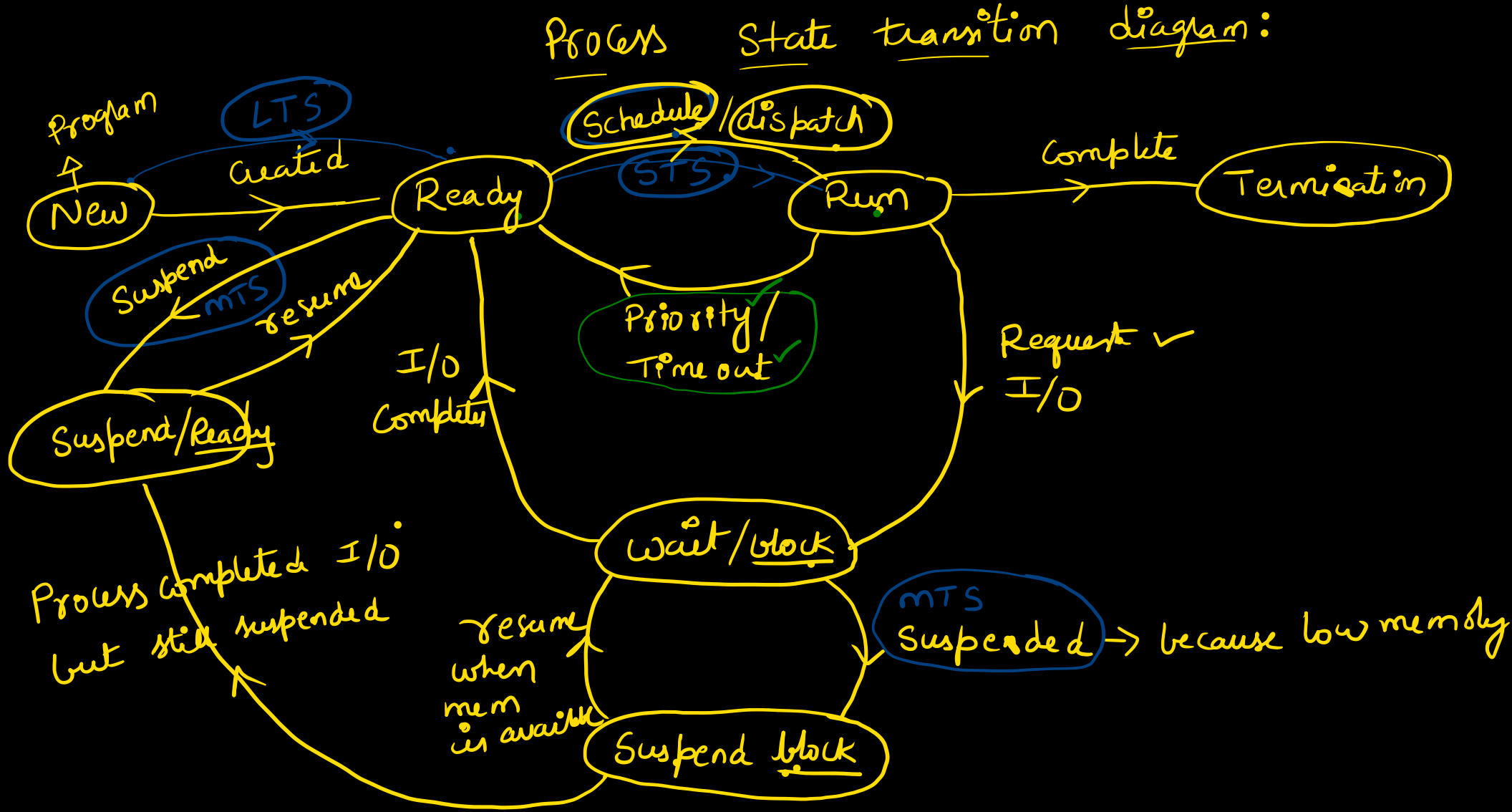
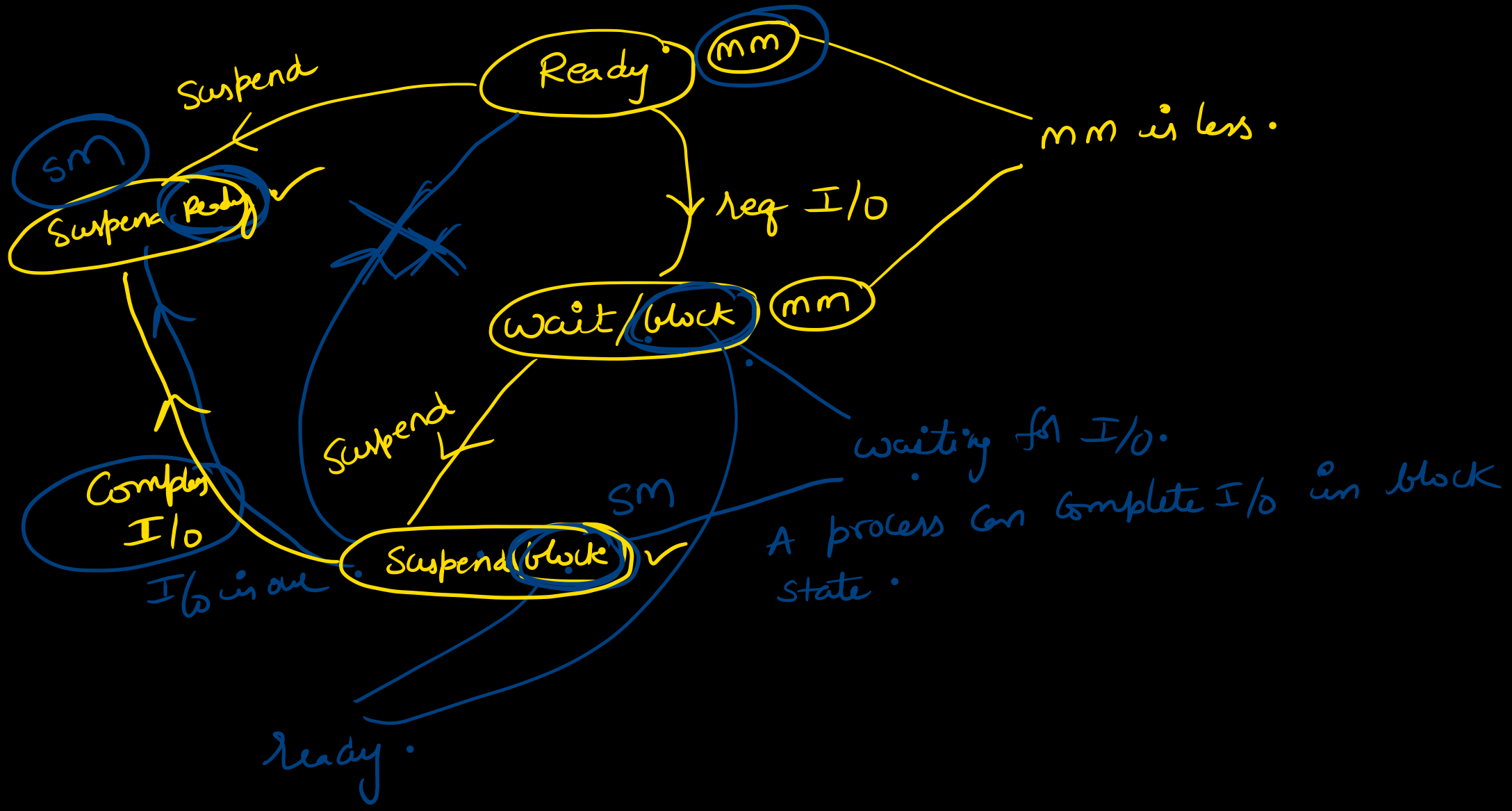
Process State transition diagram:



