COMPUTER SCIENCE & I.T

OPERATING SYSTEMS

CPU Scheduling

LECTURE- 03

Dr. KHALEEL KHAN

Topics to be Covered

HRRN

ROUND ROBIN

30|10|2022

Session - I

CPU Scheduling

Idle_time = 1 ✓

2) Shortest Job First (SJF):

Sel. Criteria: Burst Time (B.T)

Mode of op'n : Non-PreEmptive

Conflict Resolution: Favor Lower Pid

Working Principle

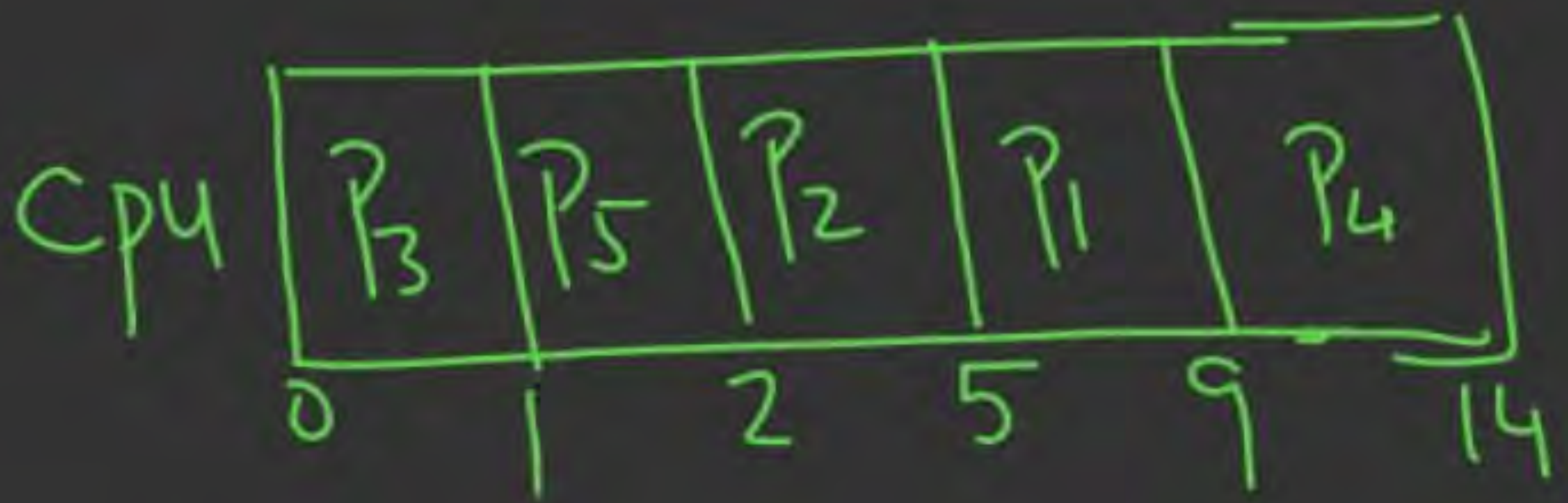
Among the Processes present in Ready 'Q' Select the one having Least 'BT'; Schedule it & Complete;

