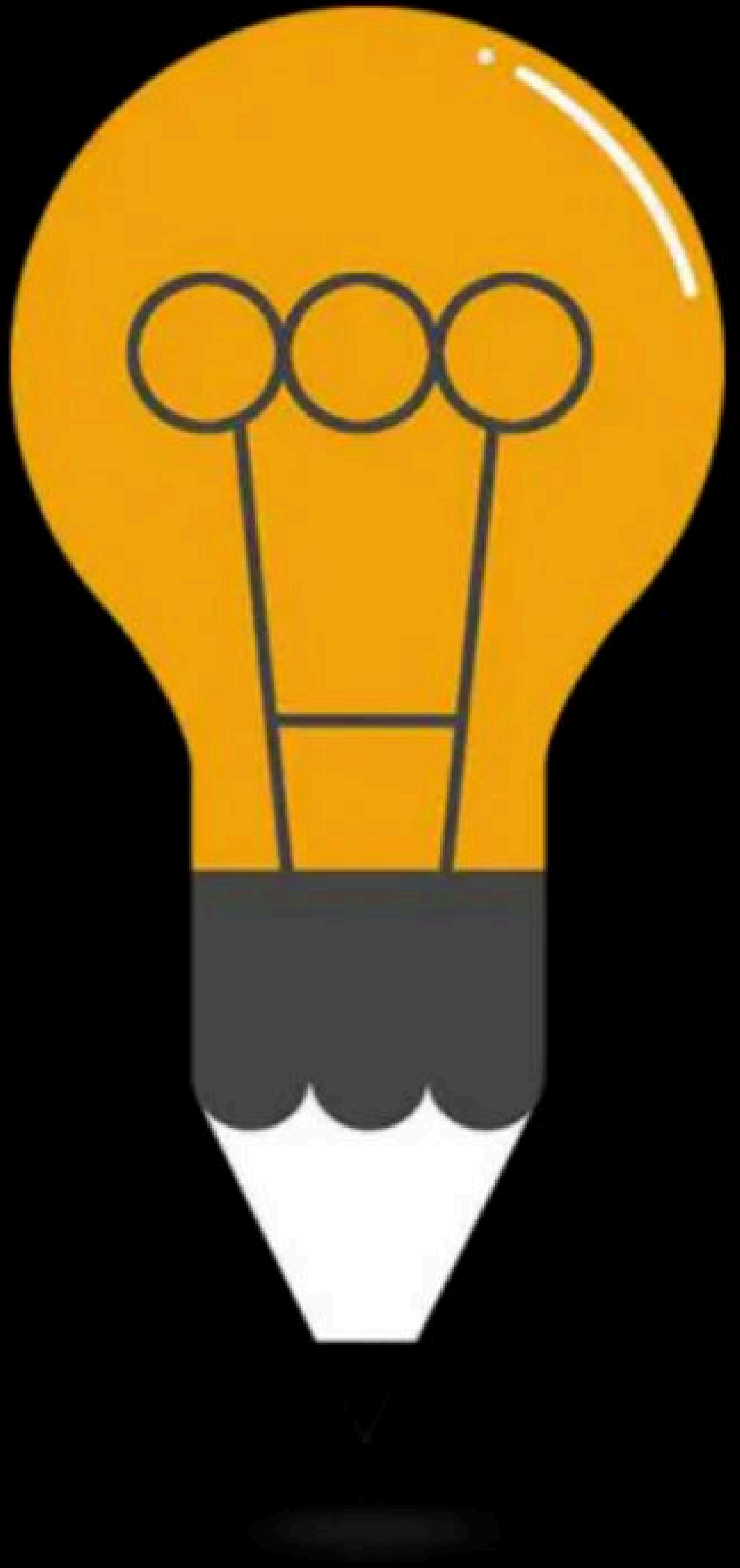
Process State Transition and Process Scheduling

