CS & IT ENGINEERING

Operating Systems

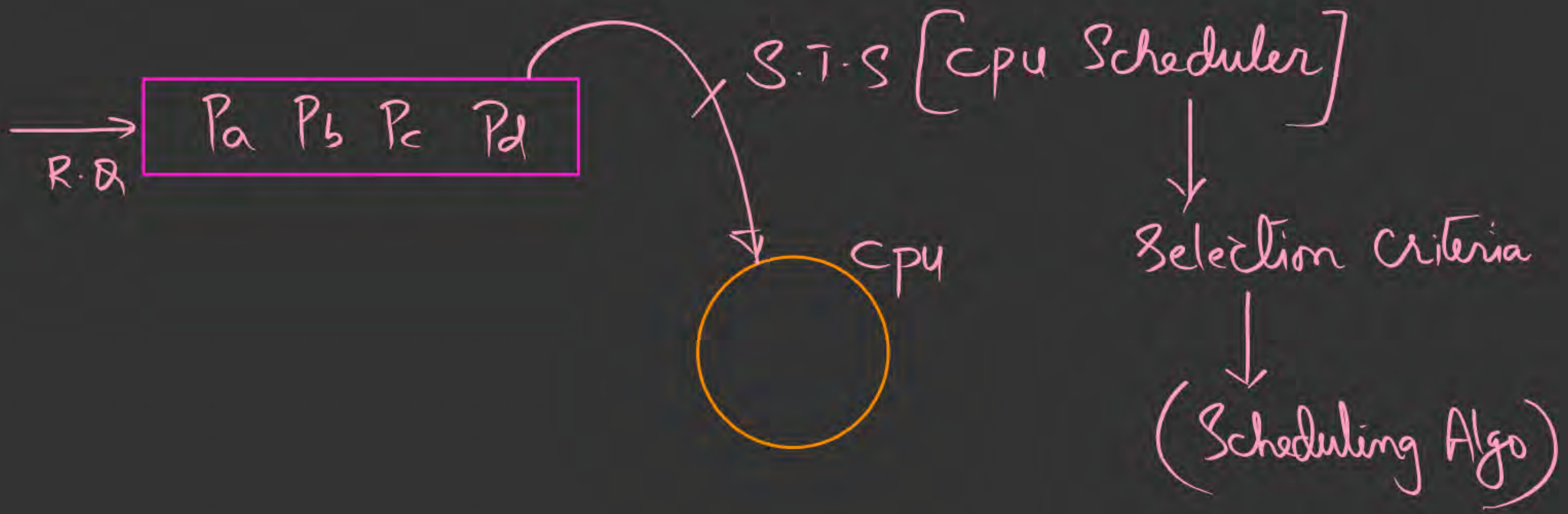
Process Management

Lecture No. 03

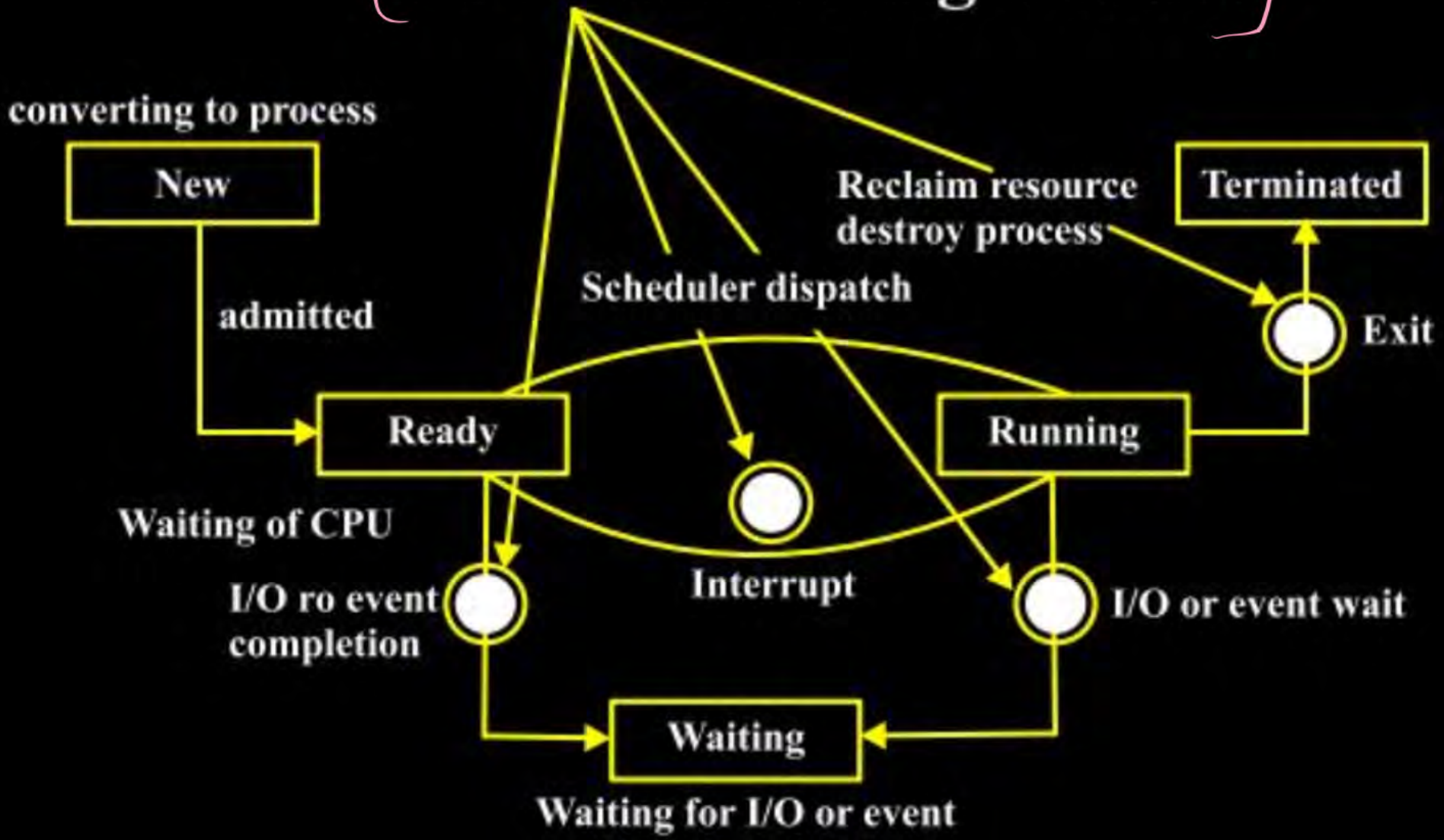
By- Dr. Khaleel Khan Sir

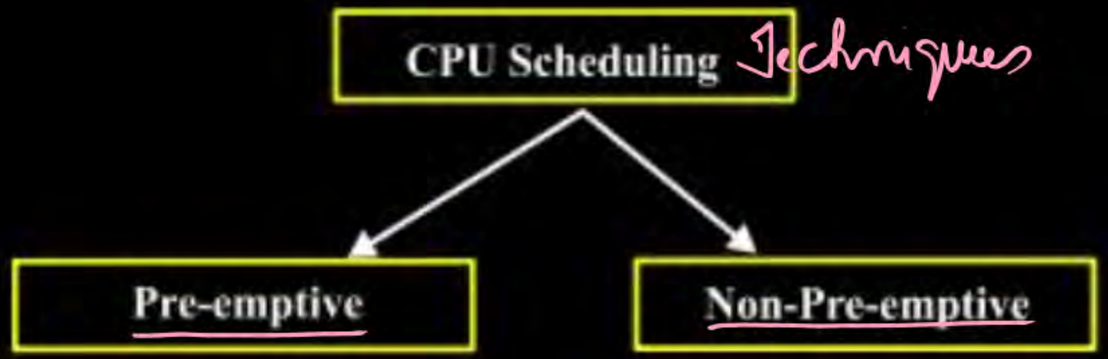
- Process Times
- Scheduling Techniques
- FCFS

Need for cpu Scheduling:



