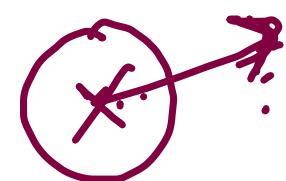


Operating System

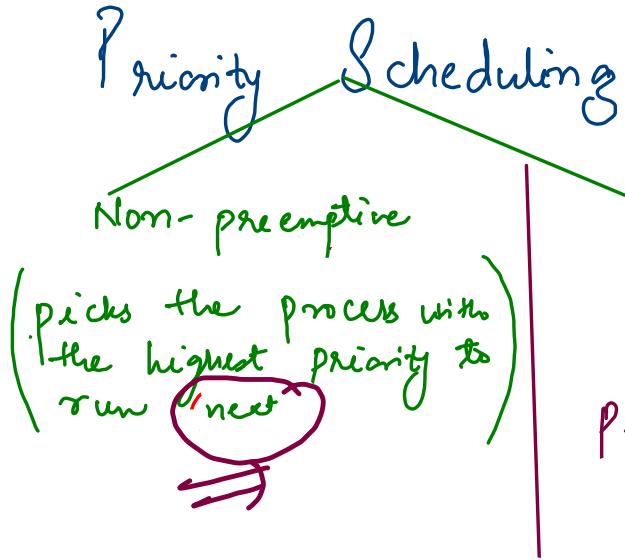
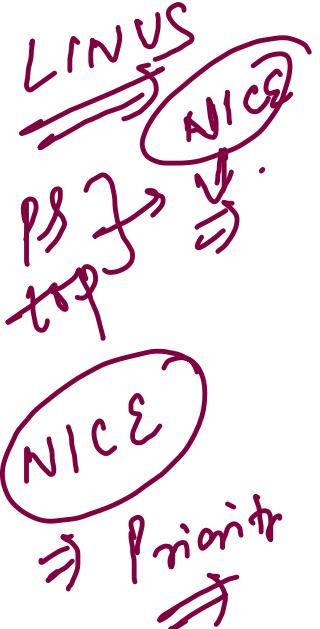
(L-4)

- Priority Scheduling
- Non pre-emptive priority scheduling
- Pre-emptive priority scheduling
- Round robin scheduling
- Multi-level queue
- Multi-level feedback queue

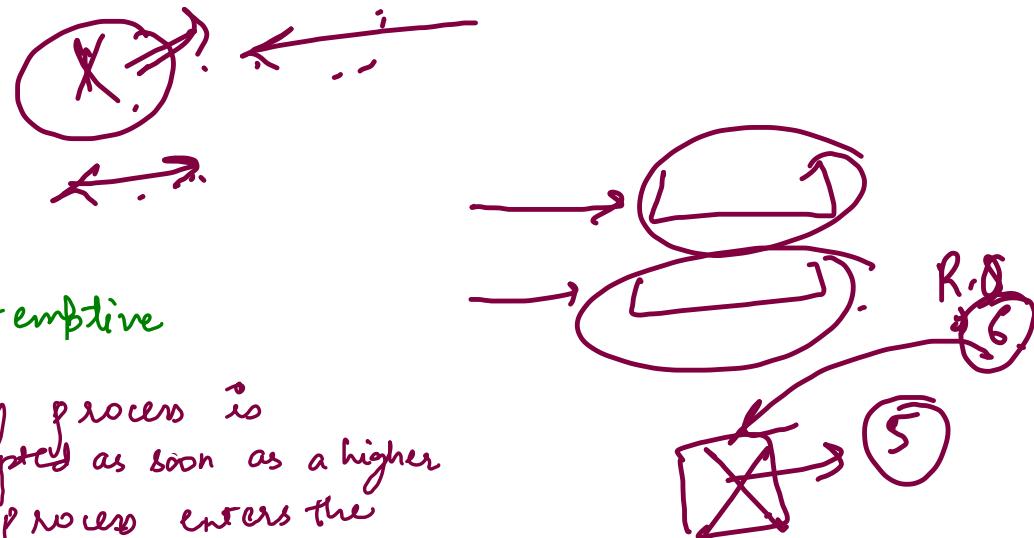
- ⇒
- 1) FCFS → Arrival Time 
 - 2) SJF \downarrow → B.T. → 
 - 3) SRTF \rightarrow 

Advantages:- 1) Relative imp. of each process can be defined.

Dis. :- Starvation.



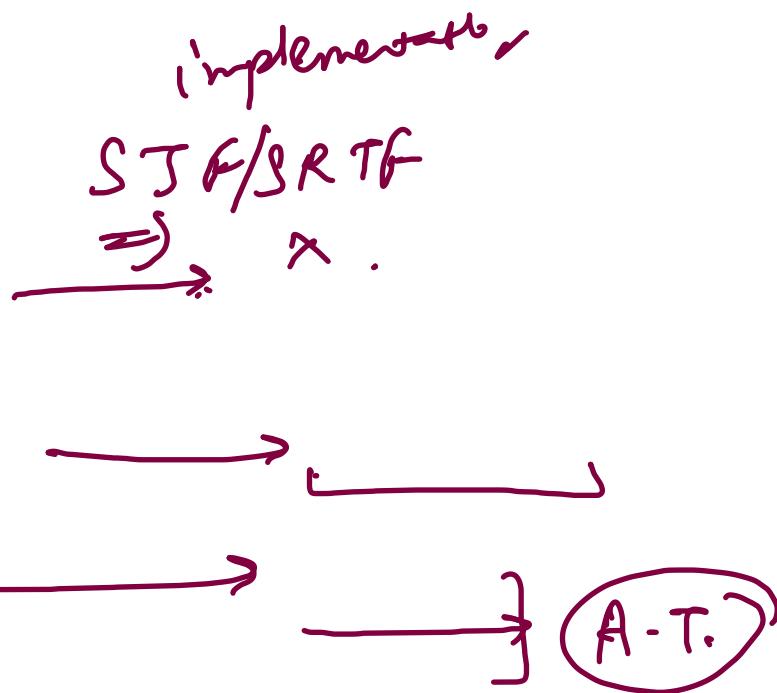
Pre-emptive
running process is pre-empted as soon as a higher priority process enters the ready queue.



Priority → Arrival Time → FCFS / RR.
SJF / SR TF → B.T.

