MISSION ISRO

Operating System

Lecture No.-01

By- Dr. Khaleel Khan sir

Topics to be covered

1. Process Concepts
2. functions
3. PYQ's

ABOUT ME

Hello, I'm Dr. Khaleel Ur Rahman Khan.

1. Ph.D. in Computer Science.
2. Professor in Computer Science.
3. Has more than 28 Years of Experience in Teaching at Engineering Colleges.
4. Published more than 50 journal articles in the areas of Wireless Networks.
5. Seven candidates have been awarded Ph.D. under his Supervision.
6. Has more than 22 years of Educating and Mentoring the GATE Aspirants.

By- Dr. Khaleel

My PW Official Telegram Channel

https://t.me/KhaleelSirPw

Process Concepts

What is O.S

→ Interface b/w user & H/w

→ Resource Manager

→ Acts like a Govt;

Functions & Goals :

- → Scheduling
- → Process Mgmnt
  - Synch
  - Deadlocks
  - IPC
- → Mem. Mgmnt
- → Device "
- → File "
- → Security & Protection

- → Convenience : Primary
- → Efficiency : Secondary
- → Robustness
- → Reliability
- → Scalability
- → Portability

Types of O.S :

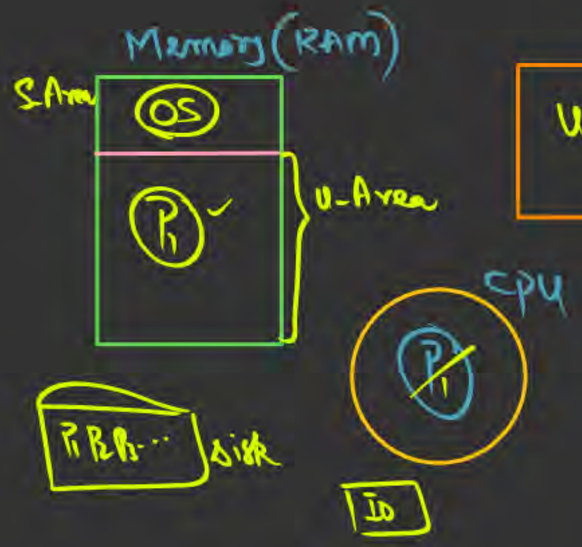
3rd Gen
↓
Disk Technology — HDD, FDD

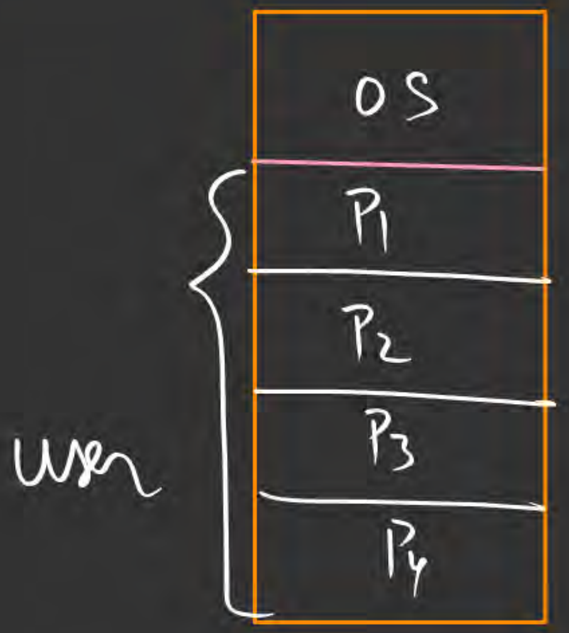
Uniprocessor

Uniprogrammed O.S	Multi-programmed O.S

– (CPU Idleness)
– Low thruput

Ability of O.S to hold Multiple ready to run Programs in Memory
↳ Max CPU utilization
↓
(Thruput)





Types of M.Pr

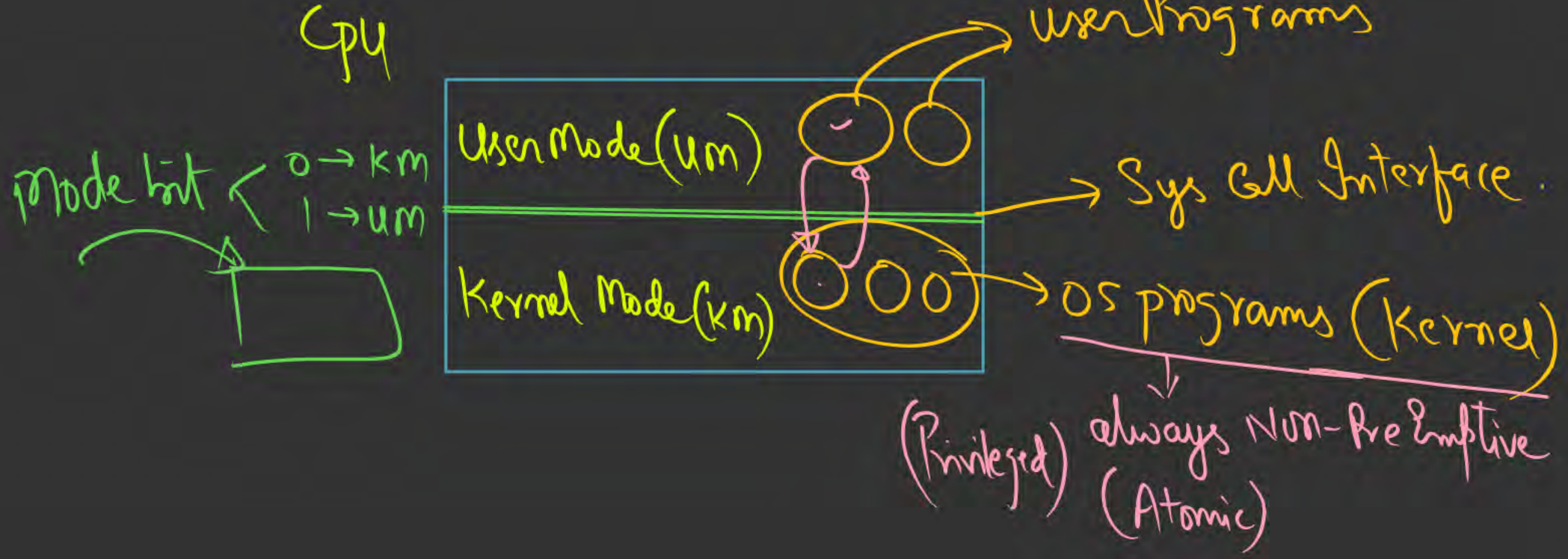
- Non-PreEmptive
  - (Lack of Interactiveness)
  - (voluntarily release)
    - complete
    - I O; System Call
- PreEmptive (Pr)
  - WIN; UNIX; LINUX/MAC
  - M.Pr; Pr. based
  - (forceful deallocation)
    - complete
    - I O | S. Call
    - (Time | Priority)

Task = Process
= Program

$\Rightarrow$ $\boxed{\text{PreEmptive based M.Pr O.S = Multi-tasking}}$

H/w Requirements

1) DMA
2) Address Translation
3) Dual Mode Opn : of CPU



Adv. O.S:

→ **Real Time O.S : (RTOS)**

: Systems that work on hard strict deadlines;

(Priority)

Hard

deadlines are very strict

(Titan)

Submarine Control | Satellite Control, missile Systems, Nuclear Systems, A.T.C

Soft

deadlines are flexible

H/w + Distributed O.S

(Transparency)

Process Concepts :

→ Program vs Process

(on Disk)

(.exe) Passive

Instrns Data

int a, b, c;

c = a + b;

Load R1, a
Load R2, b
Add R1, R2
Store c, R1

→ Program under execution

resources

<cpu + Mem + IO>

→ Process is always in Memory;

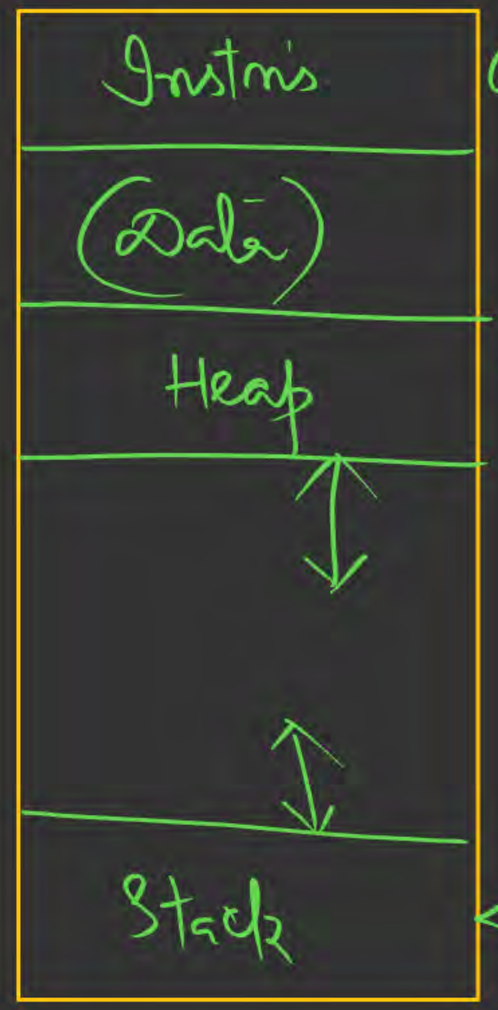
→ Process is active

→ Active entity

→ unit of cpu utiliz.

→ Impl. (by developer) as an A.D.T

Process as an A.D.T <Defn; Structure; operations; Attributes>



Code Sector

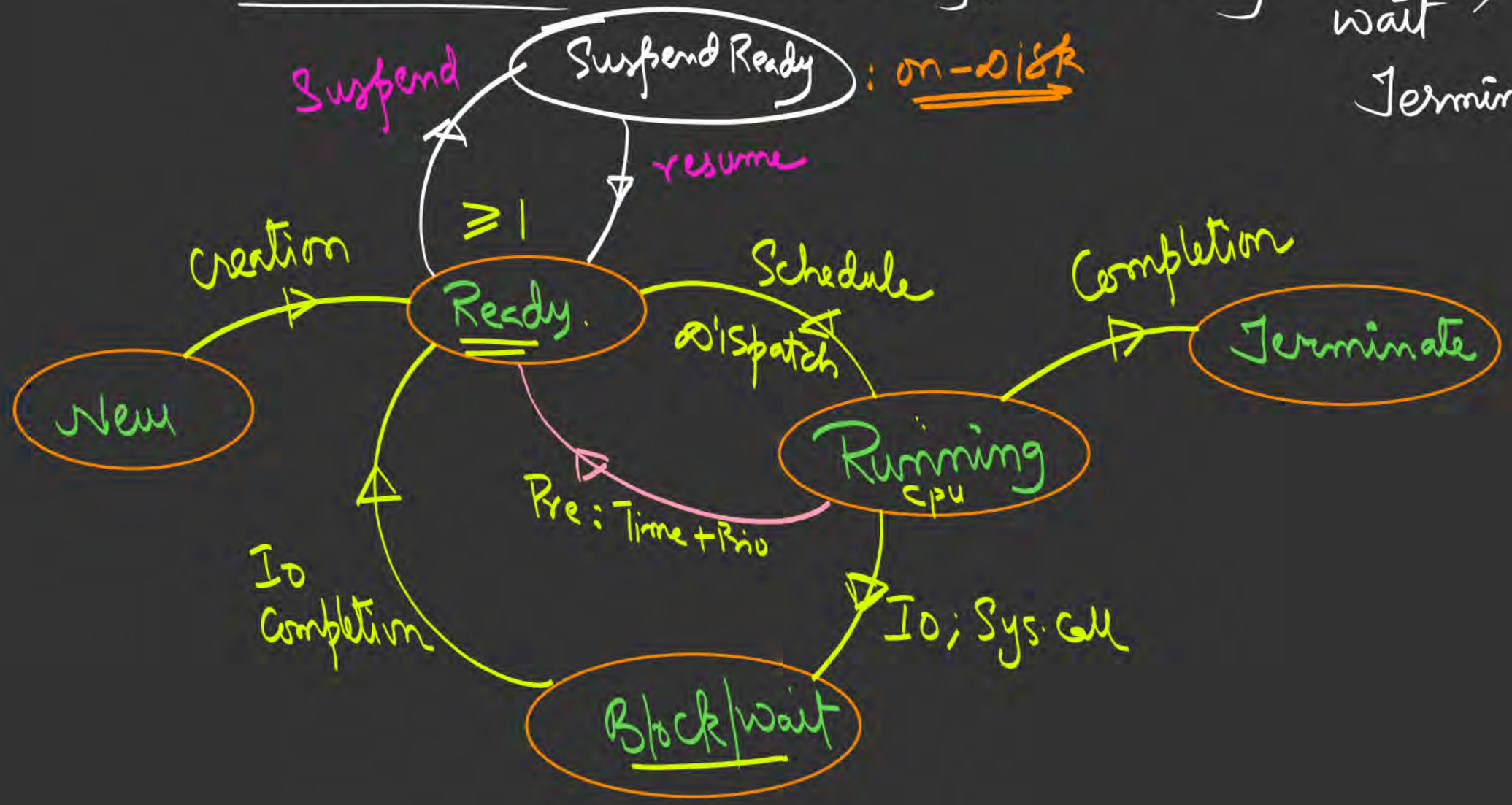
D.M.A (malloc)

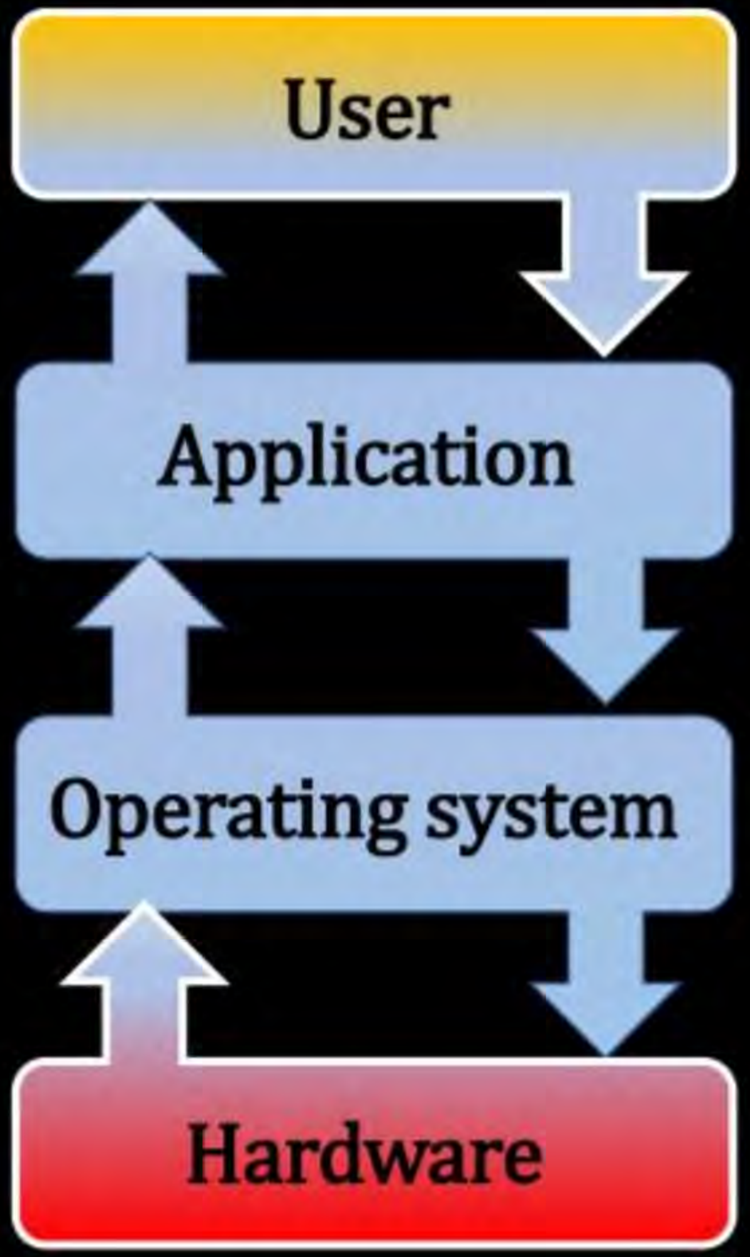
Function Calls

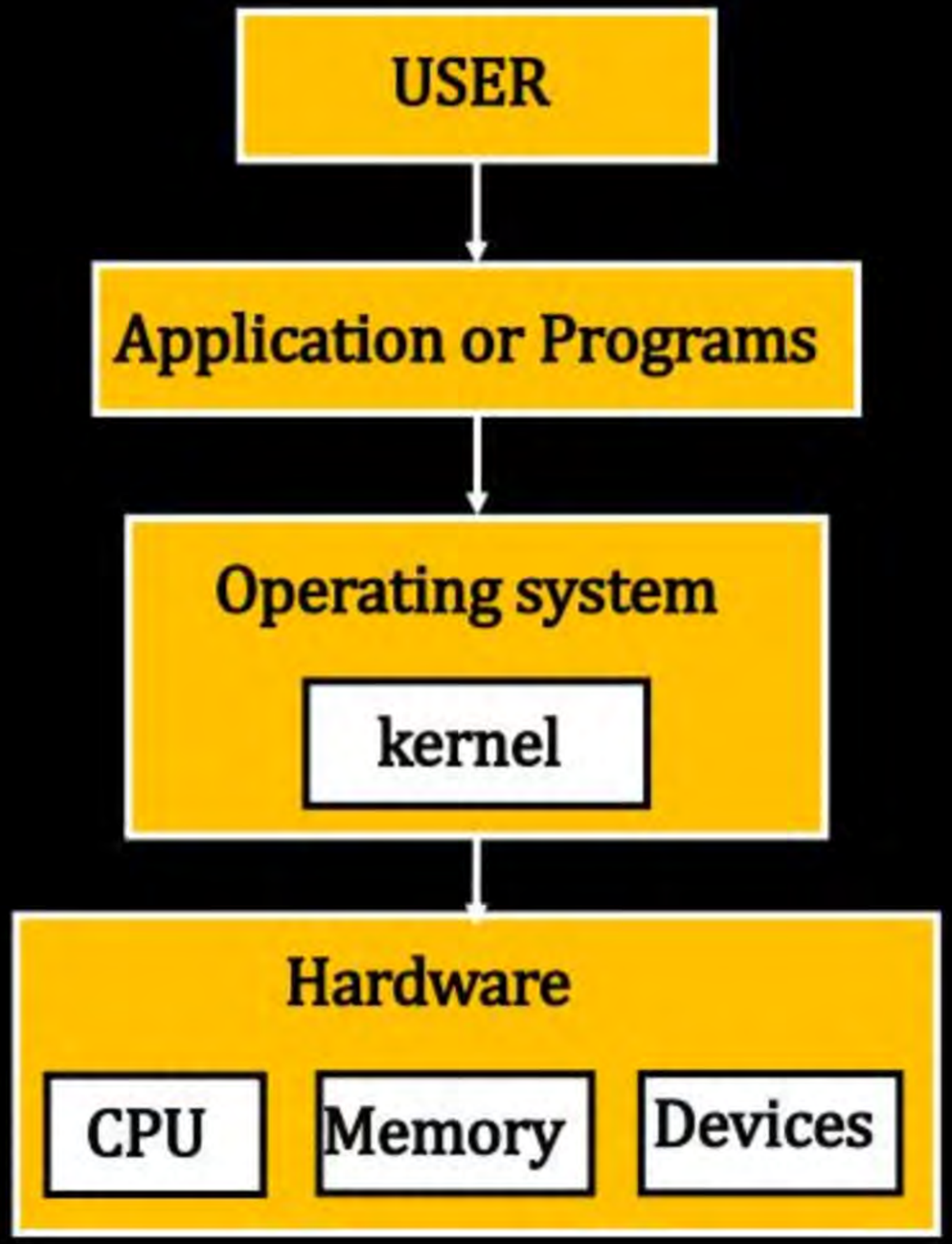
Pid, State
Type, P.C;
registers;
open files,
Priority ...