P.No	A.T	B.T
1	0	4
2	0	3
3	0	1
4	0	5
5	0	1

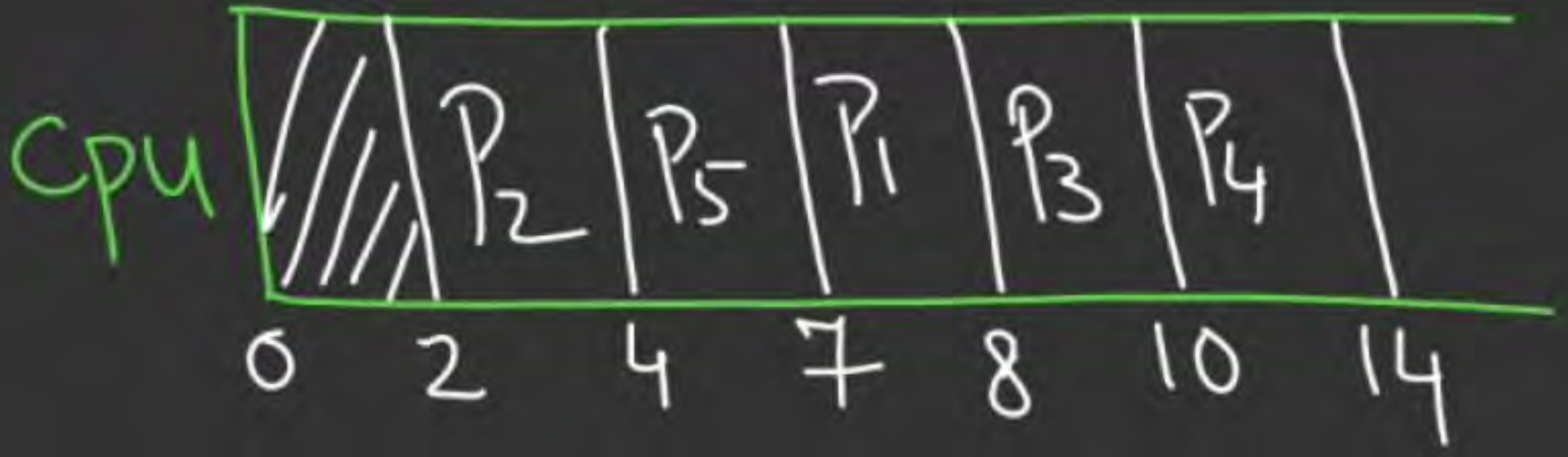
P.No	A.T	B.T
× 1	5	1
× 2	2	2
3	8	2
· 4	2	4
× 5	4	3

$\mathcal{L} =$

Av. TAT =

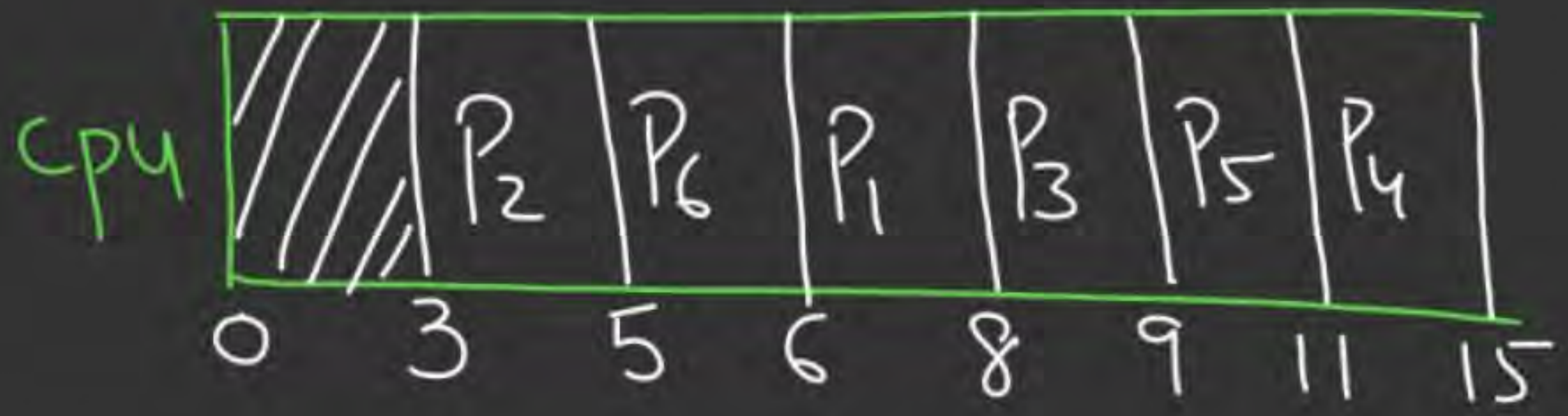


$\mathcal{L} = 14$



P.NO	A.T	B.T
x1	5	2
x2	3	2
x3	8	1
4	6	4
x5	3	2
x6	4	1

$L = 15 - 3 = 12$



3. Shortest Remaining Time First (SRTF)

Pre Emptive SJF

Sel. Criteria: B.T

Mode of opn: Pre Emptive

Conflict resoln:

