



NAME : ARKAPRATIM GHOSH

ROLL No. : 13000121058

REG. No. : 211300100110045

D.O.B. : 21/10/2002

MOB. No. : 9330450430

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Paper Name: Operating System

Paper Code: PCC CS 502

CSE, 5th Sem (2021-2025), CA-1

Question 1

Consider a uniprocessor system, where three processes (Process ID 1, 2, 3 respectively) are there. Arrival time of the three processes are last 3 digits of your registration number (i.e. if your registration number is 201300100110019, arrival time of $P_1=0$, $P_2=1$, $P_3=9$). Burst time of process 1 is the addition of date (dd, i.e. if 21/07/2003 is Date of Birth, then it is $2+1 = 3$), process 2 is addition of month (mm, if July then $0+7$, i.e. 7), and process 3 is addition of last two digit of the year (yy, if 2003 then $0+3$, i.e. 3, if it is 2000 then take first 2 digit). Assume that CPU is using Shortest remaining time first algorithm.

- i. Calculate Waiting time of each of the process.
- ii. Calculate turnaround time of each of the process.
- iii. Calculate the percentage of time CPU remains idle.

Solution

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

→ **How Arrival Time for processes are obtained ?**

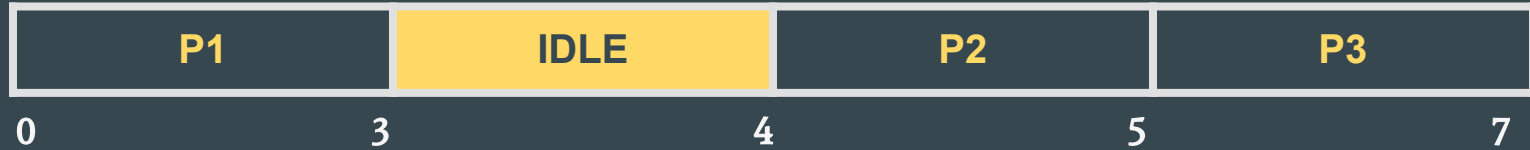
- My registration number is *211300100110045* and the last three digits of it are 0, 4, 5. Therefore, the arrival time for P1 is 0 , P2 is 4 and P3 is 5.

→ **How Burst time for processes are obtained ?**

- My birth date is 21/10/2002. Therefore,
- The burst time for P1 is 3 (sum of digits in dd i.e. $2+1=3$).
- The burst time for P2 is 1 (sum of digits in mm i.e. $1+0=1$).
- The burst time for P3 is 2 (sum of last 2 digits in yyyy i.e. $0+2=2$)

Algorithm for scheduling : Shortest remaining time first algorithm

GANTT Chart for the problem :



→ How the Gantt Chart is obtained ?

- P1 arrives at 0. Since the **Burst time for P1 is 3** and **Arrival Time for P2 is 4**, P1 operates till **3 unit time**.
- The CPU remains **idle** for 1 unit time from 3 to 4 unit time.
- The process P2 arrives at 4. Since the **Burst time for P2 is 1** the process completes at **5 unit time**.
- The process P3 arrives at 5. Since the **Burst time for P3 is 2** , the process completes at **7 unit time**.

Calculations

→ **Waiting time for each of the process:**

Waiting time (W.T.) = Completion Time - Arrival Time - Burst Time

Therefore,

- W.T. for P1 = $3 - 0 - 3 = 0$ units of time
- W.T. for P2 = $5 - 4 - 1 = 0$ units of time
- W.T. for P3 = $7 - 5 - 2 = 0$ units of time

→ **Turnaround time of each of the process**

Turnaround Time (T.A.T.) = Completion Time - Arrival Time

- T.A.T. for P1 = $3 - 0 = 3$ units of time
- T.A.T. for P2 = $5 - 4 = 1$ units of time
- T.A.T. for P3 = $7 - 5 = 2$ units of time

→ **Percentage of time CPU remains idle.**

CPU remains idle for 1 unit of time. Therefore, percentage of time CPU remains idle

= $[(\text{Idle time units}) / (\text{Total time units for completion of all processes})] * 100 \%$

= $[(1 / 7) * 100 \%] = 14.29 \%$

Question 2

Consider a uniprocessor system, where there exist three processes (Process ID 1, 2, 3 respectively). CPU assigns priority of the processes based on highest waiting time of the processes present at that time after every 2-unit time. In any process terminates before the interval time then the default situation will be FCFS scheduling. Each of the process will arrive based on the last 3 digits of your university roll number. (If Roll No. is 13000118137, arrival time of $P_0 = 1$, $P_1 = 3$, $P_2 = 7$). CPU Burst time will be first three digits of your mobile number (i.e. if your mobile number is 8756540439, CPU burst time of $P_1 = 8$, $P_2 = 7$, $P_3 = 5$, if any number is 0, then take next non zero value from your mobile number like 7000312867, CPU burst time of $P_1 = 7$, $P_2 = 3$, $P_3 = 1$).

- i. Calculate Average Waiting Time.
- ii. Calculate Average Turnaround Time.
- iii. Calculate the percentage of time CPU remains idle.

Solution

Process	Arrival Time	Burst Time
P1	0	9
P2	5	3
P3	8	3

→ **How Arrival Time for processes are obtained ?**

- My university roll number is *13000121058* and the last three digits of it are 0, 5, 8. Therefore, the arrival time for P1 is 0 , P2 is 5 and P3 is 8.

