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Contents

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-preemptive .

FIRST COME FIRST OUT(FCFS) is also know 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 process arrive at same time.

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

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 Schedualed	P0
Turn around time	6-0=6
Wating Time	6-6=0

Step 2.2: p1 arrive after completion of p0 , p1 is execute for 3.

System time	6
Process Schedualed	P0,p1
Turn around time	9-0=9
Wating Time	9-3=6

Step2.3: p2 arrive after complete execution of process p1 for 8.

System time	9
Process Schedualed	P0,p1,p2
Turn around time	17-0=17
Wating Time	17-8=9

Step 2.4:p3 arrive and gets execute for 3.

System time	17
Process Schedualed	P0,p1,p2,p3
Turn around time	20-0=20
Wating time	20-3=17

Step 2.5:similary p4 arrives gets execute for 4.

System time	20
Process Schedualed	P0,p1,p2,p3,p4
Turn around time	24-0=24
Wating time	24-4=20

Step 3: calculate average wating time and average turn around time.

Average wating 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

Gnatt Chart.

Step 4: after scheduling of all provided processes.

Process id	**Burst time**	**Arrival time**	**Finish time**	**Turn Around time**	**Wating 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
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	**Burst time**	**Arrival time**
P0	6	2
P1	3	5
P2	8	1
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 Schedualed	P3
Turn around time	3-0=3
Wating 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 Schedualed	P3.p2,p0
Turn around time	17-2=15
Wating 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 Schedualed	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 Schedualed	P3,p2,p0,p4,p1
Turn around time	24-5=19
Turn around time	19-5=19

Step 3: calculate average wating time and average turn around time.

Average wating time =(0+2+9+13+16)/5
=40/5
=8
Average turn around time :(3+10+15+17+19)/5
=64/5
=12.8

Gnatt Chart.

Step 4: after scheduling of all provided processes.

Process id	**Burst time**	**Arrival time**	**Finish time**	**Turn Around time**	**Wating 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	21-4=17	17-4=13
P1	3	5	21+3=24	24-5=19	19-3=16
AVERAGE				12.8000000	8.000000

P0	P1	P2	P3	P4

0 3 11 17 21 24

EXAMPLE 3: Consider the following example containing five processes arrive at the Same time .

Process ID	**Times new**
P0	2
P1	1
P2	6

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 Schedualed	P0
Turn around time	2-0=2
Wating Time	2-2=0

Step 2.2: p1 arrive after completion of p0 , p1 is execute for 1.

System time	2
Process Schedualed	P0,p1
Turn around time	3-0=3
Wating Time	3-1=2

Step2.3: p2 arrive after complete execution of process p1 for 6.

System time	3
Process Schedualed	P0,p1,p2
Turn around time	9-0=17
Wating Time	9-6=3

Step 3: calculate average wating time and average turn around time.

Average wating time =(0+2+3)/3
=5/3
=1.6666
Average turn around time :(2+3+9)/
=14/3
=4.6666

Gnatt Chart.

Step 4: after scheduling of all provided processes.

Process id	**Burst time**	**Arrival time**	**Finish time**	**Turn Around time**	**Wating 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

P0	P1	P2

0 2 3 9

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
P3	1	5
P4	3	4

Step 3: calculate average wating time and average turn around time.

Average wating 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

Gnatt Chart.

Step 4: after scheduling of all provided processes.