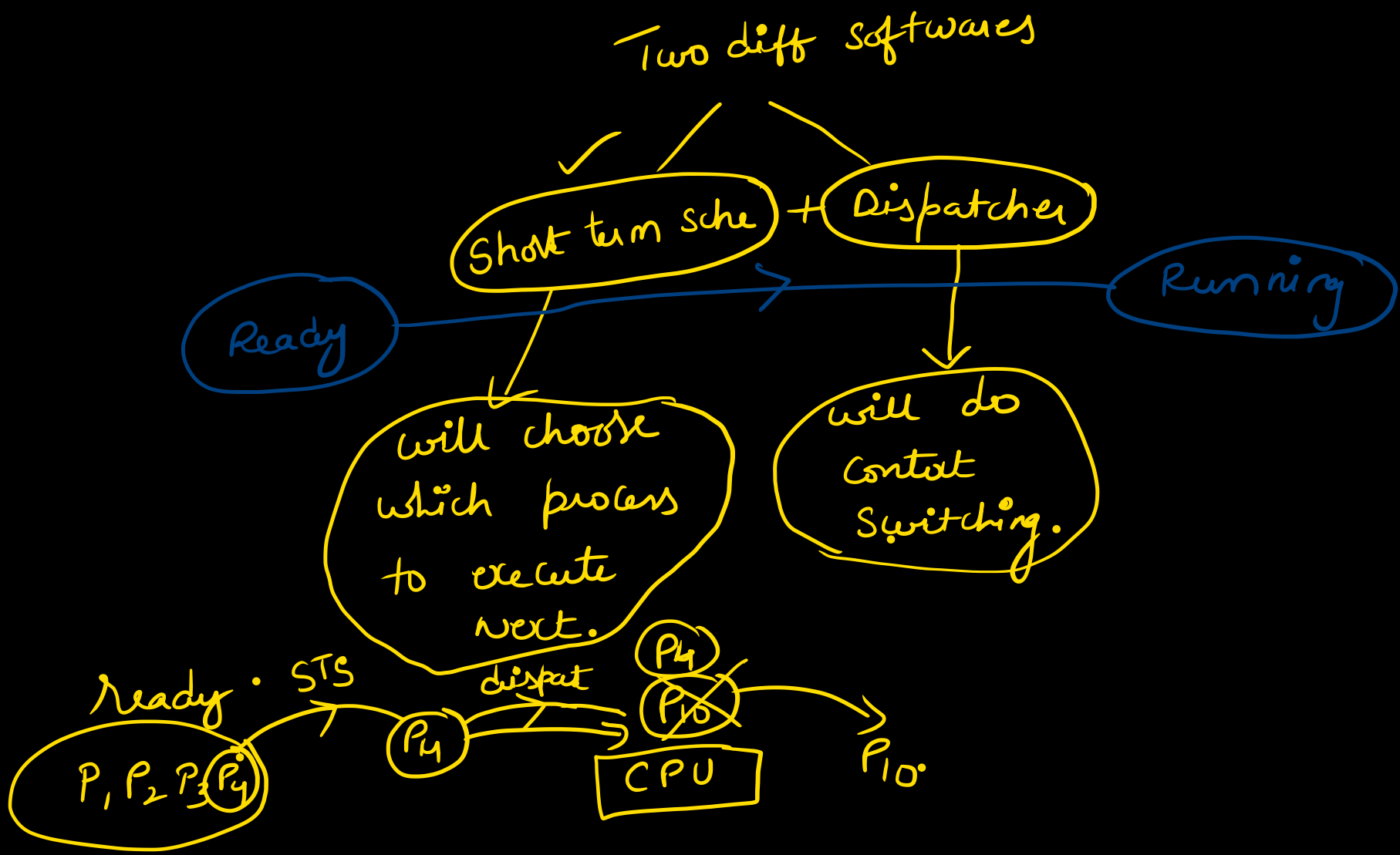

Ready
mm
Suspend
sm
Suspend Ready
mm is less.
Req I/O
wait/block
mm
Suspend
Complete I/O
I/O is over
sm
Suspend block
waiting for I/O.
A process can complete I/O in block state.
Ready.

3 types of schedulers:

Long term scheduler: Creating a process is a long term decision. LTS does it.

Short term scheduler: Scheduling a process from ready → Run is a short term decision

medium Term scheduler:
- Suspending a process is a medium term decision