Comprehensive Course on Operating System for GATE - 2024/25

Vishvadeep Gothi • Lesson 3 • Apr 20, 2023



Operating System
Process & Scheduling

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Process

Process

- **Process:**

  Program under execution

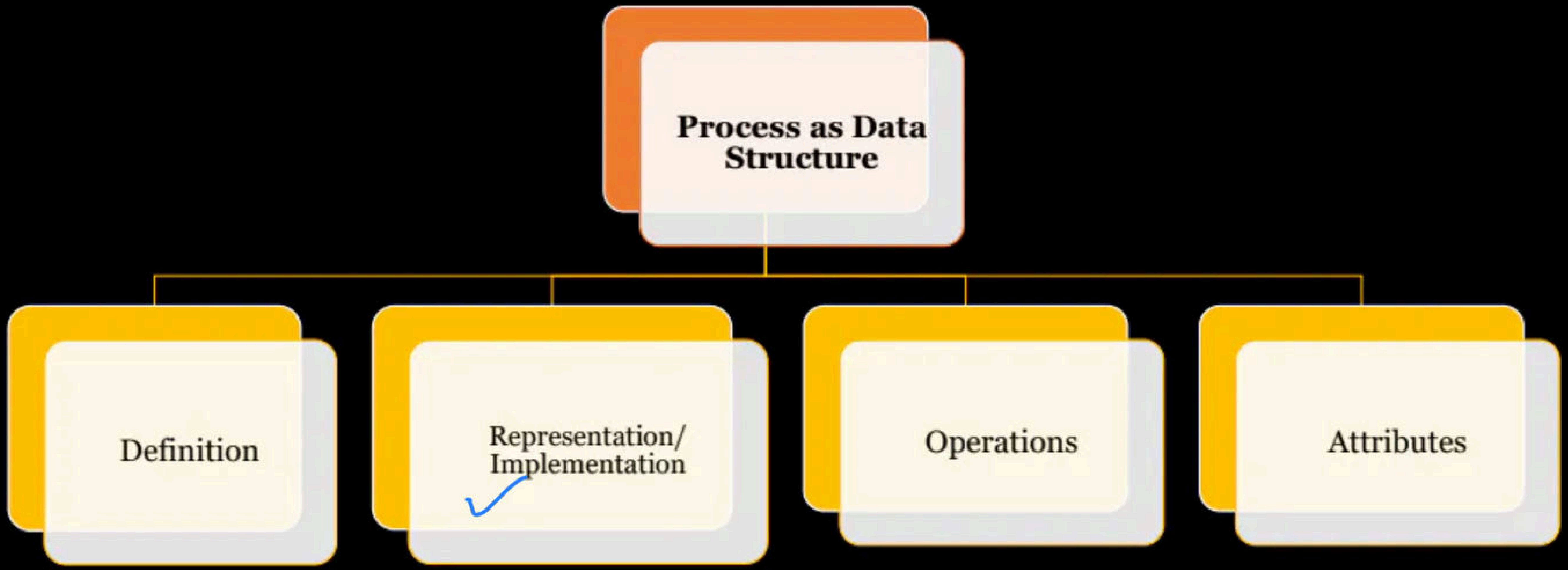
  An instance of a program

  Schedulable/Dispatchable unit (CPU)

  Unit of execution (CPU)

  Locus of control (OS)

