Computer Organization and Software Systems

Webinar 3 – CPU scheduling algorithms

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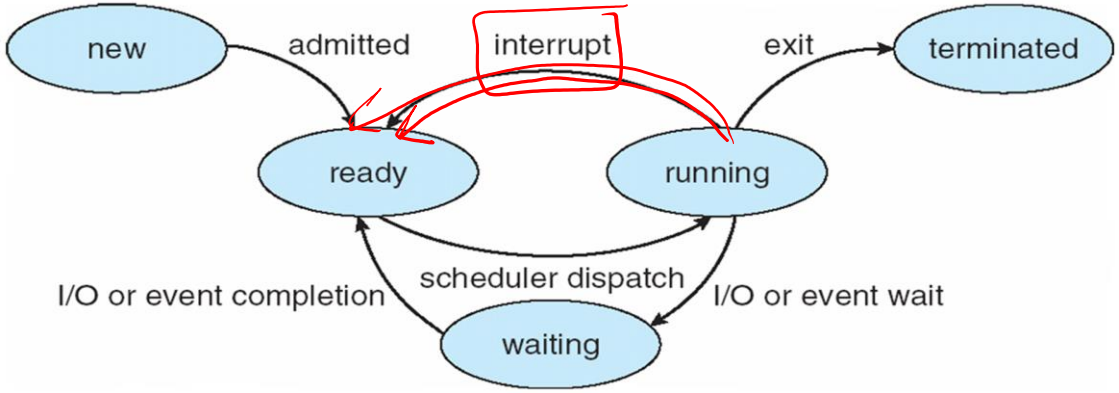
CPU Scheduling Algorithms

1. FCFS (First Come First Serve)
2. SJF (Shortest Job First)
    1. Preemptive / SRTF (Shortest Remaining Time First)
    2. Non-Preemptive
3. Priority scheduling
4. Round Robin (RR)

Key terminologies

Process States

- The state of a process is defined in part by the current activity of that process.
- **New:** The process is being created.
- **Running:** Instructions are being executed.
- **Waiting:** The process is waiting for some event to occur (such as an I/O completion or reception of a signal).
- **Ready:** The process is waiting to be assigned to a processor.
- **Terminated:** The process has finished execution.



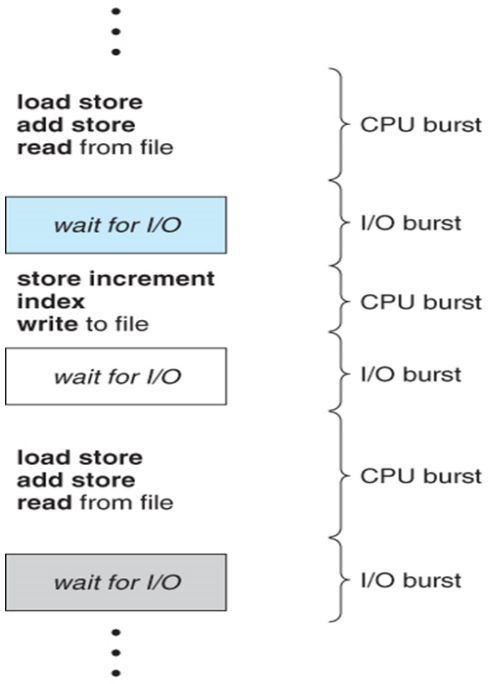
Key terminologies

- **Non-Preemptive Scheduling:**
- Once the resources (CPU cycles) is allocated to a process, the process holds the CPU till it gets terminated.

- **Preemptive Scheduling:**
- The resources (mainly CPU cycles) are allocated to the process for the **limited amount of time** and then is taken away, and the process is again placed back in the ready queue if that process still has CPU burst time remaining.