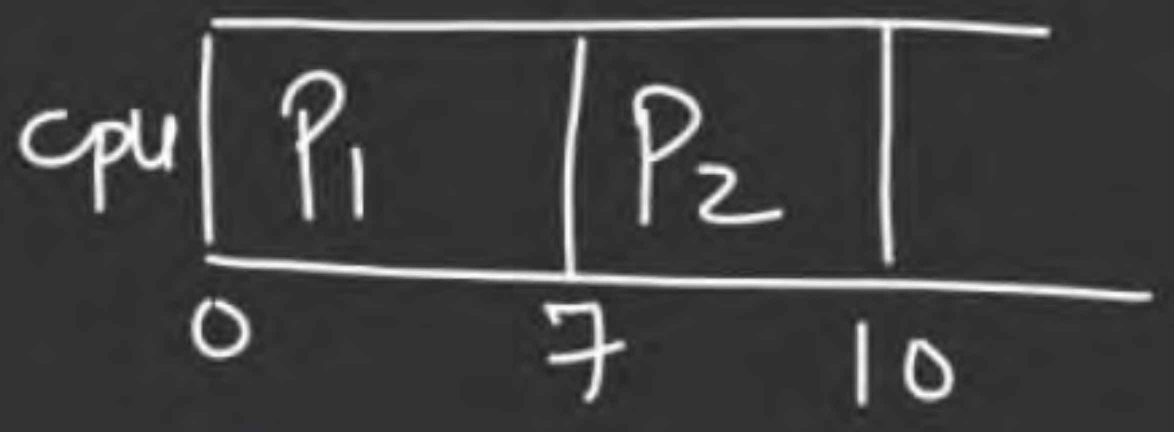
Lower Pid

" Pre Emption of running Process is based on arrival | availability of a Strictly Shorter process"