Priority

- 1) → Selects highest priority process to run.
- 2) → If equal priority then follow FCFS.
 \Leftrightarrow
- Priority can be determined by
 - 1) By system — Internal priorities
 - 2) By administrator — External priorities
- Priority ↗ static → same for entire life
 ↗ dynamic → can be changed by scheduler during execution.
 ↗



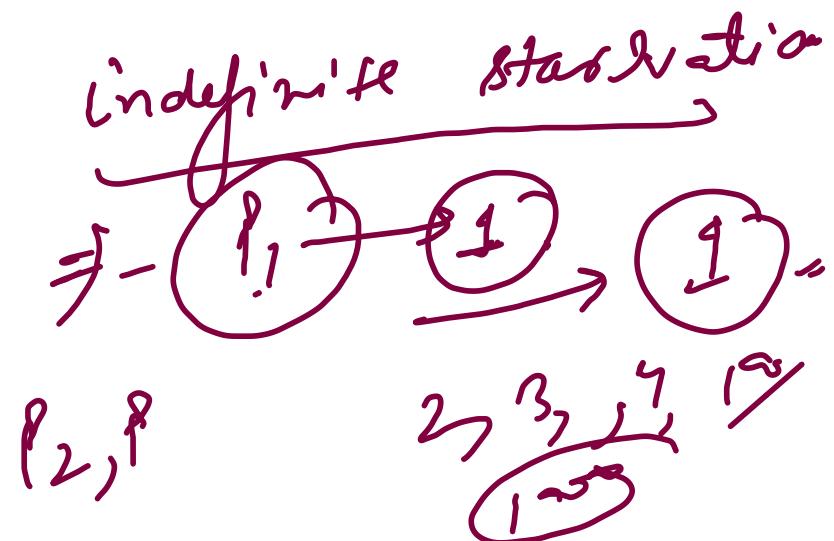
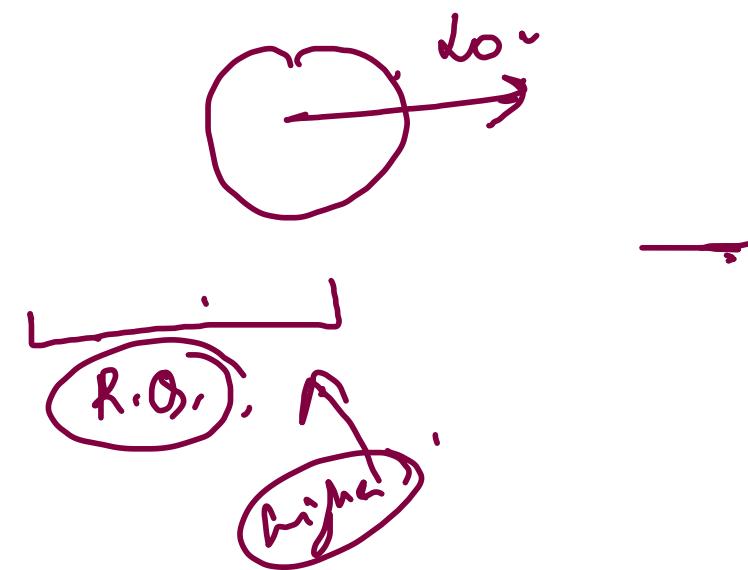
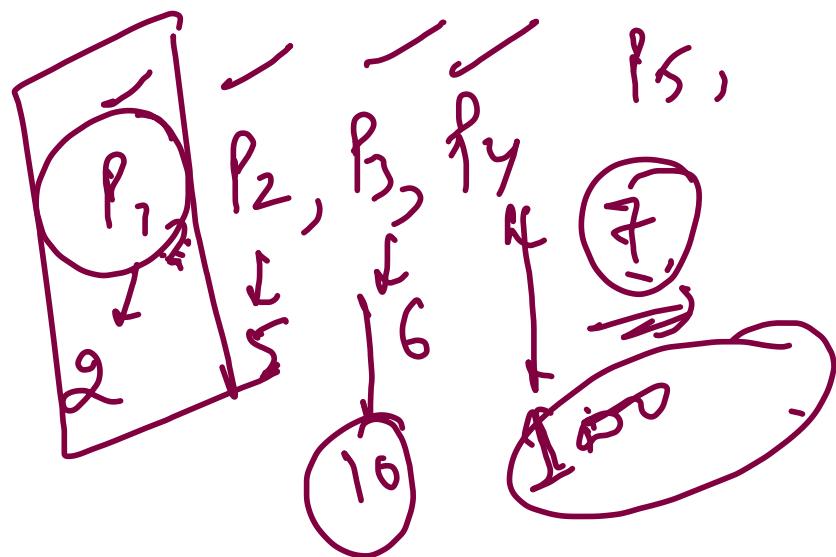
Non-pre-emptive priority scheduling

→ Process with highest priority runs next

⇒ Adv → i) Simple to use or implement —

Dis. → Starvation →

→ possibility of Convoy effect
→ lower priority may suffer



(8).

| Id | At | Bt | Priority |
|----|----|----|----------|
| 0 | 0 | 3 | 10 |
| 1 | 5 | 5 | 15 |
| 2 | 6 | 4 | 18 |
| 3 | 9 | 7 | 17 |
| 4 | 11 | 6 | 19 |

Calculate the waiting TAT time

higher the priority no higher will be its priority.