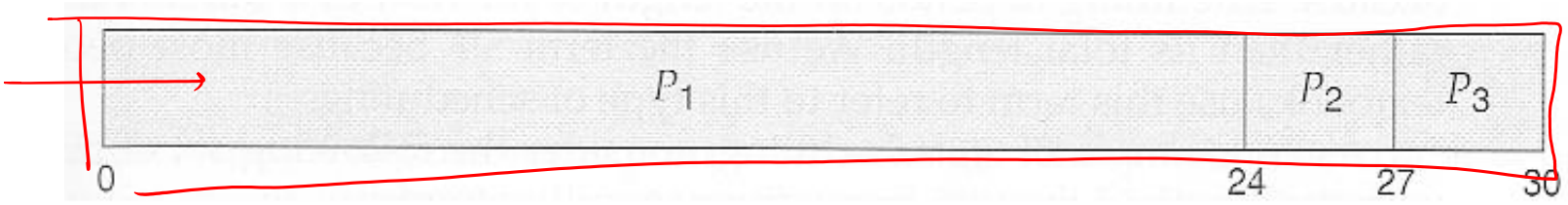
Key terminologies

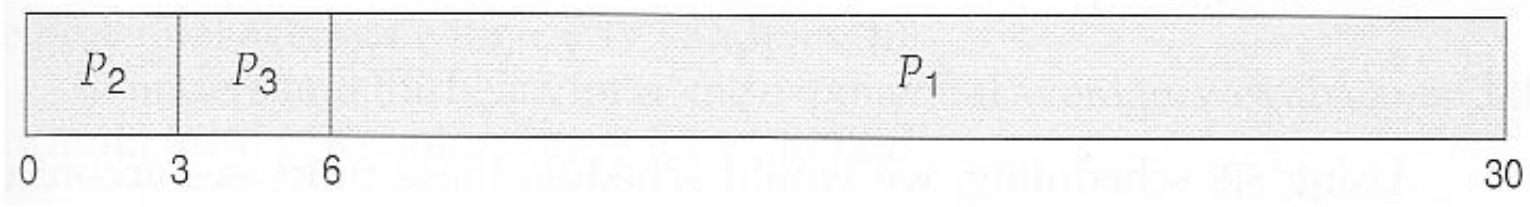
- **CPU burst** is length of time process needs to use CPU before it next makes a system call (normally request for I/O).
- **I/O burst** is the length of time process spends waiting for I/O to complete.



Key terminologies

- **GANTT chart:**
- Generalized Activity Normalization Timetable (GANTT).
- Type of chart that show the amount of work done or production completed in given period of time.





Key terminologies

- Different time with respect to a process.
- **Arrival Time (AT):**
  - Time at which the process arrives in the ready queue.
- **Completion Time (CT):**
  - Time at which process completes its execution.
- **Burst Time (BT):**
  - Time required by a process for CPU execution.
- **Turn Around Time (TAT):**
  - Time Difference between completion time and arrival time.
  - Turn Around Time = Completion Time – Arrival Time
- **Waiting Time(WT):**
  - Time Difference between turn around time and burst time.
  - Waiting Time = Turn Around Time – Burst Time

Problem1 : FCFS

Consider a System with four processes P1,P2,P3 and P4 whose arrival time and CPU-I/O bursts are as given in the table. Find average Turn Around Time, Waiting Time and Response Time.