P.C.B
<Process Control Block>

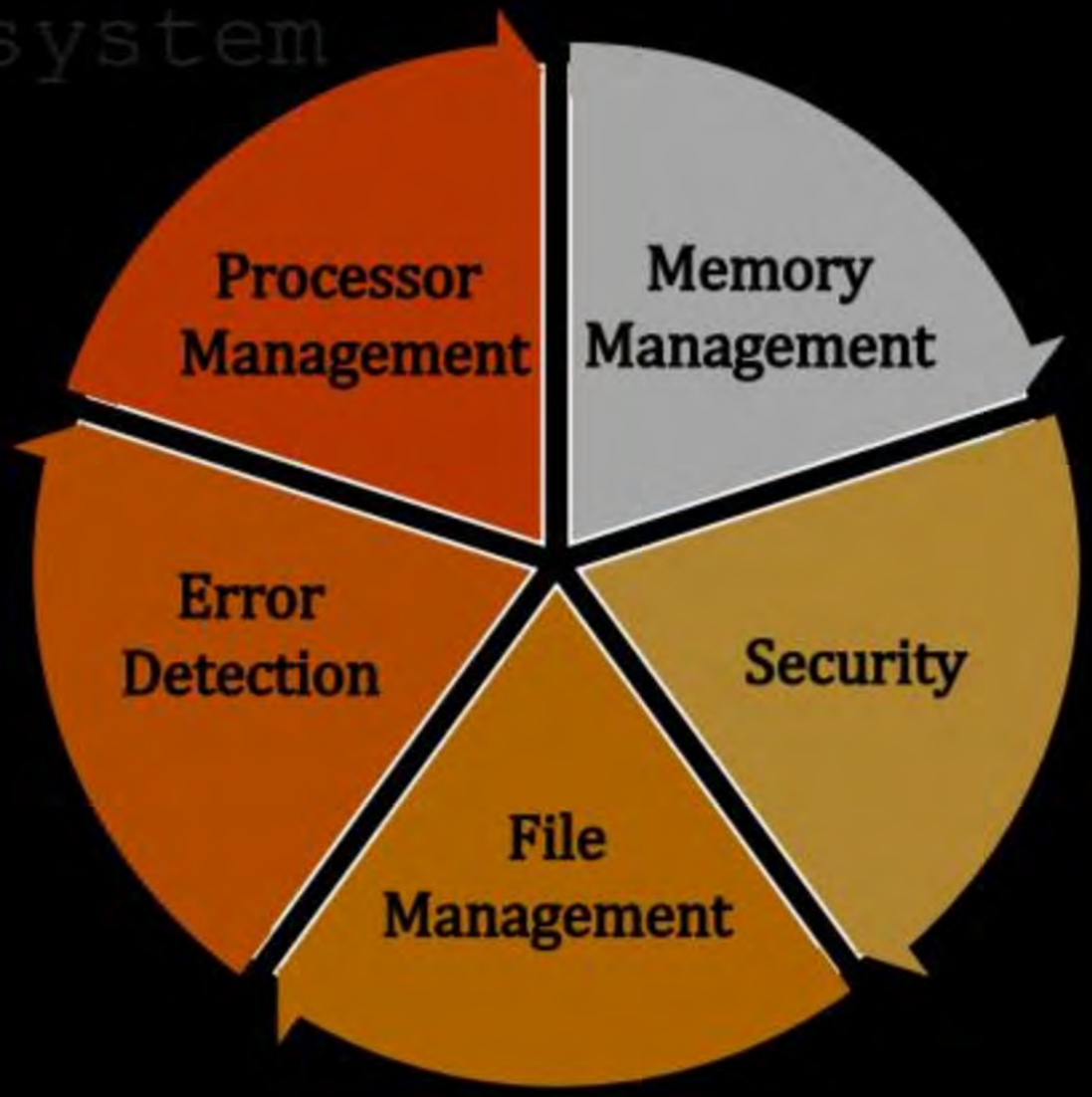
Process States: New; Ready; Running; Block/wait; Terminate

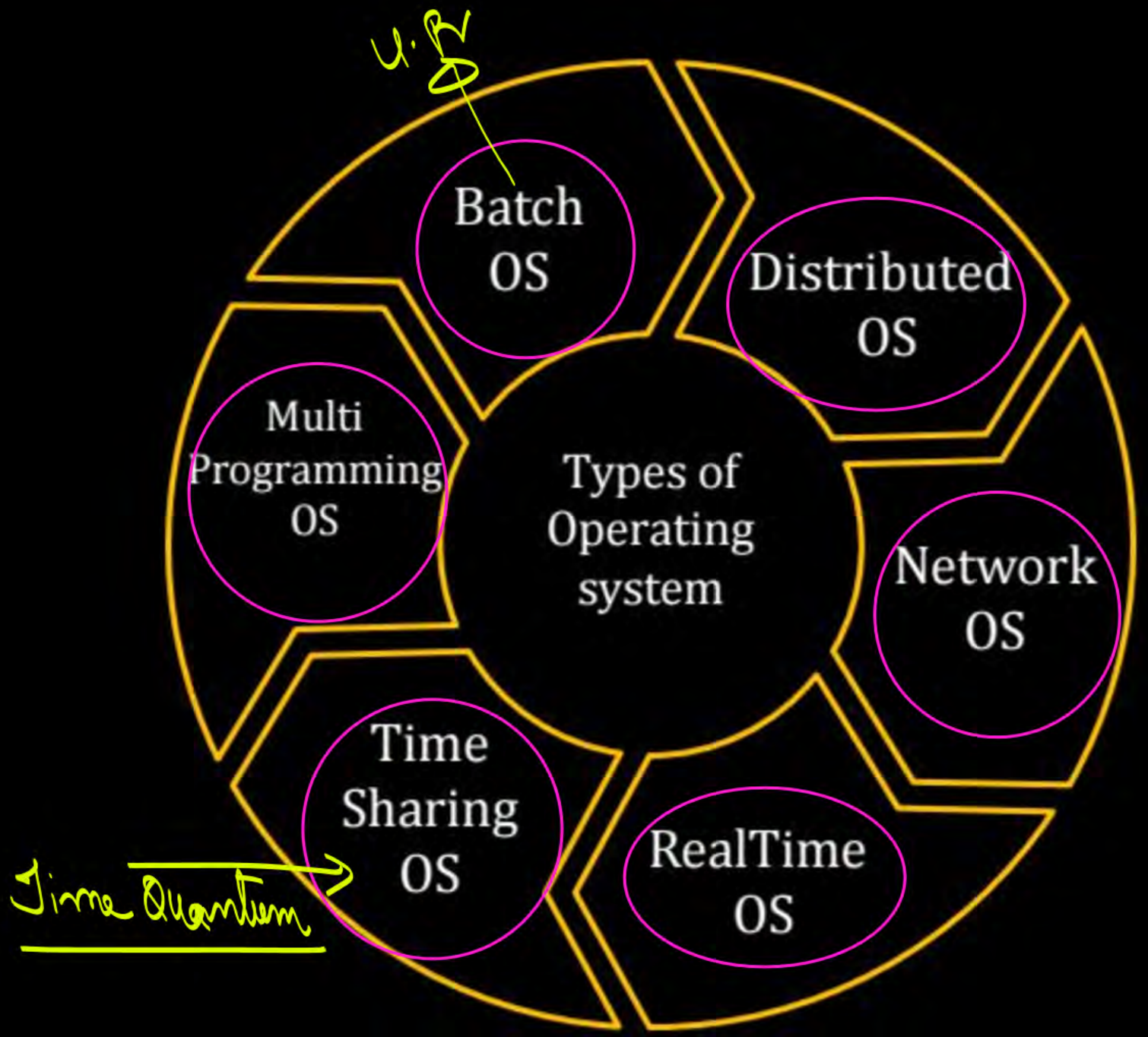



User
Application
Operating system
Hardware

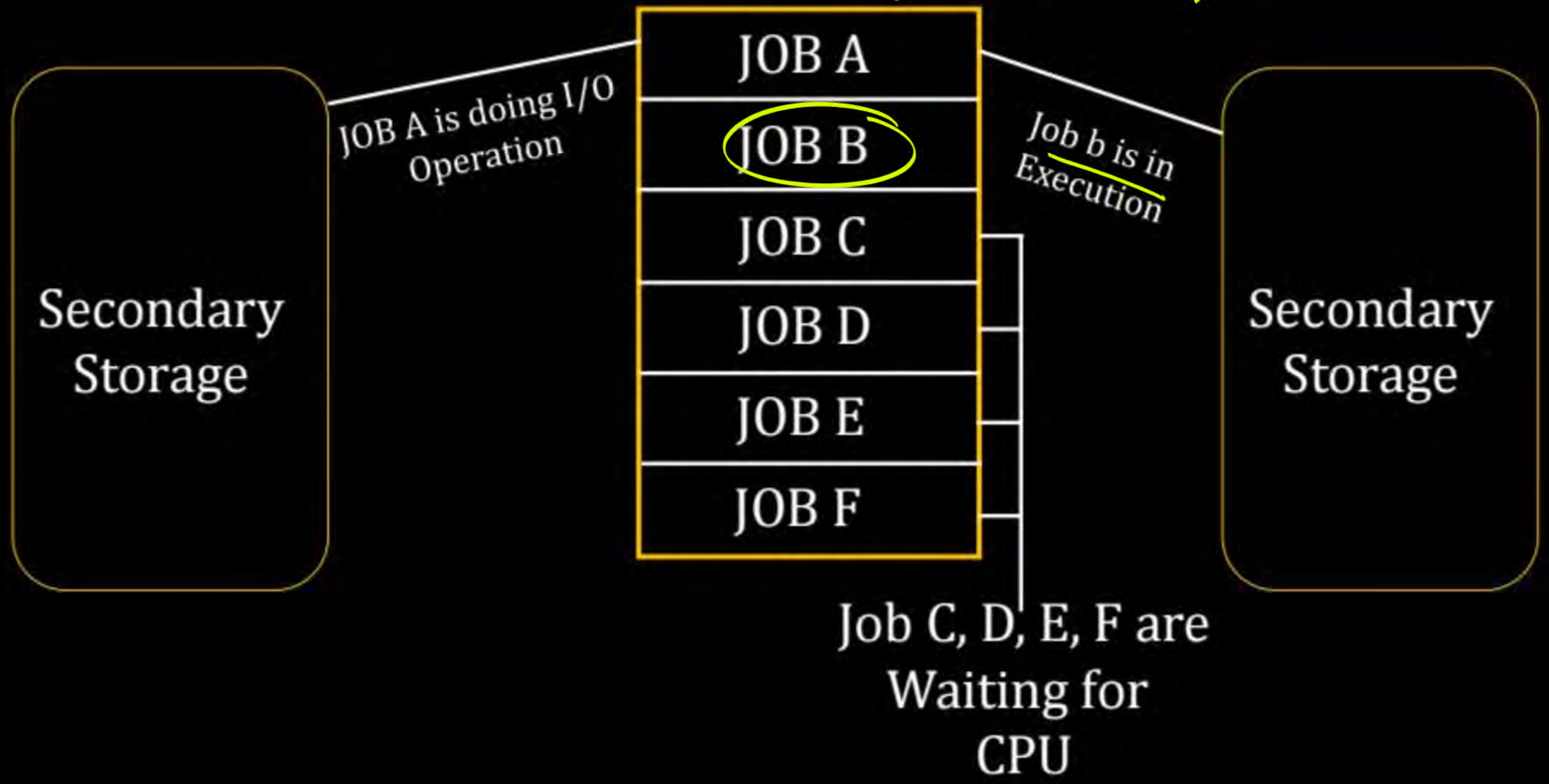

USER
Application or Programs
Operating system
kernel
Hardware
CPU
Memory
Devices

Functions of Operating system

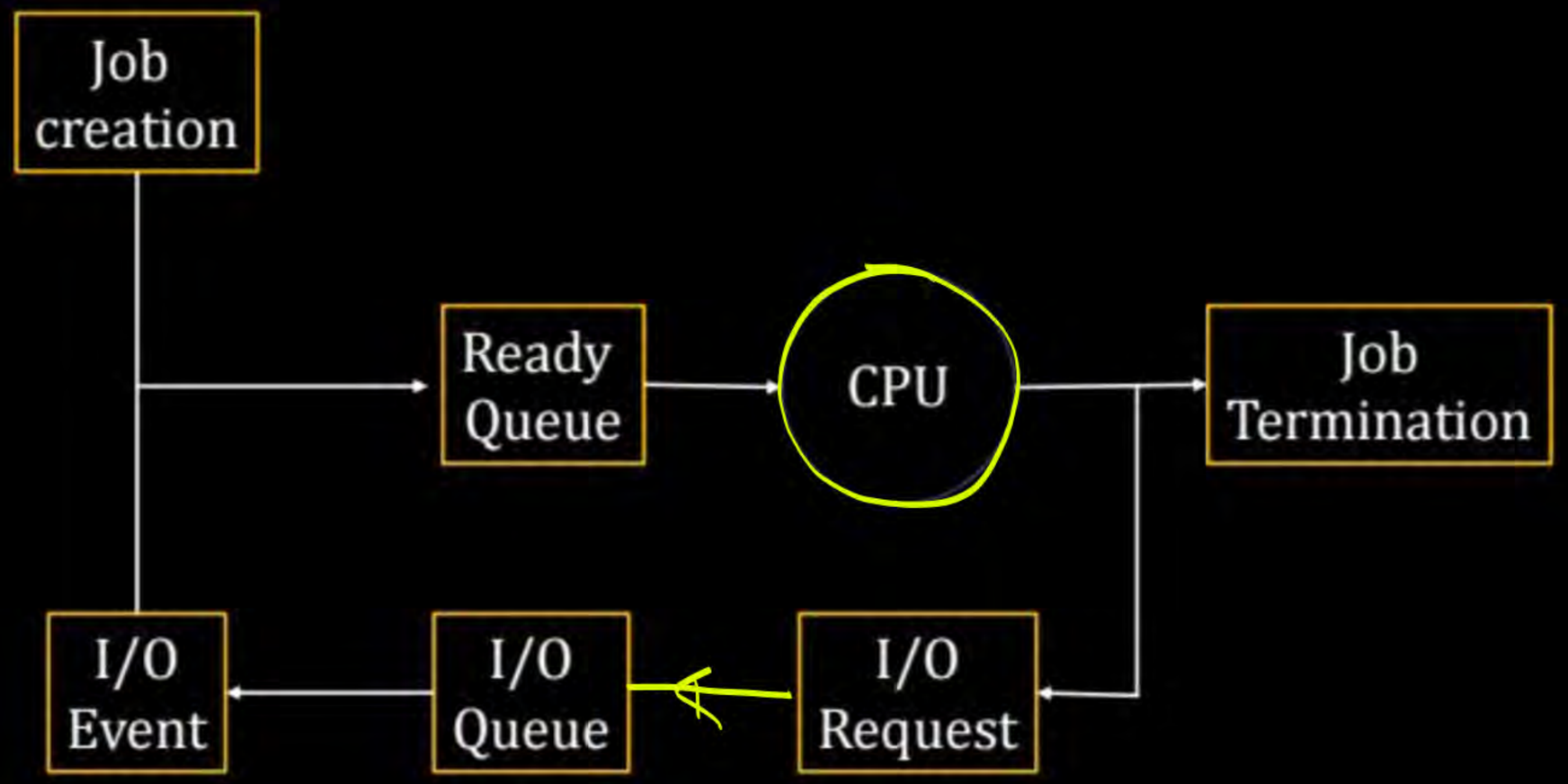



U.R
Batch OS
Distributed OS
Multi Programming OS
Types of Operating system
Network OS
Time Sharing OS
RealTime OS
Time Quantum

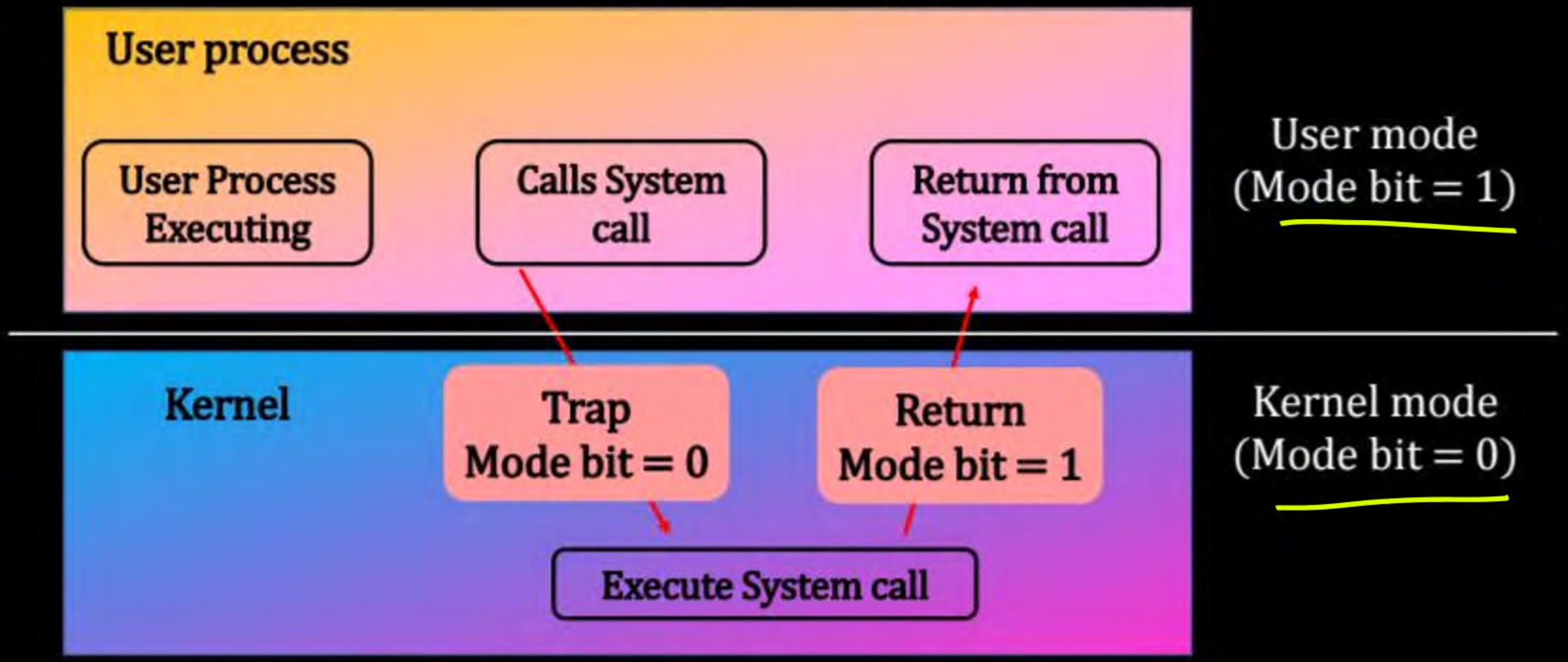
Schematic view of a M.Pr. O.S;



Multiprogramming
A Schematic view of Multiprogramming



Mode - Shifting



1. Kernel Mode

   In Kernel mode, the executing code has complete and unrestricted access to the underlying hardware. It can execute any CPU instruction and reference any memory address. Kernel mode is generally reserved for the lowest-level, most trusted functions of the operating system. Crashes in kernel mode are catastrophic; they will halt the entire PC.

2. User Mode

   In User mode, the executing code has no ability to directly access hardware or reference memory. Code running in user mode must delegate to system APIs to access hardware or memory. Due to the protection afforded by this sort of isolation, crashes in user mode are always recoverable. Most of the code running on your computer will execute in user mode.

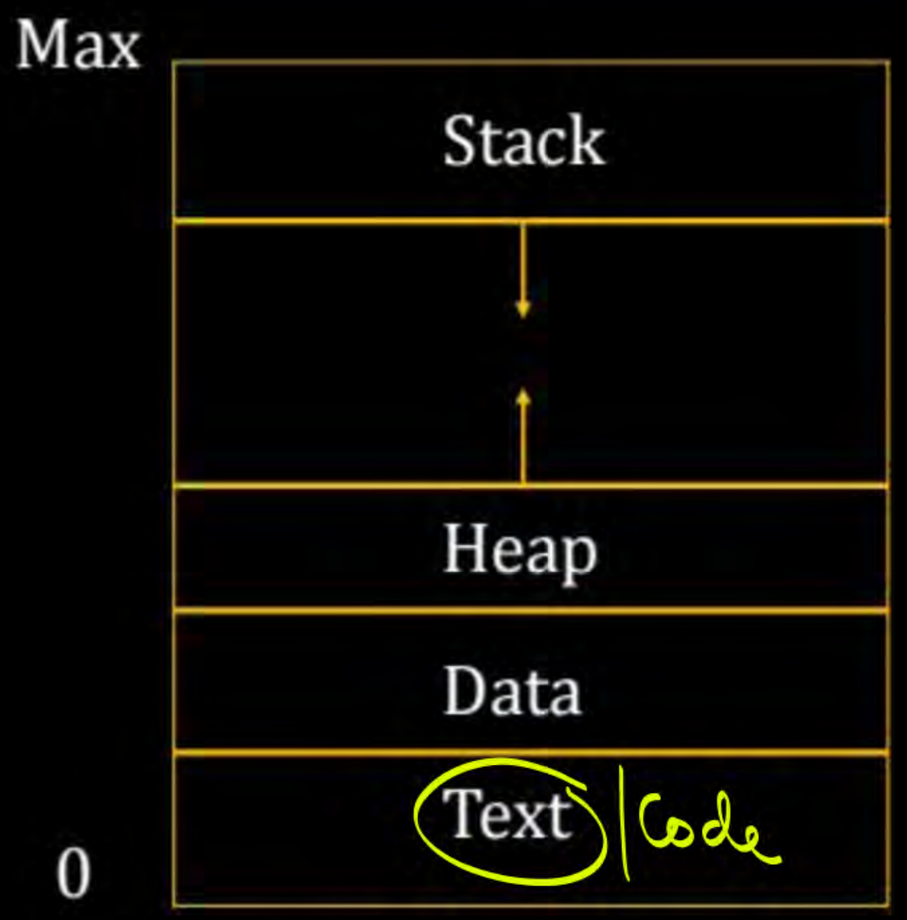
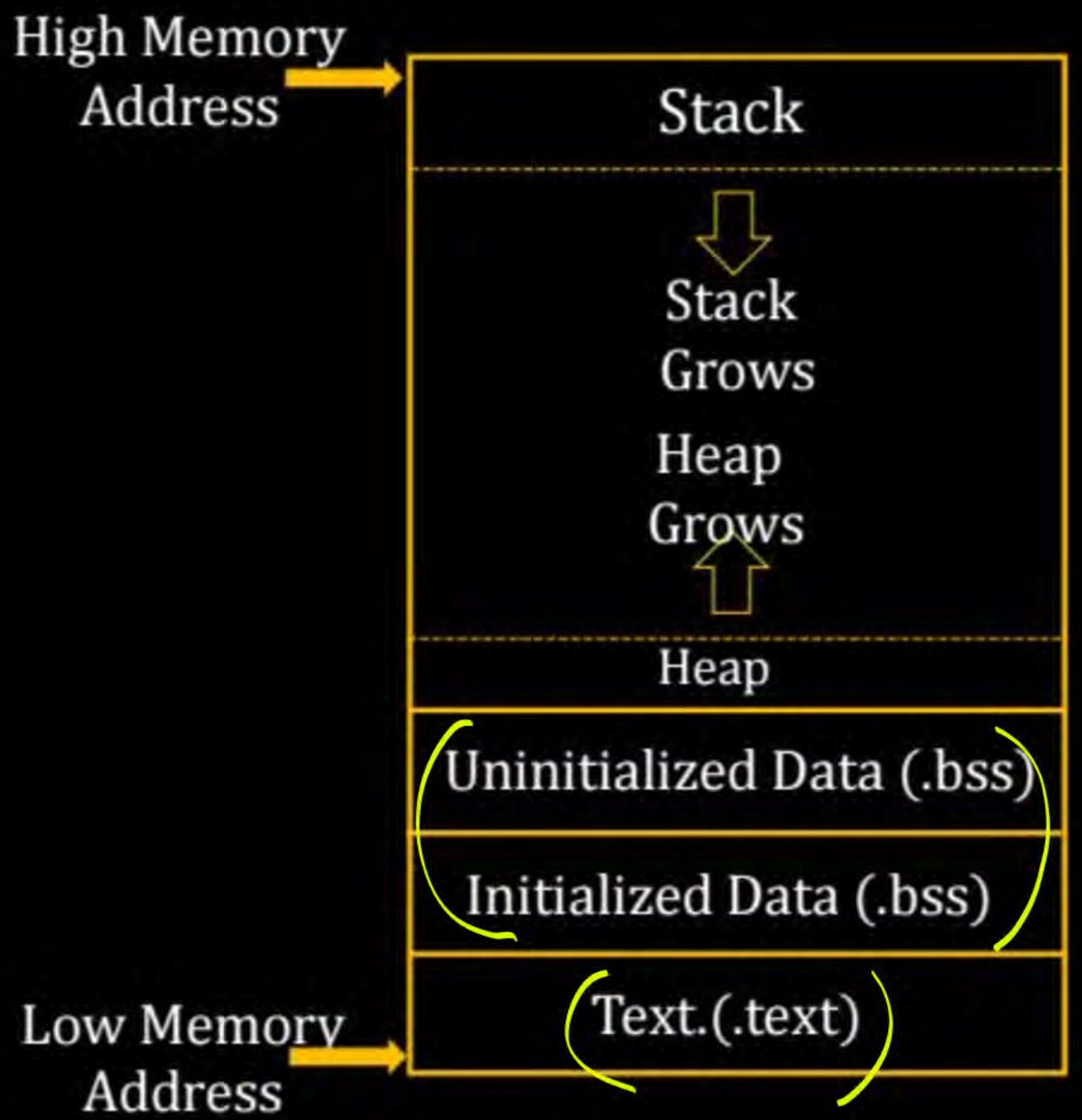