Process



Process as Data Structure

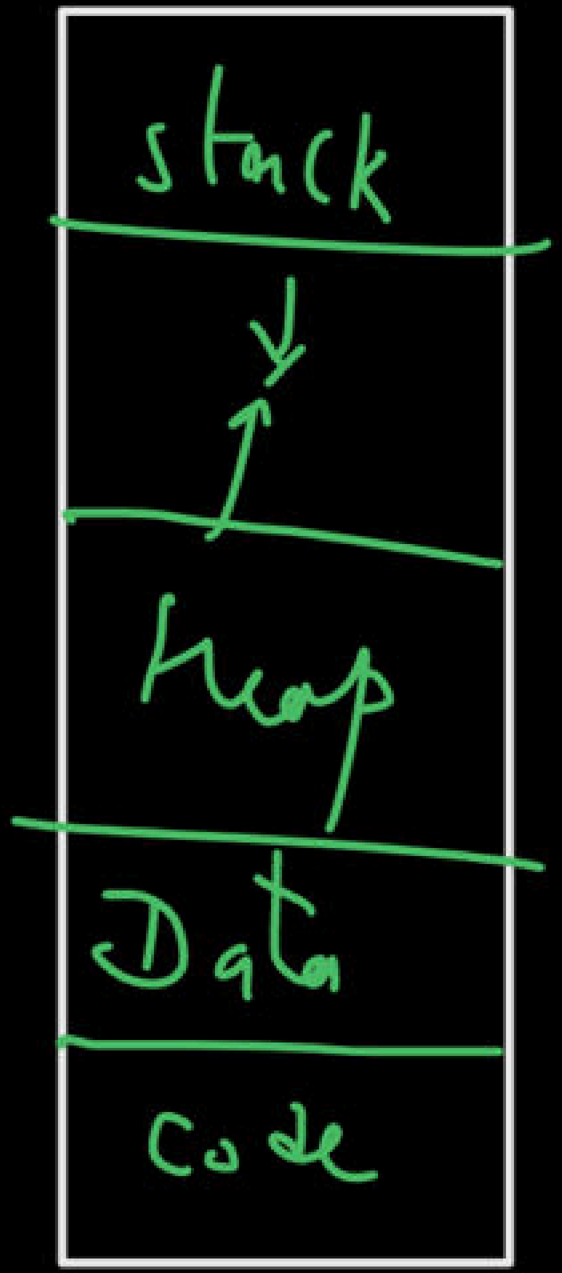
Definition

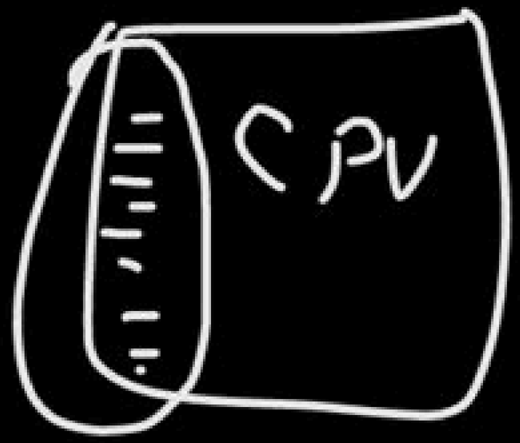
Representation/ Implementation ✓

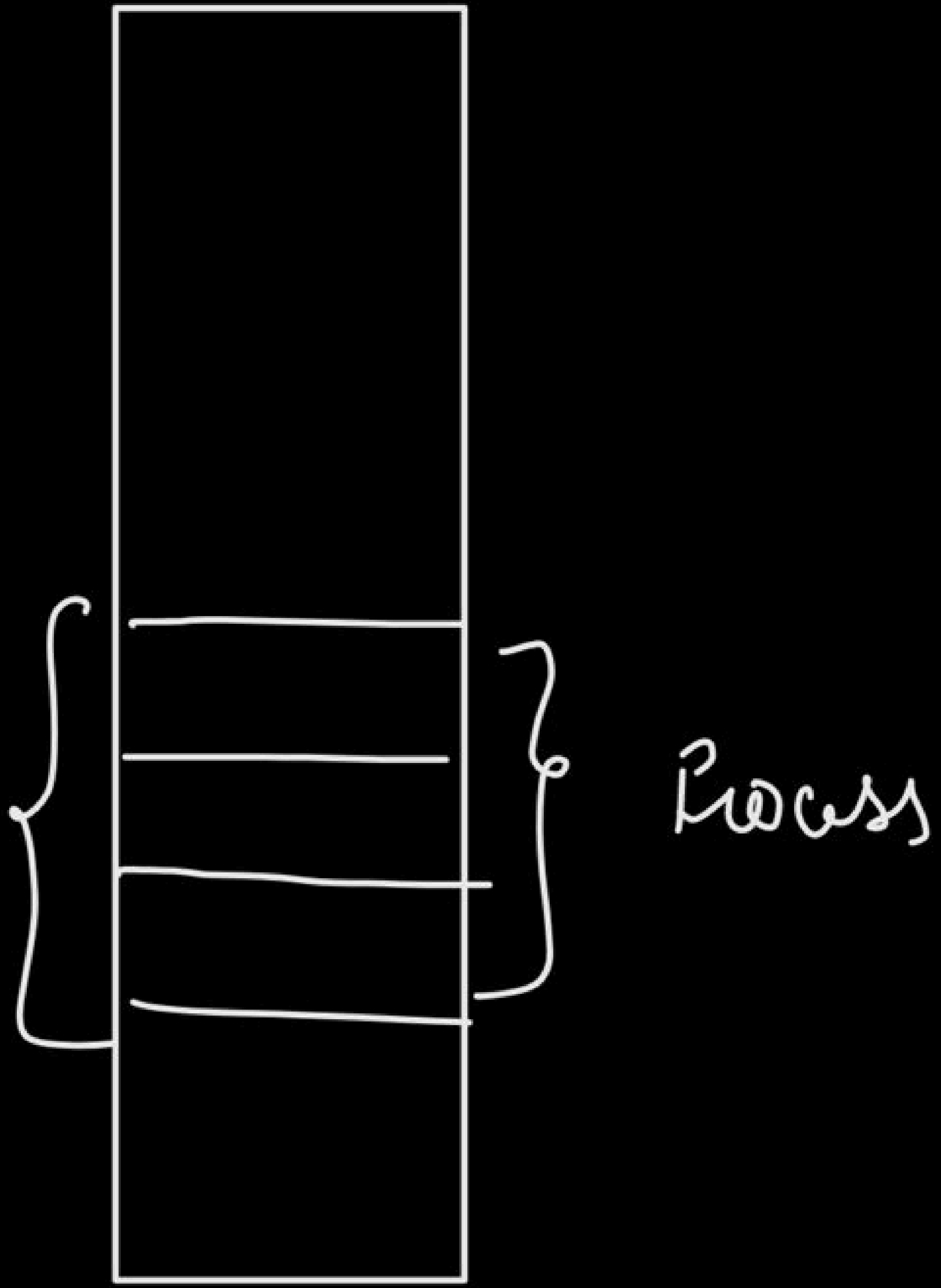
Operations

Attributes

Representation of a Process







Operations on a Process

- Create (Resource Allocation)
- Schedule, Run
- Wait/Block
- Suspend, Resume
- Terminate (Resource Deallocation)