Process	AT	BT			FT	TAT	WT	RT
		CPU	I/O	CPU				
P1	0	6	3	2				
P2	2	5	1	1				
P3	3	2	1	3				
P4	5	1	1	1				

AT – Arrival Time
TAT – Turn Around Time

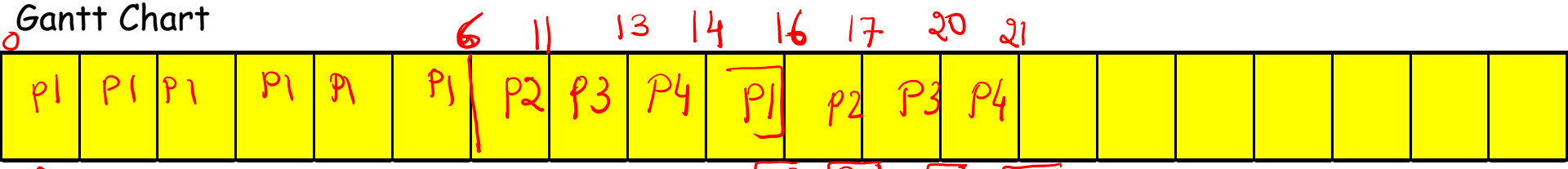
BT – Bust Time
WT – Wait Time

FT – Finish Time
RT – Response Time

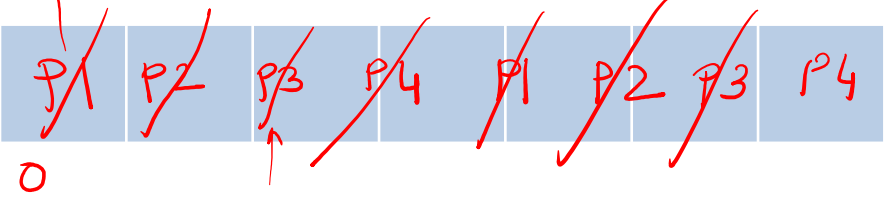
Problem1 : FCFS

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	6	3	2	16	16	5	0
P2	2	5	1	1	17	15	8	4
P3	3	2	1	3	20	17	11	8
P4	5	1	1	1	21	16	13	8