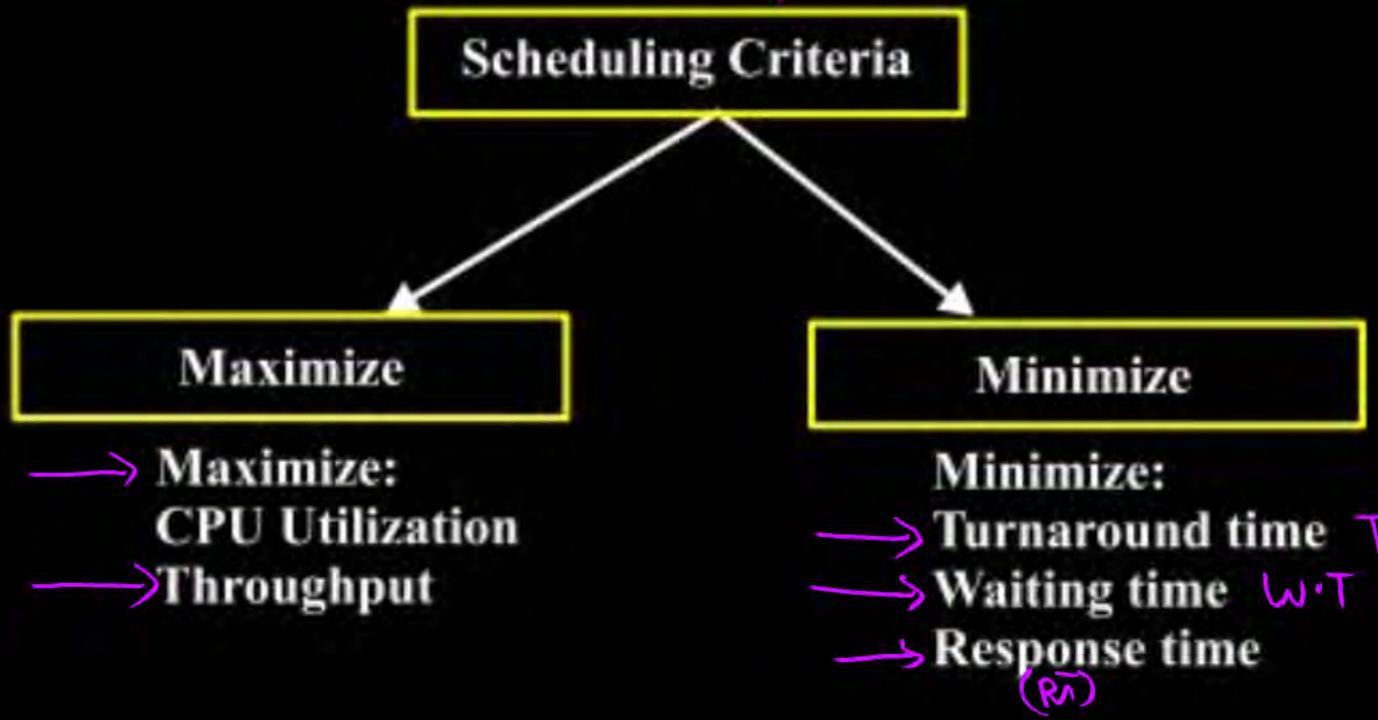
CPU Scheduling Occurs





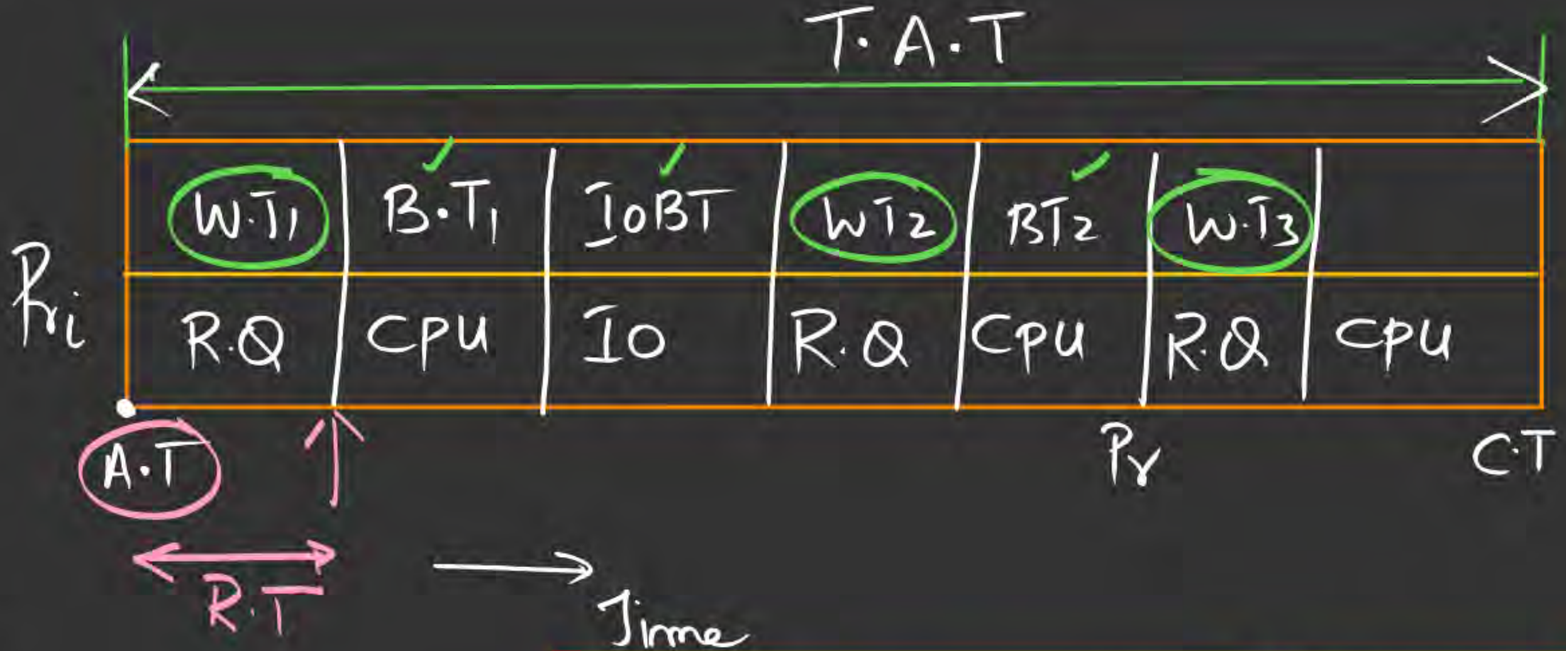
Throughput : (No. of Processes Completed Per unit Time)

Goals of cpu Scheduler



Process Times:

1) Arrival Time (AT)
2) Waiting Time (WT):
3) Burst Time (BT):
4) IO Burst time (IOBT)
5) Completion time (CT):
6) Turn-Around-Time (TAT): CT - AT



→ Waiting Time = TAT − (B.T + IOBT)

WT

if IOBT = 0, then