Attributes of a Process

- PID
- PC
- GPR
- List of Devices
- Type
- Size
- Memory Limits
- Priority
- State
- List of Files

PCB

Also known as processor descriptor

Context

The content of PCB of a process are collectively know as ‘Context’ of that process

Context Switch

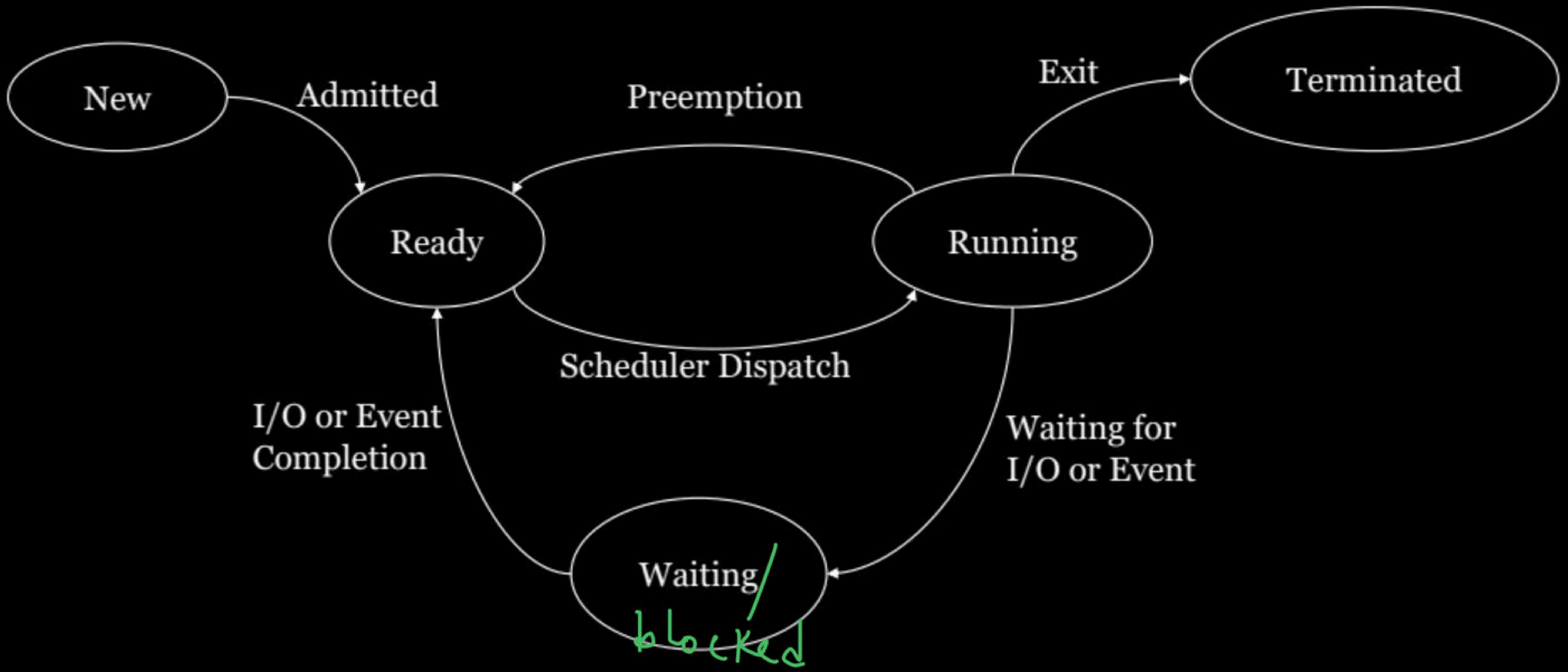
Process States

defined based on what process is doing ?