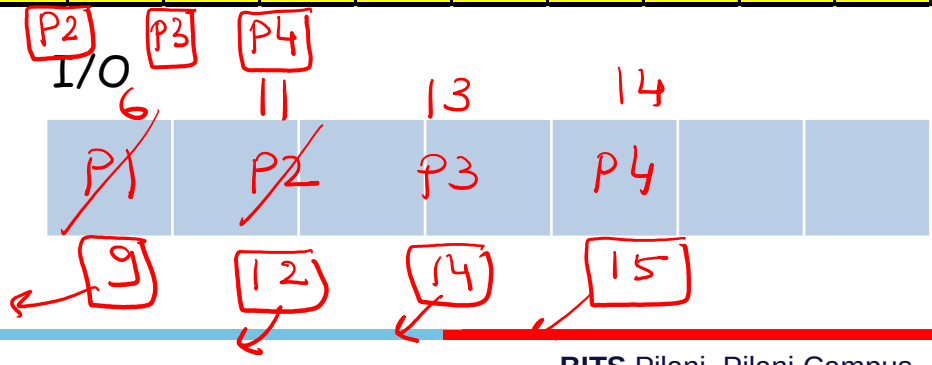
Gantt Chart



Ready Queue



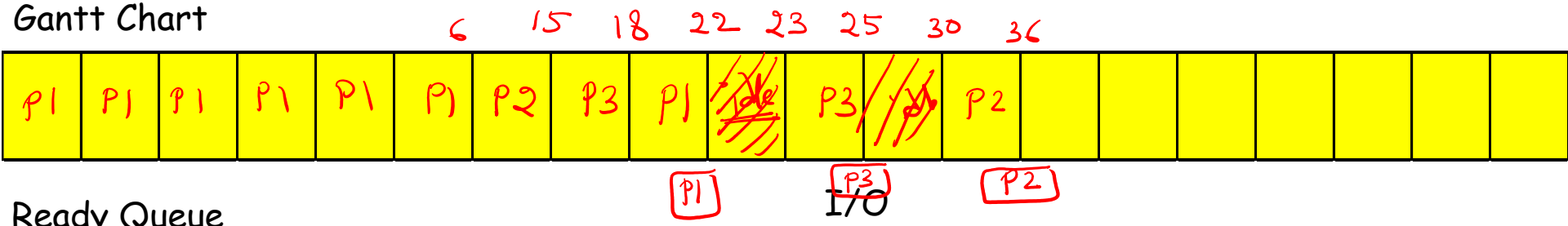
I/O



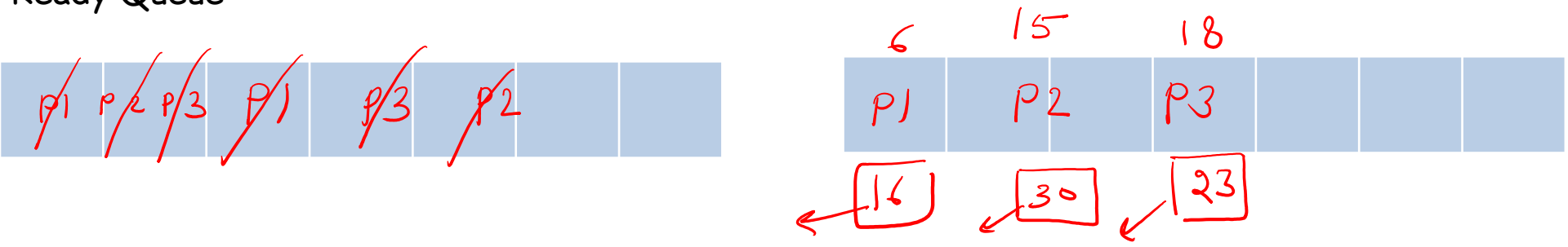
Problem2 : FCFS

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	6	10	4	22	22	2	0
P2	0	9	15	6	36	36	6	6
P3	0	3	5	2	25	25	15	15

Gantt Chart



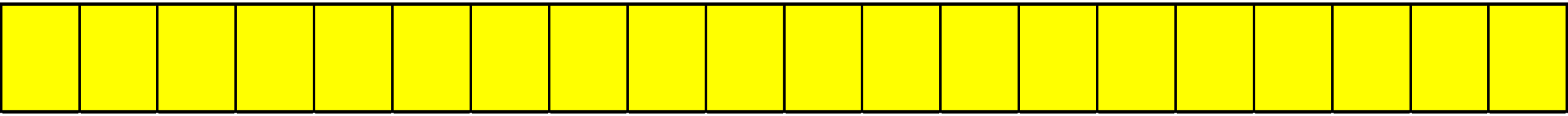
Ready Queue



Problem3 : FCFS (HW)

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	3	2	4				
P2	2	5	2	3				
P3	4	3	3	1				
P4	8	4	2	2				

Gantt Chart



Ready Queue

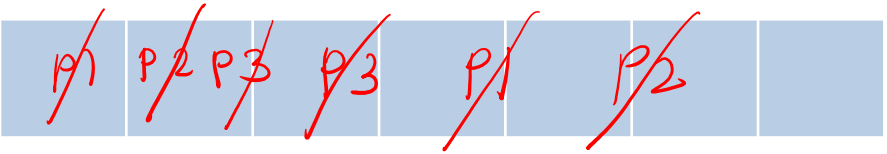
I/O

Problem4 : SJF (Non-Preemptive)

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	6	10	4	24			
P2	0	9	15	6	41			
P3	0	3	5	2	11			

Gantt Chart

Ready Queue



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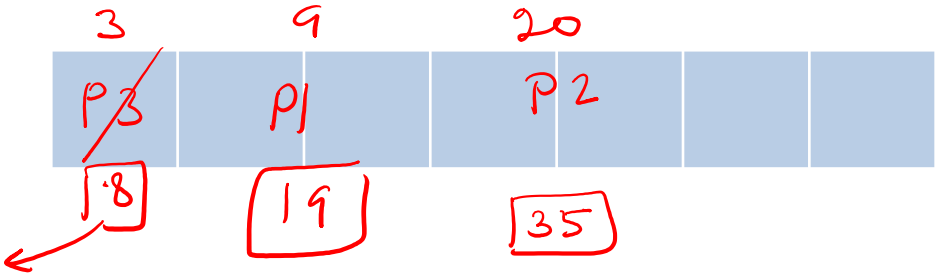
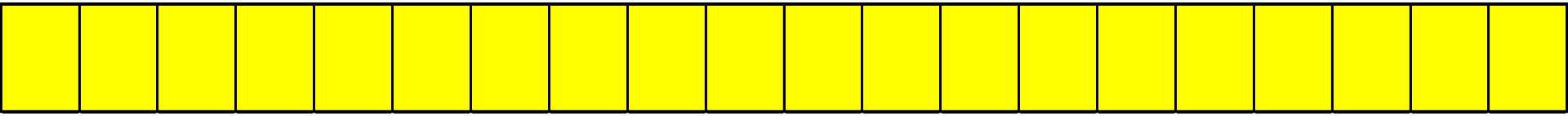