→ Non pre-emptive scheduling

| Id | At | Bt | Priority | C-T | TAT | WT |
|----|----|----|----------|-----|-----|----|
| 0 | 0 | 3 | 10 | 3 | 3 | 0 |
| 1 | 5 | 5 | 15 | 10 | 5 | 0 |
| 2 | 6 | 4 | 18 | 14 | 8 | 4 |
| 3 | 9 | 7 | 17 | 27 | 18 | 11 |
| 4 | 11 | 6 | 19 | 20 | 9 | 3 |

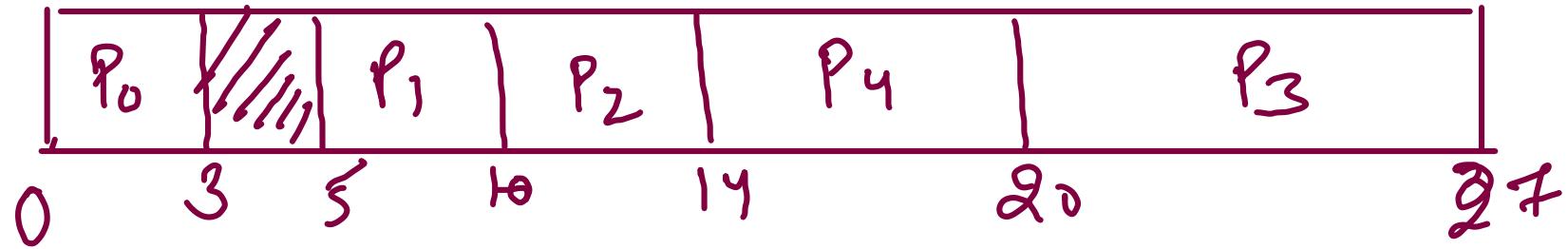
RO 

SJF
→

B-T.
A-T.

∴

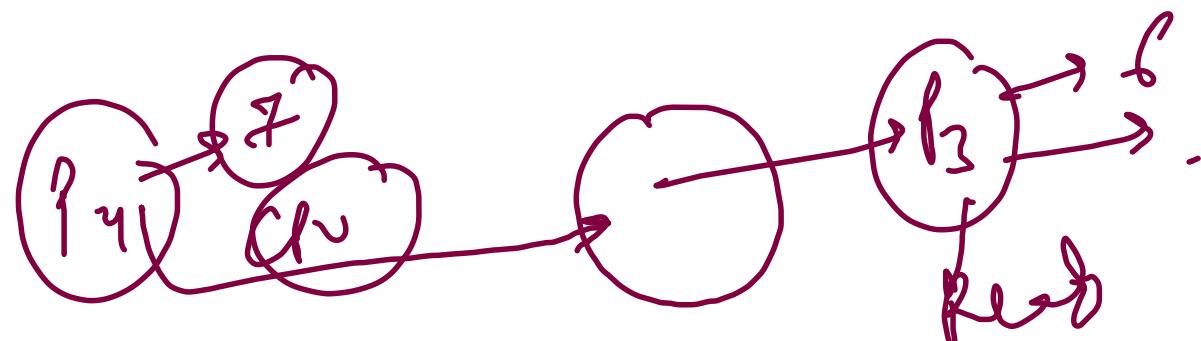
43/5 18/5



Pre-emptive Priority Scheduling

→ process under execution will be pre-empted if a higher priority process enters the ready queue

→ Starvation
→ convoy effect



Calculate wait
time, TAT time

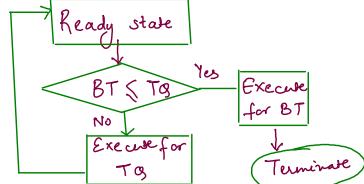
Pre-emptive priority
scheduling algo.

| PID | Pri | DT | BT |
|-----|-----|----|----|
| 1 | 2 | 0 | 1 |
| 2 | 6 | 1 | 7 |
| 3 | 3 | 2 | 3 |
| 4 | 5 | 3 | 6 |
| 5 | 4 | 4 | 5 |
| 6 | 10 | 5 | 15 |
| 7 | 9 | 15 | 8 |

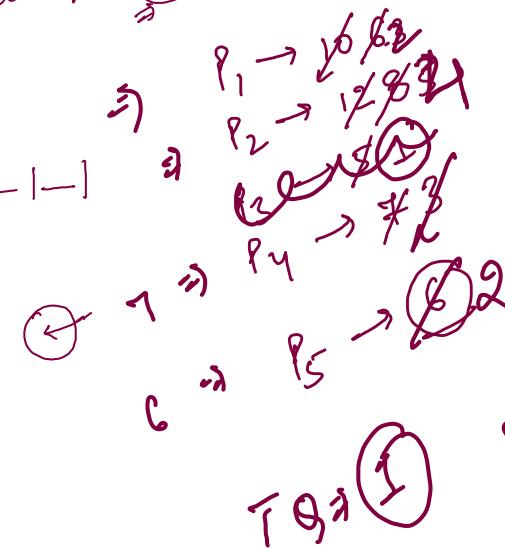
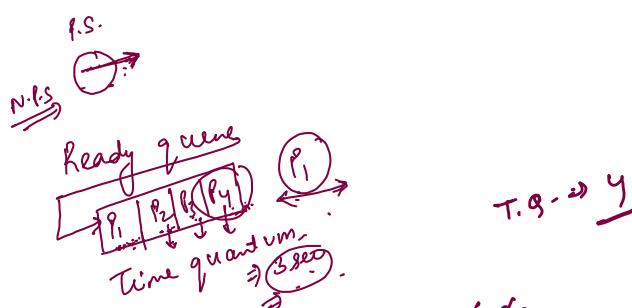
- 1) higher the numerical value, higher is the priority.

Round-Robin Scheduling

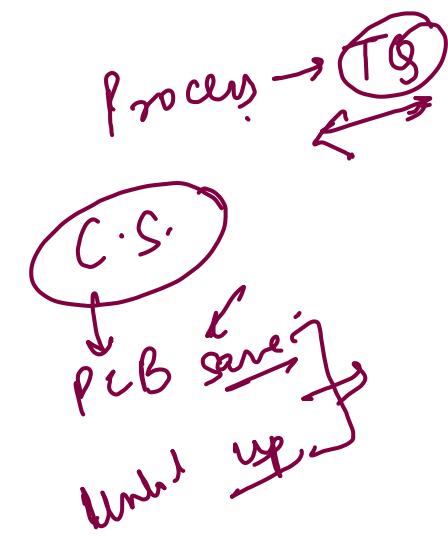
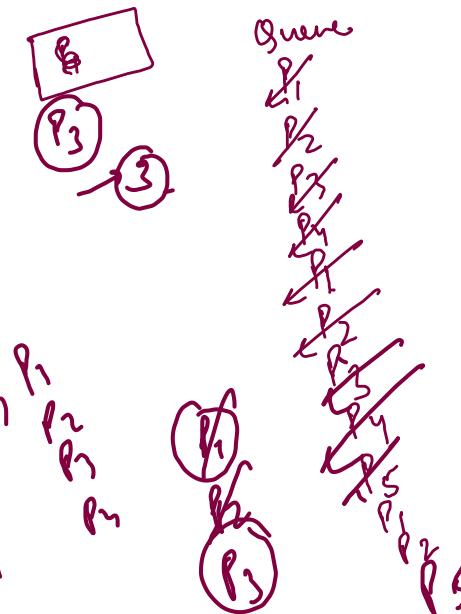
- 1) Pre-emptive scheduling \Rightarrow
- 2) FIFO queue is used \Rightarrow
- 3) Circular queue \Rightarrow
- 4) Time quantum is very important
- 5) Context switching



