CPU scheduling

Date: / /

EDWARDS

① Arrival Time:

The time at which process enter the ready Queue orstate

② Burst Time:-

Time required by a process to get execute on CPU.

③ Waiting Time:-

The time spent by a process while waiting in the ready queue.

④ Turn Around Time:-

It is difference between the time a process enters the system & the time it exits the system.

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⑤ Start Time :-

It is a moment when the process is allocated the CPU for the first time in its execution lifecycle.

⑥ Finish Time :-

It is the exact moment when the process has completed all its CPU bursts and is terminated.

There are 2 types of Scheduling

① Pre-Emptive Scheduling

In this, the OS can interrupt a running process and reassign the CPU to another process.

This type of scheduling allows higher priority process or time Quntam.

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② Non-Preemptive Scheduling.

In this, once the CPU is assigned to a process, the processor do not release until the completion of the process.

Formulas :-

Waiting time = Start Time - Arrival Time.

Finish time = Start Time + Burst Time

Turn Around Time = Finish Time - Arrival Time.

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ALGORITHM

Date: / /

① First Come First Serve (FCFS)

①

Process	CPU Burst Time
P_1	8
P_2	4
P_3	9
P_4	5

→ [When arrival time not given]

Solution :-

Gantt Chart :

P_1	P_2	P_3	P_4

0 8 12 21 26

Average Waiting Time :-

$$\frac{0+8+12+21}{4} = \frac{41}{4} = 10.25$$

Average Turn Around Time :-

$$\frac{8+12+21+26}{4} = \frac{67}{4} = 16.75$$

[When Arrival Time is given]

Date: / / [sequentially]

②

Process	Arrival Time	Burst Time
P_1	0	8
P_2	1	4
P_3	2	9
P_4	3	5

→

Gantt Chart

P_1	P_2	P_3	P_4

0 8 12 21 26

P	BT	AT	ST	WT	FT	TAT
P_1	8	0	0	0	8	8
P_2	4	1	8	7	12	11
P_3	9	2	12	10	21	19
P_4	5	3	21	18	26	23

Average WT $= \frac{0+7+10+18}{4} = \frac{35}{4} = 8.75$

Average TAT $= \frac{8+11+19+23}{4} = \frac{61}{4} = 15.25$

[When Arrival Time is Same]

[First is given the priority]

③

Process	Burst Time	Arrival Time
P_1	5	1
P_2	6	0
P_3	3	2
P_4	4	0

→

Gantt Chart.

P_2	P_4	P_1	P_3

0 6 10 15 18

P	BT	AT	ST	WT	FT	TAT
P_1	5	1	10	9	15	14
P_2	6	0	0	0	6	6
P_3	3	2	15	13	18	16
P_4	4	0	6	6	10	10

$$AWT = \frac{9+0+13+6}{4} = \frac{28}{4} = 7$$

$$ATAT = \frac{14+6+16+10}{4} = \frac{46}{4} = 11.5$$

[When Arrival Time is Given]

[Not sequentially]

④

Process	Burst Time	Arrival Time
P_1	2	1
P_2	3	2
P_3	5	0

→

Gantt Chart.

P_3	P_1	P_2

0 5 7 10

P	BT	AT	ST	WT	FT	TAT
P_1	2	1	5	4	7	6
P_2	3	2	7	5	10	8
P_3	5	0	0	0	5	5

$$AWT = \frac{4+5+0}{3} = \frac{9}{3} = 3$$

$$ATAT = \frac{6+8+5}{3} \quad \frac{19}{3} = 6.33$$

Extra Examples :-

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Date: / /

①

Job	Burst Time
P1	24
P2	3
P3	5

Gantt Chart

P1	P2	P3

0 24 27 32

Turn around time:-

$$\frac{0 + 24 + 27 + 32}{3} = 27$$

Average waiting time

$$\frac{0 + 24 + 27}{3} = \frac{51}{3} = 17$$

Date: / / EDWARDS

②

Job	Burst Time
P_1	5
P_2	15
P_3	12
P_4	25
P_5	5

Gantt Chart:

P_1	P_2	P_3	P_4	P_5

0 5 20 32 57 62

Average Waiting Time :-

$$\frac{0 + 5 + 20 + 32 + 57 + 62}{5} = \frac{176}{5} = 35.2$$

Total Turn Around Time :-

$$\frac{0 + 5 + 20 + 32 + 57}{5} = \frac{114}{5} = 22.8$$

[No AT]

Date: / /

2] SHORTEST JOB FIRST.