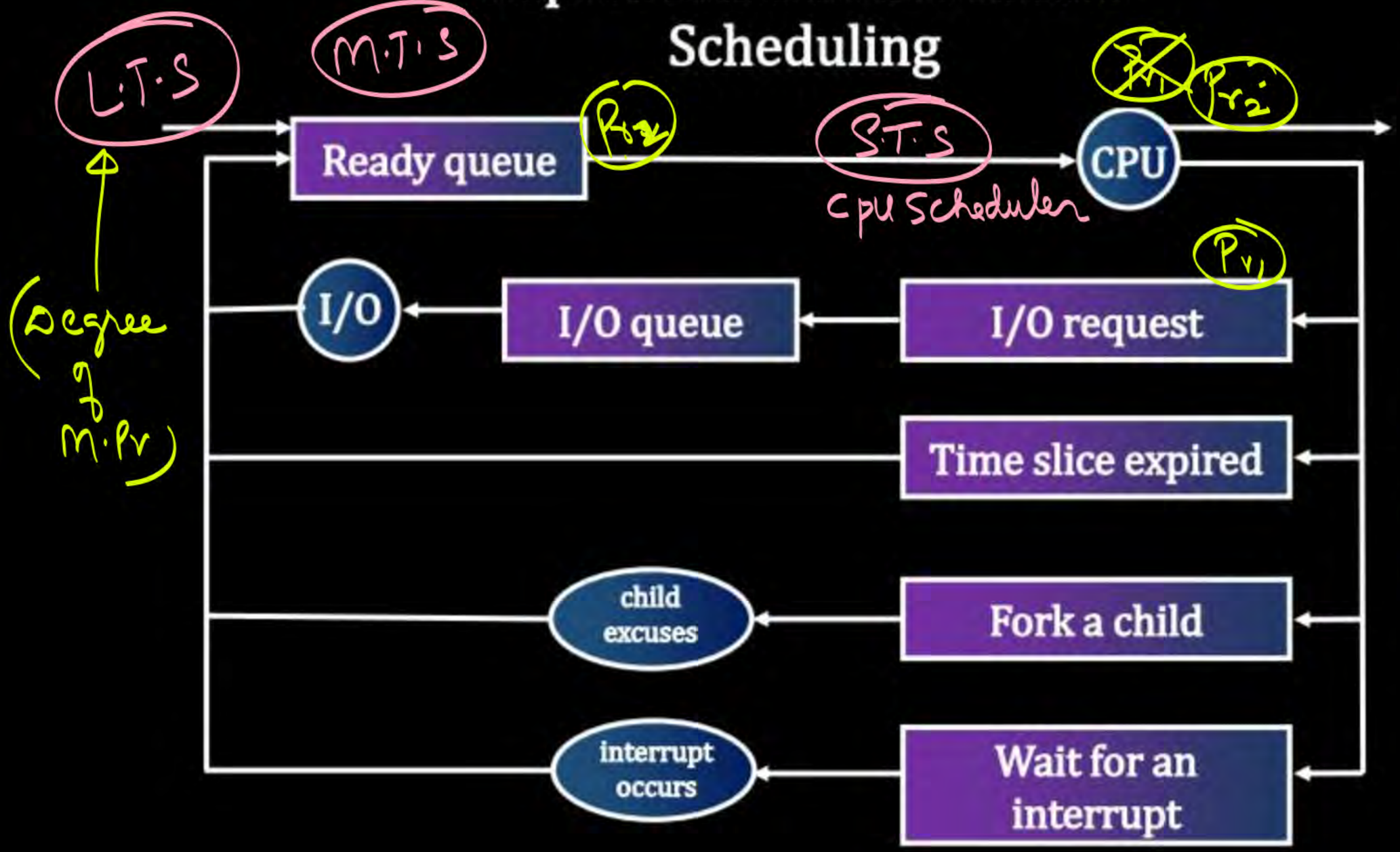
Figure: Process in the Memory



Pointer	Process State
Process number	
Process counter	
Registers	
Memory Limits	
List of open files	
...	

P.C.B

Representation of Process Scheduling



Schedulers

→ Long Term

→ Short Term

→ Medium Term

Dispatcher

↓

Content-switching

Process Switching

Q. 2007: CS

ISRO PYQ SERIES

A task in a blocked state → (IO + Sys. Call + Resource)

A is executable

B is running

C must still be placed in the run queues

D Is waiting for some temporarily unavailable resources.

Q. 2008: CS

(C.O)

ISRO PYQ SERIES

An interrupt in which the external device supplies its address as well as the interrupt requests is known as

A. Vectored interrupt

B. Maskable interrupt

C. Non maskable interrupt

D. Designated interrupt

Q. 2008: CS

ISRO PYQ SERIES

Which of the following need not necessarily be saved on a context switch between processes ?

A. General purpose registers

B. Translation look-aside buffer

C. Program counter

D. All of these

Q. 2008: CS

ISRO PYQ SERIES

What is the name of the operating system that reads and reacts in terms of actual time ?

A. Batch system

B. Quick response system

C. Real time system

D. Time sharing system

Q. 2008: CS

ISRO PYQ SERIES

An example of spooled device is a

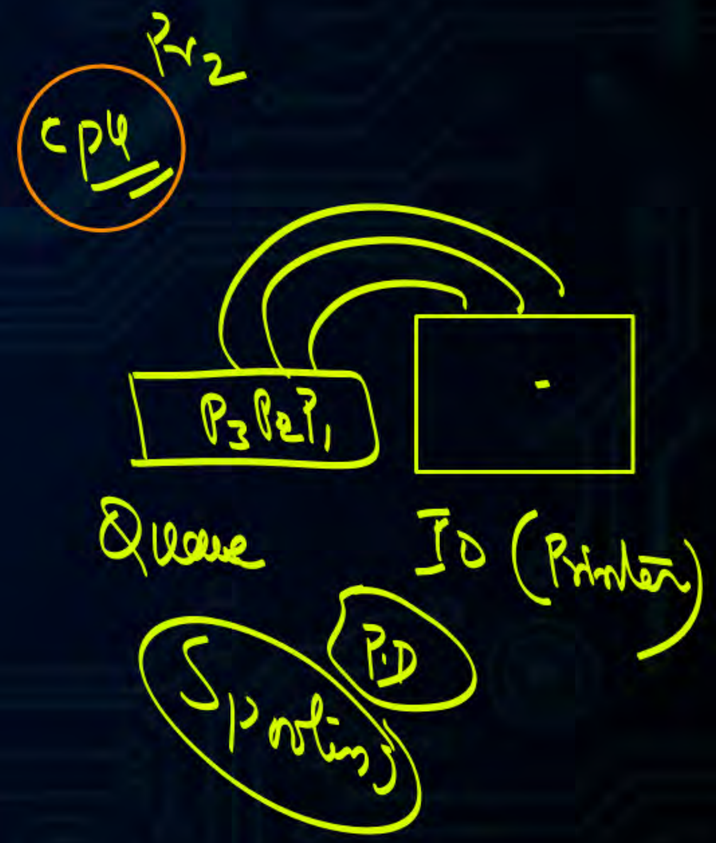
→ SPOOL : Simultaneous Peripheral op'n on-line

A. Line printer used to print the output of a number of jobs.

B. Terminal used to enter input data to a running program.

C. Secondary storage device in a virtual memory system.

D. Graphic display device.



Q. 2008: CS

ISRO PYQ SERIES

Fork is

Programmer

A. The creation of a new job.

B. The dispatching of a task.

C. Increasing the priority of a task.

D. The creation of a new process.

fork is a Sys. call to create a new Process;

Q. 2008: CS

ISRO PYQ SERIES

Which of the following need not necessarily be saved on a Context Switch between processes?

A. General purpose register

B. Translation look aside buffer

C. Program Counter

D. Stack pointer

Q. 2009: CS

ISRO PYQ SERIES

The primary purpose of an operating system is

A. To make the most efficient use of the computer hardware

B. To allow people to use the computer

C. To keep systems programmers employed

D. To make computers easier to use

Q. 2009: CS

ISRO PYQ SERIES

Which is the correct definition of a valid process transition in an operating system?

A. Wake up: ready → running

B. Dispatch: ready → running

C. Block: ready → running

D. Timer runout: → ready → blocked

Q. 2009: CS

ISRO PYQ SERIES

Special software to create a job queue is called a

A Driver

B Spooler

C Interpreter

D Linkage editor

Q. 2009: CS

ISRO PYQ SERIES

Process is

A. A program in high level language kept on disk

B. Contents of main memory

C. A program in execution

D. A job in secondary memory

Q. ISRO SC : 2011

ISRO PYQ SERIES

There are three processes in the ready queue. When the currently running process requests for I/O how many process switches take place?

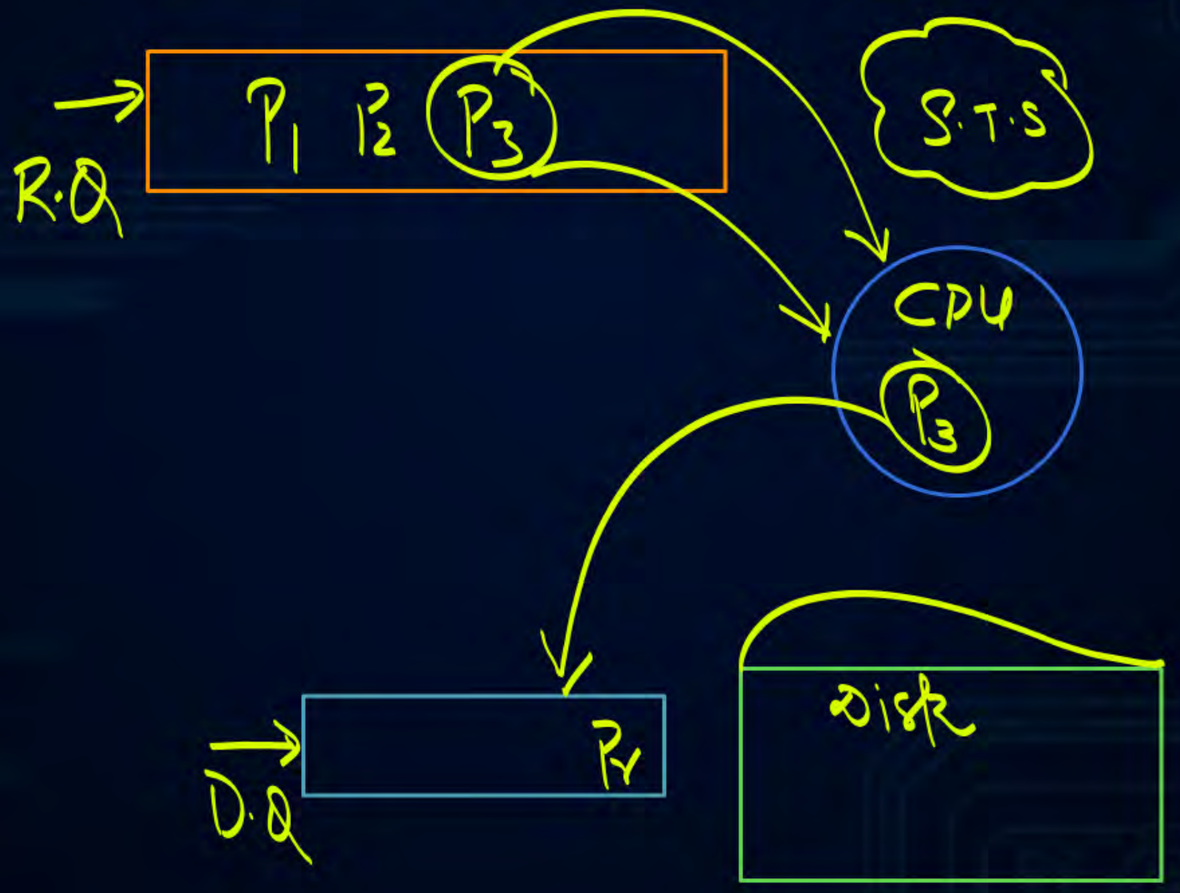
CPU

A 1

B 2

C 3

D 4



Q. ISRO SC : 2011

ISRO PYQ SERIES

Which of the following UNIX command allows scheduling a program to be executed at the specified time?

(A) cron

(B) nice : priority

(C) date and time

(D) schedule : STS

Q. 2013: CS

ISRO PYQ SERIES

The state of a process after it encounters an I/O instruction is

A ready

B blocked

C idle

D running

fork() System Call:

Program

```
main()
{
    printf("Hello");
}
```

Process

~~printf("Hello")~~

Hello

```
main()
{
1. fork();
2. printf("Hello");
}
```

Parent

1. ~~f()~~
2. ~~p()~~

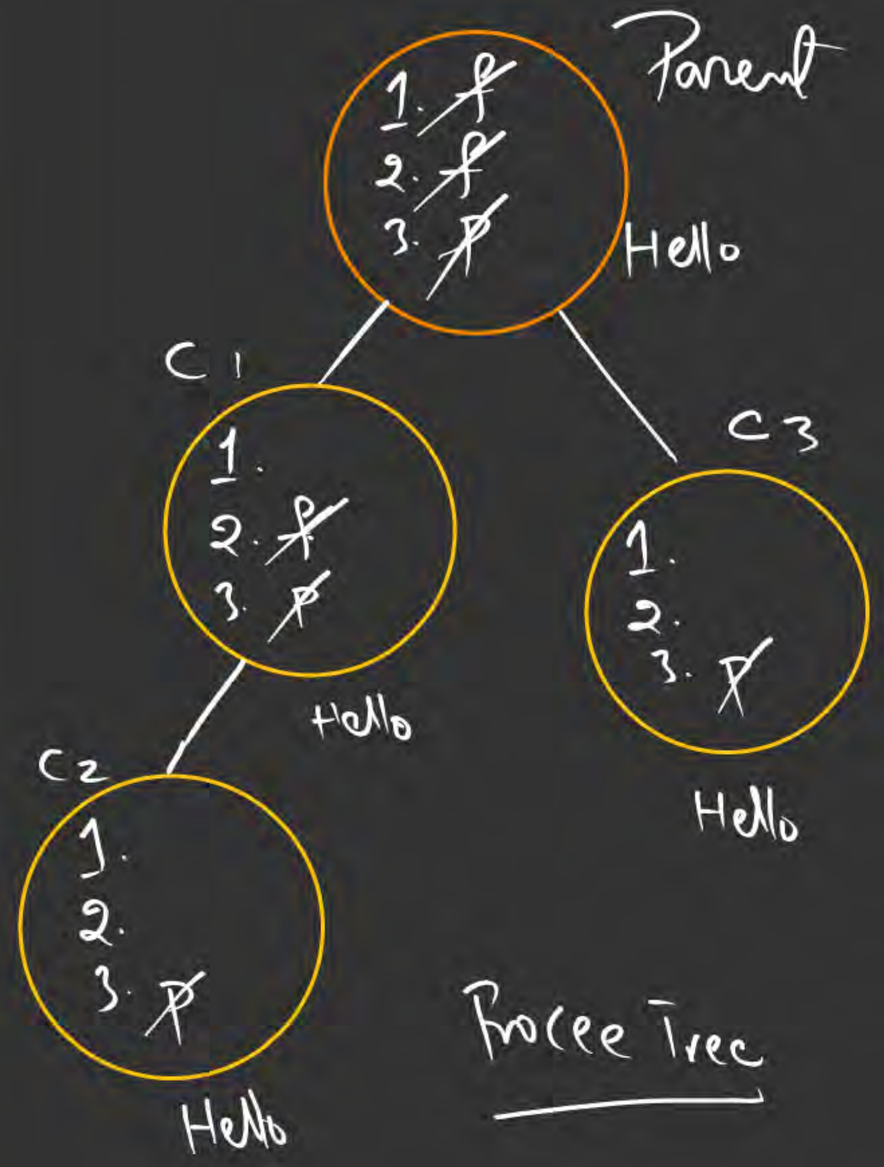
Hello

child

1. ~~f()~~
2. ~~p()~~

Hello

```
main()
{
  1. fork();
  2. fork();
  3. printf("Hello");
}
```



Process Tree

```
main()
{
  fork();
  fork();
  fork();
  printf("Hello");
}
```

Total Processes = 8

New/child Pro's = 7

```
main()
{   int i, n;
    for (i=1; i<=n; ++i)
        fork();   ; n-Times
}
```

No. of child Processes = $(2^n - 1)$;

No. of fork()	Total Processes	child Processes
1	2	1
2	4	3
3	8	7
4	16	15
⋮		
n	2^n	$(2^n - 1)$

Q. 2015: CS

ISRO PYQ SERIES

Consider the following program.

```
main()
{
fork(); fork(); fork();
}
```

How many new processes will be created?

A 8

B 6

C 7

D 5

Return-value of fork

- (−ve) (−1) → Error
- 0 → child
- (>0) +ve → Parent

fork succeeds

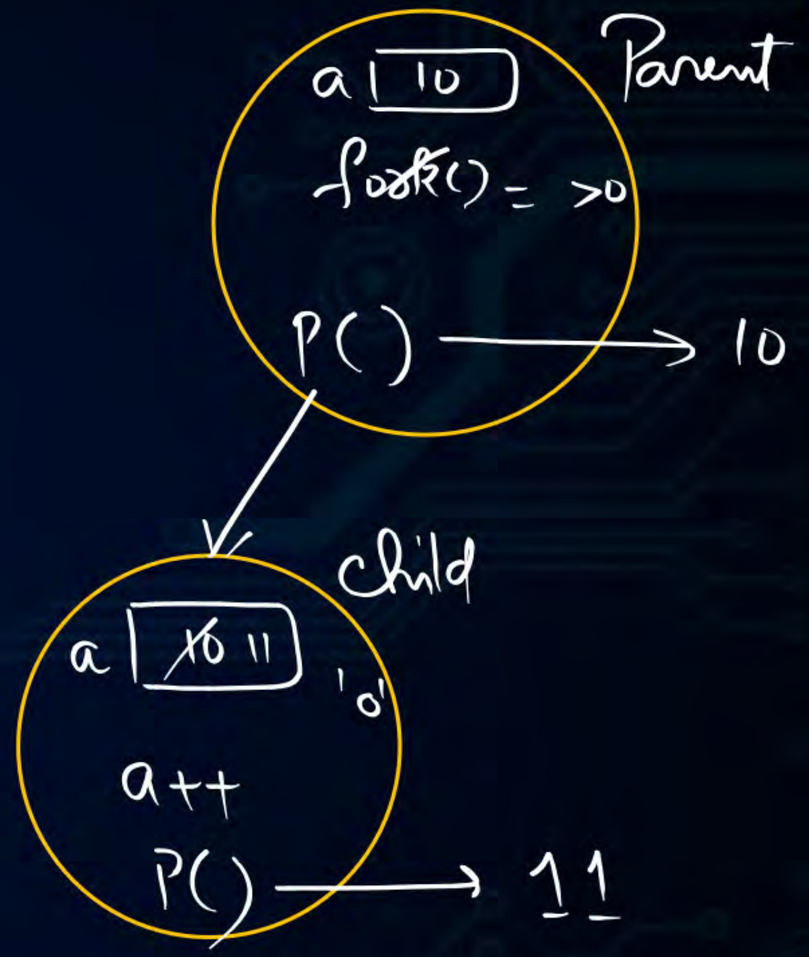
```
int ret;
ret = fork();
if (ret == 0)
{
    || child ||
}
else
{
    || Parent ||
}
```

Q. 2017: CS

ISRO PYQ SERIES

What is the output of the following program?

```
main( )
{
        int a = 10;
        if ((fork ( ) == 0))
        a++;
        printf ("%d\n", a );
}
```



A. 10 and 11

B. 10

C. 11

D. 11 and 11

Q. 2017: CS

ISRO PYQ SERIES

The linux command "mknod myfifo b 4 16"

(Block-device)

A. Will create a character device if the user is root

B. Will create a named pipe FIFO if the user is root

C. Will create a block device if the user is root

D. None of the above

Q. 2017: CS

ISRO PYQ SERIES

Which of the following statement is true?

A. Hard real time OS has less jitter than soft real time OS

B. Hard real time OS has more jitter than soft real time OS

C. Hard real time OS has equal jitter as soft real time OS

D. None of the above

Q. 2017: CS

ISRO PYQ SERIES

A process executes the following code

for (i = 0; i < n; i ++) fork( ); 'n' – times

The total number of child processes created is

(A) n^2

(B) $2^{n+1} - 1$

(C) $2n$

(D) $2^n - 1$

Q. 2017: CS

ISRO PYQ SERIES

Which of the following is false?