Two diff softwares
Short term sche
+
Dispatcher
Ready
Running
will choose which process to execute next.
will do Context Switching.
Ready
STS
dispat
P1 P2 P3 P4
P4
P4
P10
CPU
P10.

Why will a process gets blocked ?

1) waiting for I/O (input/output)

2) Some event (semaphores)

↓

later in synchronization.

Important

This decides whether there is preemption or not.

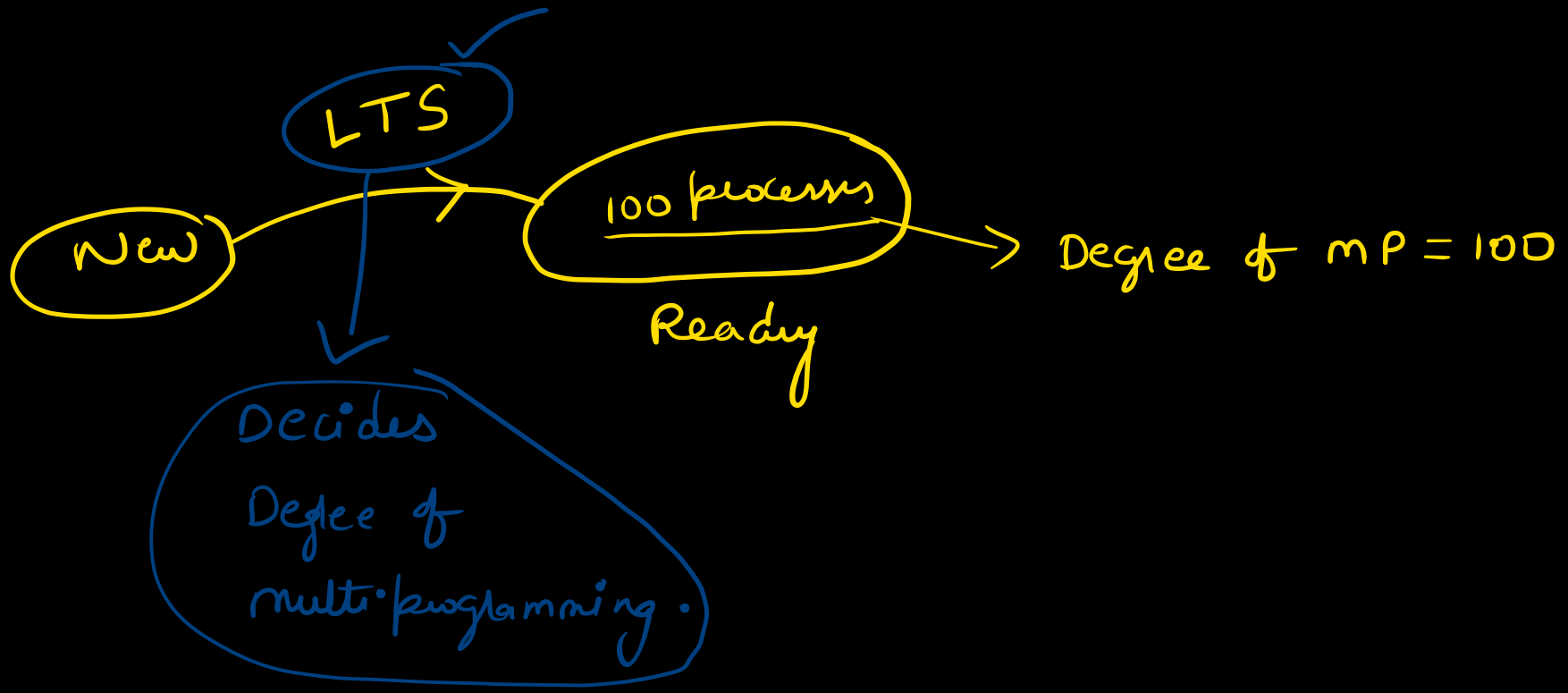
If this edge is present then it means preemption.

not present, it means no preemption.