Non-Preemtive [Simple]

①

Process	Burst Time
P_1	5
P_2	15
P_3	12
P_4	25
P_5	5

P_1	P_5	P_3	P_2	P_4

0 5 10 22 37 62

Average Waiting Time :-

$$\frac{0+5+10+22+37}{5} = \frac{74}{5} = 14.8$$

Average Turn Around Time :-

$$\frac{0+5+10+22+37+62}{5} = \frac{136}{5} = 27.2$$

[Arrival time is given] [Sequentially]

Date: / /

②

Process	Burst Time	Arrival Time
P_1	4	0
P_2	1	1
P_3	2	2
P_4	1	3

P_1	P_2	P_4	P_3

0 4 5 6 8

P	BT	AT	ST	WT	FT	TAT
P_1	4	0	0	0	4	4
P_2	1	1	4	3	5	4
P_3	2	2	6	4	8	6
P_4	1	3	5	2	6	3

$$AWT = \frac{0+3+4+2}{4} = \frac{9}{4} = 2.25$$

$$ATAT = \frac{4+4+6+3}{4} = \frac{17}{4} = 4.25$$

EDWARDS

[When Arrival time is same]

Date: / /

③

Job	Burst Time	Arrival Time
P_1	5	1
P_2	6	0
P_3	2	2
P_4	4	0

P_4	P_3	P_1	P_2

0 4 6 11 17

P	BT	AT	ST	WT	FT	TAT
P_1	5	1	6	5	11	10
P_2	6	0	11	11	17	17
P_3	2	2	4	2	6	4
P_4	4	0	0	0	4	4

$$AWT = \frac{5+11+2+0}{4} = \frac{18}{4} = 4.5$$

$$ATAT = \frac{10+17+4+4}{4} = \frac{35}{4} = 8.75$$

[Arrival time given] [Non-Sequentially]

Date: / / EDWARDS

④

Process	Burst Time	Arrival Time
P_1	5	1
P_2	1	0
P_3	2	2
P_4	4	3

P_2	P_1	P_3	P_4

0 1 6 8 12

P	BT	AT	ST	WT	FT	TAT
P_1	5	1	1	0	6	5
P_2	1	0	0	0	1	1
P_3	2	2	6	4	8	6
P_4	4	3	8	5	12	9

$$AWT = \frac{0+0+4+5}{4} = \frac{9}{4} = 2.25$$

$$ATAT = \frac{5+1+6+9}{4} = \frac{21}{4} = 5.25$$

[When Arrival Time is given [sequentially]]

EDWARDS

Date: / /

SHORTEST REMAINING TIME FIRST

Its a preemptive version of SJF

①

Process	Burst Time	Arrival Time
P_1	8 - 1 = 7	0
P_2	4	1
P_3	9	2
P_4	5	3

Gantt Chart. [Premptive]

P_1	P_2	P_4	P_1	P_3

0 1 5 10 17 26

P	BT	AT	ST	WT	FT	TAT
P_1	8	0	9	9	17	17
P_2	4	1	1	0	5	4
P_3	9	2	17	15	26	27
P_4	5	3	5	2	10	7

Avg :- 6.5 13

P_1 ST -> 10 - 1 = 9 explained.

total before.

(2)

Process	Burst Time	Arrival Time
P_1	2	1
P_2	3	2
P_3	$5-1=4$	0

Gantt Chart

P_3	P_1	P_2	P_3

0 1 3 6 10

Process	BT	AT	ST	WT	FT	TAT
P_1	2	1	1	0	3	2
P_2	3	2	3	1	6	4
P_3	$5-1=4$	0	$5\ (6-1)$	5	10	10

Average Waiting Time :- $\frac{0+1+5}{3}$

$= 2.$

Average Turn Around Time :- $\frac{2+4+10}{3}$

$= 5.33$

(3)

Process	Burst Time	Arrival Time
P_1	5	1
P_2	6	0
P_3	2	1
P_4	4 (3)	0

Gantt Chart.