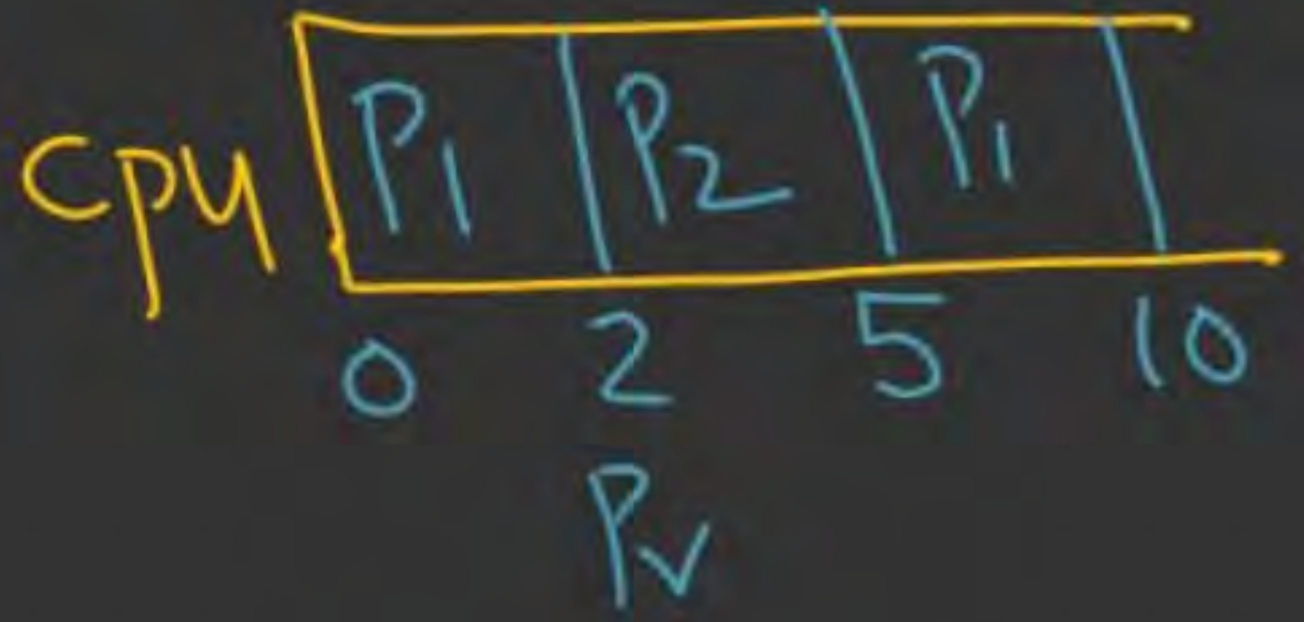
<

P.NO	A.T	B.T
1	0	~~7~~ 5
2	2	3

SJF : N.Pr



SRTF | Pr-SJF



P.NO	A.T	B.T
1	2	~~8~~ 6.
2	3	7.
x 3	4	4

$\delta = 0$

S.J.F

CPU | ▨ | P_1 | P_3 | P_2 |