Dispatcher :-

It does context switch

Process States (Preemptive system)



Process States

New:

All installed processes are in known to be in new state | new state processes are in secondary memory .

Ready:

All processes which are ~~waiting~~ ready to run on CPU are known to be in ready state

Running:

A process which is running on CPU has its state as running

Terminated:

A completed process has its state as terminated

Blocked:

All processes which are waiting for any IO or event

Process States

New To Ready: When process is admitted by OS → resource allocatn (memory, files)

Ready to Running: When a process is dispatched to CPU

Running to Terminated: When a process is completed → Resource deallocatn

Running to Blocked: When a process goes for IO or event

Running to Ready: When a process is preempted

Blocked to Ready: When a process completes IO or event

If process is in ready or running or blocked state
then process is in main memory.

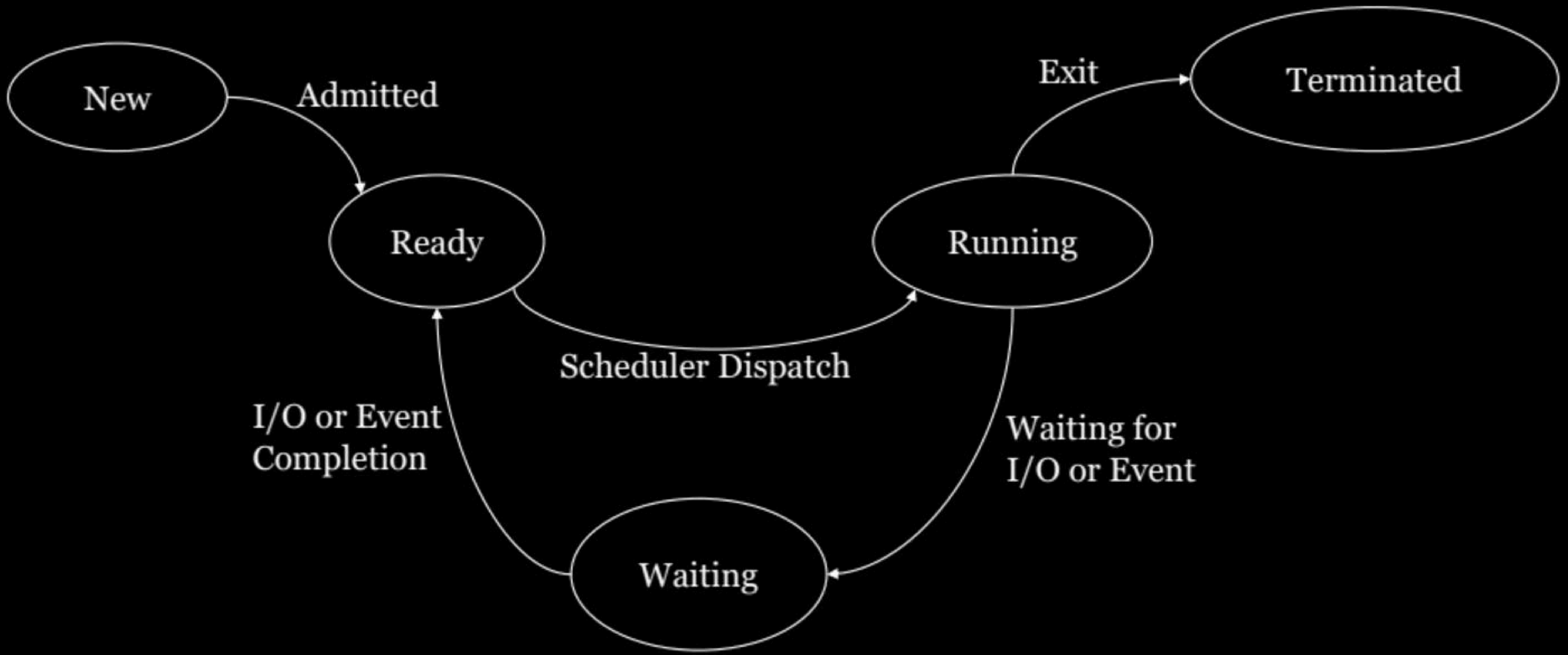
Process States

2 Transitions are voluntary: (Process can do with it's own wish)

- Running to Terminated
- Running to Blocked

Remaining all, OS does

Non-preemptive Process States



CPU vs IO Bound Process

CPU Bound: If the process is intensive in terms of CPU operations (CPU intensive processes)