Preemption → Stopping a process in between.

Degree of multiprogramming:

Number of processes that can be present in ready state at maximum



Gate: Consider a system with 'N' CPUs and 'm' processes, then what is the max and min in the following.

	min	max
✓ ready	0	M
✓ running	0	N
✓ block	0	M

- N CPUs
- m processes

→ all processes are ready

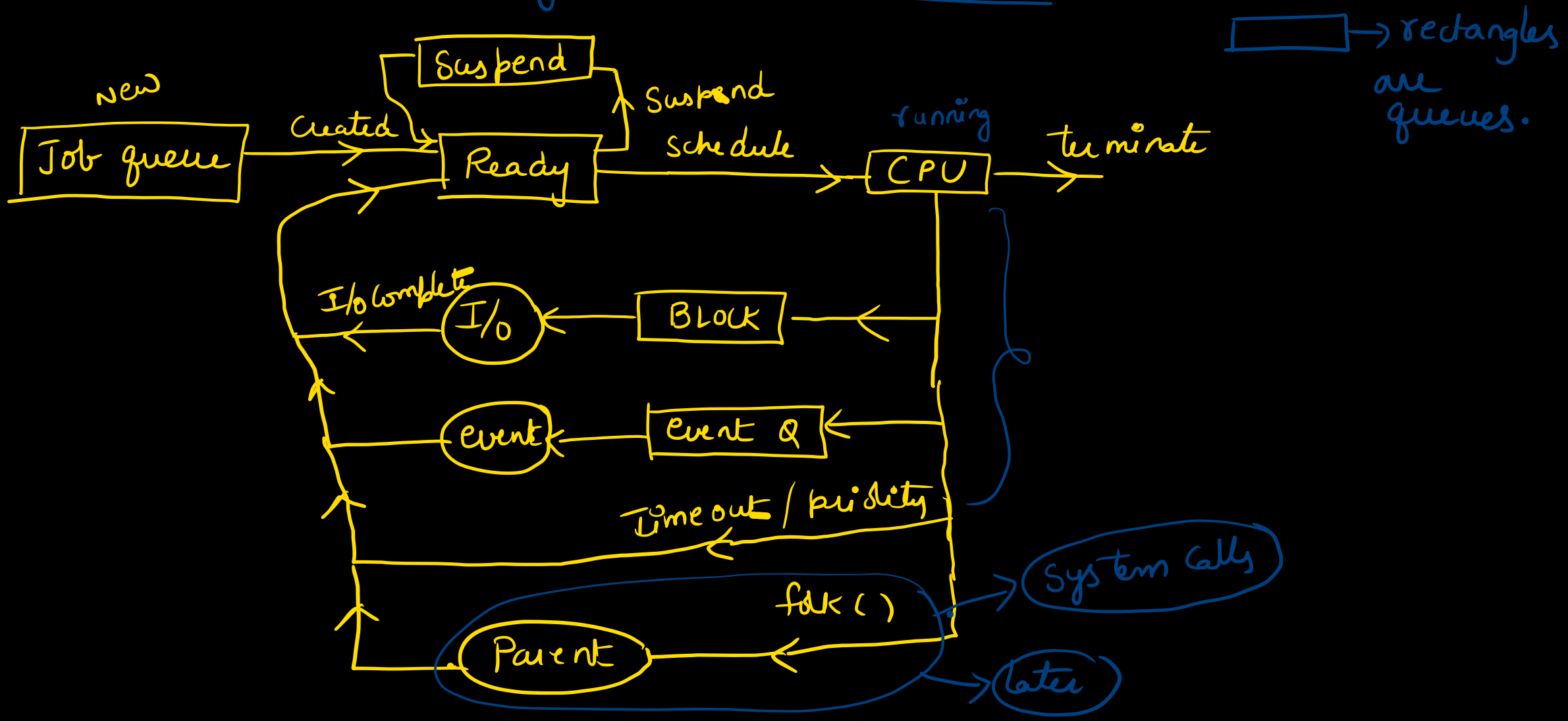
→ all processes may be blocked

→ we have N CPUs

→ all pro may be blocked

→ NO process may be blocked

Scheduling queues (Process queues)