Adv \rightarrow 1) No starvation \Rightarrow $0|0|-(-|-)$
 Dis. 1) No priority can be assigned $\Rightarrow \times$
 2) Can be too much context switching overhead if TQ is taken very small



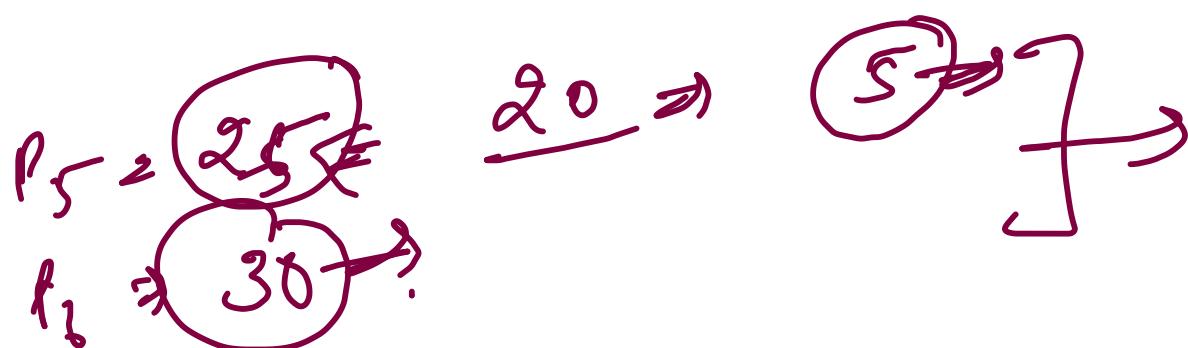
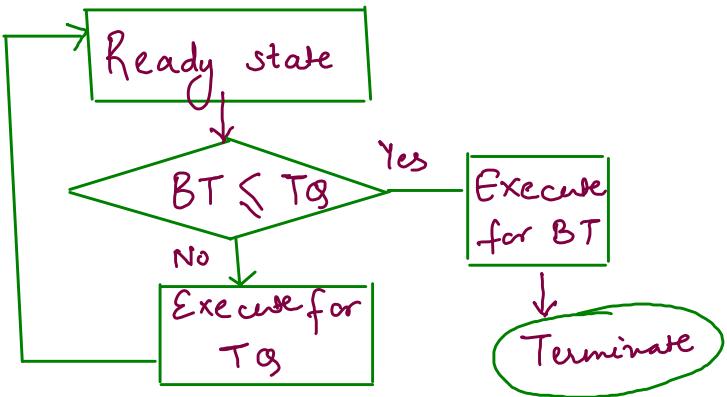
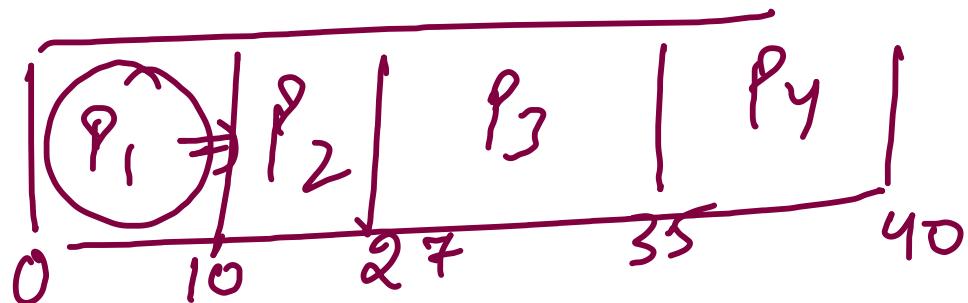
TQ = 2.0
 FCFS



$$TQ = 20 \Rightarrow$$

$P_1 \Rightarrow 10 \Rightarrow$
 $P_2 \Rightarrow 17 \Rightarrow$
 $P_3 \Rightarrow 8 \Rightarrow$
 $P_4 \Rightarrow 5 \Rightarrow$
 $P_5 \Rightarrow 25 \Rightarrow$