A. User level threads are not scheduled by the kernel T

B. Context switching between user level threads is faster than context switching between kernel level threads T (No Need of Mode Shifting)

C. When a user thread is blocked all other threads of its processes are blocked T

D. Kernel level threads cannot utilize multiprocessor systems by splitting threads on different processors or cores F

Q. 2018: CS

ISRO PYQ SERIES

The following C program

```
main()
{
    fork() ; fork() ; printf ("yes");
}
```

If we execute this core segment, how many times the string yes will be printed ?

A. Only once

B. 2 times

C. 4 times

D. 8 times

Q. 2018: CS

ISRO PYQ SERIES

In multi-programmed systems, it is advantageous if some programs such as editors and compilers can be shared by several users. Which of the following must be true of multi-programmed systems in order that a single copy of a program can be shared by several users?

I. The program is a macro

II. II. The program is recursive

III. III. The program is reentrant (Read-only Code)

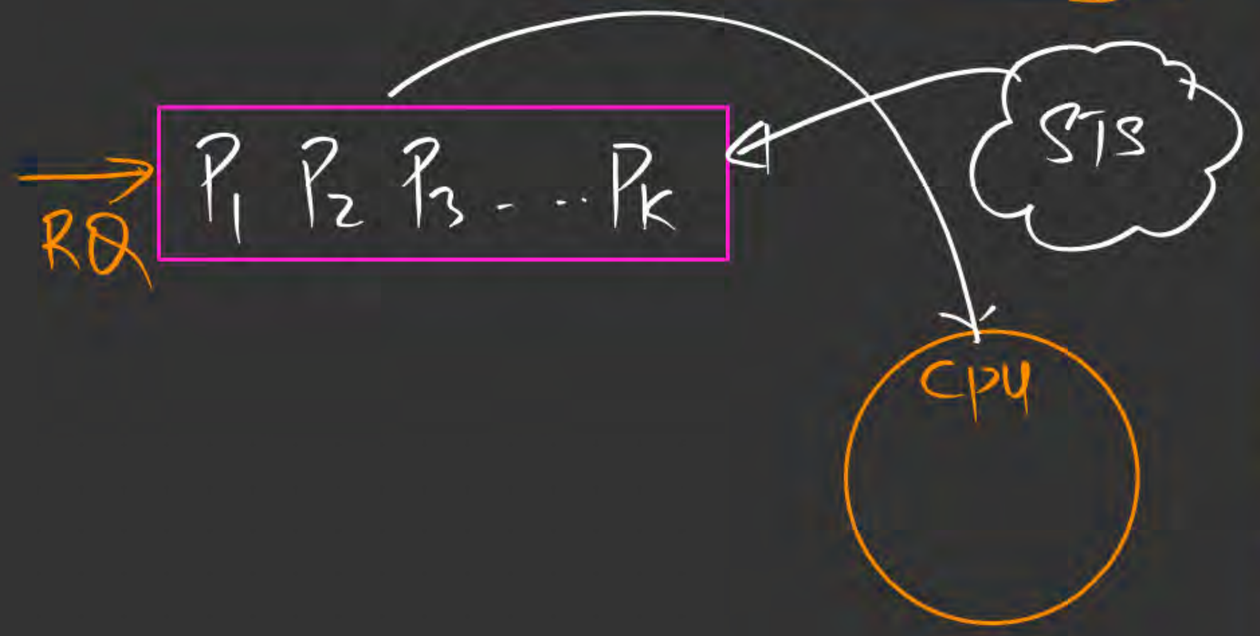
A. I only

B. II only

C. III only

D. I, II and III

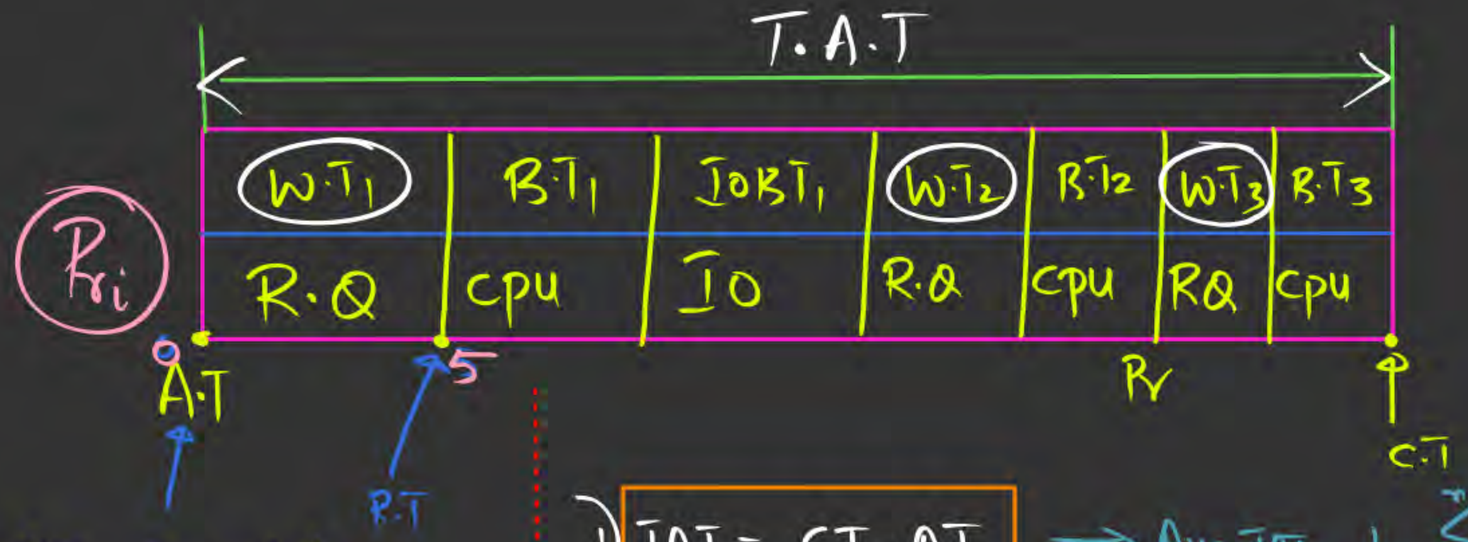
CPU Scheduling : < Design of S.T.S >



Goals

1) Max cpu utilization (Throughput)

2) Minimize
   - (i) Turn-Around Time (TAT)
   - (ii) Waiting Time (WT)
   - (iii) Response Time (RT)



→ AT = Arrival Time

→ BT = cpu Burst time

→ C.T = Completion Time

1) $\boxed{TAT = CT - AT}$ $\Longrightarrow$ $Avg.TAT = \frac{1}{n}\sum_{i=1}^{n}(CT-AT)$

2) $\boxed{W.T = TAT - (BT + IOBT)}$

if IOBT=0

$\boxed{W.T = TAT - BT}$

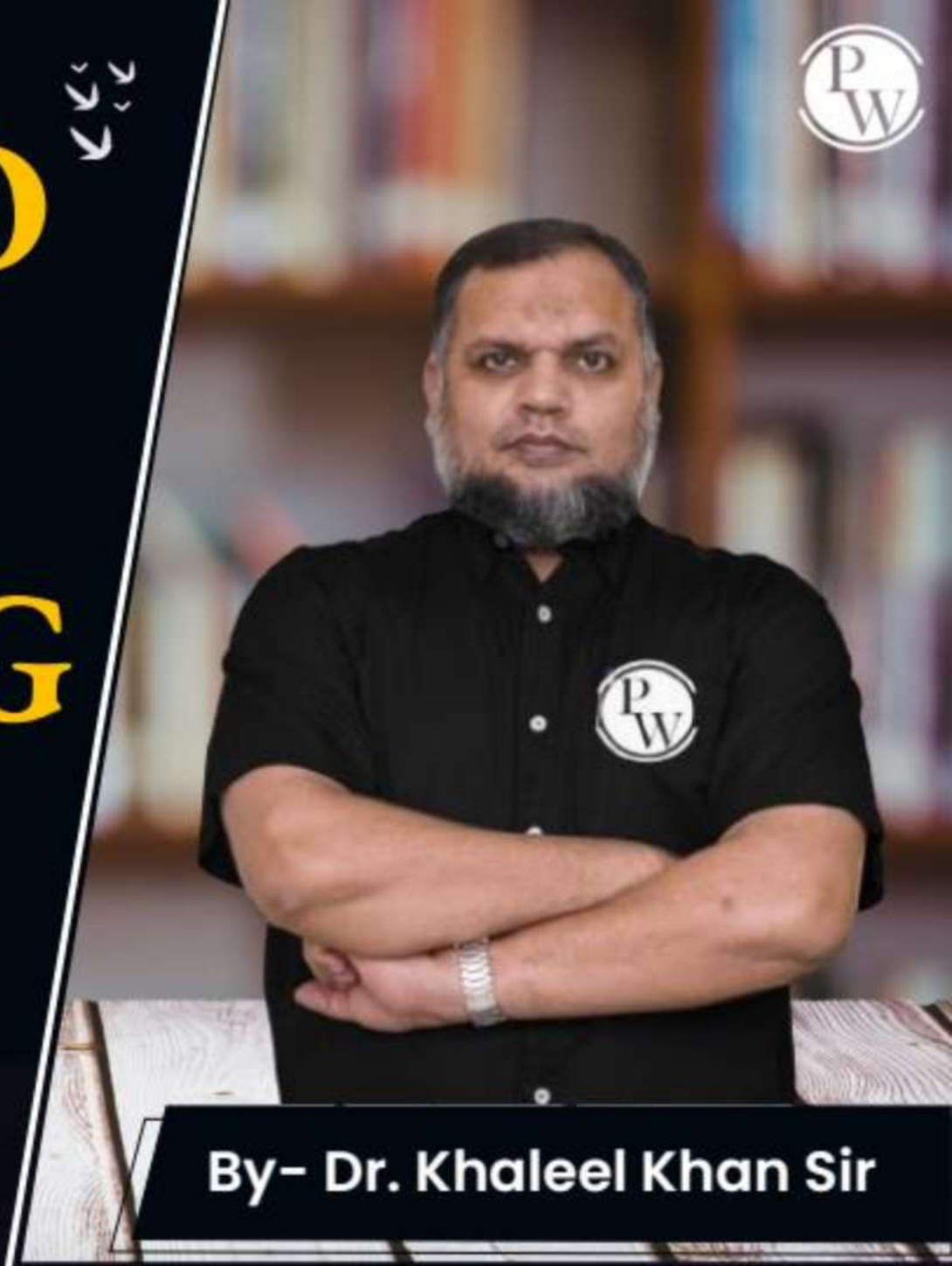
Response Time = The difference of Time of Arrival to the time where it gets onto cpu for the first Time)

Thank You...

MISSION ISRO CS & IT ENGINEERING

Operating System

Lecture No.- 02



By- Dr. Khaleel Khan Sir

Recap of Previous Lecture

Topic Process Concept

Topics to be Covered

Topic CPU Scheduling

CPU Scheduling:

Non-PreEmptive

→ voluntary release of CPU

PreEmptive

→ Forceful reallocation of Process from CPU

1) FCFS
2) S.J.F | SRTF
3) Priority based
4) Round-Robin

1) FCFS

CT − AT

(TAT − BT)

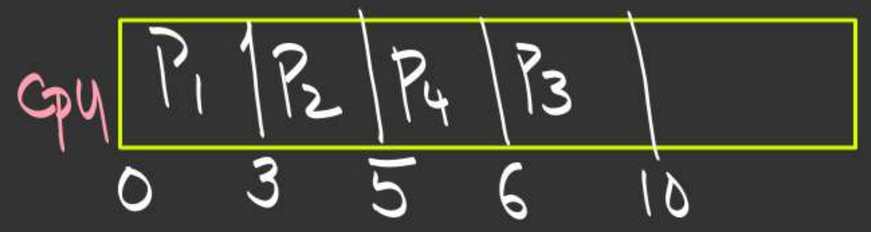
P.NO	A.T	B.T	C.T	TAT	W.T
1	0	2	2	2	0
2	1	1	3	2	1
3	3	3	6	3	0
4	5	4	10	5	1
5	8	6	16	8	2

Gantt-chart

2) S.J.F (Shortest Job First):

Criteria: B.T
Mode : N.Pr

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



3) S.R.T.F (Shortest Remaining Time First)

Pre Emptive SJF

Criteria: B.T

"PreEmption of Running Process is based on arrival/availability of a Strictly Shorter Process"

P.No	A.T	B.T
1	0	~~5~~ 3
2	2	2

Cpu	P_1	P_2	P_1	

0 2 4 7

P_r

P.No	A.T	B.T
1	0	~~8~~ 7 ✓
2	1	~~5~~ ~~3~~ 4 ✓
3	2	5 ✓
4	3	~~2~~ 1
5	4	1 ✓

Cpu	P_1	P_2	P_4	P_5	P_2	P_3	P_1	

0 1 3 5 6 10 15 22

P_r P_r

4) Round-Robin: Time Quantum (TQ)

R.Q: FIFO order: Preemptive: Preemptive FCFS

TQ = 2

P.No	A.T	B.T	C.T	TAT	W.T
1	0	4	7	7	3
2	0	3	8	8	5
3	0	1	5	5	4

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

CPU	P_1	P_2	P_3	P_1	P_2	

0, 2, 4, 5, 7, 8

Pr, Pr

TQ = 3

P.No	A.T	B.T
1	0	7
2	1	6
3	3	3
4	5	2
5	6	4

R.Q: ~~P1~~; ~~P2~~; ~~P3~~; ~~P1~~; ~~P4~~; ~~P5~~; ~~P2~~; ~~P1~~; P5

CPU	P_1	P_2	P_3	P_1	P_4	P_5	P_2	P_1	P_5

0, 3, 6, 9, 12, 14, 17, 20, 21, 22

Pr, Pr, Pr, Pr

Time →

Topic : CPU Scheduling

to overcome Starvation / Inc. Priority of Process;

#Q. The term "aging" refers to **CS: 2007**

A. booting up the priority of a process in multi-level of queue without feedback.

B. gradually increasing the priority of jobs that wait in the system for a long time to remedy infinite blocking.

C. keeping track of the following a page has been in memory for the purpose of LRU replacement.

D. letting job reside in memory for a certain amount of time so that the number of pages required can be estimated accurately.

Topic : CPU Scheduling

#Q. Consider a set of n tasks with known runtimes r_1, r_2 ..... r_n to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput? **CS: 2007**

Shortest Job First / optimal Algo
↓
Max. Throughput
Min Av. TAT ;
Av. W.T

A. Round robin

B. Shortest job first

C. Highest response ratio next

D. First cum first served

Topic : CPU Scheduling

#Q. Round Robin scheduling is essentially the pre-emptive version of **CS: 2007**

A. FIFO

B. Shortest job First

C. Shortest remaining time

D. Longest remaining time

Topic : CPU Scheduling

#Q. On a system using non-preemptive scheduling, processes with expected run times of 5,18, 9 and 12 are in the ready queue. In what order should they be run to minimize wait time? **CS: 2007**

SJF : 5 ; 9 ; 12 ; 18

A. 5, 12, 9, 18

B. 5, 9, 12, 18

C. 12, 18, 9, 5

D. 9, 12, 18, 5

Topic : CPU Scheduling

#Q. Feedback queues

A. are very simple to implement

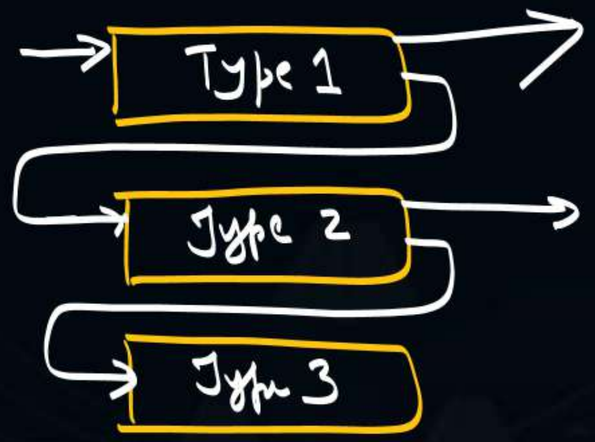
B. dispatch tasks according to execution characteristics

C. are used to favor real time tasks

D. require manual intervention to implement properly

Multi-Level-Feedback

CS: 2007



Topic : CPU Scheduling

#Q. Four jobs to be executed on a single processor system arrive at time 0 in the order A, B, C, D. Their burst CPU time requirements are 4,1, 8, 1, time units, respectively. The completion time of A under round robin scheduling with time slice of one-time unit is **CS: 2008**

R.Q: A, ~~B~~, C, ~~D~~; A; C

A. 10

B. 4

C. 8

D. 9

CPU

A	B	C	D	A	C	A	C	A

0 1 2 3 4 5 6 7 8 9

Topic : CPU Scheduling

#Q. With Round-Robin CPU scheduling in a time-shared system **CS: 2008**

A. Using very large time slices (Quantas) degenerates into First-Come First served (FCFS) algorithm.

B. Using extremely small time slices improves performance.

C. Using very small time slices degenerates into Last-In First-Out (LIFO) algorithm.

D. Using medium sized time slices leads to shortest Request Time First (SRTF) algorithm.

Topic : CPU Scheduling

#Q. The performance of Round Robin algorithm depends heavily on **CS: 2008**

A. Size of the process.

B. The I/O bursts of the process.

C. The CPU bursts of the process.

D. The size of the time quantum.

Performance of Round Robin depends on Time-Quantum

Topic : CPU Scheduling

#Q. Consider three CPU-intensive processes, which require 10, 20 and 30 time units and arrive at times 0, 2, and 6, respectively. How many context switches are needed if the operating system implements a shortest remaining time first scheduling algorithm? Do not count the context switches at time zero and at the end

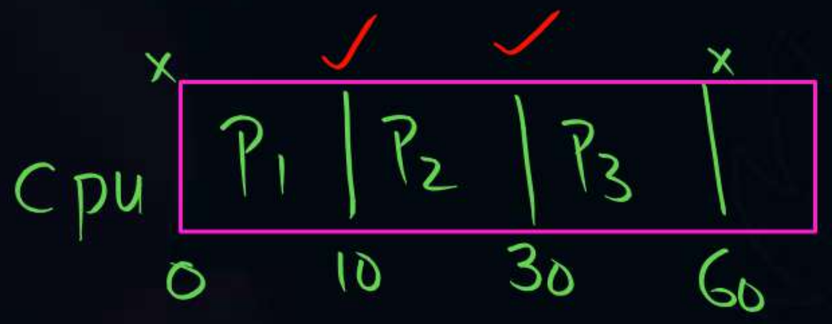
CS: 2009

A. 1

B. 2

C. 3

D. 4



P.NO	A.T	B.T
1	0	10
2	2	20
3	6	30

Topic : CPU Scheduling

#Q. Consider a set of 5 processes whose arrival time, CPU time needed and the priority are given below

Process Priority	Arrival Time (in ms)	CPU Time Needed (In ms)	Priority
P1	0	10	5
P2	0	5	2
P3	2	3	1
P4	5	20	4
P5	10	2	3

(Smaller the number, higher the priority.)
If the CPU scheduling policy is priority scheduling without pre-emption, the average waiting time will be

CS: 2009

A. 12.8 ms

B. 11.8 ms

C. 10.8 ms

D. 09.8 ms

CPU | P2 | P3 | P4 | P5 | P1 |

0 5 8 28 30 40

Slide 13

Topic : CPU Scheduling

#Q. The following table shows the processes in the ready queue and time required for each process for completing its job.

Process	A.T	Time (ms)
P_1	0	10
P_2	0	5
P_3	0	20
P_4	0	8
P_5	0	15

RQ: ~~P1~~, ~~P2~~, ~~P3~~, ~~P4~~, ~~P5~~, ~~P1~~; ~~P3~~; ~~P4~~; ~~P5~~; ~~P3~~; P5
P3

CPU	P_1	P_2	P_3	P_4	P_5	P_1	P_3	P_4	P_5	P_3

0 5 10 15 20 25 30 35 38 43 48

P_5	P_3

48 53 58

If round robin scheduling with 5ms is used what is the average waiting time of the processes in the queue?

CS: 2011

A. 27 ms

B. 26.2 ms

C. 27.5 ms

D. 27.2 ms

Topic : CPU Scheduling

#Q. In a system having a single processor, a new process arrives at the rate of six processes per minute and each such process requires seven seconds of service time. What is the CPU utilization? **CS: 2011**

A. 70 %

B. 30 %

C. 60 %

D. 64 %

RQ | $P_1 \cdots P_6$ |
7

60s (1 m)

| P_1 | P_2 | $\cdots$ | P_6 |
7 7 $\cdots$ 7

42s

% CPU utiliz $= \left(\frac{42}{60}\right) \times 100$

Topic : CPU Scheduling

#Q. A CPU scheduling algorithm determines an order for the execution of its scheduled processes. Given 'n' processes to be scheduled on one processor, how many possible different schedules are there? **CS: 2013**

A. n

B. n^2

C. n!

D. 2^n

^nP_r

$n = 3$

$3!$

$\langle 1, 2, 3 \rangle$
$\langle 1, 3, 2 \rangle$
$\langle 2, 1, 3 \rangle$
$\langle 2, 3, 1 \rangle$
$\langle 3, 1, 2 \rangle$
$\langle 3, 2, 1 \rangle$

6

Topic : CPU Scheduling

#Q. A starvation free job scheduling policy guarantees that no job indefinitely waits for a service. Which of the following job scheduling policies is starvation free?

CS: 2013

A. Priority Queuing

B. Shortest Job First

C. Youngest Job First

D. Round Robin

Topic : CPU Scheduling

#Q. Consider the following set of processes, with arrival times and the required CPU-burst times given in milliseconds.

Process	Arrival Time	Burst Time
P1	0	4
P2	2	2
P3	3	1

RQ: P1, P2, P1, P3,

What is the sequence in which the processes are completed? Assume round robin scheduling with a time quantum of 2 milliseconds. **CS: 2013**

A. P1, P2, P3

B. P2, P1, P3

C. P3, P2, P1

D. P2, P3, P1

P1	P2	P1	P3	

0 2 4 6 7

Topic : CPU Scheduling

#Q. A particular parallel program computation requires 100 seconds when executed on a single CPU. If 20% of this computation is strictly sequential, then theoretically the best possible elapsed times for this program running on 2 CPUs and 4 CPUs respectively are **CS: 2013**

A. 55 and 45 seconds

B. 80 and 20 seconds

C. 75 and 25 seconds

D. 60 and 40 seconds

20 → Seq.