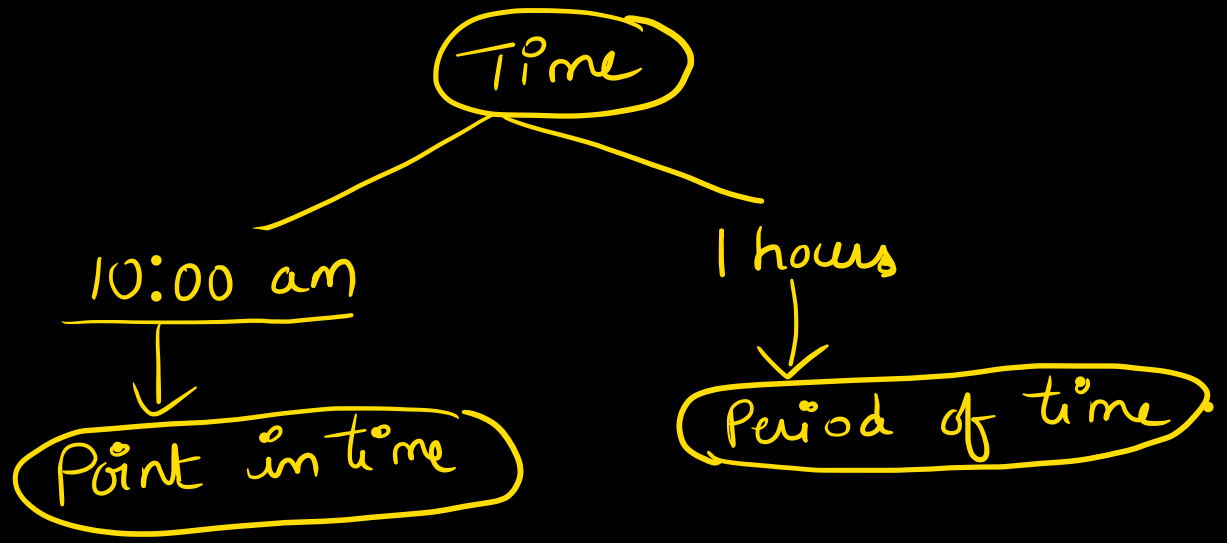


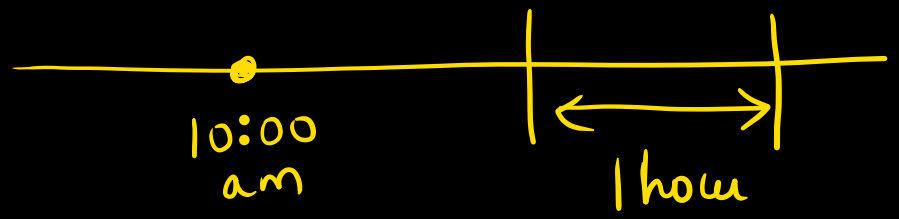
Scheduling algorithms:

Basics are very important for all algo.

Break - 5 min

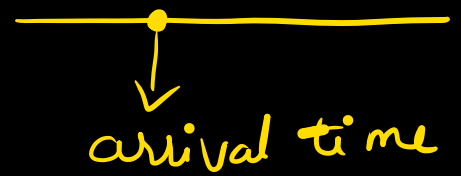
Important parameter:



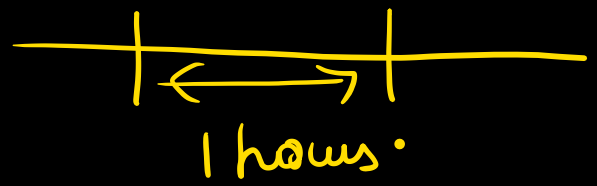


1) Arrival time: Time at which a process enters the ready queue. (point in time)

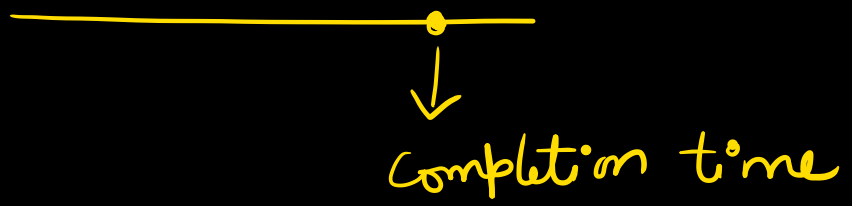
like: 10:00 am.



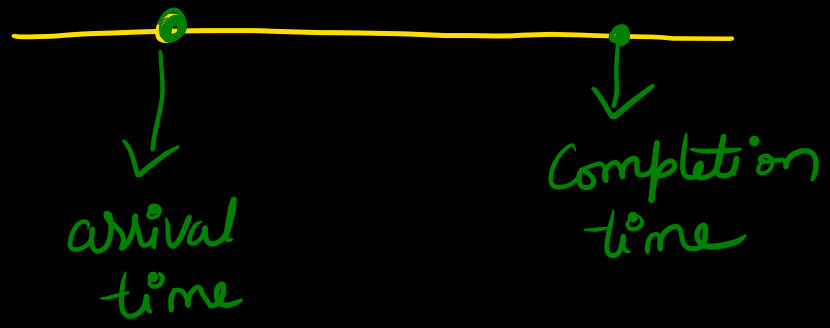
2) Burst time: The amount of CPU time required by a process to finish its execution.
(duration → period of time)



3) Completion time: Time at which a process finishes.
(point of time)