P_4	P_3	P_4	P_1	P_2

0 1 3 6 11 17

P	BT	AT	ST	WT	FT	TAT
P_1	5	1	6	5	11	10
P_2	6	0	11	11	17	17
P_3	2	1	1	0	3	2
P_4	4	0	2	2	6	6

$AWT = \frac{5+11+0+2}{4} = \frac{18}{4} = 4.5$

$ATAT = \frac{10+17+2+6}{4} = \frac{35}{4} = 8.75$

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3] PRIORITY ALGORITHM.

①

Process	Burst Time	Priority
P_1	10	3
P_2	1	1
P_3	2	3
P_4	1	4
P_5	5	2

Gantt Chart :-

P_2	P_5	P_1	P_3	P_4

0 1 6 16 18 19

Average Waiting Time $= \frac{0+1+6+16+18}{5}$

$= 41/5 = \underline{8.2}$

Average Turn Around Time $= 0+1+6+16+18+19$

$= \frac{60}{5}$

$= \underline{12}$

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②

Process	Burst Time	Priority
J_1	4	4
J_2	6	1
J_3	2	3
J_4	3	5

Gantt Chart :-

J_2	J_3	J_1	J_4

0 6 8 12 15

Average waiting Time :-

$= \frac{0+6+8+12}{4} = \frac{26}{4} = 6.5$

Average turn around Time :-

$\frac{0+6+8+12+15}{4} = \frac{41}{4} = 10.25$

EDWARDS

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4] Round Robbin Scheduling Algorithm

- RR is the preemeptive process scheduling algorithm.
- It is designed for time sharing system.
- It follows the FCFS but each process is allowed to run only in a limited time around.
- Here, Time Quantum is present.

①

Process	Burst Time
P_1	24
P_2	3
P_3	3

Time Quantum (TQ) = 4.

Gantt chart :-

P_1	P_2	P_3	P_1	P_1	P_1	P_1	P_1

0 4 7 10 14 18 22 26

26 30

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Waiting Time :- 5.6

Turn Around Time :- 15.6

* TAT = Completion Time - Arrival Time.

* ~~P_I~~ = WT :- Turn Around Time - Burst Time.

P	BT	AT	ST	CT	WT	TAT
P_1	24	0	(10-4) 6	30	6	30
P_2	3	0	4	7	4	7
P_3	3	0	7	10	7	10

(Assume AT as '0')

* $AWT = \frac{6+4+7}{3} = \frac{17}{3} = 5.6$

$ATAT = 30+7+10 = \frac{47}{3} = 15.6$

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TAT = CT − AT
WT = TAT − BT

(2)

Process	Burst Time	Arrival Time
P_1	5	0
P_2	3	1
P_3	8	2
P_4	6	3

Time Quantum (TQ) = 3

P_1	P_2	P_3	P_4	P_1	P_3	P_4	P_3

0 3 6 9 12 14 17 20 22

P	BT	AT	ST	CT	WT	TAT
P_1	5	0	12-3 9	14	9	14
P_2	3	1	3	6	2	5
P_3	8	2	12	22	12	20
P_4	6	3		20	11	17

$$AWT = \frac{9+2+12+11}{4} = \frac{34}{4} = 8.5$$

$$ATAT = \frac{14+5+20+17}{4} \quad \frac{56}{4} = 14$$

(3)

Process	Burst Time	Arrival Time
P_1	3	1
P_2	2	2
P_3	5	0

Time Quantum = 1

P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_3	P_3

0 1 2 3 4 5 6 7 8 9 10

P	BT	AT	CT	WT	TAT
P_1	3	1	8	4	7
P_2	2	2	6	2	4
P_3	5	0	10	5	10

$$AWT = \frac{4+2+5}{3} = \frac{11}{3} = 3.66 \ (\approx 3.67)$$

$$ATAT = \frac{7+4+10}{3} = \frac{21}{3} = 7$$