80 → Parallel

40 40

40	40
CPU1	CPU2

(20 + 40) = 60

20 + 20 = 40

20	20	20	20

Topic : CPU Scheduling

#Q. Which of the following is not an optimization criterion in the design of a CPU scheduling algorithm? **CS: 2013**

A. Minimum CPU utilization

B. Maximum throughput

C. Minimum turnaround time

D. Minimum waiting time

Topic : CPU Scheduling

#Q. In a lottery scheduler with 40 tickets, how we will distribute the tickets among 4 processes P_1, P_2, P_3, P_4 and such that each process gets 10%, 5%, 60% and 25% respectively?

CS: 2015

	P_1	P_2	P_3	P_4
(a)	12	4	70	30
(b)	7	5	20	10
(c)	4	2	24	10
(d)	8	5	40	30

A. a

B. b

C. c

D. d

Topic : CPU Scheduling

#Q. Suppose a system contains n processes and system uses the round-robin algorithm for CPU scheduling then which data structure is best suited for ready queue of the process **CS: 2015**

A. Stack

B. Queue

C. Circular queue

D. Tree

Topic : CPU Scheduling

#Q. Suppose two jobs, each of which needs 10 minutes of CPU time, start simultaneously. Assume 50% I/O wait time. How long will it take for both to complete, if they run sequentially? **CS: 2015**

A. 10

B. 20

C. 30

D. 40

Topic : CPU Scheduling

#Q. For the real time operating system, which of the following is the most suitable scheduling scheme? **CS: 2016**

A. Round robin

B. pre-emptive

C. First come first serve

D. Random scheduling

Topic : CPU Scheduling

#Q. Consider three CPU intensive processes, which require 10, 20, 30 units and arrive at times 0,2,6 respectively. How many context switches are needed if shortest remaining time first is implemented? Context switch at 0 is included but context switch at end is ignored **CS: 2017**

A. 1

B. 2

C. 3

D. 4

Topic : CPU Scheduling

#Q. Consider the following scheduling

A. Gang scheduling	s. Guaranteed scheduling
B. Rate Monotonic scheduling	t. Thread scheduling
C. Fair share scheduling	u. Real time scheduling

Matching the table in the order A, B, C gives

CS: 2017

A. t, u, s

B. s, t, u

C. u, s, t

D. u, t, s

Topic : CPU Scheduling

#Q. Which of the following algorithms defines time quantum? CS: 2020

A. Shortest job scheduling algorithm

B. Round robin scheduling algorithm

C. Priority scheduling algorithm

D. Multilevel queue scheduling algorithm

Topic : CPU Scheduling

context-switching Time
Process-switching

#Q. Dispatch latency is defined as **CS: 2020**

A. the speed of dispatching a process from running to the ready state

B. the time of dispatching a process from running to ready state and keeping the CPU idle

C. the time to stop one process and start running another one

D. none of these

Topic : CPU Scheduling

#Q. Three CPU-bound tasks, with execution times of 15, 12 and 5 time units respectively arrive at times 0, t and 8, respectively. If the operating system implements a shortest remaining time first scheduling algorithm, what should be the value of t to have 4 context switches? Ignore the context switches at time 0 and at the end. **CS: 2020**

A. $0 < t < 3$

B. $t = 0$

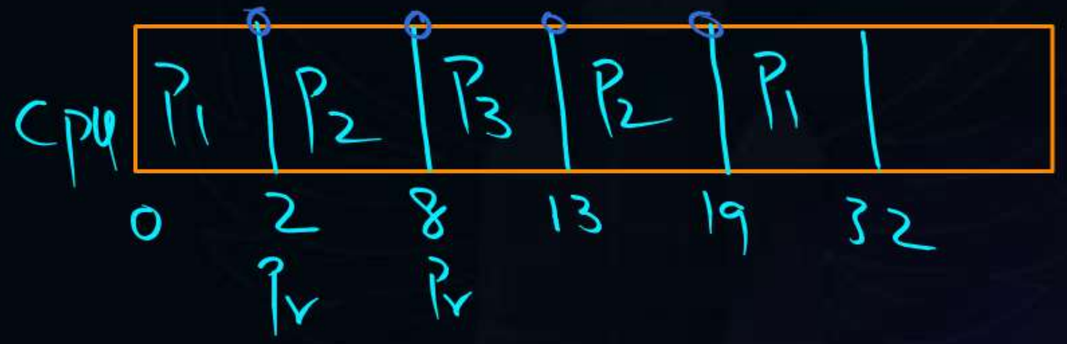
C. $t \leq 3$

D. $3 < t < 8$

P.No	A.T	B.T
1	0	~~15~~ 13
2	t	~~12~~ 6
3	8	5

SRTF

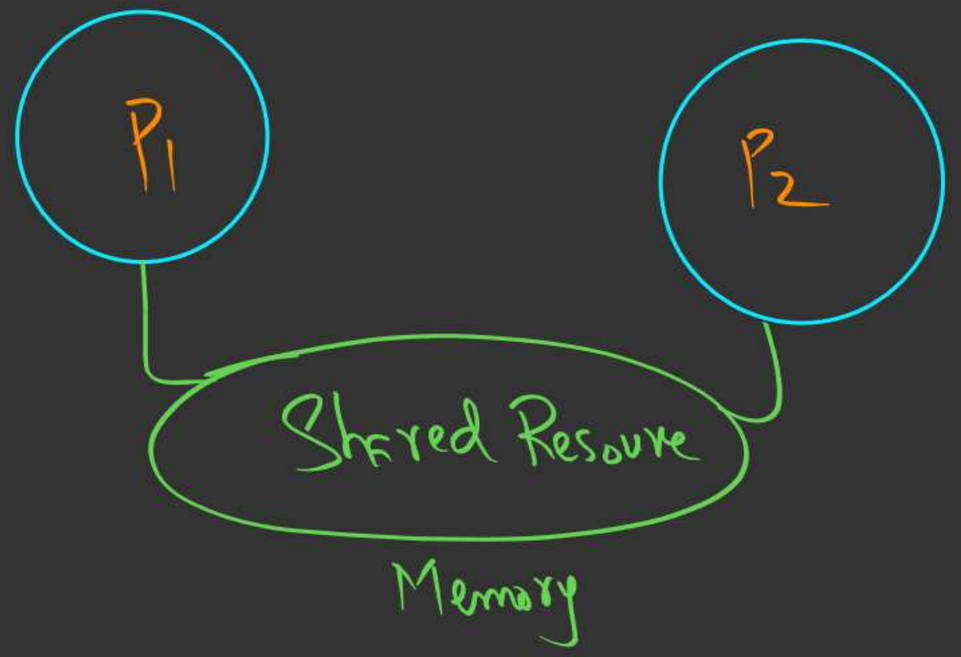
$t = 2$



Process Synchronization / Process Coordination

I.P.C : Interprocess Communication

(i) Critical Section
(ii) classical Problems
(iii) Concurrency
(iv) Deadlocks ;



Problems due to lack of Synchroniz.

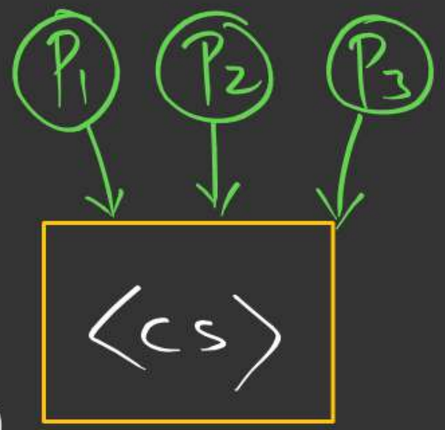
1. Inconsistency (Incorrectness)
2. Data loss
3. Deadlocks ;

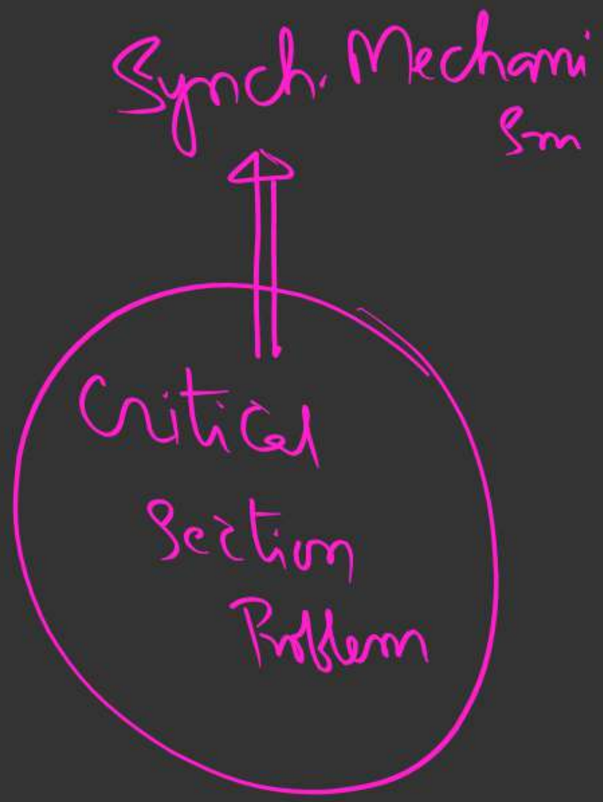
Necessary Conditions

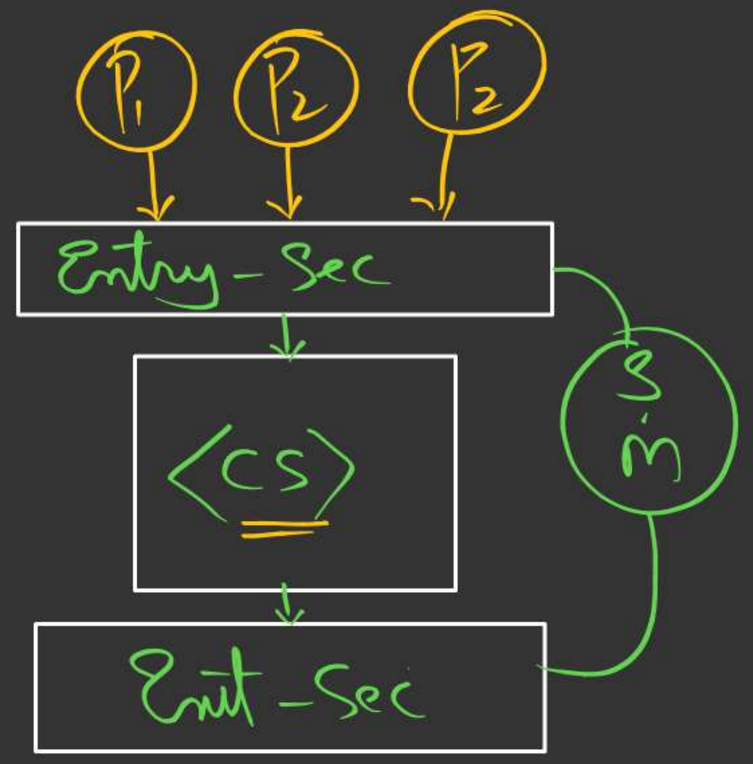
1) Critical Section(CS): that part of the Program where Shared resources are access;

2) Race Conditions:

3) Pre Emptive Environment







(Arch./Model of CS Problem)

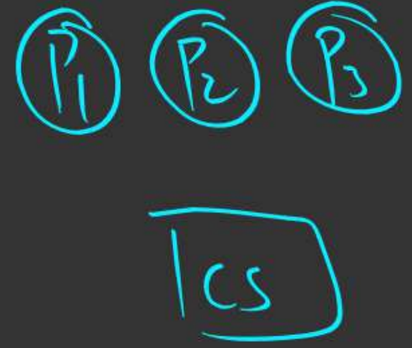
(*) Requirements of C.S Problem

1) **Mutual Exclusion** :

2) **Progress** : If CS is free then some Process should enter

3) **Bounded-wait** :

(Starvation) <Fair-chance>

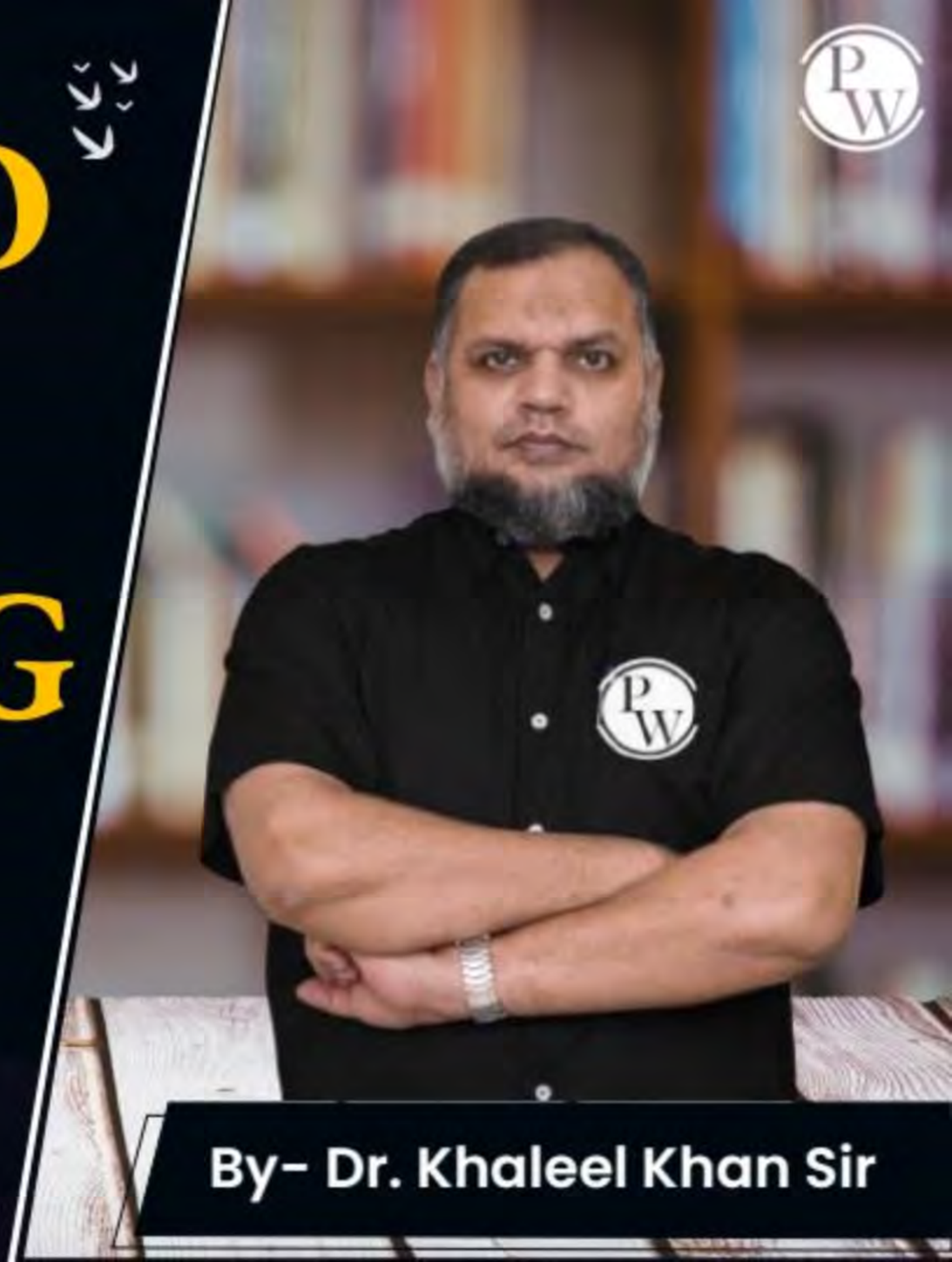


THANK - YOU

MISSION ISRO CS & IT ENGINEERING

Operating System

Lecture No.- 03



By- Dr. Khaleel Khan Sir

Recap of Previous Lecture

Topic CPU Scheduling

Topics to be Covered

Topic Process Synchronization / Coordination

→ Synch. Mechanisms (Semaphores)

→ Deadlocks

Synchronization Mechanisms

- Busy-waiting (loop)
- Non-Busy-waiting (Blocking) (if-then-else)

S/W

- → Dekker's Algo
- → Lock Variable
- → Strict Alternation
- → Peterson Solution

H/W

- T.S.L Instn
- SWAP Instn

OS-Based

- → Semaphores

Semaphores: is a variable (SEM : ADT) that takes only Integer values;

WIN | UNIX

- Counting
  - $\langle -\infty \text{ to } +\infty \rangle$
- Binary (mutexes)
  - $\langle 0 | 1 \rangle$

→ **Semaphore operations:**

DOWN	UP
Wait	Signal
P	V

"Atomic"

No-PreEmption

Topic : Process Synchronization

#Q. Semaphores

CS: 2007

A. synchronize critical resources to prevent deadlock

B. synchronize critical resources to prevent contention

C. are used to do I/O

D. are used for memory management.

Topic : Process Synchronization

#Q. A critical section is a program segment

CS: 2008

A. Which should run in a certain specified amount of time.

B. Which avoids deadlock.

C. Where shared resources are accessed.

D. Which must be endorsed by a pair of semaphore operations, P & U.

Topic : Process Synchronization

#Q. Semaphores are used to solve the problem of I. Race Condition II. Process Synchronization III. Mutual Exclusion **CS: 2015**

A. I and II

B. II and III

C. All of the above

D. None of the above

Topic : Process Synchronization

#Q. At a particular time of computation, the value of a counting semaphore is 7. Then 20 P operations and 15 V operations were completed on this semaphore. The resulting value of the semaphore is : **CS: 2015**

A. 42

B. 2

C. 7

D. 12

$S = 7$

$\cancel{20}(P) + 15(V)$

$\boxed{-13} + 15 = \boxed{2}$

Topic : Process Synchronization

#Q. Mutual exclusion problem occurs

CS: 2017

A. Between two disjoint processes that do not interact

B. Among processes that share resources

C. Among processes that do not use the same resource

D. Between two processes that uses different resources of different machine

Topic : Process Synchronization

#Q. A critical region

CS: 2017

A. is a piece of code which only one process executes at a time

B. is a region prone to deadlock

C. is a piece of code which only a finite number of processes execute

D. is found only in windows NT operating system

Topic : Process Synchronization

#Q. Processes P1 and P2 have a producer-consumer relationship, communicating by the use of a set of shared buffers.

P1: repeat
Obtain an empty buffer
Fill it
Return a full buffer
forever

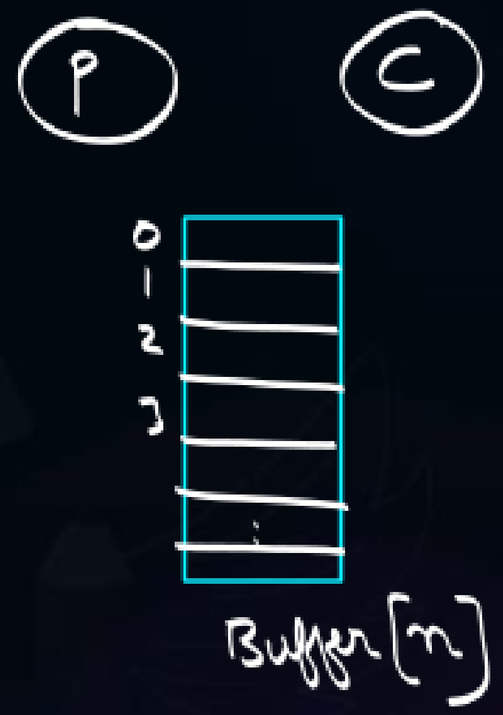
P2: repeat
Obtain a full buffer
Empty it
Return an empty buffer
forever

A. III only

B. II only

C. I only

D. II and III only



Increasing the number of buffers is likely to do which of the following? I. Increase the rate at which requests are satisfied (throughput)

II. Decrease the likelihood of deadlock

III. Increase the ease of achieving a correct implementation

CS: 2018

Topic : Process Synchronization

#Q. A counting semaphore was initialised to 7. Then 20 P (wait) operations and x V (signal) operations were completed on this semaphore. If the final value of semaphore is 5, then the value x will be **CS: 2017**

A. 0

B. 13

C. 18

D. 5

$S = 7$

$[7 - 20 + x] = 5$

$x = 18$

Topic : Process Synchronization

#Q. The hardware implementation which provides mutual exclusion is **CS: 2020**

A. Semaphores

B. Test and set instruction

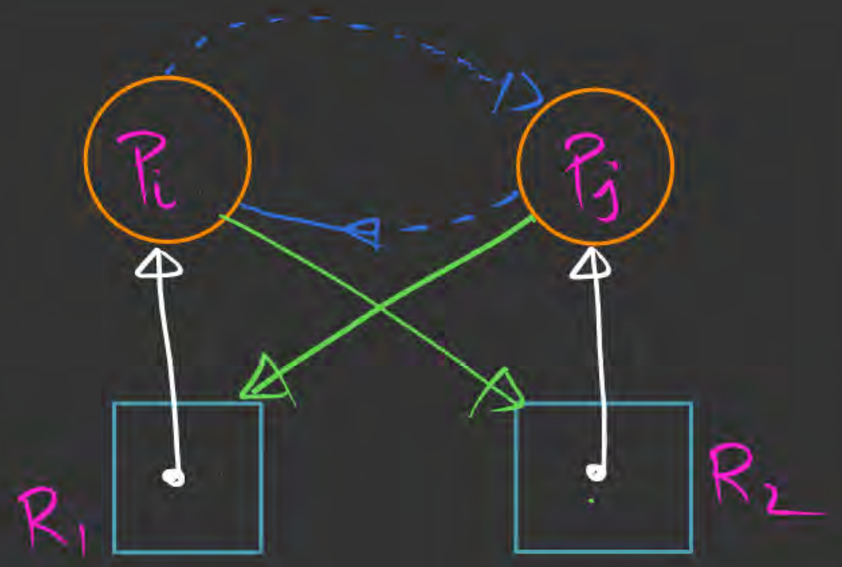
C. Both options

D. None of the options

Deadlock

Deadlock: Two/more Processes are said to be in deadlock iff they wait for the happening of an event which would never happen,