Process id	**Burst time**	**Arrival time**	**Finish time**	**Turn Around time**	**Wating time**
P0	4	3	6	3	1
P1	3	5	12	7	4
P2	2	0	2	2	0
P3	1	5	13	8	7
P4	3	4	9	5	92
AVERAGE				5.0000	2.40000

P2	P0	P4	P1	P3
2	6	9	12	13	0

IMPLEMENATION:

```
import java.util.Scanner;

public class P1_FCFS_PD
{ 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 < 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){
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 Scheduling algorithm :");
System.out.format("%20s%20s%20s%20s%20s%20s\n","ProcessId","BurstTime"
```

```
,"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_PD
obj=new P1_FCFS_PD(); obj.getProcessData(input);
obj.firstComeFirstServeAlgorithm();

}
}
```

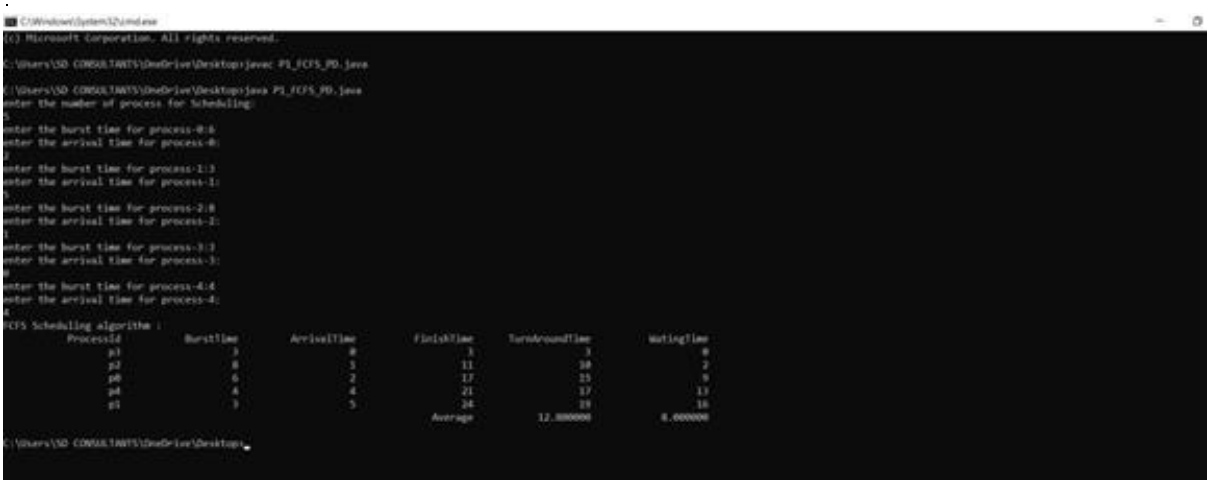
INPUT:

```
C:\Windows\System32\cmd.exe
(c) Microsoft Corporation. All rights reserved.

C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac P1_FCFS_PD.java

C:\Users\SD CONSULTANTS\OneDrive\Desktop>java P1_FCFS_PD.java
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
```

OUTPUT:

```
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
```

SAMPLE OUTPUT-01:


C:\Windows\System32\cmd.exe
(c) Microsoft Corporation. All rights reserved.
C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac P1_FCFS_PD.java
C:\Users\SD CONSULTANTS\OneDrive\Desktop>java P1_FCFS_PD.java
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 12.000000 8.000000
C:\Users\SD CONSULTANTS\OneDrive\Desktop>

INPUT:

```
C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac  P1_FCFS_PD.java

C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac  P1_FCFS_PD.java

C:\Users\SD CONSULTANTS\OneDrive\Desktop>java  P1_FCFS_PD.java
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 :
```

OUTPUT:

```
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
```

SAMLE OUTPUT-02:

```
C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac  P1_FCFS_PD.java

C:\Users\SD CONSULTANTS\OneDrive\Desktop>java  P1_FCFS_PD.java
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
```

INPUT:

C:\Windows\System32\cmd.exe

```
C:\Users\SD CONSULTANTS\OneDrive\Desktop>java  P1_FCFS_PD.java
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:

```
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
```

SAMPLE OUTPUT 3:

C:\Windows\System32\cmd.exe