WT = TAT − BT

Framework :

- → n : no. of Processes
- → A_i : A.T of Pr_i
- → C_i : C.T of Pr_i
- → X_i : B.T of Pr_i
- → Y_i : IOBT of Pr_i

d) $W.T(Pr_i) = (C_i - A_i) - (X_i + Y_i)$

e) $Av.WT = \frac{1}{n}\sum_{i=1}^{n}(C_i - A_i) - (X_i + Y_i)$

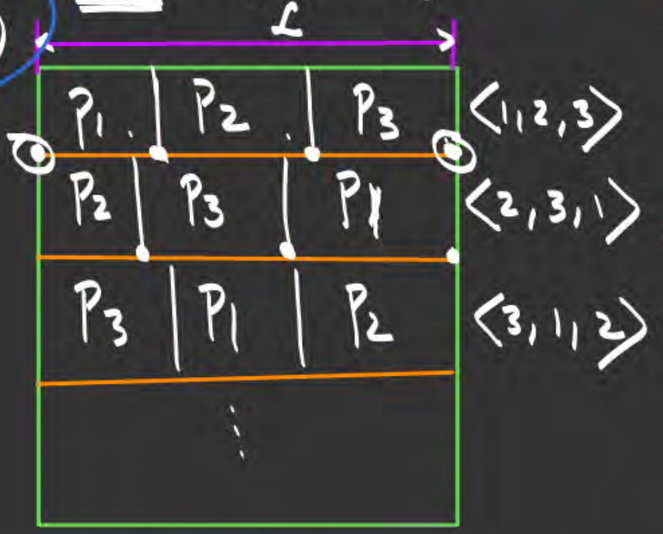
Non-Preemptive → No. of Schedules $= n!$

120 m — 15 topics
1 m — ?
$\mu = \frac{15}{120}$

f) Schedule length ($\mathcal{L}$)