<Infinite Blocking>



Necessary conditions:

a) Mutual Exclusion
b) Hold and wait
c) No-PreEmption
d) circular-wait

R.A.G

$G = (V, E)$

Deadlock - Handling Strategies

1) Deadlock Prevention
2) Deadlock Avoidance ← (Banker's Algo)

T_1 : (Deadlock Never occurs)

3) Deadlock Detection & Recovery
4) Deadlock Ignorance (Ostrich Algo) | (No-Strategy)

T_2 : (Deadlock occurs)

Deadlock Prevention: by dissatisfying one/more of the Necessary conditions

→ (Starvation)

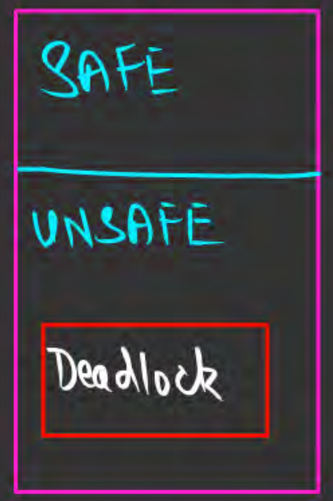
Deadlock-Avoidance (Banker's Algorithm)

↓

Concept of Sys. State (Safety Algo)

- Safe: <No-Deadlock>
- unsafe: <Need of Processes are not Satisfiable>

To operate the System always in Safe-State



(ii) Resource-Request: To check whether request of a Process can be granted or not

Topic : Deadlock

#Q. Consider a system having 'm' resources of the same type. These resources are shared by 3 processes A,B,C, which have peak time demands of 3,4, 6 respectively. The minimum value of 'm' that ensures that deadlock will never occur is__. **CS: 2007**

A. 11

B. 12

C. 13

D. 14

$R = m$

	R	deadlock
A	3	2
B	4	3
C	6	5

Max $\Rightarrow$ 10 $+ 1 = 11$

(1 - 10)

Topic : Deadlock

#Q. In which of the following four necessary conditions for deadlock processes claim exclusive control of the resources they require ? **CS: 2008**

A. No preemption

B. Mutual exclusion

C. Circular wait

D. Hold and wait

Topic : Deadlock

#Q. Consider a system having "n" resources of same type. These resources are shared by 3 processes A, B, C. These have peak demands of 3,4 and 6 respectively. For what value of "n" deadlock won't occur **CS: 2009**

insO
Max

A. 15

B. 9

C. 10

D. 13

[1 - 10] ⟹ deadlock

> 10 : NO "

Topic : Deadlock

(recovery)

#Q. When a process is rolled back as a result of deadlock the difficulty which arises is

CS: 2009

(Starvation)

A. Starvation

B. System throughput

C. Low device utilization

D. Cycle stealing

Topic : Deadlock

Max - Used

(Banker's Algo)

#Q. A total of 9 units of a resource type are available, and given the safe state shown below, which of the following sequence will be a safe state? **CS: 2011**

Process	Used	Max	Need
P_1	2	7	5
P_2	1	6	5
P_3	2	5	3
P_4	1	4	3

Avail: 3

<4>

: <P3; P1; P2; P4>

: <P4;

A. $<P_4, P_1, P_3, P_2>$

B. $<P_4, P_2, P_1, P_3>$

C. $<P_4, P_2, P_3, P_1>$

D. $<P_3, P_1, P_2, P_4>$

Topic : Deadlock

#Q. Which of the following is not a necessary condition for deadlock? CS: 2013

A. Mutual exclusion

B. Reentrancy

C. Hold and wait

D. No pre-emption

Topic : Deadlock

"UNSAFE"

#Q. Consider the following process and resource requirement of each process. **CS: 2013**

Process	Type-1			Type-2		
	Need	Used	Max	Need	Used	Max
P1 ×	1	1	2	2	1	3
P2 ×	2	1	3	1	1	2
P3 ×	2	2	4	3	1	4

Avail

T_1	T_2
1	1

Predict the state of this system, assuming that there are a total of 5 instances of resource type 1 and 4 instances of resource type 2.

A. Can go to safe or unsafe state based on sequence

B. Safe state

C. Unsafe state ✓

D. Deadlock state

Topic : Deadlock

#Q. What is the minimum number of resources required to ensure that deadlock will never occur, if there are currently three processes P1 , P2, and P3 running in a system whose maximum demand for the resources of same type are 3,4 and 5 respectively.

CS: 2014

A. 3

B. 7

C. 9

D. 10

	R	Max Deadlock	Min No deadlock
P_1	3	2	
P_2	4	3	
P_3	5	4	
		9	

$+1 = 10$

Topic : Deadlock

#Q. With single resource, deadlock occurs

CS: 2016

A. if there are more than two processes competing for that resources

B. if there are only two processes competing for that resources

C. if there is a single process competing for that resources

D. None of these

Topic : Deadlock

#Q. A system has 3 processes sharing 4 resources. If each process needs a maximum of 2 units, then

CS: 2016

A. Deadlock can never occur

B. Deadlock may occur

C. Deadlock has to occur

D. None of these

	R	Deadlock
P_1	2	1
P_2	2	1
P_3	2	1
		3

+1

R = 4

4

Topic : Deadlock

#Q. Which of the following is not true with respect to deadlock prevention and deadlock avoidance schemes? **CS: 2017**

A. In deadlock prevention, the request for resources is always granted if resulting state is safe

B. In deadlock avoidance, the request for resources is always granted, if the resulting state is safe

C. Deadlock avoidance requires knowledge of resource requirements a priori

D. Deadlock prevention is more restrictive than deadlock avoidance

Topic : Deadlock

#Q. Which of the following is not true with respect to deadlock prevention and deadlock avoidance schemes? **CS: 2017**

A. In deadlock prevention, the request for resources is always granted if resulting state is safe

B. In deadlock avoidance, the request for resources is always granted, if the resulting state is safe

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Topic : Deadlock

#Q. Consider a system having m resources of the same type. These resources are shared by 3 processes A, B, C which have peak time demands of 3, 4, 6 respectively. The minimum value of m that ensures deadlock will never occur is **CS: 2018**

A. 11

B. 12

C. 13

D. 14

Topic : Deadlock

Tool

#Q. An aid to determine the deadlock occurrence is

CS: 2020

A. Resource allocation graph (RAG)

B. Starvation graph

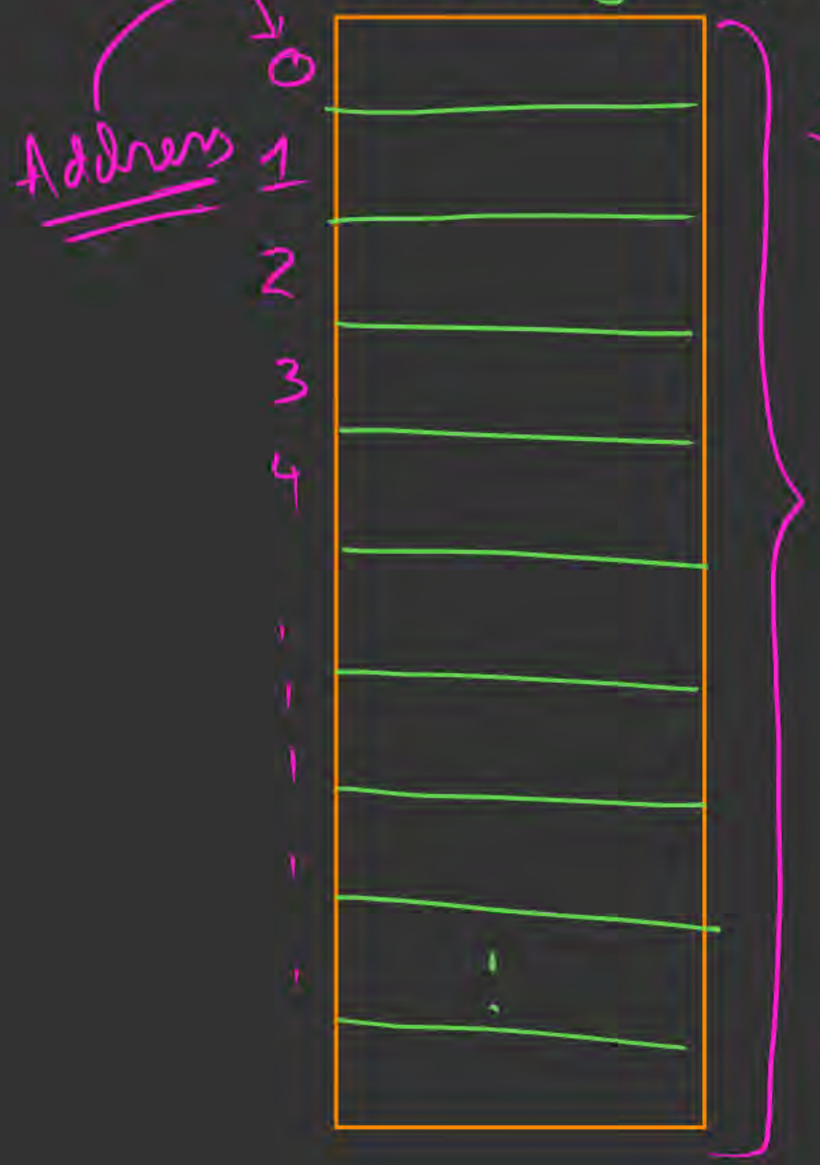
C. Inversion graph

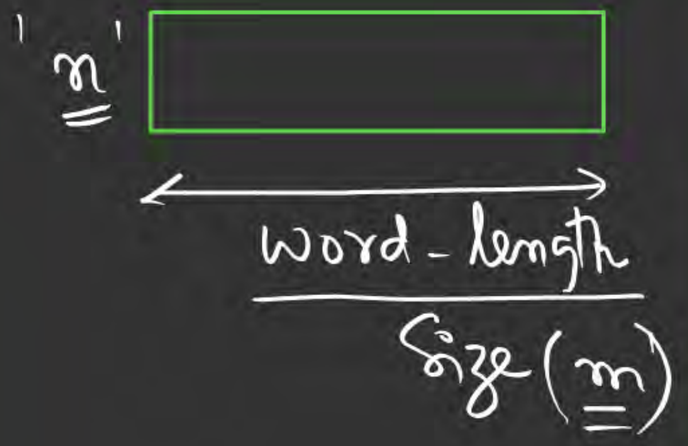
D. None of the above

Memory Mgmnt

- **Primary**
  - Physical
  - Volatile
  - Faster (ns)
  - Smaller (GB)
  - Ex: RAM, ROM, Cache
- **Secondary (Aux)**
  - Non-volatile
  - Slow access (ms)
  - larger (TB)
  - Hard-Disk
  - Tapes
  - Cartridges
  - Pen-Drives
  - CD's

Memory : linear 1-Dim array of words / locations cells;





$(N \times n)$

$N = 512\,KB$

$n = 9 + 10 = 19$ bits (2^{19})

$N = 2^n$ words/Bytes

$n = \log_2 N$ bits

$$2^{10} = \overset{10^3}{\overline{1024}} = 1K$$

$$2^{20} = 10^6 = 1M$$

$$2^{30} = 10^9 = 1G$$

$$2^{40} = 10^{12} = 1T$$

$$2^{50} = 10^{15} = 1P$$

2) $N = 64\,GB$

$n = 6 + 30 = 36$ bits ✓

3) $n = 27$ bits

$N = 2^{27} = 2^7 \times 2^{20} = 128\,MB$

4) $n = 21$ bits ; $m = 32$ bits $= (4B)$

$N_{Bytes} = 2^{21} \times 4B = 2M \times 4B$

$= 8MB$ ✓

THANK - YOU

MISSION ISRO CS & IT ENGINEERING

Operating System

Lecture No.- 04

By- Dr. Khaleel Khan Sir

Recap of Previous Lecture

Topic Process Synchronization

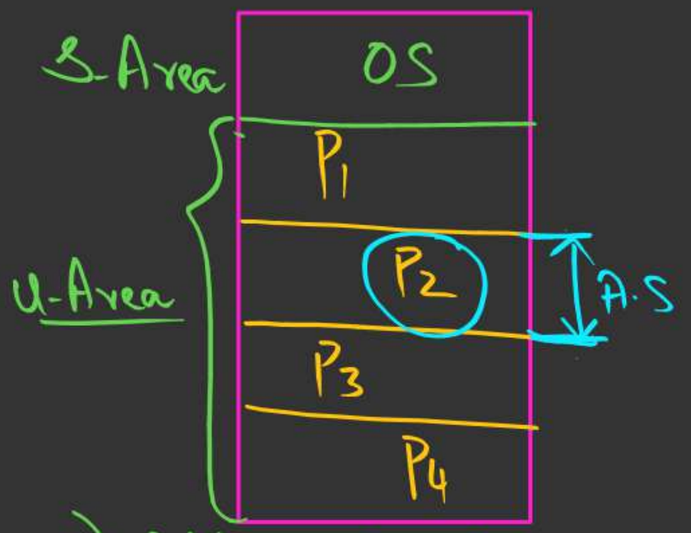
Topics to be Covered

Topic Memory Management

Memory Management

Functions & Goals of Mem. Manager

1) Mem. Allocation
2) Protection



3) Address Translation
4) Free Space Mgment
5) Deallocation

1) Efficient utiliz. of Memory
   - Fragmentation
     - Internal
     - External
2) Manage execution of larger Programs in Small Memory areas,
   - Degree of M.P
     - → Thruput
   - → Overlays
   - → Virtual Memory

Techniques

Contiguous

- → Partitions
  - Fixed
  - Variable
- → overlays

Non-Contiguous

- → Paging
- → Segmentation
- → Seg-Paging
- → Virtual Memory

Partitions :

Internal fragmentation

U_Area

Pnew : 20KB

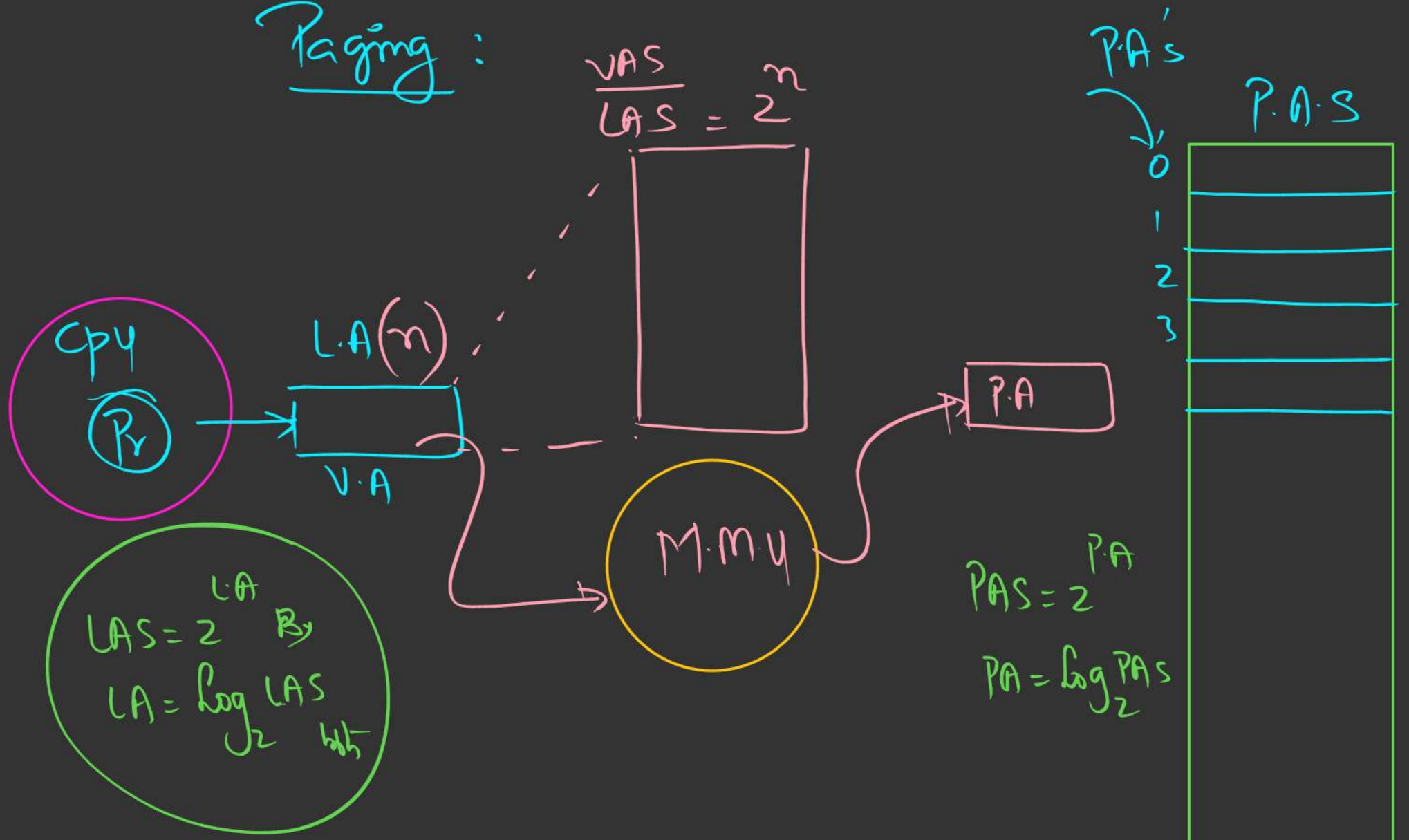
Partition Alloc. Policies

First Fit

Best Fit

worst Fit

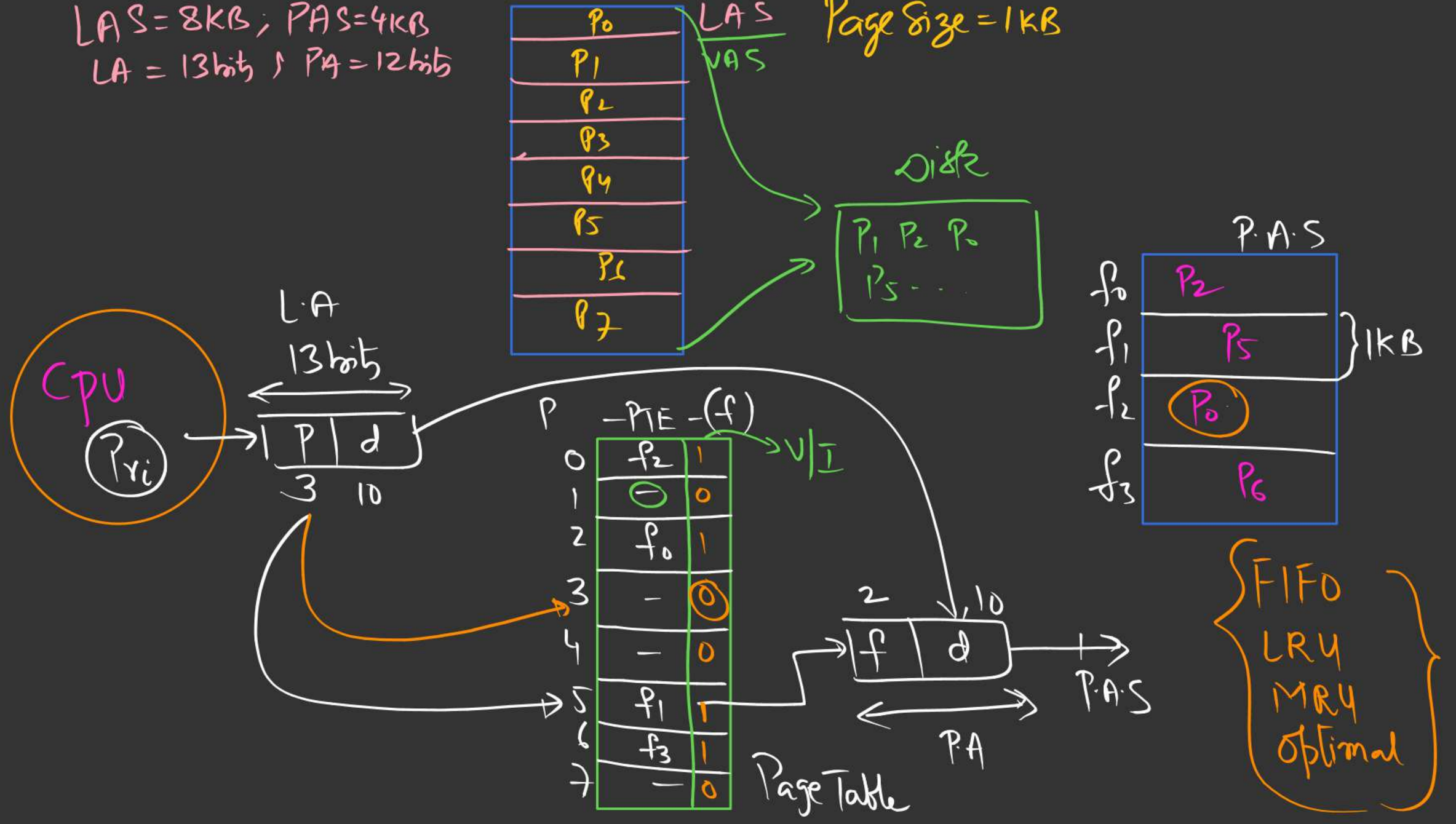
Paging :


VAS
LAS = 2^n
CPU
Pr
L.A(n)
V.A
M.M.U
P.A
P.A's
P.A.S
0
1
2
3
$LAS = 2^{L.A}$ By
$LA = \log_2 LAS$ bits
$PAS = 2^{P.A}$
$PA = \log_2 PAS$

LAS = 8KB ; PAS = 4KB

LA = 13 bits ; PA = 12 bits

Page Size = 1KB



Topic : Memory Management

#Q. The principal of locality of reference justifies the use of **CS: 2007**

A. Virtual memory

B. Interrupts

C. Main memory

D. Cache memory

Topic : Memory Management

#Q. What is the name of the technique in which the operating system of a computer executes several programs concurrently by switching back and forth between them ?