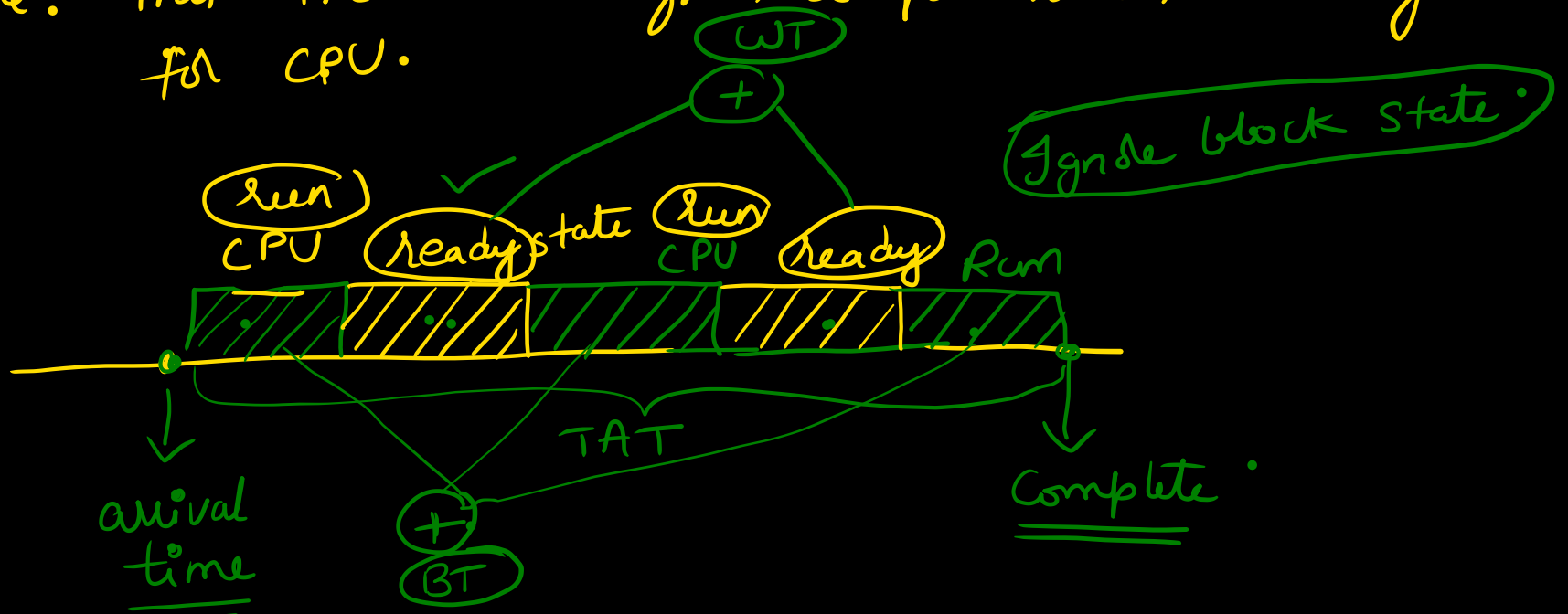


4) Turn around time: Total time a process is in the system.



$$TAT = CT - AT$$

5) waiting time: This the time ~~System~~ a process is waiting for CPU.

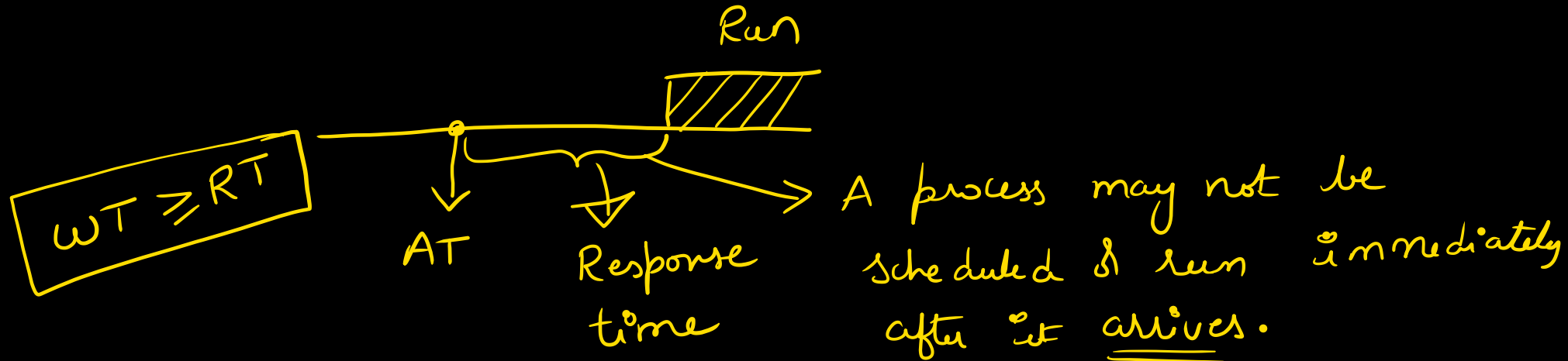


$$TAT = CT - AT$$

$$TAT = BT + WT.$$

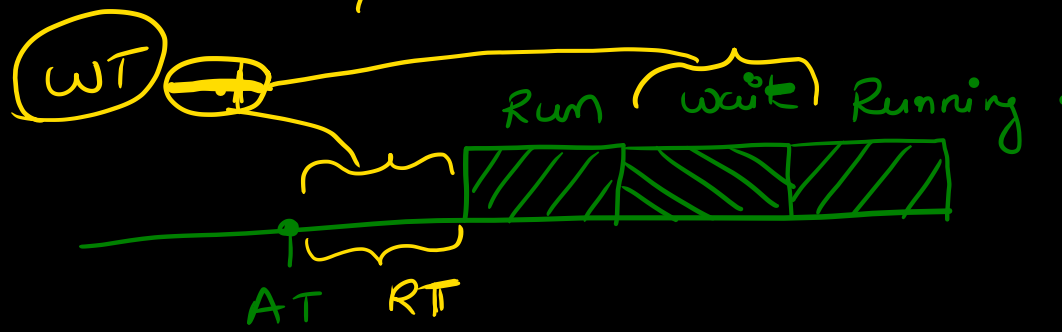
$$WT = TAT - BT$$

6) Response time: ~~time~~ The time taken from AT to scheduling a process for the first time.



A process may not be scheduled to run immediately after it arrives.