$\mathcal{L} = Max(C_i) - Min(A_i)$

$n = 3$; $\langle P_1, P_2, P_3 \rangle$



a) $TAT(Pr_i) = C_i - A_i$

b) $Av.TAT = \frac{1}{n}\sum_{i=1}^{n}(C_i - A_i)$

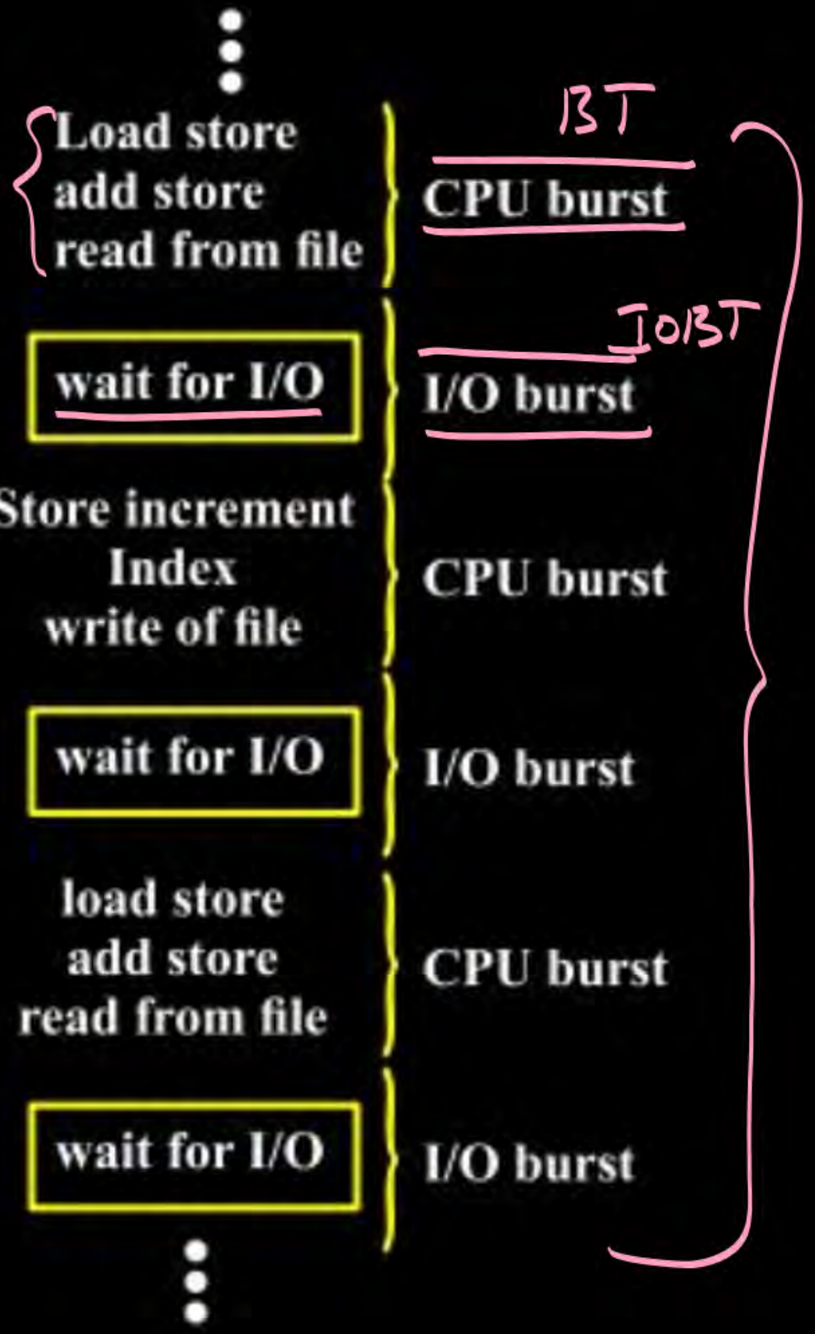
c) $wtd.TAT = \frac{C_i - A_i}{X_i}$

g) Throughput (μ)

n — $\mathcal{L}$ units
? — 1 unit

$$\mu = \frac{n}{\mathcal{L}}$$

h) Response Time of a Process : The Time duration from arrival to the Time at which it runs on CPU for the first run



CPU-I/O bursts

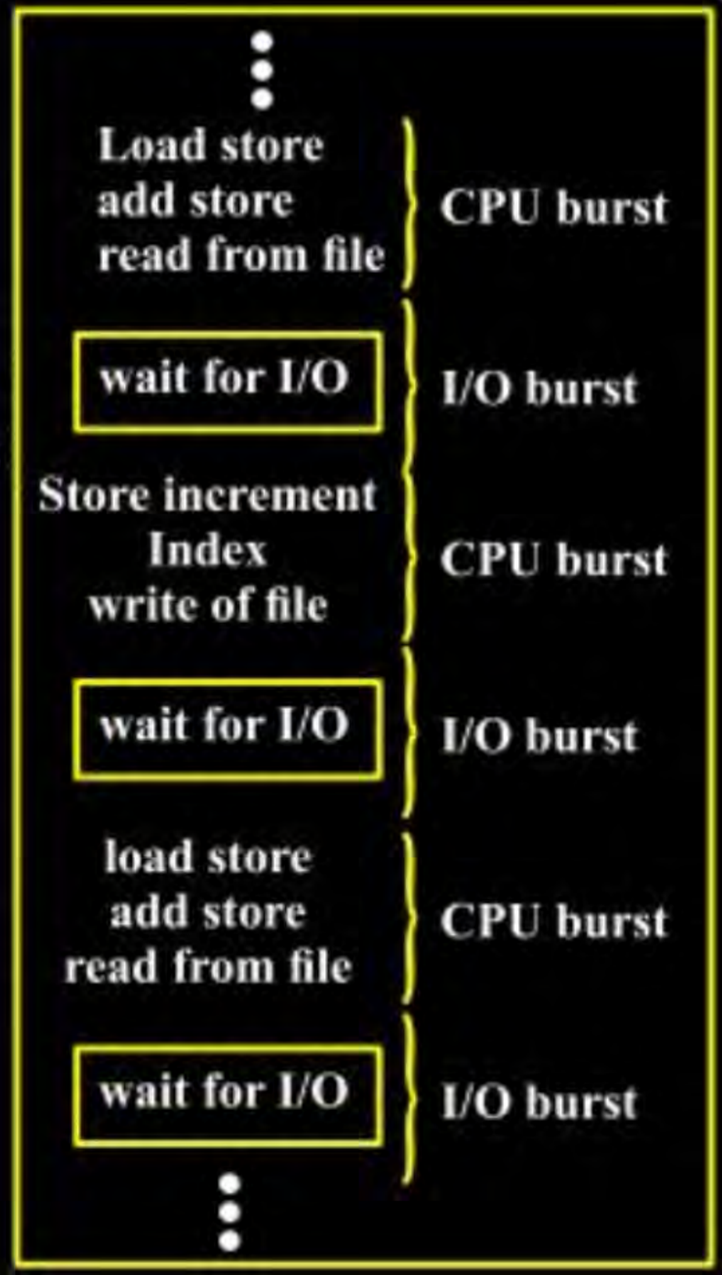
Process execution consists of a cycle of CPU execution and I/O wait