FCFS



TQ \Rightarrow small \Rightarrow context switching

TQ \Rightarrow big \Rightarrow FCFS

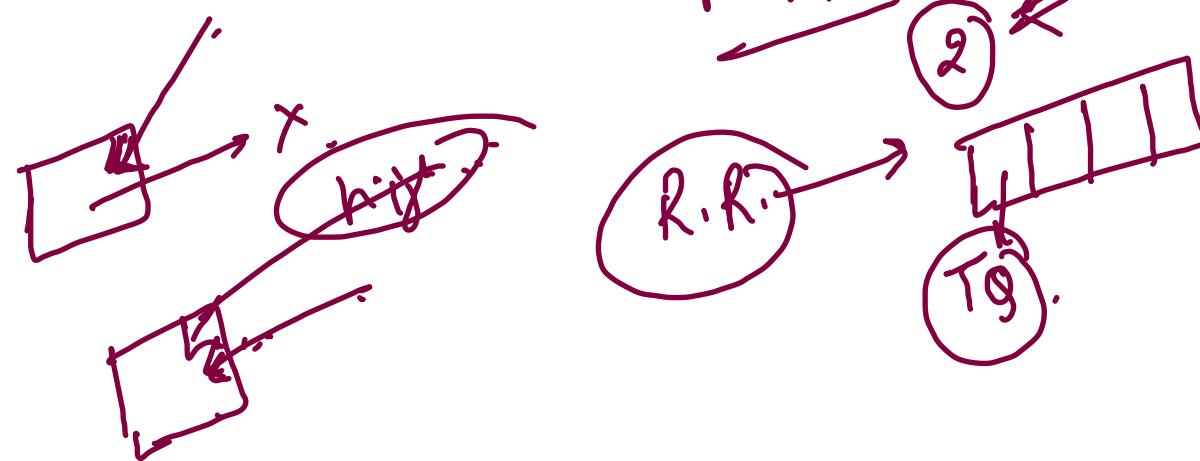
TQ \Rightarrow moderate

priority
~~NICE~~
 PID

P.S.
 top
 free

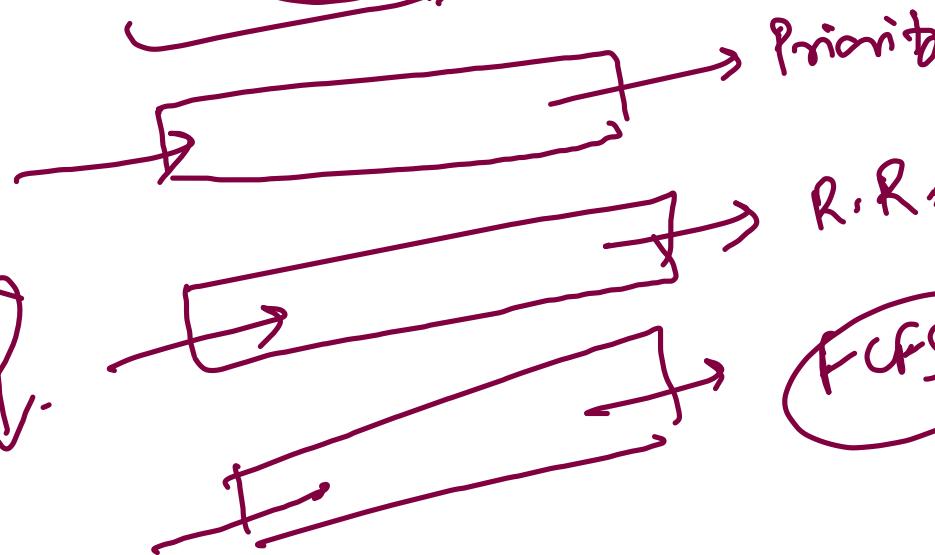
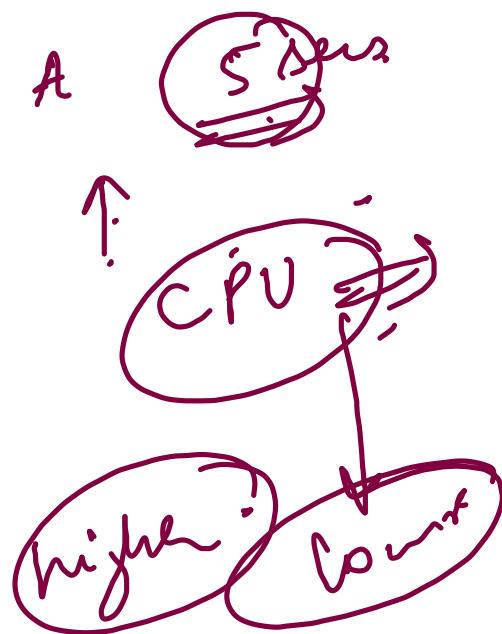
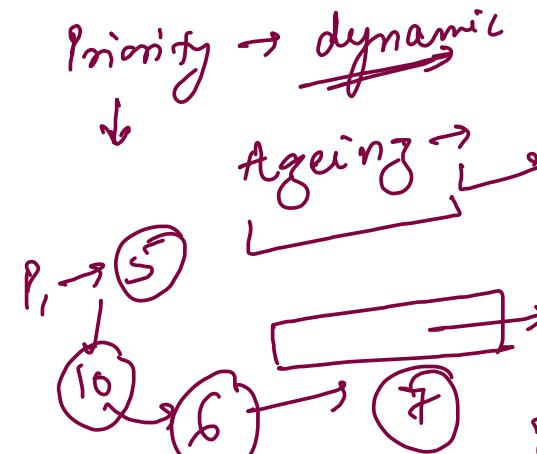
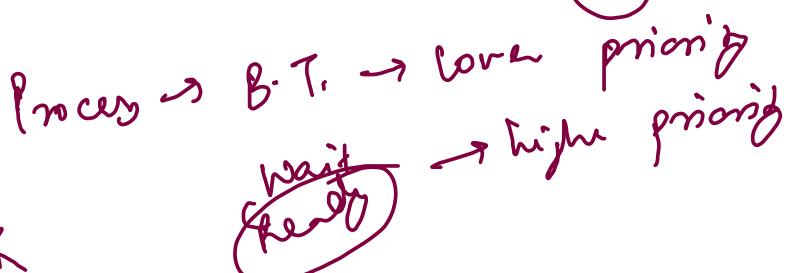
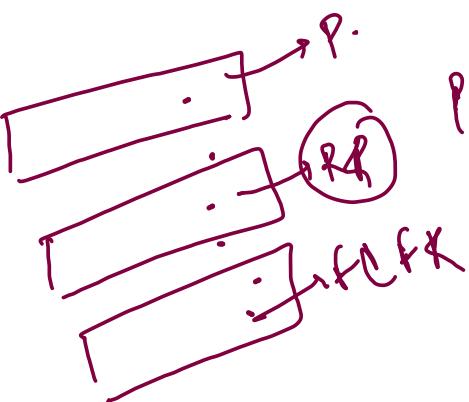
| | FCFS | RR | SJF | SRTF | P.P | P.N.P |
|---------------|------|----|-----|------|-----|-------|
| Starvation | X | X | ✓ | ✓ | ✓ | ✓ |
| Convoy effect | ✓ | X | X | X | ✓ | ✓ |
| Pre-emptive | X | ✓ | X | ✓ | ✓ | X |