Problem5 : SJF (Non-Preemptive) HW

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	3	4	3				
P2	2	4	2	4				
P3	4	5	1	4				
P4	6	2	2	4				

Gantt Chart



Ready Queue

I/O

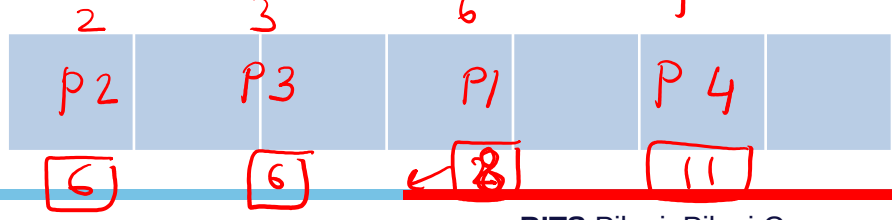
Problem6 : SJF (Preemptive) /SRTF

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	3	2	2	14			
P2	0	2	4	1	7			
P3	2	1	3	2	11			
P4	5	2	2	1	12			

Gantt Chart

Ready Queue

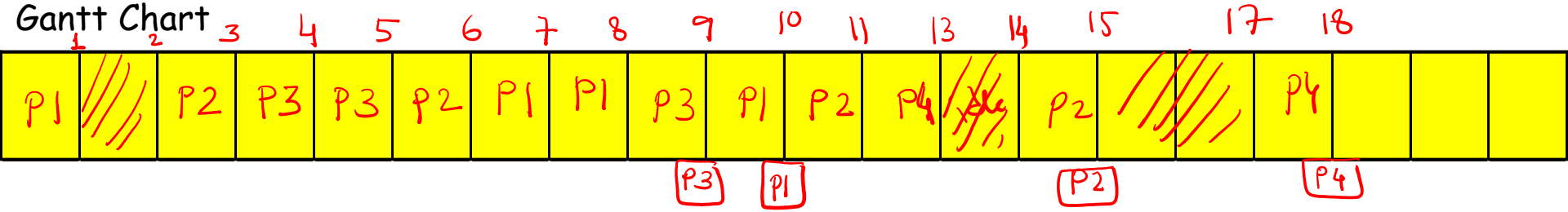
I/O



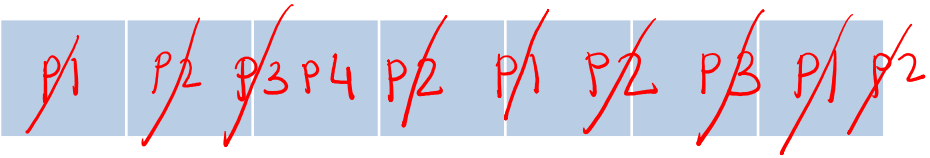
Problem7 : Priority Scheduling(Preemptive)

Process	Priority	AT	BT			FT	TAT	WT	RT
			CPU	I/O	CPU				
P1	2	0	1	5	3	10			0
P2	3	2	3	3	1	15			
P3	1[H]	3	2	3	1	9			
P4	4[L]	3	2	4	1	18			

Gantt Chart



Ready Queue



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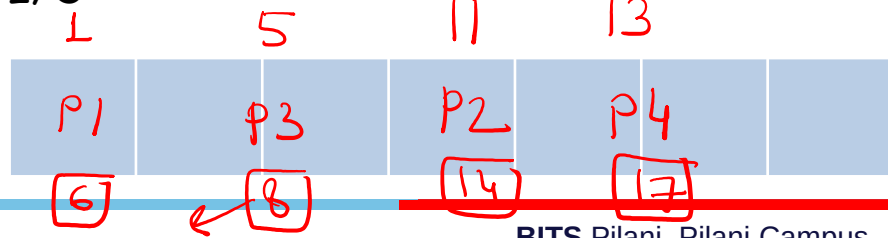
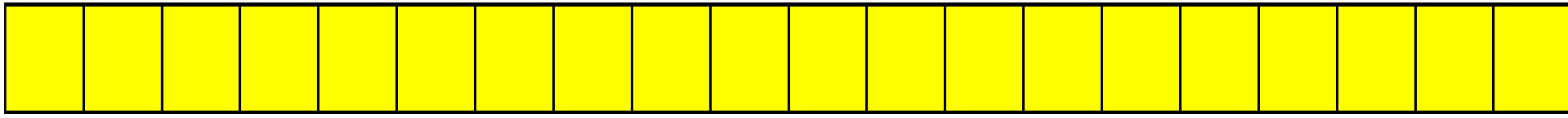