- different processes may have different distributions of burts

  CUP-bound process: performs lots of computations in long bursts, very little I/O

  I/O-bound process: performs lots of I/O followed by short burst of computation

- ideally, the system admits a mix of CPU bound and I/O-bound processes to maximize CPU and I/O



1. First Come First Served (FCFS):

Sel. criteria: A.T

Mode of operation: Non-Preemption

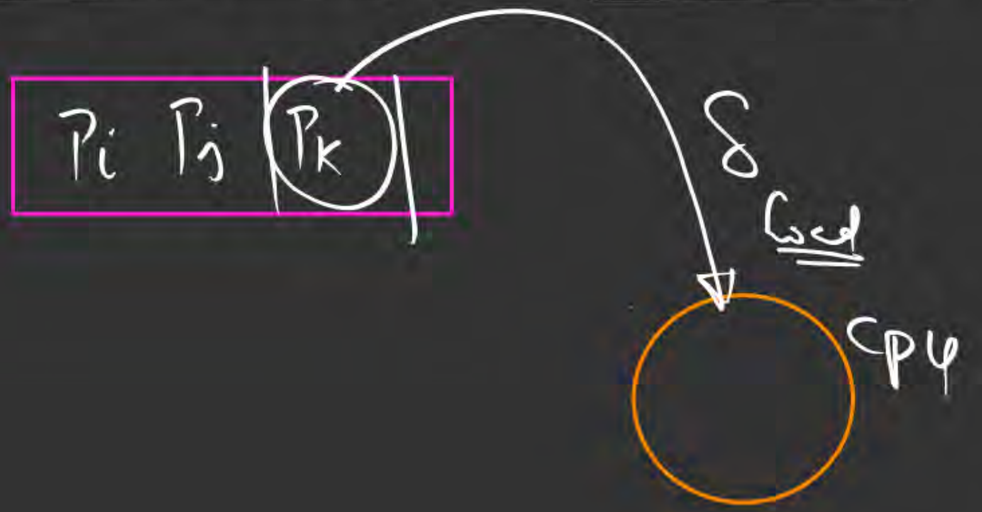
Conflict Resolution: (Lower Pid) Tie

Assumptions:

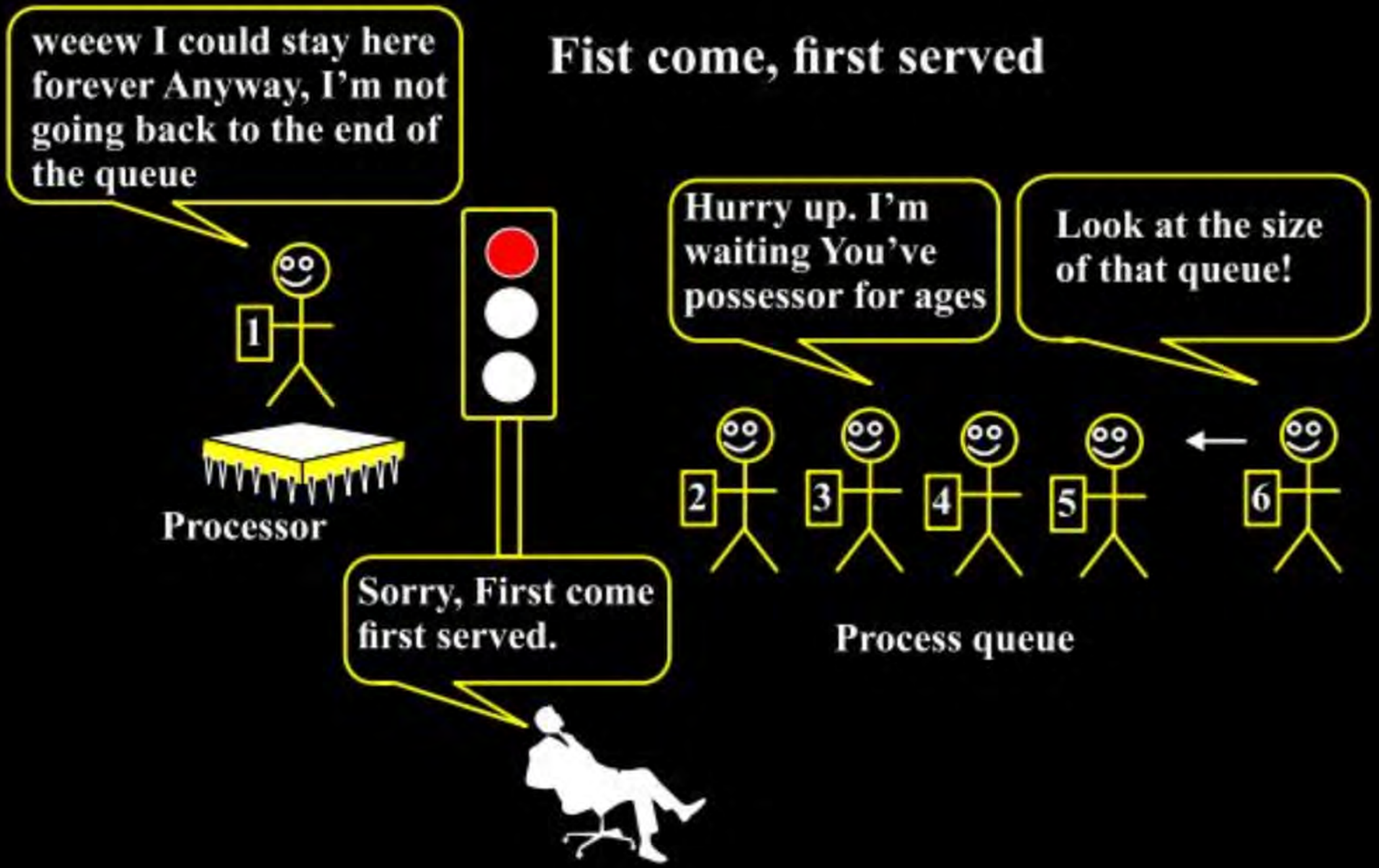
→ Timer is in clk Ticks

→ IOBT's = 0 (cpu-Bound)

→ cpu Schdling ovhd (δ) = Negligible (0)



Fist come, first served



$L = 14 - 0 = 14$

1)

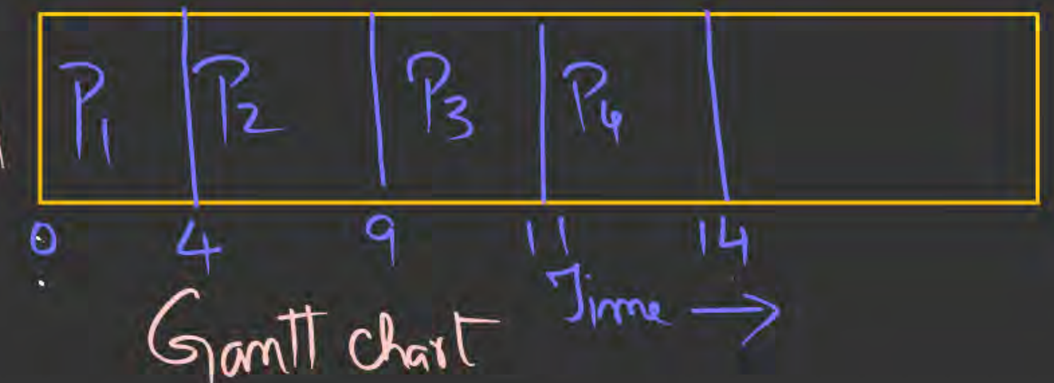
P.No	A.T	B.T	C.T	TAT	W.T	R.T
1	0	4	4	4	0	0
2	0	5	9	9	4	4
3	0	2	11	11	9	9
4	0	3	14	14	11	11

$Av.TAT = \frac{4+9+11+14}{4} =$

$Av.WT = \frac{0+4+9+11}{4} =$

$Av.RT = \frac{0+4+9+11}{4} =$

RQ ~~P_1~~ ~~P_2~~ ~~P_3~~ ~~P_4~~



Gantt chart

2)

P.No	A.T	B.T
1	2	3
2	6	1
3	8	3
4	10 ✓	2
5	11	4

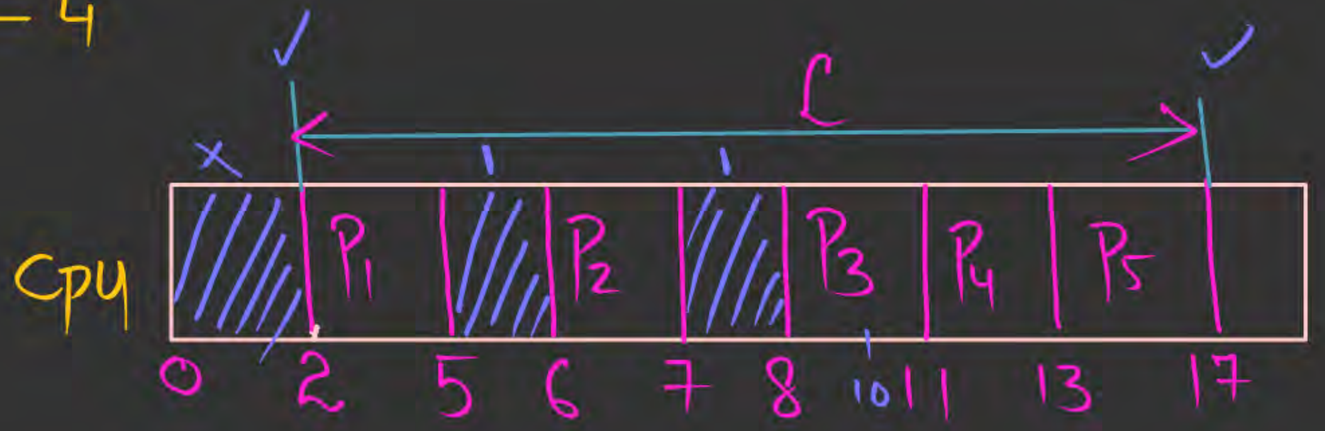
Av. TAT = $\frac{3+1+3+3+6}{5} = 16/5 = 3.2$ ✓