→ **How Burst time for processes are obtained ?**

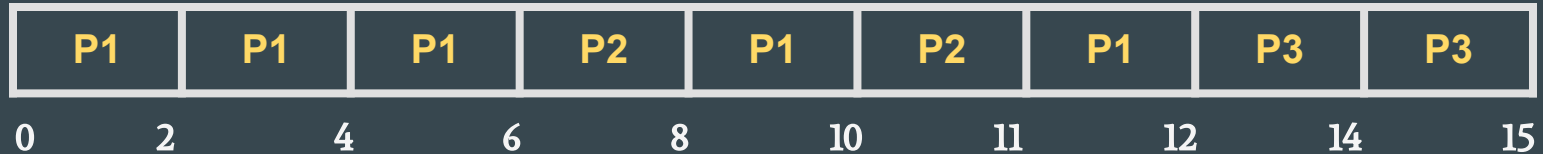
- My mobile number is *9330450430* and the first three digits are 9, 3, 3.
Therefore,
 - The burst time for P1 is 9.
 - The burst time for P2 is 3.
 - The burst time for P3 is 3.

→ **Time quantum (T.Q.) is 2 units of time**

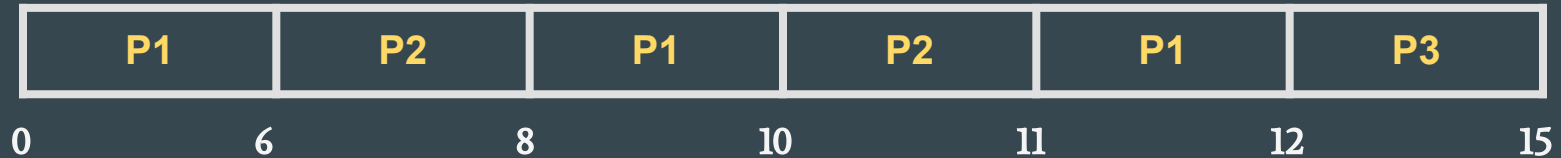
Algorithm :

- Priority of processes based on highest waiting time of the processes present at that time after every 2-unit time.
- FCFS (First Come First Serve) Scheduling if any process ends before the interval of 2 unit time

GANTT Chart for the problem



Resultant GANTT chart



→ How the GANTT chart is obtained ?

- At 0 unit time , process P1 arrives.
- At 2 unit time , process P1 continues as no other process arrive.
- At 4 unit time , process P1 continues as no other process arrive.

Waiting time for process P_x after n unit time = $n - (\text{arrival time of P}_x) - (\text{Time units P}_x \text{ was executed})$

- At 6 unit time :
Waiting time for P1 = $6 - 0 - 6 = 0$ unit of time.
Waiting time for P2 = $6 - 5 - 0 = 1$ unit of time. (highest waiting time)
Therefore P2 gets the CPU from 6 unit time to 8 unit time.
- At 8 unit time :
Process P3 arrives.
Waiting time for P1 = $8 - 0 - 6 = 2$ units of time. (highest waiting time)
Waiting time for P2 = $8 - 5 - 2 = 1$ unit of time.
Waiting time for P3 = $8 - 8 - 0 = 0$ unit of time
Therefore P1 gets the CPU from 8 unit time to 10 unit time.

→ How the GANTT chart is obtained ? (continued)

- At 10 unit time :

Waiting time for P1 = $10 - 0 - 8 = 2$ units of time.

Waiting time for P2 = $10 - 5 - 2 = 3$ units of time. (highest waiting time)

Waiting time for P3 = $10 - 8 - 0 = 2$ units of time

Therefore **P2** gets the CPU from **10 unit time** to **12 unit time**.

P2 completes at **11 unit time**.

- At 11 unit time :

P2 completes **before 12 unit time** and **FCFS (First Come First Serve) Scheduling** is followed for giving the CPU to the next process. Since **P1** arrived **before P3**, **P1** gets the CPU from **11 unit time** to **12 unit time**. **P1** completes at **12 unit time**.

- At 12 unit time :

As **P3** is only remaining, **P3** gets the CPU and completes at **15 unit time**.

Calculations

→ Waiting time for each of the process:

Waiting time (W.T.) = Completion Time - Arrival Time - Burst Time

Therefore,

- W.T. for P1 = $12 - 0 - 9 = 3$ units of time
- W.T. for P2 = $11 - 5 - 3 = 3$ units of time
- W.T. for P3 = $15 - 8 - 3 = 4$ units of time

$$\text{Average Waiting Time (A.W.T.)} = [(\text{W.T. of P1}) + (\text{W.T. of P2}) + (\text{W.T. of P3})] / 3$$

$$\text{Therefore A.W.T} = (3 + 3 + 4) / 3 = 3.33 \text{ units of time}$$

→ Turnaround time of each of the process

Turnaround Time (T.A.T.)= Completion Time - Arrival Time

- T.A.T. for P1 = $12 - 0 = 12$ units of time
- T.A.T. for P2 = $11 - 5 = 6$ units of time
- T.A.T. for P3 = $15 - 8 = 7$ units of time

$$\text{Average Turnaround Time (A.T.A.T.)} = [(\text{TAT of P1}) + (\text{TAT of P2}) + (\text{TAT of P3})] / 3$$

$$\text{Therefore ATAT} = (12 + 6 + 7) / 3 = 8.33 \text{ units of time}$$

→ Percentage of time CPU remains idle is 0 %

THANK YOU