RS ≠ WT



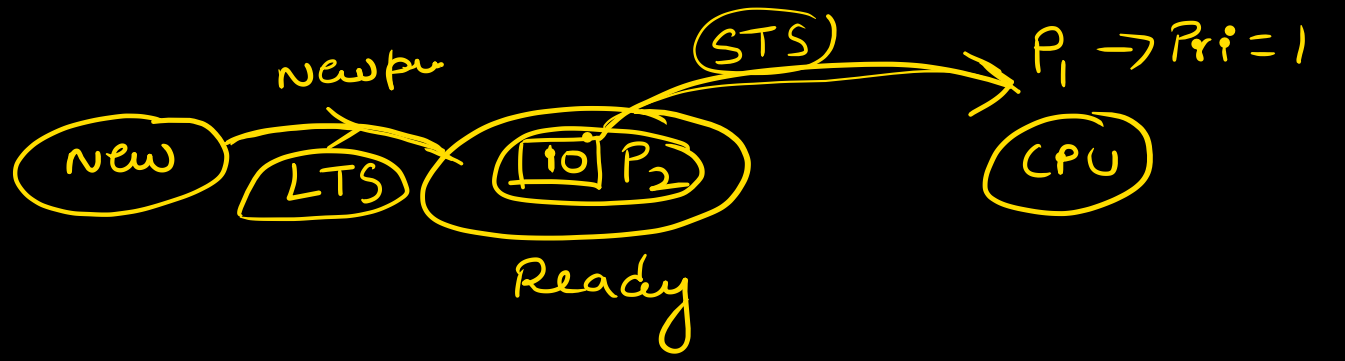
CPU scheduling:

Picking up a process from ready state and giving it to CPU is CPU scheduling. STS + dispatcher → CPU scheduling

When will short term scheduler do the scheduling

STS will run on all these events.

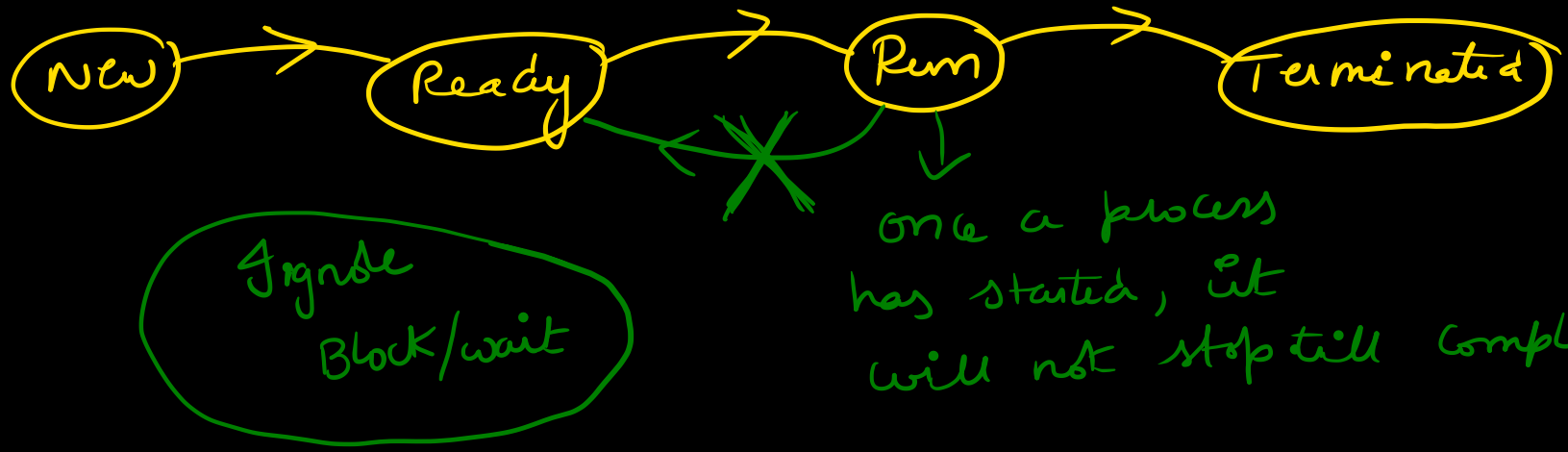
1) Run → Termination (when a process terminates, then new process needs to be scheduled)
2) Run → wait (when a process gets blocked)
3) Run → Ready (when a process is preempted)
4) New → Ready (when a process is newly created, it may be eligible for immediate scheduling)
5) wait → Ready (when a process becomes eligible)



First Come First Serve : (FCFS)

Criteria : Arrival time → we take decision based on AT

mode : Non-preemptive → A process will not be stopped in the middle.