Process → priority → 
 1
 2
 3



Multilevel feedback scheduling

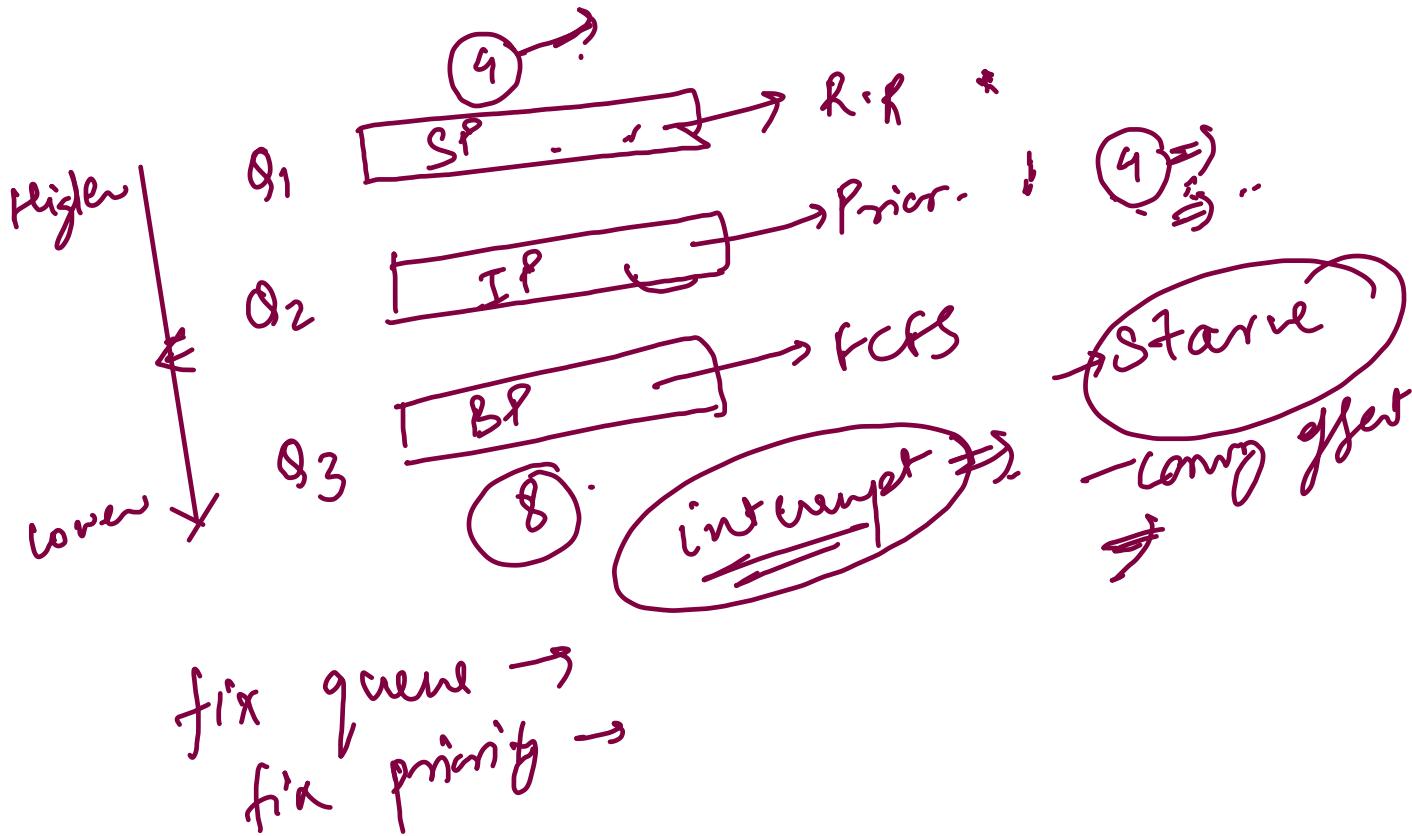
- Priority is dynamic
- Aging
- dynamic priority
- flexible
- less starvation
- can move b/w queues



Starvation
carry effect

Multilevel queue scheduling

- foreground ↗
- background ↘
- system ↗
- interactive ↗
- Background ↘
- Multiple queues
- fixed priority scheduling
- convoy effect
- starvation



| PID | A.T. | B.T. |
|-----|------|------|
| 0 | 0 | 10 |
| 1 | 4 | 3 |
| 2 | 5 | 5 |
| 3 | 9 | 7 |

$$T_q \geq 3 \Rightarrow$$

Calculate waiting time,
average time for each
process.

$$\underline{T_q = 2 \Rightarrow}$$

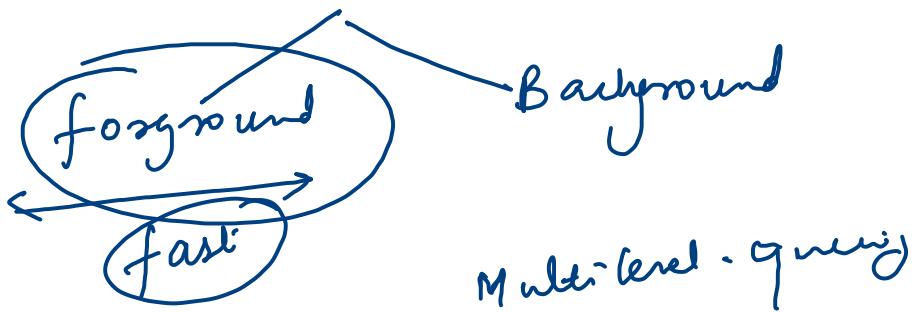
$$TAT = CT - AT$$

$$WT = TAT - BT$$

Multi-level queues Scheduling

Divided our processes

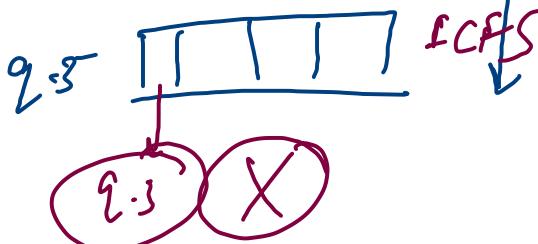
use time



1) System processes \rightarrow Priority -1 $\frac{q-1}{| | | | | |}$ \rightarrow Priority.

