5
enter the burst time for process-0:6
enter the arrival time for process-0:
0
enter the burst time for process-1:3
enter the arrival time for process-1:
0
enter the burst time for process-2:8
enter the arrival time for process-2:
0
enter the burst time for process-3:3
enter the arrival time for process-3:
0
enter the burst time for process-4:4
enter the arrival time for process-4:
0
```

OUTPUT:-

```
enter the arrival time for process-4:
0
FCFS Scheduling algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime         WatingTime
                 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
```


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SAMPLE OUTPUT- 03:-

```
enter the number of process for Scheduling:
5
enter the burst time for process-0:6
enter the arrival time for process-0:
0
enter the burst time for process-1:3
enter the arrival time for process-1:
0
enter the burst time for process-2:8
enter the arrival time for process-2:
0
enter the burst time for process-3:3
enter the arrival time for process-3:
0
enter the burst time for process-4:4
enter the arrival time for process-4:
0
FCFS Scheduling algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime          WatingTime
                 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
```

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INPUT:-

```
enter the number of process for Scheduling:
5
enter the burst time for process-0:4
enter the arrival time for process-0:
3
enter the burst time for process-1:3
enter the arrival time for process-1:
5
enter the burst time for process-2:2
enter the arrival time for process-2:
0
enter the burst time for process-3:1
enter the arrival time for process-3:
5
enter the burst time for process-4:3
enter the arrival time for process-4:
4
```

OUTPUT:-

```
FCFS Scheduling algorithm :
          ProcessId          BurstTime        ArrivalTime         FinishTime      TurnAroundTime          WatingTime
                 p2                  2                  0                  2                  2                   0
                 p0                  4                  3                  6                  3                  -1
                 p4                  3                  4                  9                  5                   2
                 p1                  3                  5                 12                  7                   4
                 p3                  1                  5                 13                  8                   7
                                                                    Average           5.000000            2.400000
```


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SAMPLE OUTPUT- 04:-

```
enter the number of process for Scheduling:
5
enter the burst time for process-0:4
enter the arrival time for process-0:
3
enter the burst time for process-1:3
enter the arrival time for process-1:
5
enter the burst time for process-2:2
enter the arrival time for process-2:
0
enter the burst time for process-3:1
enter the arrival time for process-3:
5
enter the burst time for process-4:3
enter the arrival time for process-4:
4
FCFS Scheduling algorithm :
          ProcessId          BurstTime         ArrivalTime         FinishTime      TurnAroundTime         WatingTime
                 p2                  2                   0                  2                   2                  0
                 p0                  4                   3                  6                   3                 -1
                 p4                  3                   4                  9                   5                  2
                 p1                  3                   5                 12                   7                  4
                 p3                  1                   5                 13                   8                  7
                                                                    Average          5.000000           2.400000
```

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