Av. W.T = $(0+0+0+1+2)/5 = 3/5 = 0.6$ ✓

Av. R.T = $(0+0+0+1+2)/5 = 3/5$

L = Max(CT) − Min(AT)

= 17 − 2 = 15 ✓

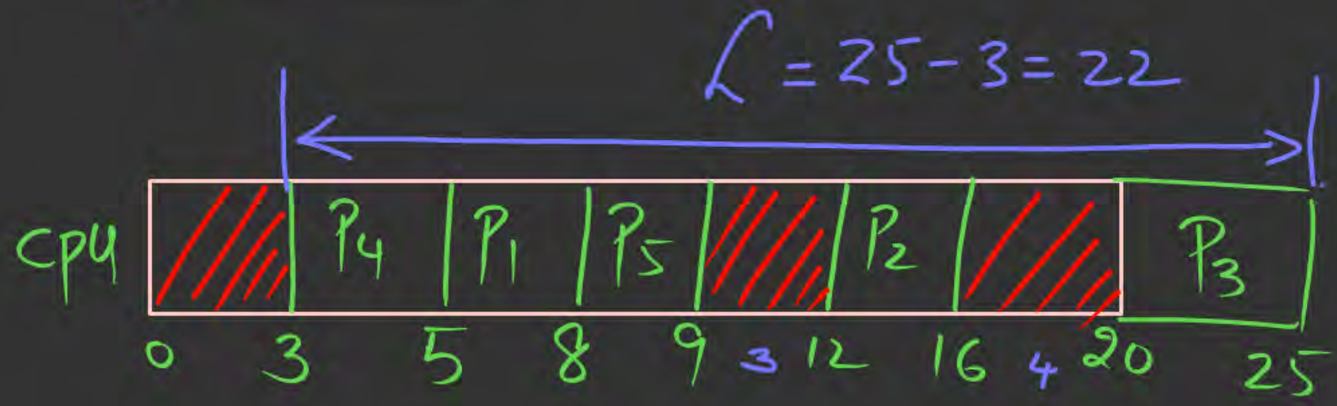


$\% \left(\frac{\text{cpu-Idleness}}{L}\right) = \frac{2}{15}$ ✓

3)

P.No	A.T	B.T
× 1	4	3
2	12	4
3	20	5
× 4	3	2
× 5	5	1

Jumbled A.T's



∴ CPU Idleness = $\frac{7}{22}$ ✓

4) FCFS with CPU Scheduling overhead

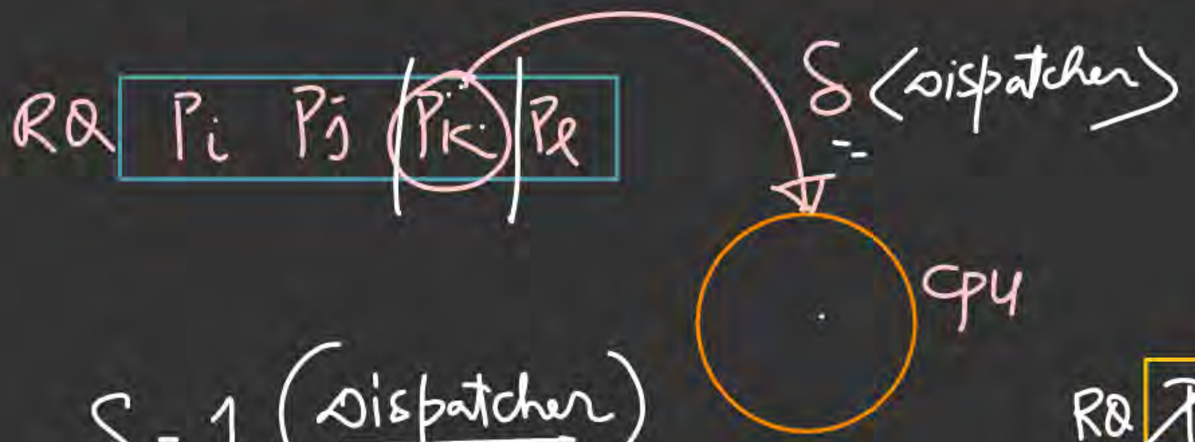
W.T = Time Spent by Process in R.Q

TAT(P1) = 3 (WT = TAT − BT)

WT(P1) = 0 (δ ≠ 0)

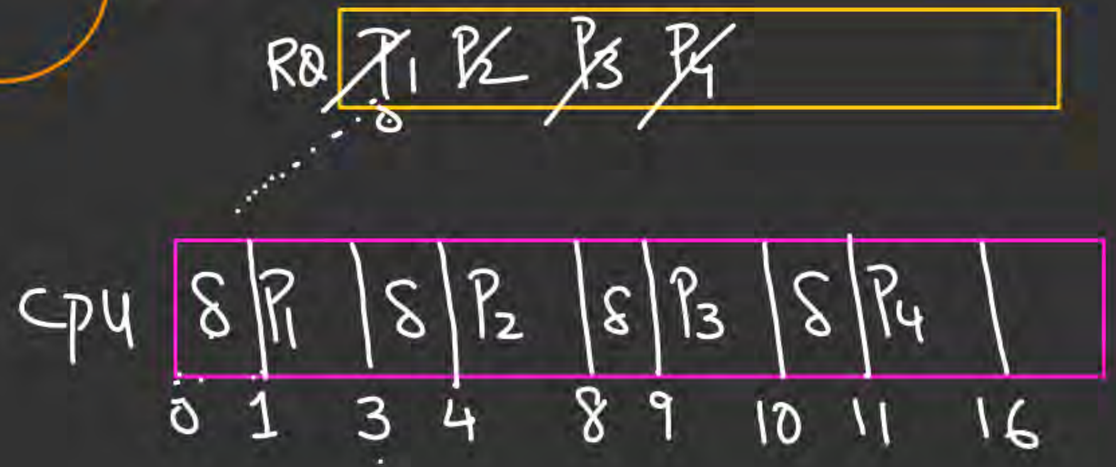
= TAT − (BT + δ)