0 2 10 14 21

SRTF

CPU | ▨ | P_1 | P_3 | P_1 | P_2 |

0 2 4 8 14 21

Pγ

$\mathcal{L} = 21-2$

P.NO	A.T	B.T
1	0	~~5~~ ~~4~~ 3
2	1	4
x 3	2	2

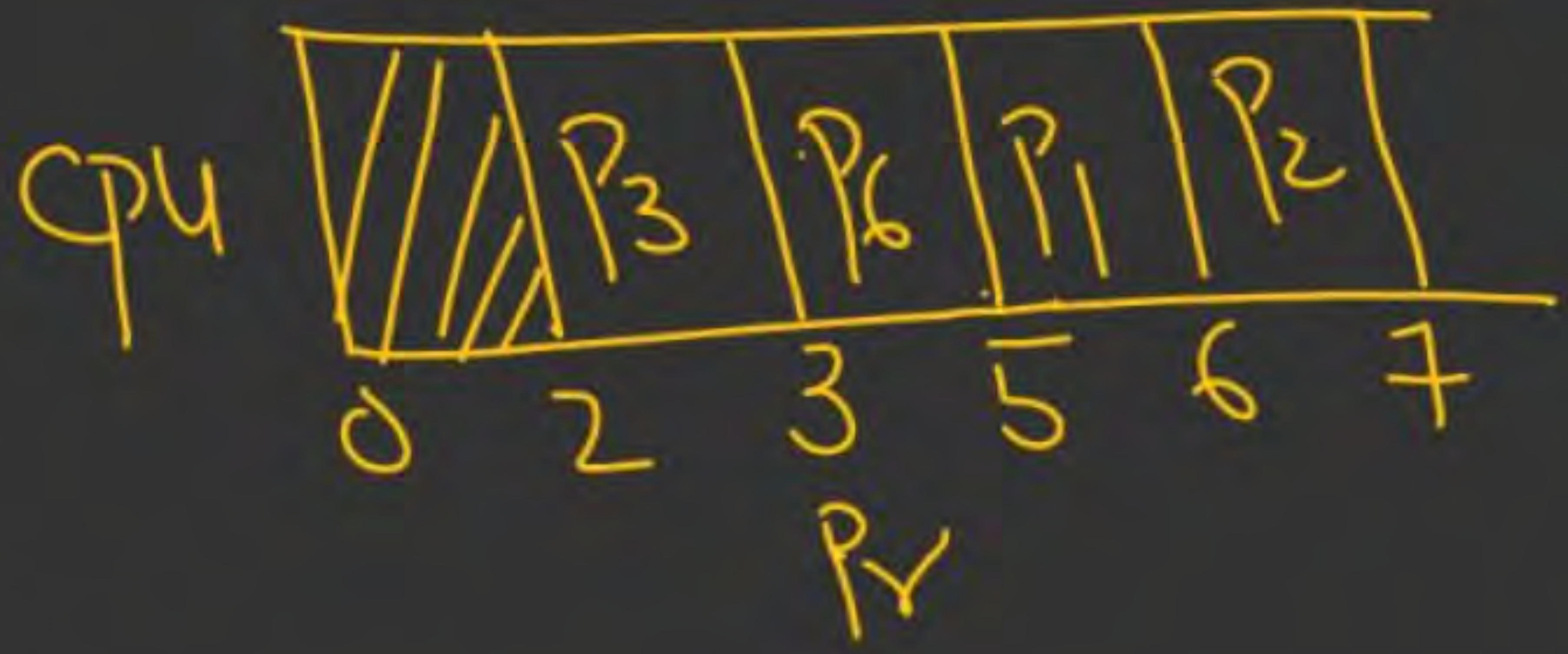
SRTF:

CPU | P_1 | P_3 | P_1 | P_2 | |

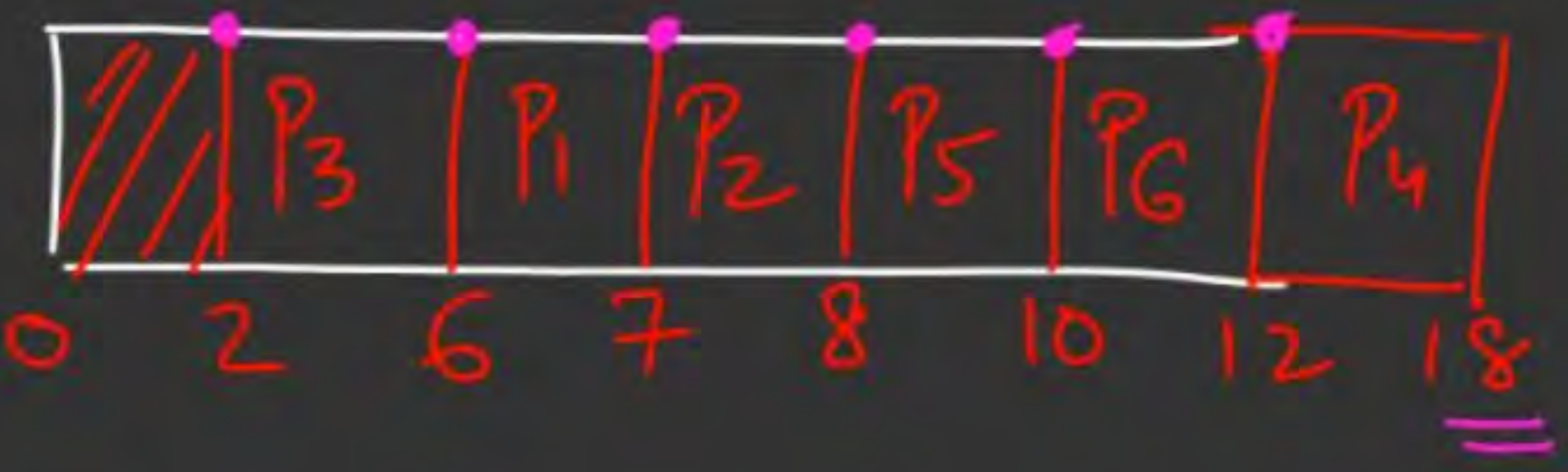
0 2 4 7 11

PV

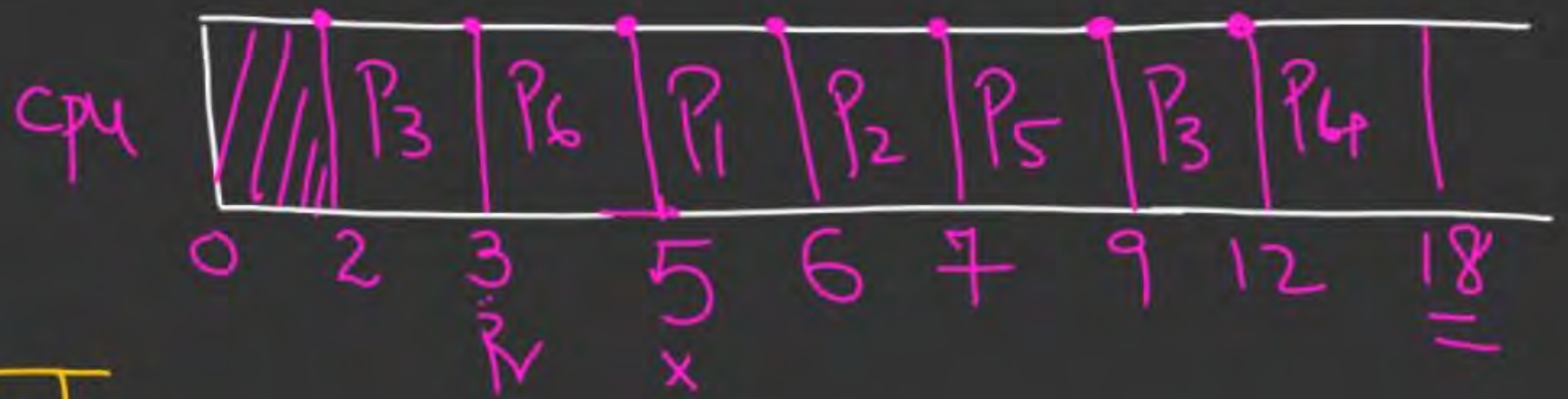
P.No	A.T	B.T
✓ 1	4	1
2	6	1
3	2	~~4~~ 3
4	2	6
5	5	2
6	3	~~2~~ ~~1~~



SJF



SRTF:



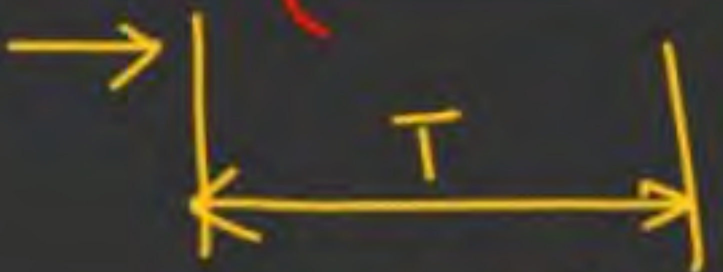
→ Performance of S.J.F/S.R.T.F

→ "Favors Shorter Process"

Optimal Algo

{Advantage}

→



- → Complete more # of Processes
- → Increased Thruput (Max.)
- → Minimizing Avg TAT & W.Ts ;

{Drawback}

→ Cause Starvation to Longer Process

{Practical Limitation of SJF}

⇓

→ SJF Cannot be implemented with Real B.T's, but Can be impl. with Predicted B.T's

→ Since Burst times of Processes are not known a priori

SJF/SRTF is practically non-Implementable;