CS: 2007

A. Partitioning

B. Multi tasking (Pre Emptive based multiprogramming)

C. Windowing

D. Paging

Topic : Memory Management

V.M
↳ Demand (DP)
Paging

CS: 2007

#Q. Virtual memory is

A. Part of Main Memory only used for swapping

B. A technique to allow a program, of size more than the size of the main memory, to run

C. Part of secondary storage used in program execution

D. None of these

Topic : Memory Management

#Q. The number of page frames that must be allocated to a running process in a virtual memory environment is determined by **CS: 2007**

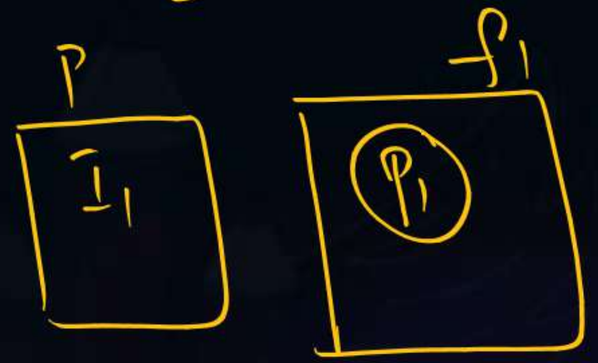
A. the instruction set architecture

B. Page size

C. Number of processes in memory

D. Physical memory size

Min → 1-Instn → Arch: Addrs. Modes



Topic : Memory Management

#Q. In a resident – OS computer, which of the following systems must reside in the main memory under all situations? **CS: 2008**

A. Assembler

B. Linker

C. Loader

D. Compiler

Topic : Memory Management

#Q. Dynamic Address translation

CS: 2008

A. Is part of the operating system paging algorithm.

B. Is useless when swapping is used.

C. Is the hardware necessary to implement paging.

D. Storage pages at a specific location on disk.

Topic : Memory Management

#Q. Thrashing : Excessive | High Page fault rate

CS: 2008

A. Always Occurs on large computers.

B. Is a natural consequence of virtual memory systems.

C. Can always be avoided by swapping.

D. Can be caused by poor paging algorithms.

Topic : Memory Management

CS: 2008

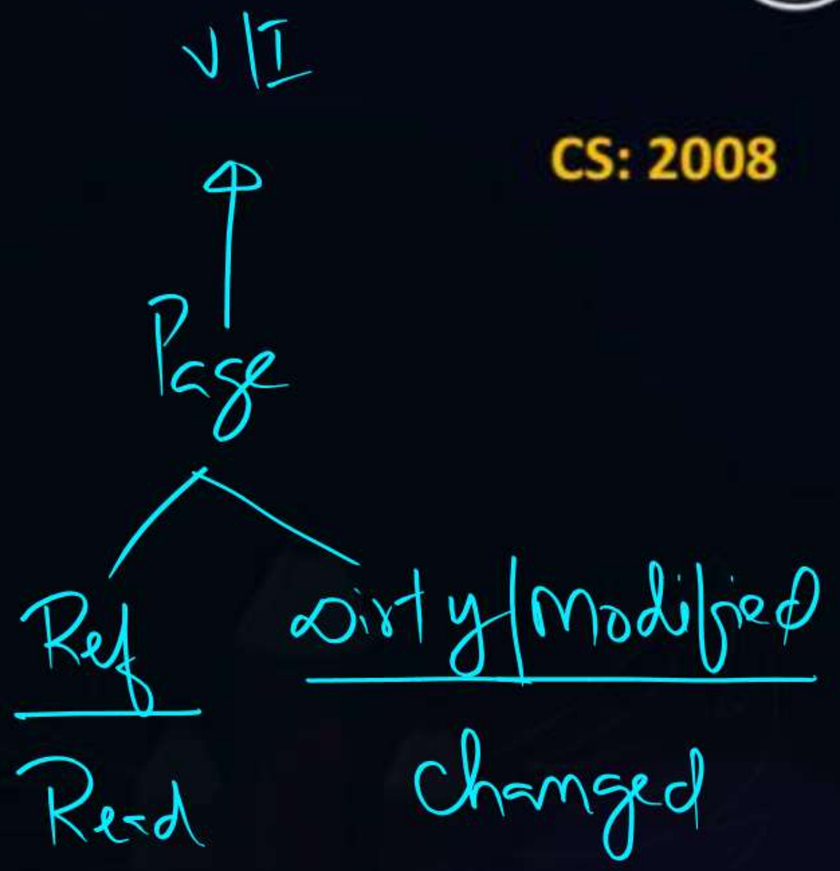
#Q. Dirty bit for a page in a page table

A. Helps avoid unnecessary writes on a paging device.

B. Helps maintain LRU information.

C. Allows only read on a page.

D. None of these.



Topic : Memory Management

#Q. Overlaying

CS: 2008

A. Requires use of a loader.

B. Allows larger programs but requires more effort.

C. Is most used on large computers.

D. Is transparent to the user.

Topic : Memory Management

#Q. Consider a logical address space of 8 pages of 1024 words ,each mapped into memory of 32 frames. How many bits are there in the logical address? **CS: 2008**

A. 13 bits

B. 15 bits

C. 14 bits

D. 12 bits

8 Pages → 1024

32 frames

L.A.S = No. of Pages * Page Size

$= 8 * 1024\,w$

$= 2^3 \times 2^{10}$

$= 2^{13}\,w$

$\boxed{L.A = 13 \text{ bits}}$

Topic : Memory Management

#Q. The page replacement algorithm which gives the lowest page fault rate is **CS: 2008**

A. LRU

B. FIFO

C. ~~Optional~~ optimal page replacement.

D. Second chance algorithm.

Topic : Memory Management

#Q. The correct matching for the following pairs is

(A)	Disk ~~check~~ Scheduling	(1)	Round robin
(B)	Batch processing	(2)	Scan
(C)	Time sharing	(3)	LIFO
(D)	Stack operation	(4)	FIFO

CS: 2009

	A	B	C	D
A.	3	4	2	1
B.	4	3	2	1
C.	3	4	1	2
D.	2	4	1	3

A → 2
B → 4
C → 1
D → 3

Topic : Memory Management

#Q. A page fault

CS: 2009

A. Occurs when a program accesses an available page of memory

B. Is an error in a specific page

C. Is a reference to a page belonging to another program

D. Occurs when a program accesses a page not currently in memory

Topic : Memory Management

#Q. If the page size in a 32-bit machine is 4K bytes then the size of page table is **CS: 2011**

P.S

V.A/L.A

A. 1 M bytes

B. 2 M bytes

C. 4 M bytes

D. 4 K bytes

$N = \frac{2^{32}}{2^{12}} = 2^{20}$

$e = 1B$

2^{20}

$1M \times B$

1MB

No. of entries in P.T = No. of Pages (N)

P.T.E Contains frame Number (e)

P.T. Size = N * e B

Topic : Memory Management

#Q. Belady's anomaly means **CS: 2011**

A. Page fault rate is constant even on increasing the number of allocated frames

B. Pages fault rate may increase on increasing the number of allocated frames

C. Pages fault rate may increase on decreasing the number of allocated frames

D. Pages fault rate may decrease on increasing the number of allocated frames

Topic : Memory Management

#Q. Which of the following are the likely causes of thrashing? **CS: 2013**

Less Memory

High degree of M.P

A. Page size was very small

Processes

B. There are too many users connected to the system

C. Least recently used policy is used for page replacement

D. First in First out policy is used for page replacement

Topic : Memory Management

#Q. Consider a logical address space of 8 pages of 1024 words each, mapped onto a physical memory of 32 frames. How many bits are there in the physical address and logical address respectively? **CS: 2013**

A. 5, 3

B. 10, 10

C. 15, 13

D. 15, 15

P = 3

N = 8 ; P.S = 1024 → d = 10

M = 32 → f = 5

LA | p | d

3 10

13 bits

| f | d | P.A

5 10

15 bits

Topic : Memory Management

No. of frames = $\frac{2GB}{8KB} = \frac{2^{31}}{2^{13}}$
$= 2^{18}$

V.A PAS

#Q. In a 64-bit machine, with 2 GB RAM, and 8 KB page size, how many entries will be there in the page table if it is inverted? **CS: 2013**

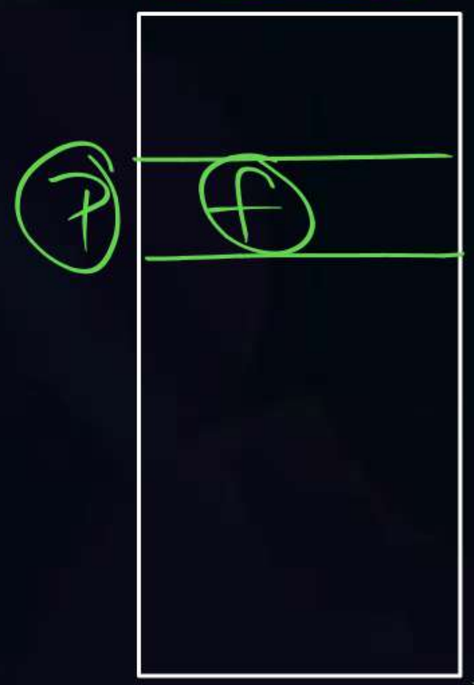
A. 2^{18}

B. 2^{20}

C. 2^{33}

D. 2^{51}

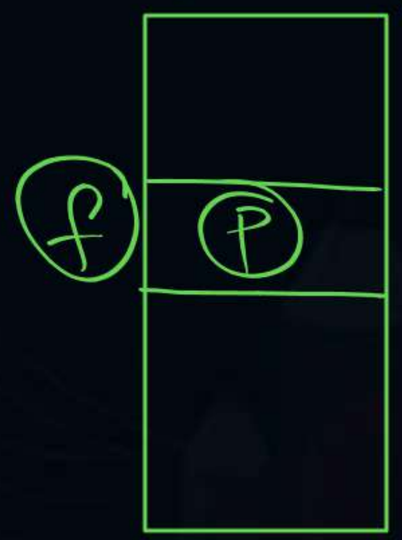
Trad. P.T



No of Pages

$\frac{2^{64}}{2^{13}} = 2^{51}$

Inv. P.T



No. of frames

2^{18}

Topic : Memory Management

(Working Set)

#Q. Consider the list of page references in the timeline as below:
9 6 2 3 4 4 4 4 3 4 4 2 5 8 6 8 5 5 3 2 3 3 9 6 2 7
What is the working set at the penultimate page reference if Δ is 5? **CS: 2013**

Δ = 5

A. {8, 5, 3, 2, 9, 6}

B. {4, 3, 6, 2, 5}

C. {3, 9, 6, 2, 7}

D. {3, 9, 6, 2}

Working Set window
= { Set of unique Pages referred during the past 'Δ' references }

{2, 3, 6, 9}

Topic : Memory Management

#Q. Consider the following segment table in segmentation scheme:

Segment Id	Base	Limit
0	200	200
1	5000	1210
2	1527	498
3	2500	50

What happens if the logical address requested is - Segment Id 2 and Offset 1000?

CS: 2014

A. Fetches the entry at the physical address 2527 for segment Id 2

B. A trap is generated

C. Deadlock

D. Fetches the entry at offset 27 in segment Id 3

Topic : Memory Management

#Q. Using the page table shown below, translate the physical address 25 to virtual address. The address length is 16 bits and page size is 2048 words while the size of the physical memory is four frames. → V.A

Page	Present (1-In, O-Out)	Frame
0	1	3
1	1	2
2	1	0
3	0	-

V.A

P	d

$P_2 \Rightarrow 2 * 2048$

$4096 + 25$

$= 4121$

CS: 2014

A. 25

B. 6169

C. 2073

D. 4121

$\boxed{P.A = 25}$

$f \Rightarrow 25/2048 = 0$

$d \Rightarrow 25 \% 2048 = 25$

$P.S = 2048$

$LA = 16$ bits

V.A | P.A : decimal;

L.A

P d

P.A

f d

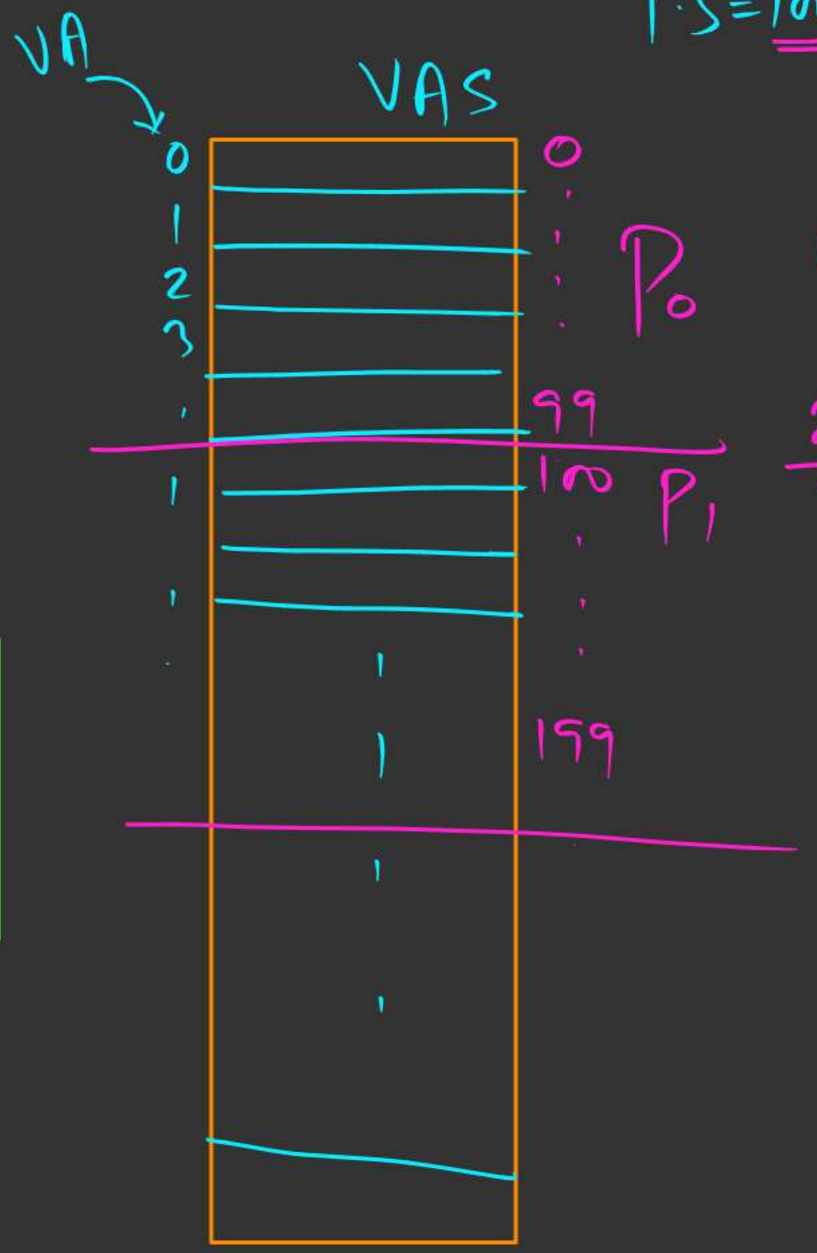
$P = VA / PS$

$d = VA \% PS$

$f = PA / PS$

$d = VA \% PS$

P.S = 100w



254

2 | 54

P | d

Topic : Memory Management

#Q. A computer has 16 pages of virtual address space, but the size of main memory is only four frames. Initially the memory is empty. A program references the virtual pages in the order of 0 , 2 , 4 , 5 , 2 , 4 , 3 ,11 , 2 , 10. How many page faults occur if LRU page replacement algorithm is used? **CS: 2014**

A. 3

B. 5

C. 7

D. 8

~~0~~	3	3	3			
2	2	2	2			
4	4	~~4~~	10			
5	~~5~~	11	4			

Topic : Memory Management

#Q. Consider a system where each file is associated with a 16-bit number. For each file, each user should have the read and write capability. How much memory is needed to store each user's access data?

CS: 2014

A. 16 KB

B. 32 KB

C. 64 KB

D. 128 KB

File id = 16 bits ⟹ No. of Files = 2^{16} = 64K

R
NR
W
NW

Acc : 2 bits

Mem Needed = $2^{16} \times 2$ bits

= 2^{17} bits

= $\frac{128 \text{ K bits}}{8}$

= 16 KB

Topic : Memory Management

#Q. Dirty bit is used to indicate which of the following? CS: 2014

A. A page fault has occurred

B. A page has corrupted data

C. A page has been modified after being loaded into cache

D. An illegal access of page

Topic : Memory Management

#Q. What is the size of the physical address space in a paging system which has a page table containing 64 entries of 11 bit each (including valid/invalid bit) and a page size of 512 bytes? **CS: 2014**

A. 211

B. 2^{15}

C. 2^{19}

D. 2^{20}

$N = 64$;

$e = 11$ $(10 + 1)$

(frame no)

Page Size = 512 By

$d = 9$ bits

PA | f | d |

10 9

19 bits

$\therefore$ PAS $= 2^{19}$

Topic : Memory Management

#Q. If there are 32 segments, each size 1 k bytes, then the logical address should have

CS: 2015

A. 13 bits

B. 14 bits

C. 15 bits ✓

D. 16 bits

L.A.S = No. of Segments * Seg-Size

= 32 × 1KB = 32KB

L.A = 15 bits

Topic : Memory Management

#Q. Increasing the RAM of a computer typically improves performance because:

CS: 2015

A. Virtual Memory increases

B. Larger RAMs are faster

C. Fewer page faults occur

D. Fewer segmentation faults occur

Topic : Memory Management

#Q. Dirty bit for a page in a page table

CS: 2015

A. helps avoid unnecessary writes on a paging device

B. helps maintain LRU information

C. Allows only read on a page

D. None of the above

Topic : Memory Management

#Q. Determine the number of page faults when references to pages occur in the following order: 1, 2, 4, 5, 2, 1, 2, 4 Assume that the main memory can accommodate 3 pages and the main memory already has the pages 1 and 2, with page one having brought earlier than page 2. (LRU page replacement algorithm is used) **CS: 2016**

A. 3

B. 5

C. 4

D. None of these

4	~~1~~	5
2		
~~4~~	1	

LA : | P | d |

PA : | f | d |

P	f	VI	.....

P.T.E

Topic : Memory Management

#Q. Working set at an instant of time is

CS: 2016

A. the set of future references that the OS will make

B. the set of future references that the OS will make in next unit of time

C. the set of references with high frequency

D. the set of pages that have been referenced in the last time units

Topic : Memory Management

#Q. In which one of the following page replacement policies, Belady's anomaly may occur? **CS: 2016**

A. FIFO

B. Optimal

C. LRU

D. MRU

Topic : Memory Management

#Q. Given reference to the following pages by a program

0, 9, 0, 1, 8, 1, 8, 7, 8, 7, 1, 2, 8, 2, 7, 8, 2, 3, 8, 3

How many page faults will occur if the program has three page frames available to it and uses an optimal replacement?

CS: 2017

A. 7

B. 8

C. 9

D. None of these

~~0~~ 8
3 ~~9~~ ~~7~~
~~1~~ 2

Topic : Memory Management

#Q. A virtual memory system uses FIFO page replacement policy and allocates a fixed number of frames to the process. Consider the following statements

M : Increasing the number of page frames allocated to a process sometimes increases the page fault rate

N : Some programs do not exhibit locality of reference

Which one of the following is true? **CS: 2017**

A. Both M and N are true and N is the reason for M

B. Both M and N are true but N is not the reason for M

C. Both M and N are false

D. M is false, but N is true

Topic : Memory Management

#Q. A system uses FIFO policy for page replacement. It has 4 page frames with no pages loaded to begin with. The system first accesses 50 distinct pages in some order and then accesses the same 50 pages in reverse order. How many page faults will occur?

CS: 2017

A. 96 ✓

B. 100

C. 97

D. 92

1 . . . . 50 1

100 − 4 = 96

Topic : Memory Management

#Q. Determine the number of page faults when references to pages occur in order 1, 2, 4, 5, 2, 1, 2, 4. Assume that the main memory can accommodate 3 pages and the main memory already has the pages 1 and 2, with page 1 having brought earlier than page 2.(assume LRU algorithm is used) **CS: 2018**

A. 3

B. 4

C. 5

D. None of these

Topic : Memory Management

#Q. A computer has 1000 K of main memory. The jobs arrive and finish in the following sequence Job 1 requiring 200 K arrives Job 2 requiring 350 K arrives Job 3 requiring 300 K arrives Job 1 finishes Job 4 requiring 120 K arrives Job 5 requiring 150 K arrives Job 6 requiring 80 K arrives Among best fit and first fit, which performs better for this sequence?

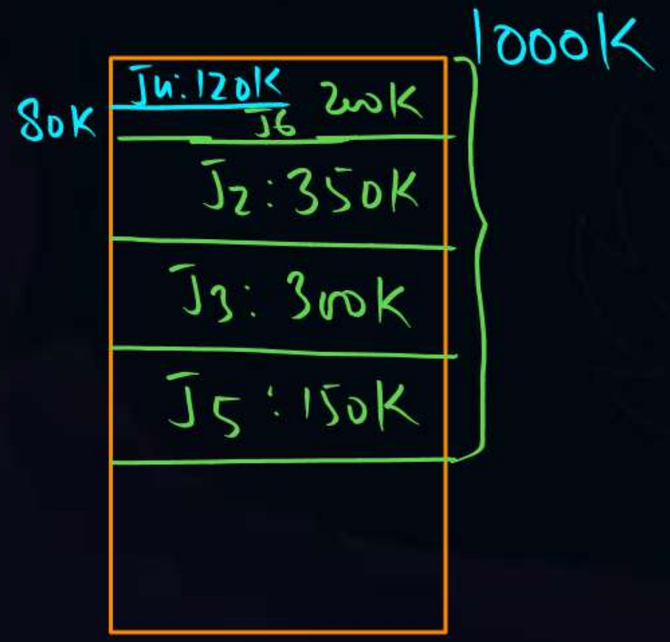
CS: 2018

A. First fit

B. Best fit

C. Both perform the same

D. None of the above



$J_1 \rightarrow 200K$

$J_2 \rightarrow 350K$

$J_3 \rightarrow 300K$

$J_1 \rightarrow$ Finishes

$J_4 \rightarrow 120K$

$J_5 \rightarrow 150K$

$J_6 \rightarrow 80K$

Topic : Memory Management

No. of unique Pages = 7

<1 . . 7>

#Q. Consider the following page reference string.