= 3 − (2 + 1) = 0



δ = 1 (dispatcher)

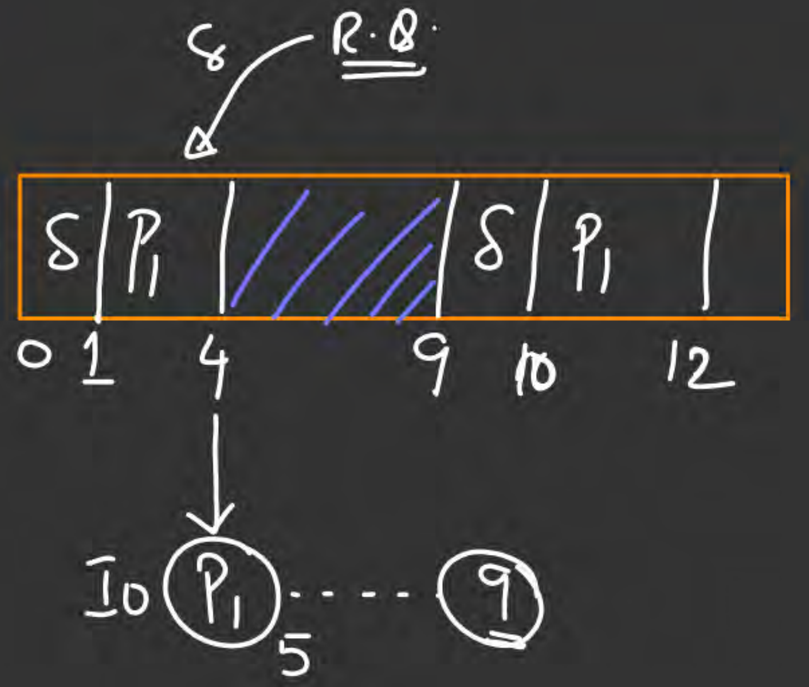
P.No	A.T	B.T
1	0	2
2	3	4
3	5	1
4	7	5



5) FCFS with IOBT & Scheduling ovh'd

S = 1

P.NO	A.T	Lifecycle <BT + IOBT + BT>
1	0	<3 ; 5 ; 2>



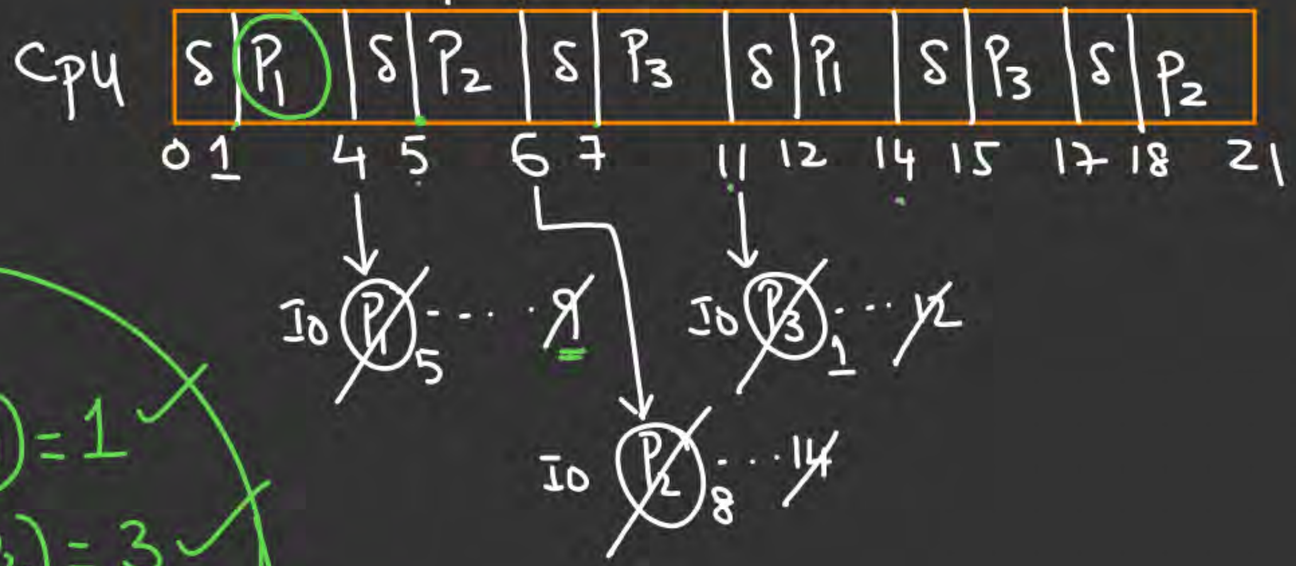
(*)

P.NO	A.T	< B.T + IOBT + B.T >
1	0	< 3 ; 5 ; 2 >
2	2	< 1 ; 8 ; 3 >
3	4	< 4 ; 1 ; 2 >

S = 1

There are Multiple IO-devices available;

R.Q: ~~P1~~; ~~P2~~; ~~P3~~; P1; ~~P3~~; ~~P2~~;



R.T(P1) = 1 ✓

R.T(P2) = 3 ✓

R.T(P3) = 3 ✓

→ TAT(P1) = 14

→ W.T(P1) = 2 ✓

W.T(Pi) = TAT − (BT + IOBT + n * δ)

= 14 − (5 + 5 + 2 * 1)

= 14 − (12) = 2 ✓


THANK YOU
GW
SOLDIERS !