2) Interactive \rightarrow Prio. \geq $\frac{q-2}{| | | | |}$ RR

3) Background (Batch) \rightarrow Prio -3



- 1) Categorized process
2) Queue \rightarrow Priority
 \rightarrow Scheduli. Algo

| | FCFS | RR | SJF | SRTF | P.P | P.N.P |
|---------------|------|----|-----|------|-----|-------|
| Starvation | X | X | ✓ | ✓ | ✓ | ✓ |
| Convoy effect | ✓ | X | X | X | ✓ | ✓ |
| Pre-emptive | X | ✓ | X | ✓ | ✓ | X |

Multi-level feedback

queue → least priority

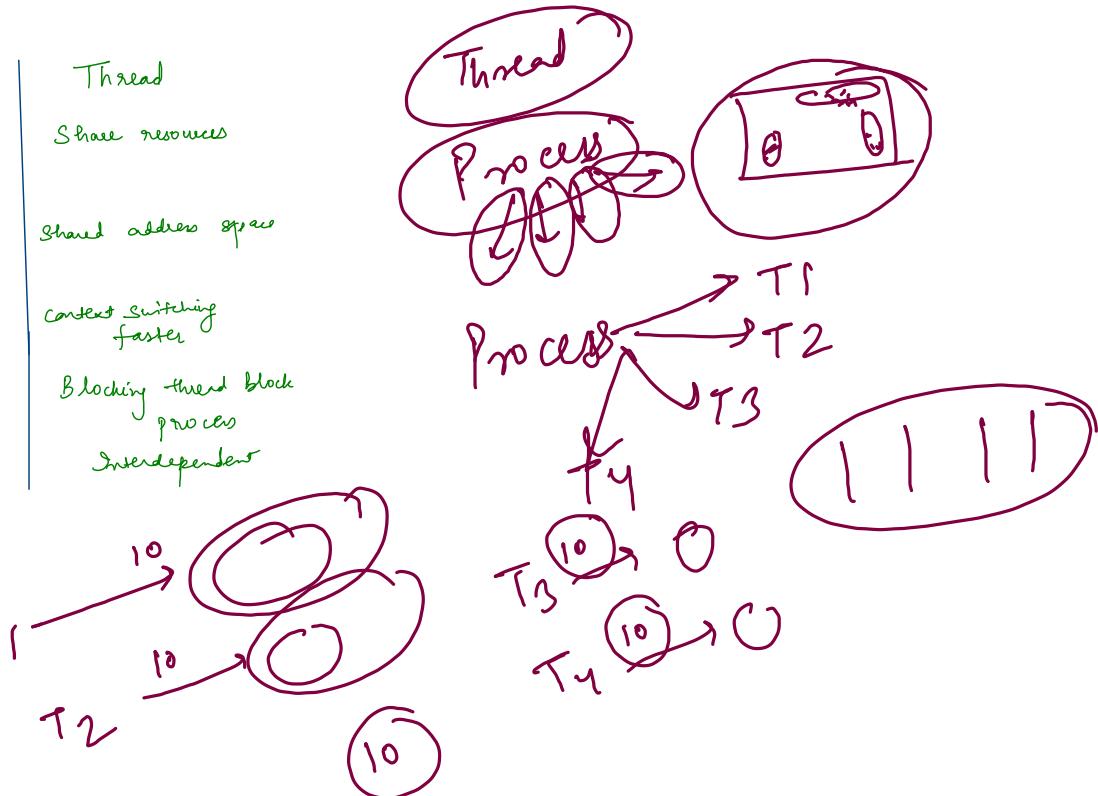
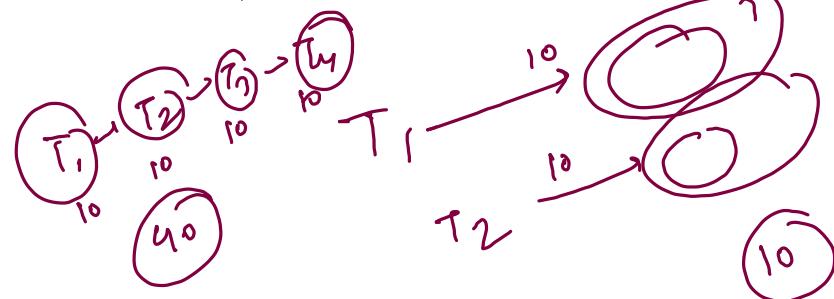
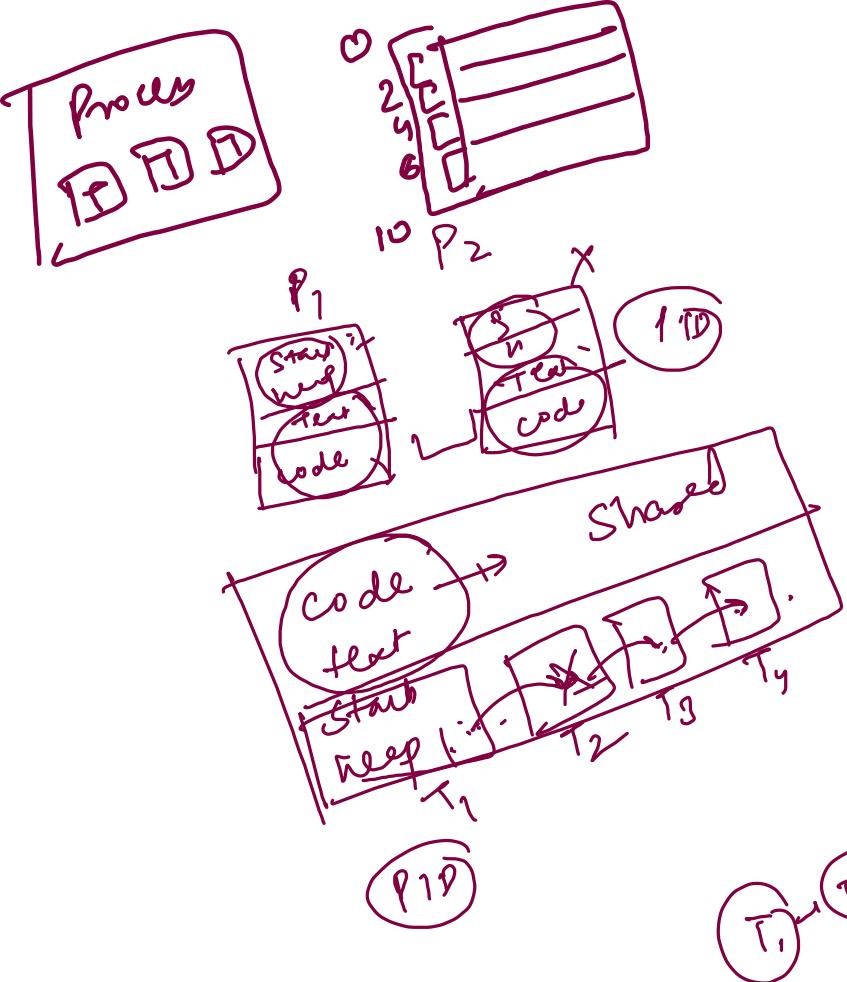