IO Bound: If the process is intensive in terms of IO operations (I/O intensive processes)

CPU vs IO Bound Process

CPU Bound: If the process is intensive in terms of CPU operations

IO Bound: If the process is intensive in terms of IO operations

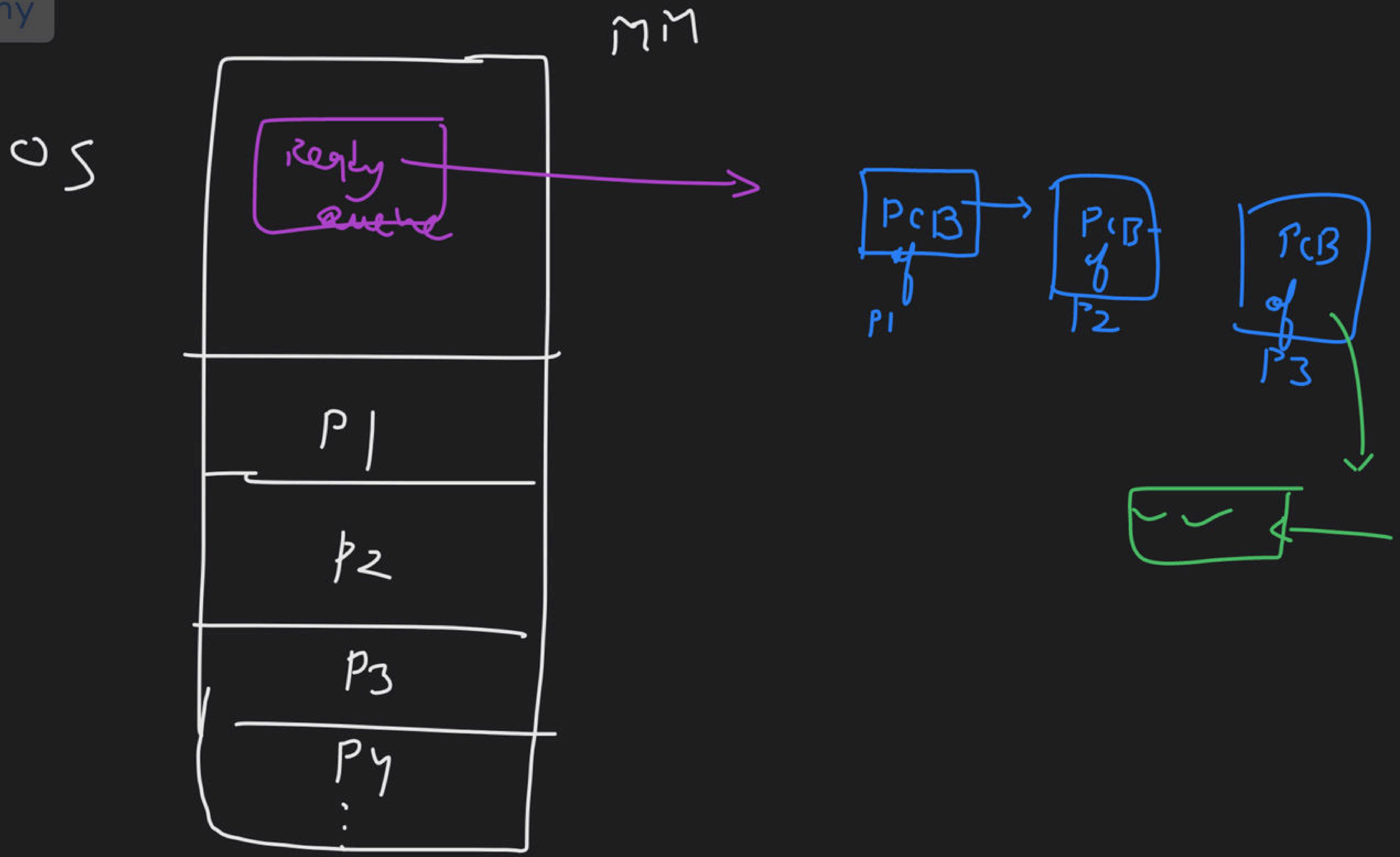
Process Scheduling

Needed Because?