Gate

PNO	AT	BT	CT	TAT	WT	RT
1	0	4	4	4	0	0
2	1	3	7	6	3	3
3	2	1	8	6	5	5
4	3	2	10	7	5	5
5	4	5	15	11	6	6

5 process

34 19

Never asked in gate! good to know

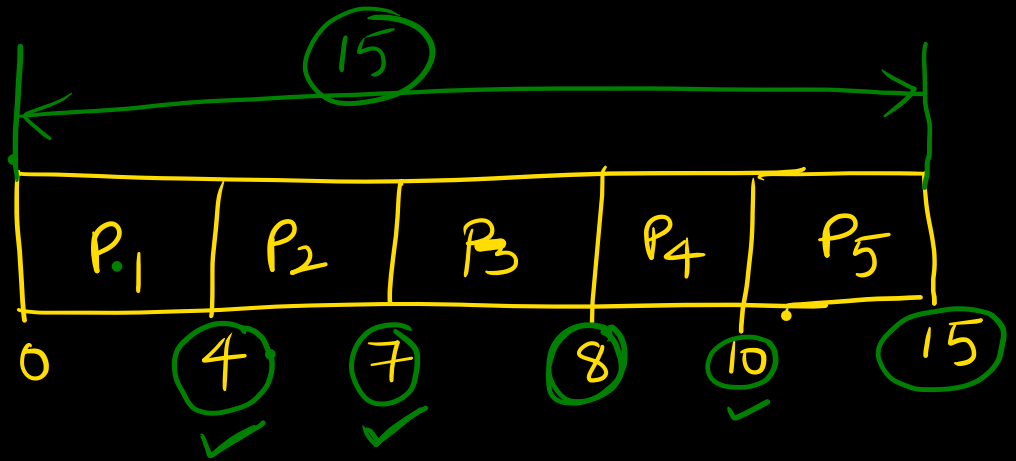
$WT = TAT - BT$

$TAT = CT - AT$

$\text{Avg } TT = \frac{34}{5}$ ✓

$\text{Avg } WT = 19/5$ ✓

Length of the schedule
→ starting of first process to ending of last process.
= 15

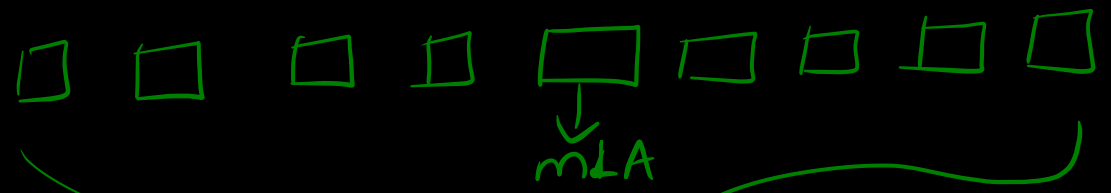


In case of non preemptive algos, $RT = WT$

Adv of FCFS → Simple to implement.

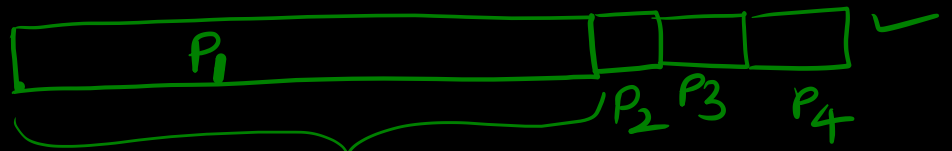
Queue is required → FCFS

Dis of FCFS → Convoy effect.



Convoy. it causes inconvenience to others.

AT $P_1 = 0$



Big process comes eadly → wait for long time → Starvation

Ex on Convoy effect.

When ever AT is same, use smaller process number

PNO	AT	BT	CT	TAT	WT
1	0 ✓	20	20	20	0
2	1	2	22	21	19
3	1	1	23	22	21

AV TT = 21

A WT = 40/3 = 13.33

Convoy effect

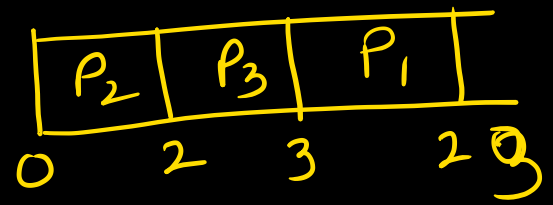
PNO	AT	BT	CT	TT	WT
1	1	20	23	22	2
✓2	0	2	2	2	0
3	0	1	3	3	2

AV TAT = 9

AV WT = 4/3 = 1.3

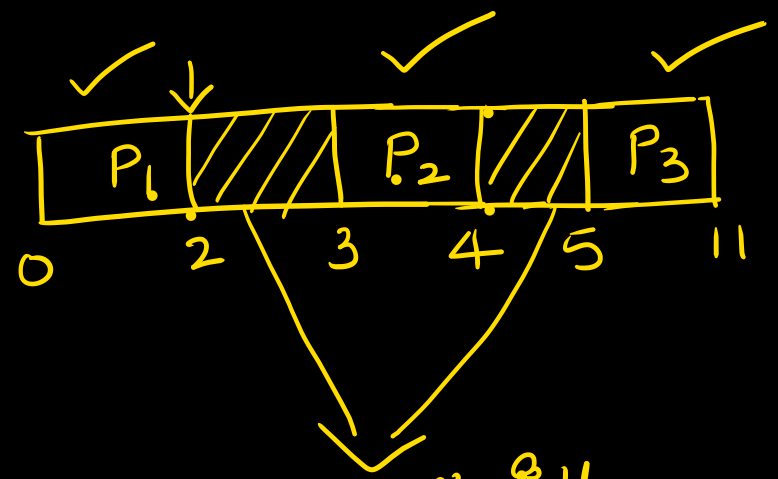
Convoy effect

→ Starvation.



Gate:

PNO	AT	BT	CT	TT	WT	RT
1	0	2	2	2	0	0
2	3	1	4	1	0	0
3	5	6	11	6	0	0



CPU is idle because no process is available.

avg TT

$\frac{9}{3} = 3$