Priority of the processes dynamic

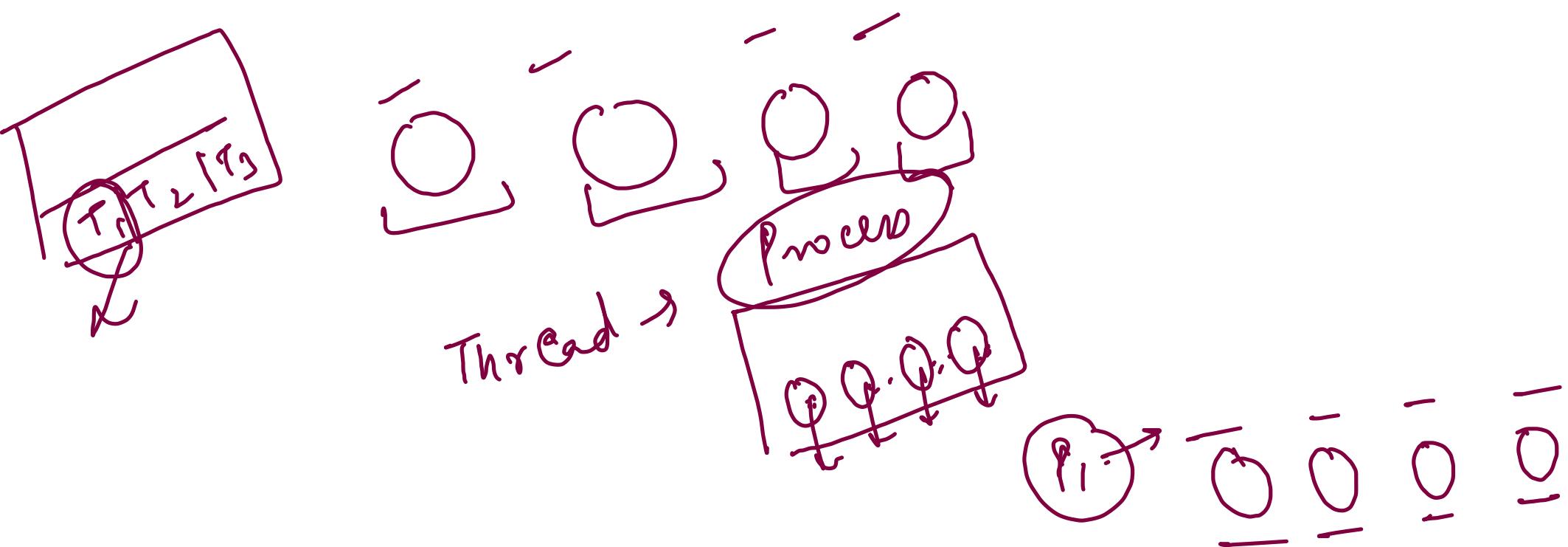
Dynamic → CPU

- ① Priority $\xrightarrow{\text{dec}}$ CPU time[↑]
Cause error -
- ② Priority $\xrightarrow{\text{inc}}$ it has not been allotted
for a whr
 \hookrightarrow queues come prior

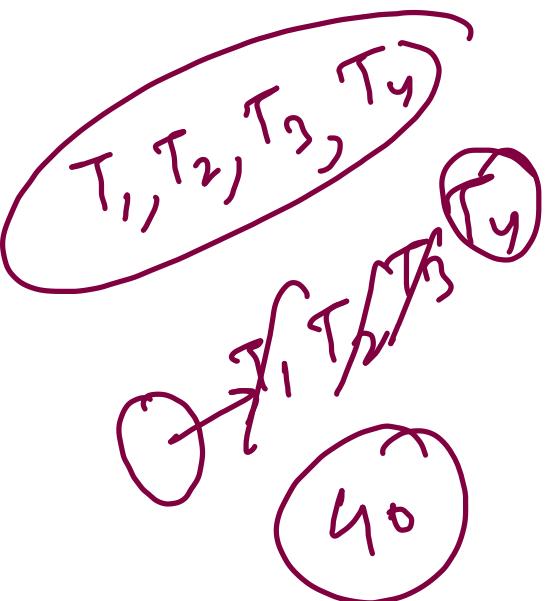
Starvation



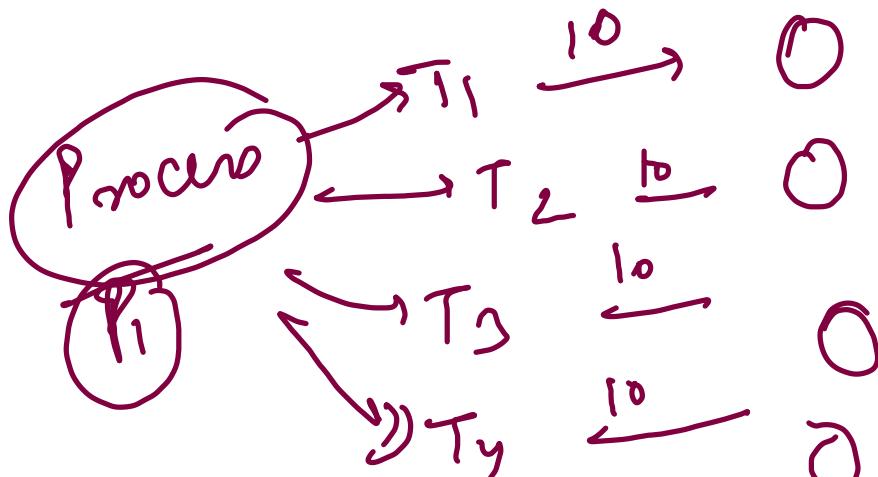
Intra
Process mgt
Algo → S → Multi
Proc, n.f
C.E.



Thread →



Process
independent
support



Multithreading