Scheduling Queues

- ◎ Job Queue ⇒ all processes which are in new state
- ◎ Ready Queue ⇒ all processes which are in ready state, are kept in ready queue
- ◎ Device Queue
  ↳ all processes which are waiting for a specific device, are kept into it's device queue.

⇒ each device has it's own Queue.


MM
OS
Ready queue
P1
P2
P3
P4
PCB of P1
PCB of P2
PCB of P3

Types of Schedulers

- ◎ Long-Term Scheduler (Job)
- ◎ Short-Term Scheduler (CPU)
- ◎ Mid-Term Scheduler (Medium-term)

→ long-term scheduler :- This schedules processes from New state to ready state.

(brings process from secondary memory to main memory)

⇒ long-term scheduler can increase degree of multiprogramming.

⇒ — " ——— controls degree of multiprogramming

Short-Term Scheduler:-

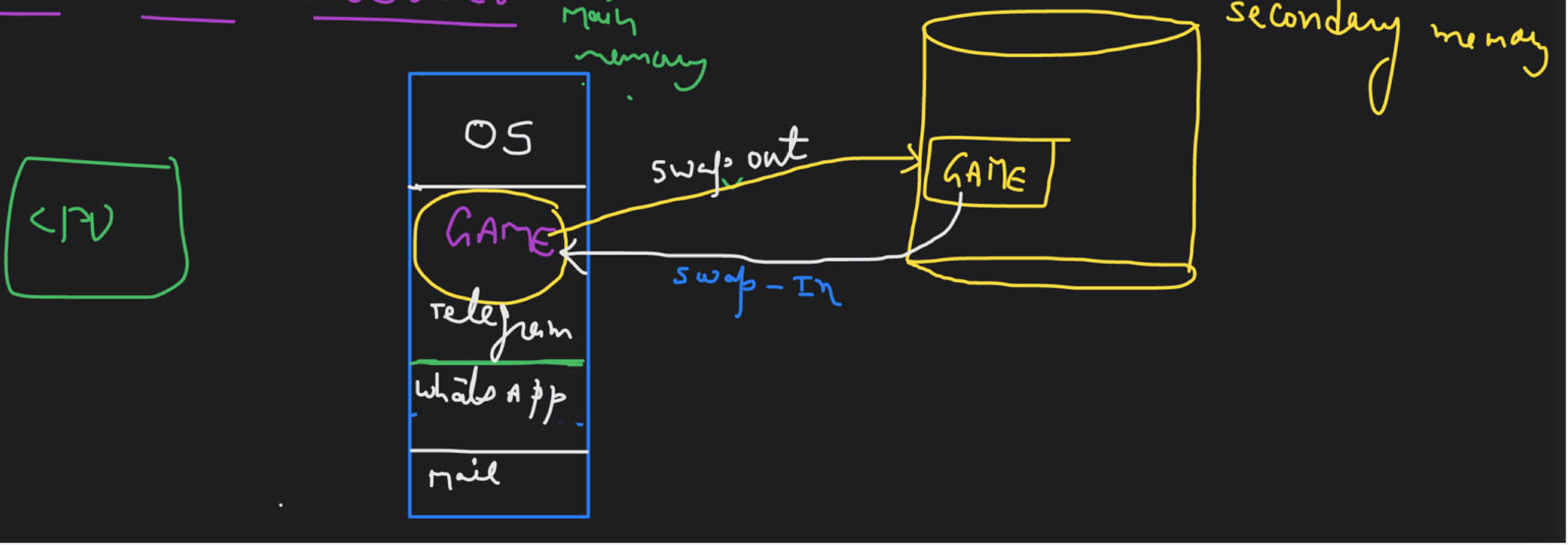
It selects one of the ready processes to run on CPU next.

⇒ short-term scheduler does not affect degree of multiprogramming.