Optimal Algo

↓

Benchmark

R.Q | P1 P2 P3

CPU

↓

Can we predict the B.T's of P's

Exponential Averaging Technique to Predict NEXT CPU B.T of Process

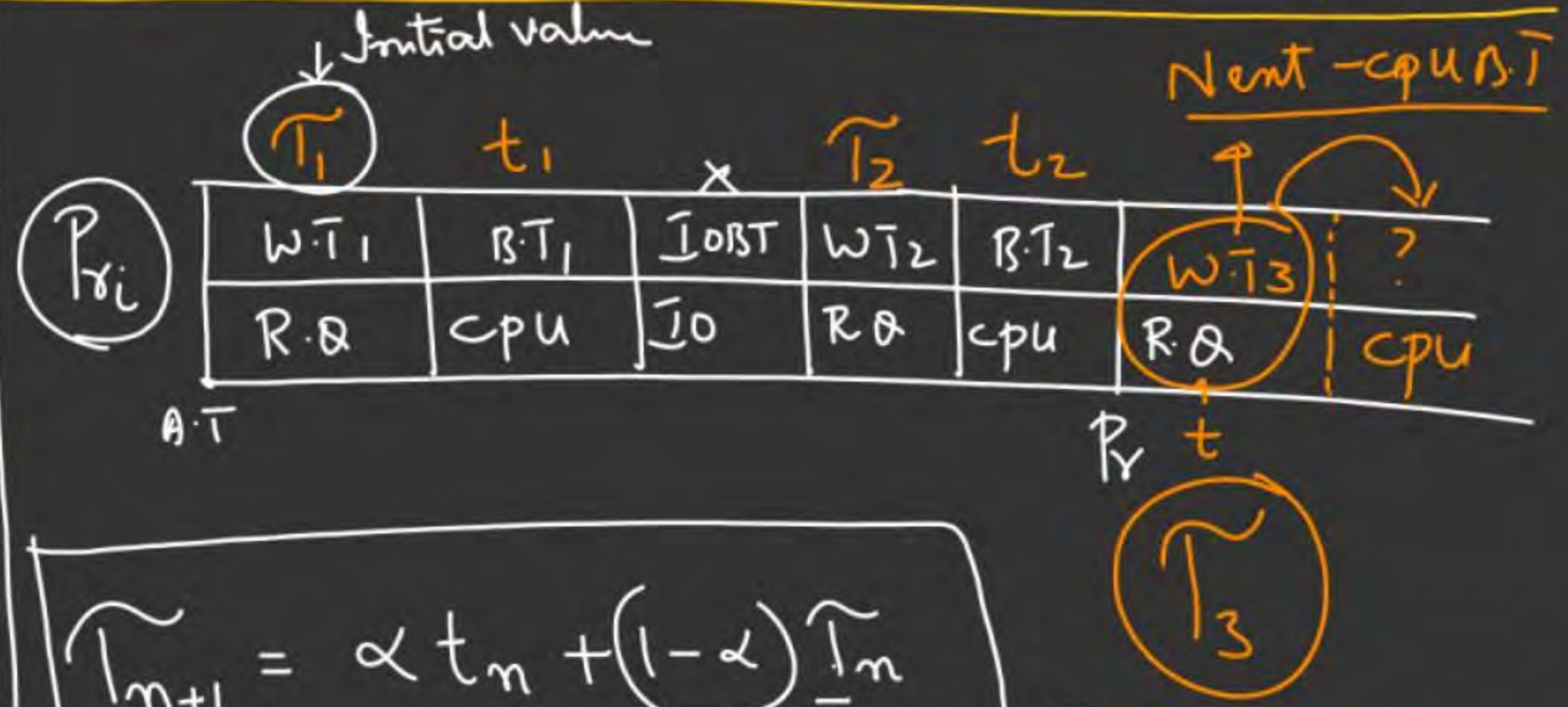
→ Let P_i be Process

→ Let 't_i' Completed B.T

→ Let 'τ_i' the Predicted B.T

Let τ_{n+1} : Next cpu B.T of P_i

→ we already completed n-cpu Bursts



τ_1	t_1	×	τ_2	t_2	↑	
W.T₁	B.T₁	IOBT	WT₂	B.T₂	W.T3	?
R.Q	cpu	IO	RQ	cpu	R.Q	cpu

$$\tau_{n+1} = \alpha t_n + (1-\alpha)\tau_n$$

$$0 \le \alpha \le 1$$

Recurrence

Recursive Eqn

$f(n) = n * f(n-1)$ ✓

→ $f(0) = 1$

$f(n+1) = \alpha f(n)$

$\tau_{n+1} = \alpha t_n + (1-\alpha)\tau_n$ — ①

α : a Constant

$0 \le \alpha \le 1$

$\tau_n = \alpha t_{n-1} + (1-\alpha)\tau_{n-1}$ — ②

Back Substitution

$\tau_{n-1} = \alpha t_{n-2} + (1-\alpha)\tau_{n-2}$ —

$$\tau_{n+1} = \alpha t_n + (1-\alpha)\left[\alpha t_{n-1} + (1-\alpha)\tau_{n-1}\right]$$