```
C:\Users\SD CONSULTANTS\OneDrive\Desktop>java  P1_FCFS_PD.java
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
```

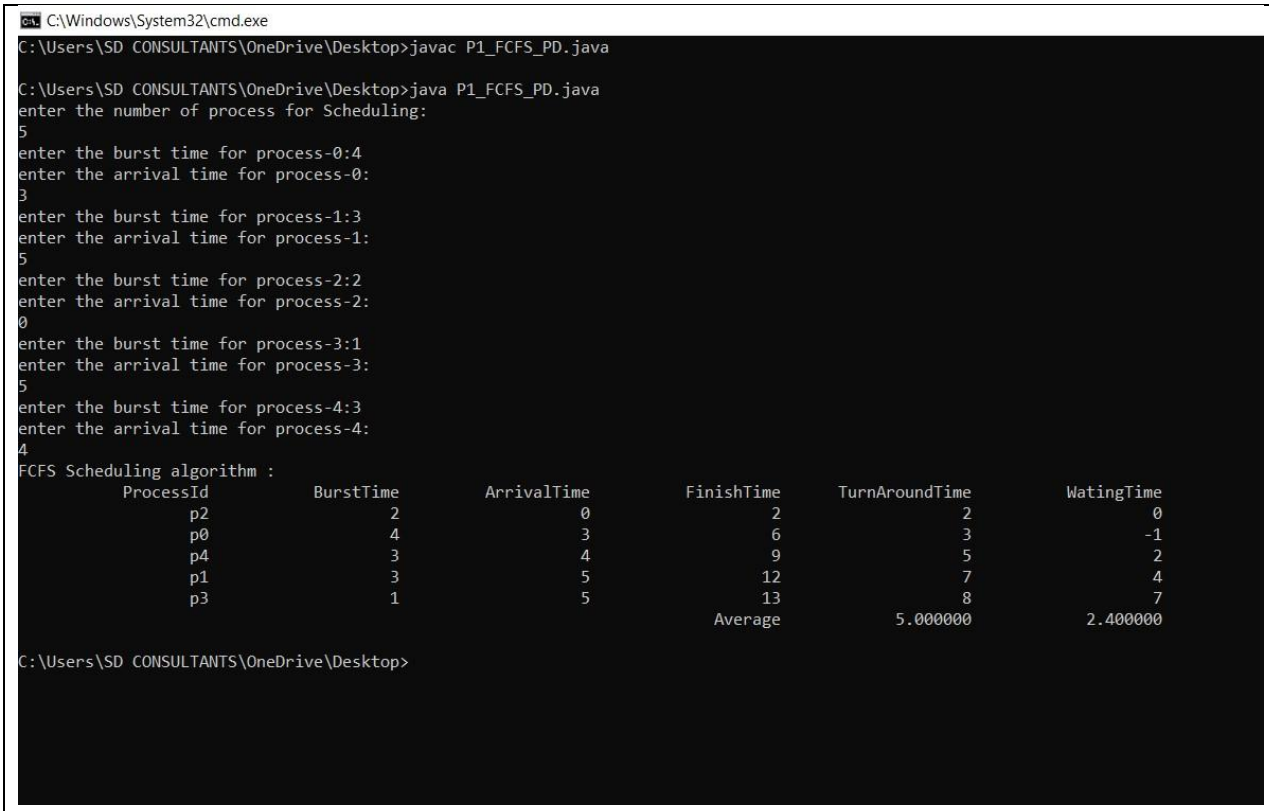
INPUT:

```
C:\Windows\System32\cmd.exe
C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac P1_FCFS_PD.java

C:\Users\SD CONSULTANTS\OneDrive\Desktop>java P1_FCFS_PD.java
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

C:\Users\SD CONSULTANTS\OneDrive\Desktop>
```

SAPMLE OUTPUT 4:


C:\Windows\System32\cmd.exe
C:\Users\SD CONSULTANTS\OneDrive\Desktop>javac P1_FCFS_PD.java
C:\Users\SD CONSULTANTS\OneDrive\Desktop>java P1_FCFS_PD.java
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
C:\Users\SD CONSULTANTS\OneDrive\Desktop>