Problem8 : Priority Scheduling (Preemptive) HW

Process	Priority	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
			CPU	I/O	CPU				
P1	2	0	1	5	3				
P2	3 [L]	2	3	3	1				
P3	1 [H]	3	2	3	1				

Gantt Chart



Ready Queue

I/O

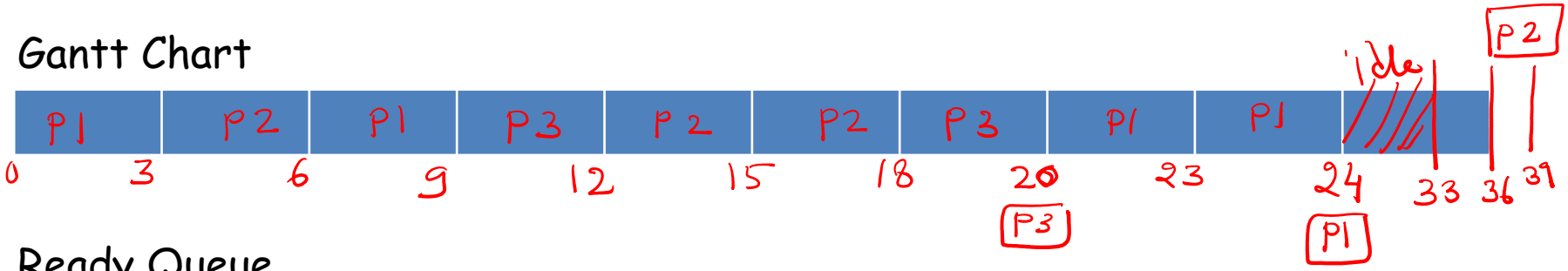
(Non preemptive)

Problem9 : Round Robin

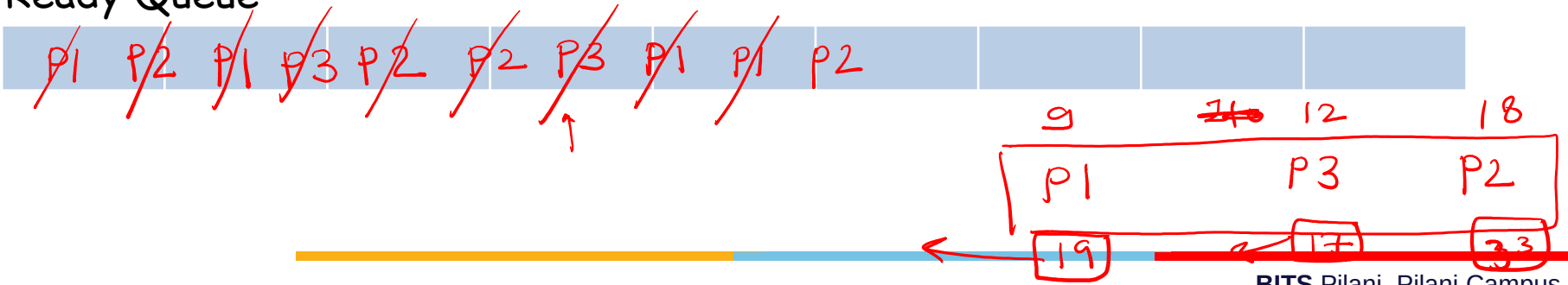
Quantum=3

Process	AT	BT			FT	TAT (FT-AT)	WT (TAT-BT)	RT
		CPU	I/O	CPU				
P1	0	~~6~~ 3	10	~~4~~ 1	24	24	4	0
P2	2	~~9~~ 6	15	6	39	37	7	1
P3	4	~~3~~	5	~~2~~	20	16	6	5

Gantt Chart



Ready Queue



Questions ?

Thank you.

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