⇒ Long_term scheduler is needed less frequently

⇒ short- — 11 ______ 11 ______ more — 11 —

Mid-Term scheduler :-



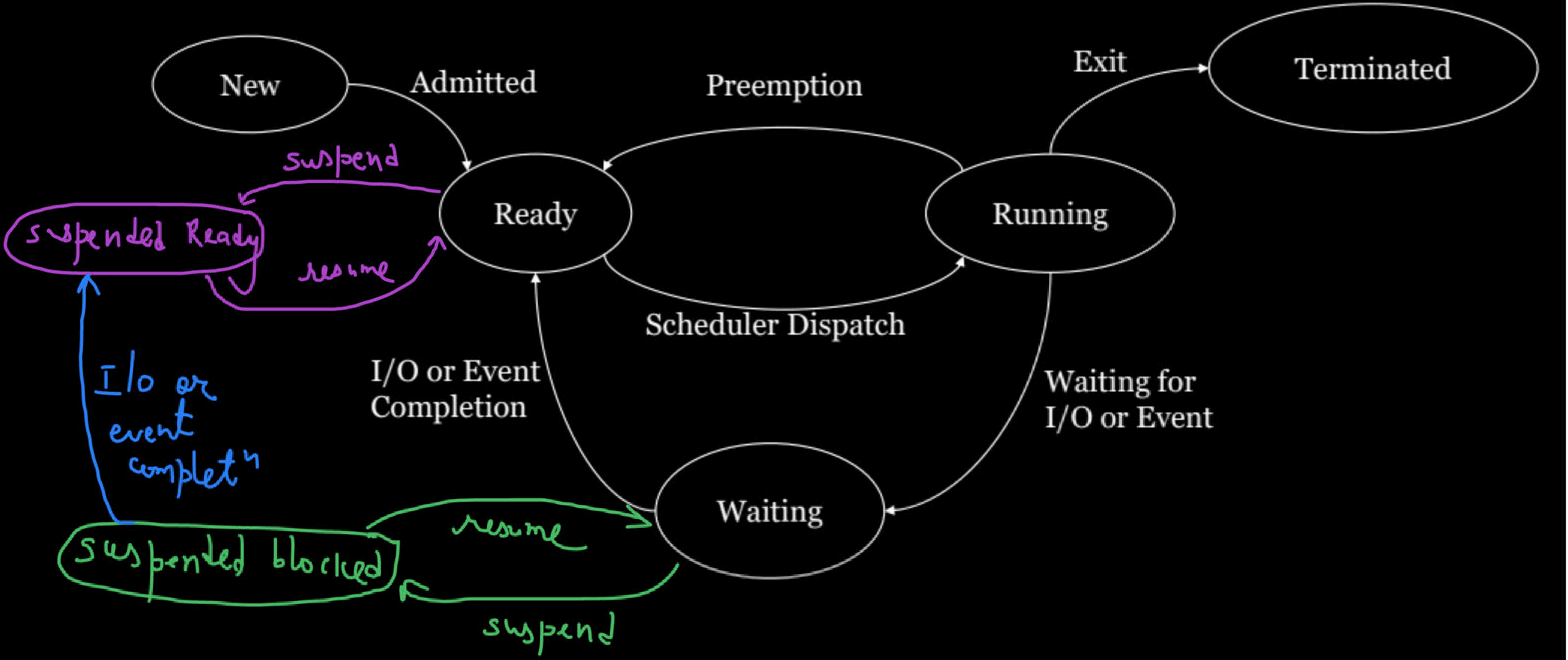
⇒ mid-term schedulere performs swapping of process
(swap-out, swap-In)

⇒ If swap-out & swap-In done based on priority of process.
then known-as roll-out, roll-in

⇒ mid-term scheduler can increase and can decrease degree of multiprogramming.

⇒ swapped-out processes are kept into secondary memory on "swap-space".

Updates Process States



CPU Scheduling

Function:

Make a selection. which process will run next on CPU.

Goal

Minimize Wait time and Turn-around time

Maximize CPU utilization (Throughput)

Fairness

Question

Which of the following scheduler reduces the degree of multiprogramming?

a) Short-Term

b) Long-Term

[✓ c) Mid-Term]

d) Long-Term and Mid-Term both

CPU Scheduling Types

→ Preemptive

→ Non-preemptive

Scheduling Times

Arrival Time (AT):

Burst/Service Time (BT):

Waiting Time (WT):

Completion Time (CT):

Turn-Around Time (TAT):

Scheduling Times

Response Time (RT):

Scheduling Length (L):

Throughput:

Scheduling Algorithms

1. FCFS
2. SJF
3. SRTF
4. HRRN
5. Priority Based
6. Round Robin
7. Multilevel Queue Scheduling
8. Multilevel Feedback Queue Scheduling

Happy Learning.!