$$= \alpha t_n + \alpha(1-\alpha)t_{n-1} + (1-\alpha)^2\tau_{n-1} \quad \text{— ③}$$

$$= \alpha t_n + \alpha(1-\alpha)t_{n-1} + \alpha(1-\alpha)^2 t_{n-2} + (1-\alpha)^3\tau_{n-2} \quad \text{— ④}$$

$$\vdots$$

$$\tau_1$$

Even if, we Implement SJF with Predicted B.T, then still, it will Suffer from the Problem of STARVATION.

⟹ To overcome the problem of Starvation in SJF, we use "HRRN"

Consider a System using exponential Avging to Predict next cpu B.T. Assume $\underline{\alpha = 0.5}$, $\underline{\tau_1 = 10}$;

Previous Runs of a Process generats B.Ts of $\overline{8, 12, 14, 10}$

$\langle t_1 \; t_2 \; t_3 \; t_4 \rangle \; \tau_5$

Predict the <u>Next cpu Burst</u> ?

$$\tau_5 = \alpha t_4 + (1-\alpha)\tau_4$$

$$= \frac{1}{2}(t_4 + \tau_4) = \frac{1}{2}(10 + \tau_4) = \frac{1}{2}(10 + 12.25) = \frac{22.25}{2} = \boxed{11.125} \checkmark$$

$$\tau_4 = \frac{1}{2}(t_3 + \tau_3) = \frac{1}{2}(14 + \tau_3) = \frac{1}{2}(14 + 10.5) = \frac{24.5}{2} = \underline{12.25}$$

$$\tau_3 = \frac{1}{2}(t_2 + \tau_2) = \frac{1}{2}(12 + \tau_2^{9}) = \frac{21}{2} = 10.5$$

$$\tau_2 = \frac{1}{2}(t_1 + \tau_1) = \frac{1}{2}(8 + 10) = \underline{\underline{9}}$$

4) Longest Remaining Time First (LRTF): ⊛

⊛ G

Sel. Criteria : B.T
Mode of opn : PreEmptive

Tie breaking Rule : { Given ?

In case of a tie b/w Processes, favor the process having lower Pid"

P.No	A.T	B.T
1	0	2
2	0	~~4~~ 3
3	0	~~8~~ ~~4~~ 3

CPU	P3	P2	P3	P2	P3	P1	P2	P3	P1	P2	P3

0 4 5 6 7 8 9 10 11 12 13 14

Pr Pr Pr Pr Pr Pr Pr Pr

Q) Compute Avg. TAT using LRTF: (2m)

$$\frac{12+13+14}{3} = \frac{39}{3} = \boxed{13}$$ ✓

CPU	P3	

0 4

Q.3 Consider the following processes, with the arrival time and the length of the CPU burst given in milliseconds. The scheduling algorithm used is preemptive Shortest Remaining-Time First (SRTF).

Process	Arrival Time	Burst Time
P1	0	10
P2	3	6
P3	7	1
P4	8	3

The average turnaround time of these processes is ________ milliseconds.

NAT

2m G

Q.4 Consider the following four processes with arrival times (in milliseconds) and their length of CPU bursts (in milliseconds) as shown below:

11:45

am

Process	P_1	P_2	P_3	P_4
Arrival time	0	1	3	4
CPU burst time	3	1	3	Z

These processes are run on a single processor using preemptive Shortest Remaining Time First (SRTF) Scheduling Algorithm. If the average waiting time of the processes is 1 millisecond, then the value of Z is

THANK YOU!