1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6

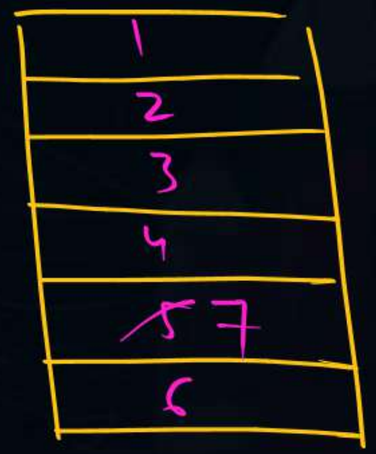
What are the minimum number of frames required to get a single page fault for the above sequence assuming LRU replacement strategy? **CS: 2020**

A. 7

B. 4

C. 6

D. 5



Topic : Memory Management

#Q. What is compaction referring to

CS: 2020

A. a technique for overcoming internal fragmentation

B. a paging technique

C. a technique for overcoming external fragmentation

D. a technique for compressing the data

THANK - YOU

MISSION ISRO CS & IT ENGINEERING

Operating System

Lecture No.- 05

By- Dr. Khaleel Khan Sir

Recap of Previous Lecture

Topic Memory Management

Topics to be Covered

Topic File system & Device Management

Topic : Memory Management

#Q. A computer has 1000 K of main memory. The jobs arrive and finish in the following sequence Job 1 requiring 200 K arrives Job 2 requiring 350 K arrives Job 3 requiring 300 K arrives Job 1 finishes Job 4 requiring 120 K arrives Job 5 requiring 150 K arrives Job 6 requiring 80 K arrives Among best fit and first fit, which performs better for this sequence? **CS: 2018**

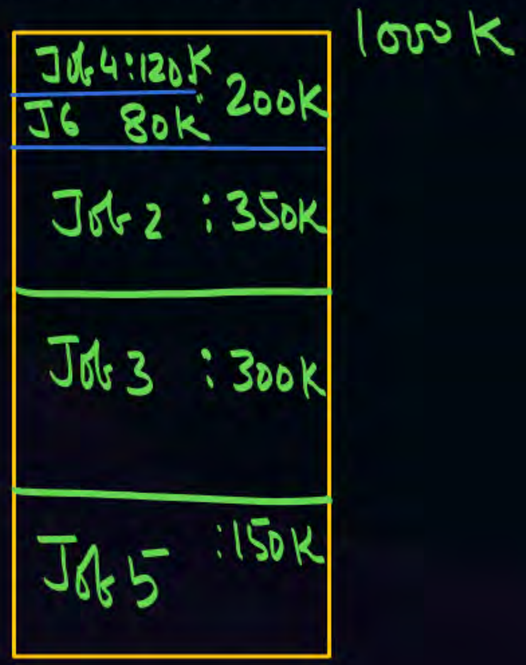
A. First fit

B. Best fit

C. Both perform the same

D. None of the above

(i) F.F



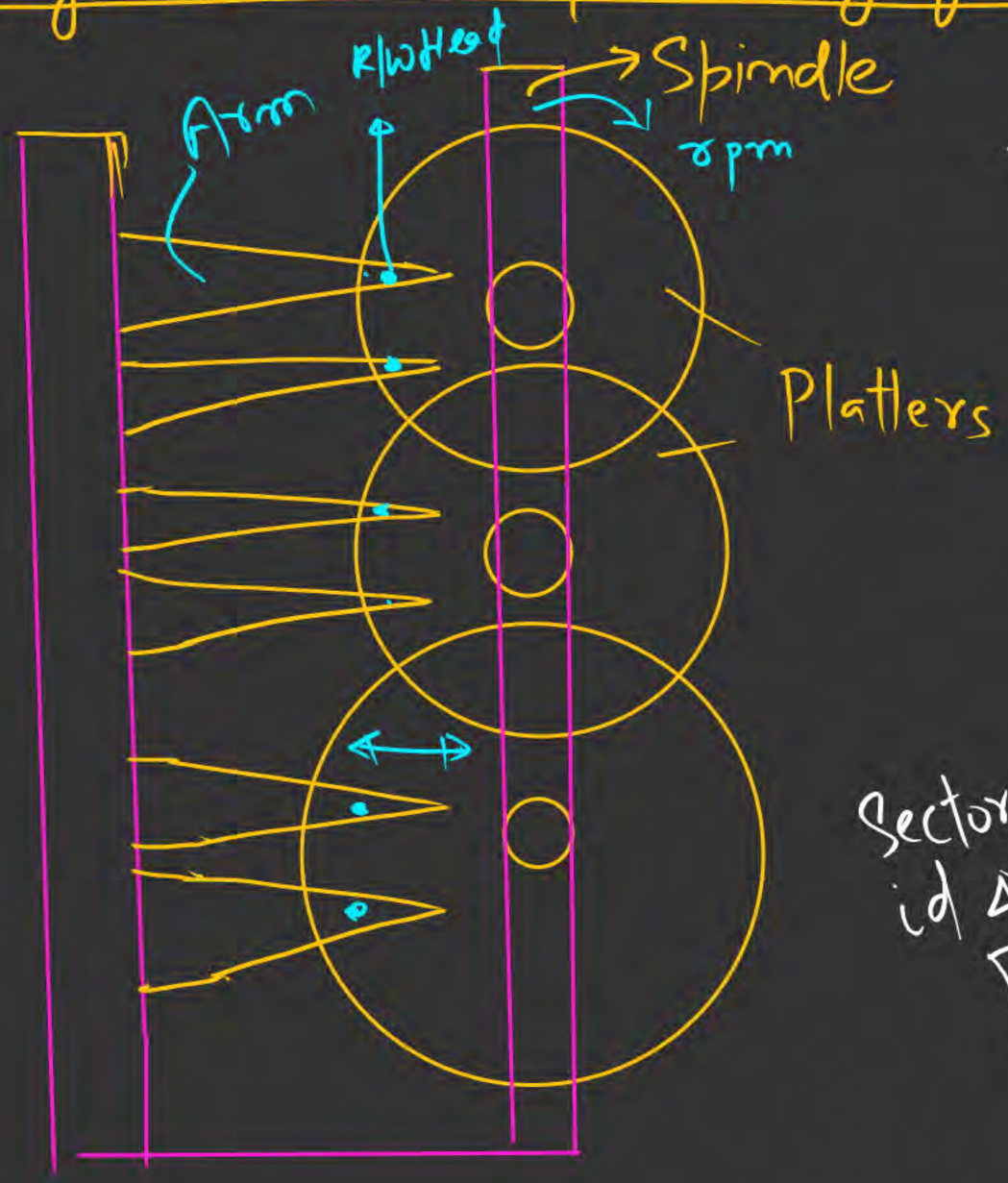
(ii) Best Fit

File System + Device (Disk) Management

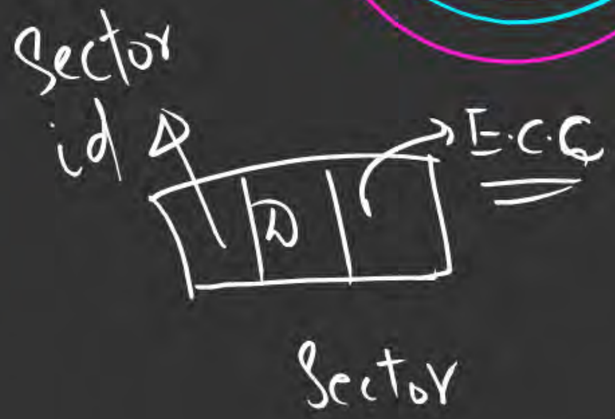
- Concepts of File & Directories
- Allocation Methods (CG; NCG + Index)
- Free Space Mgmnt

- Physical Structure of Disk
- Device (Disk Scheduling) → (IO-Scheduling)

Physical Structure/Geometry of Disk :



Disk
↳ Platters
↳ 2-Surface
↓
Tracks
↓
Sectors



Disk IO-Time : Seek time + Latency Time + Transfer Time

Time to R/W a Sector

$|x-y| * TTT$

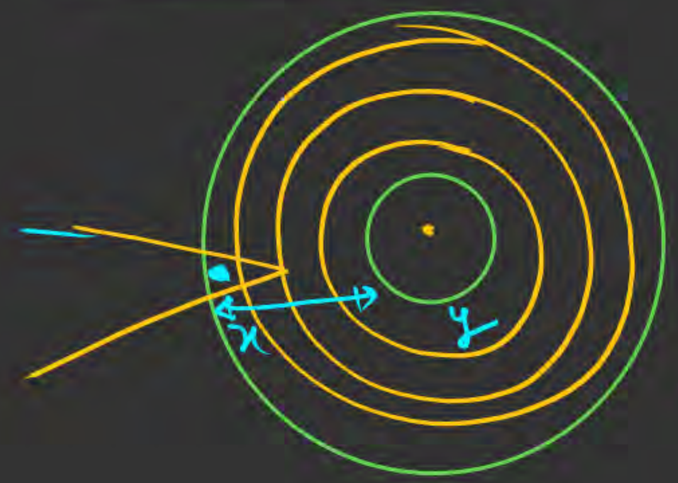
$\frac{R}{2}$

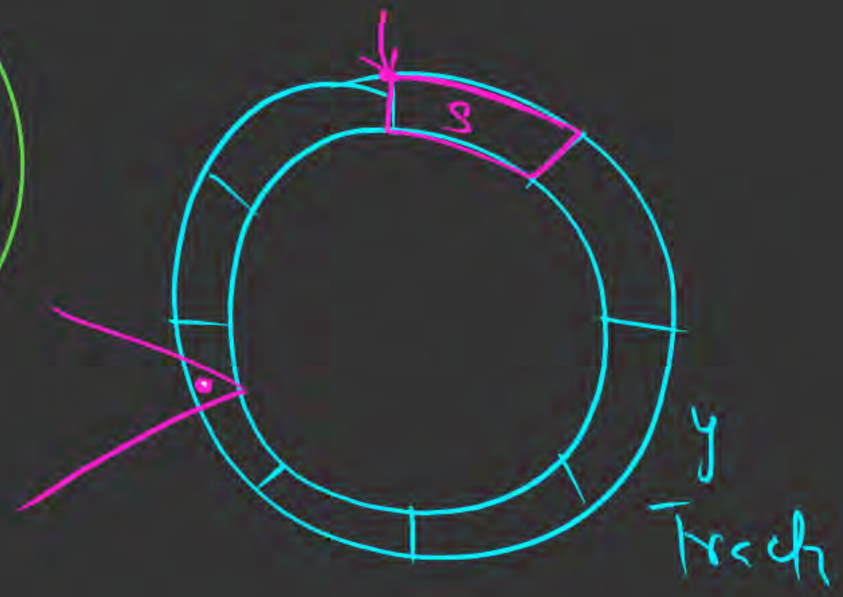
R = Time for one Rotation

$\left(\frac{SR}{x}\right)$

(TTT: Track-Track time)

R ~ rpm





Track Size = 'X' By

Sec. Size = 'S' By

Rot. Time = 'R'

X By — R

S By — ?

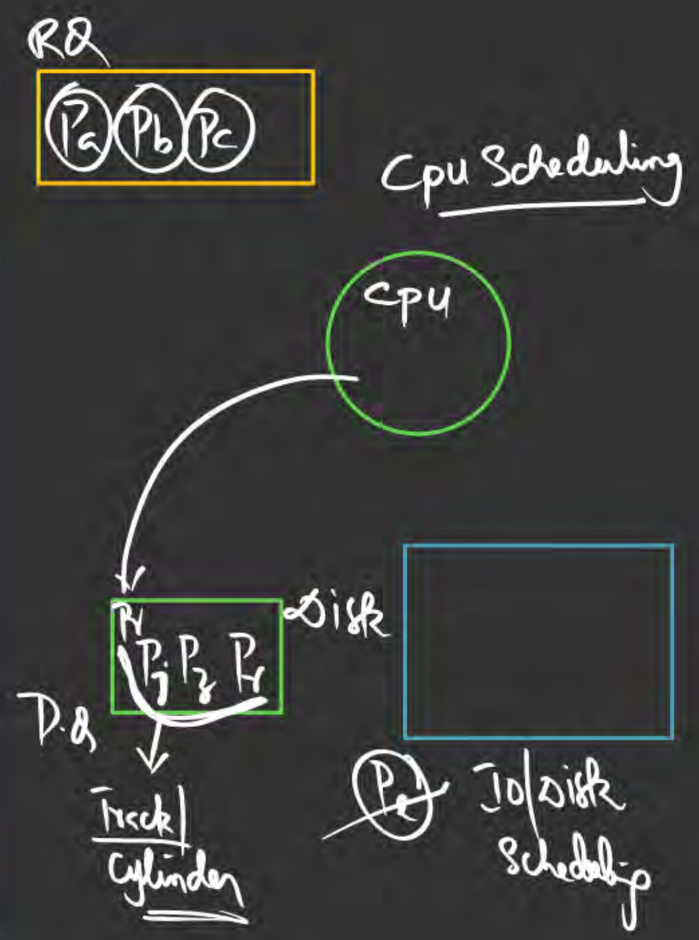
$TT = \frac{S \cdot R}{X}$

Data transfer Rate : (B/s)

'X' Bytes – R ms

? – 1 s

DTR $\boxed{\left(\frac{X}{R}\right) B/s}$



(i) FCFS ✓

(ii) Shortest Seek Time First ✓

(iii) SCAN ✓

(iv) C-SCAN ✓

(v) Look

(vi) C-Look

Topic : file System & Device Management

Tracks

#Q. Disk requests are received by a disk drive for cylinder 5, 25,18, 3, 39, 8 and 35 in that order. A seek takes 5 msec per cylinder moved. How much seek time is needed to serve these requests for a Shortest Seek First (SSF) algorithm? Assume that the arm is at cylinder 20 when the last of these requests is made with none of the requests yet served.

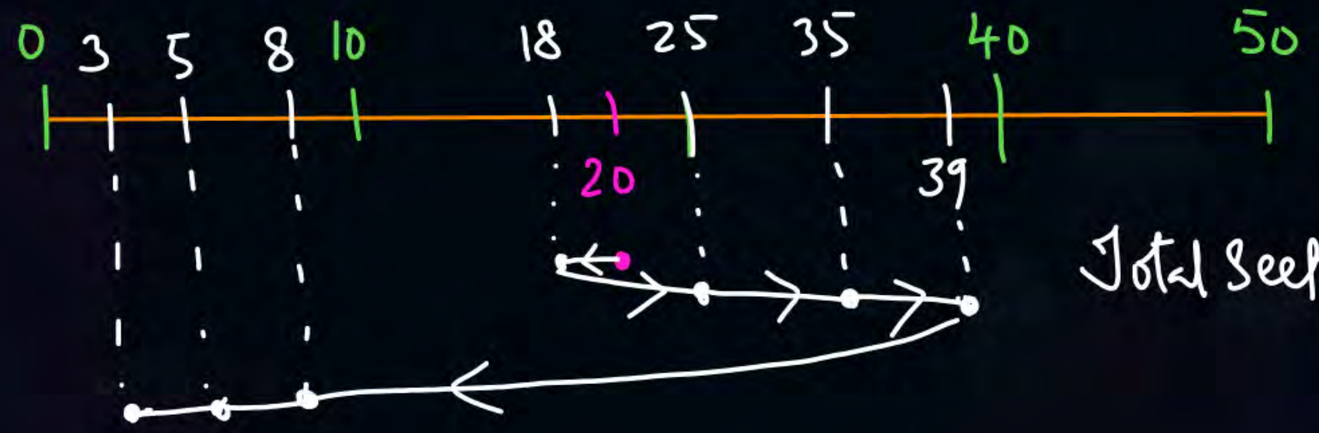
CS: 2007

A. 125 msec

B. 295 msec

C. 575 msec

D. 750 msec



Total Seeks: (39-3) + (39-18) + (20-18) = 59

Total Seek Time = 59 × 5 = 295 ms.

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Sector

#Q. Using larger block size in a fixed block size file system leads to

CS: 2007

A. Better disk throughput but poorer disk space utilization

B. Better disk throughput and better disk space utilization

C. Poorer disk throughput but better disk space utilization

D. Poorer disk throughput and poorer disk space utilization

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8 Platters

#Q. Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stores in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively

CS: 2009

A. 256 Mbyte, 19 bits

B. 256 Mbyte, 28 bits

C. 512 Mbyte, 20 bits

D. 64 Gbyte, 28 bits

Surf Capacity = $[128 * 256 \times 512\ B]$

Disk Capacity = $[16 * 128 \times 256 \times 512]\ B$

$= 2^4 \times 2^7 \times 2^8 \times 2^9 = 2^{28} = 256\ MB$

	3	1	7	8	9
Sector Address	Plat	Surf	Track	Sec	d

$= 28$ bits

$2^{28} = 256\ MB$

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1K = 1024

rot. Per Minute

#Q. A fast wide SCSI-II disk drive spins at 7200 RPM, has a sector size of 512 bytes, and holds 160 sectors per track. Estimate the sustained transfer rate of this drive.

DTR (B/s)

CS: 2011

A. 576000 Kilobytes / sec

B. 9600 Kilobytes / sec

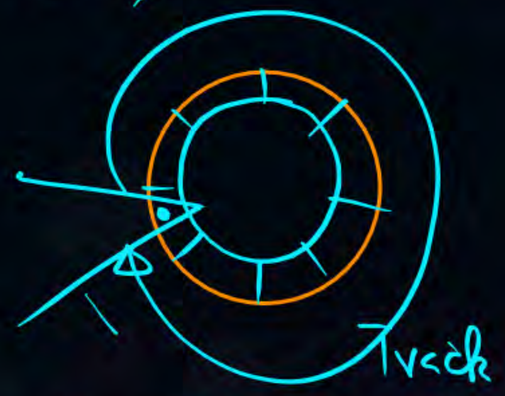
C. 4800 Kilobytes / sec

D. 19200 Kilobytes / sec

7200 rot — 60 S
? — 1 S

$$1S = \frac{7200}{60} = 120$$

→ Track Size = 160 * 512 B



1 Rot — 160 × 512 B
120 Rots — ?

DTR (B/s) : $\frac{160 \times 512 \times 120}{1024}$ B/s

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#Q. Suppose we have variable logical records of lengths of 5 bytes, 10 bytes, and 25 bytes while the physical block size in disk is 15 bytes. What is the maximum and minimum fragmentation seen in bytes? **CS: 2013**

A. 25 and 5

B. 15 and 5

C. 15 and 0

D. 10 and 5

		Frag
5 B	→ 15 Bytes ⇒	10 B
10 B	→ 15 Bytes ⇒	5 B
25 B	→ 15 Bytes ⇒	5 B
	2	

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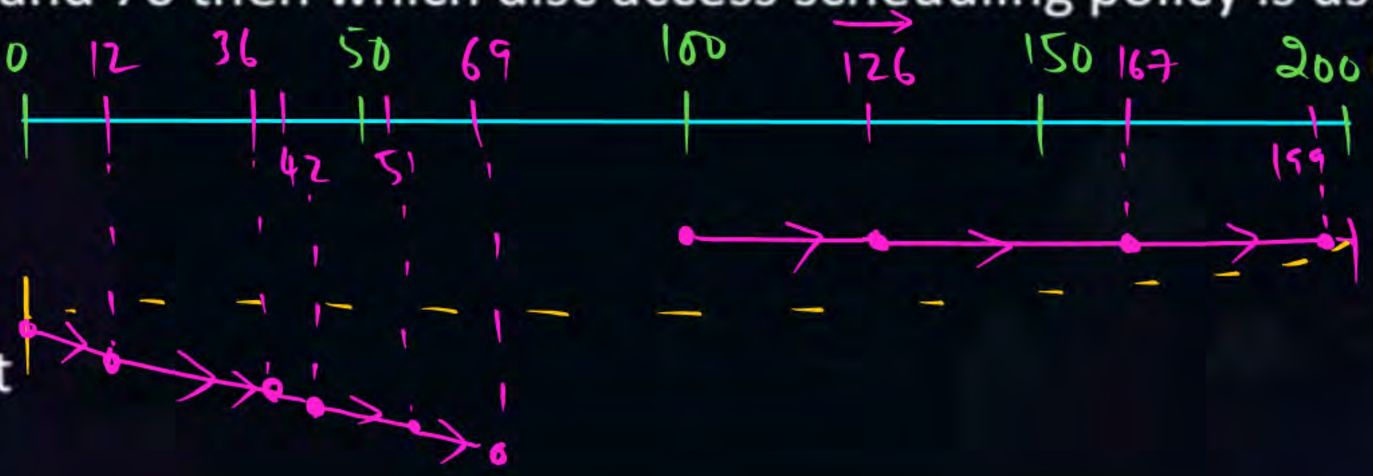
#Q. There are 200 tracks on a disk platter and the pending requests have come in the order - 36, 69,167, 76, 42, 51,126,12, and 199. Assume the arm is located at the 100'h track and moving towards track 200. If sequence of disc access is 126, 167, 199, 12, 36, 42, 51, 69, and 76 then which disc access scheduling policy is used? **CS: 2014**



A. Elevator

B. Shortest Seek-time First

C. C-SCAN

D. First Come First Served

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R/2

IO_time = S.T + L.T + T.T

#Q. A hard disk system has the following parameters : Number of tracks = 500 Number of sectors/track = 100 Number of bytes /sector = 500 Time taken by the head to move from one track to adjacent track = 1 ms Rotation speed = 600 rpm. What is the average time taken for transferring 250 bytes from the disk ? **CS: 2015**

A. 300.5 ms

B. 255.5 ms

C. 255 ms

D. 300 ms

Avg. Seek time : $(0+1+2+3+\cdots+499)/500 = \frac{499(500)}{2\times 500} = (249.5)$ ms

600 rpm ⇒ 600 M - 60 s ⇒ $R = \frac{60}{600}\,s = \frac{1}{10}\,s \Rightarrow 10^{-1}\times 1000 = \frac{100\text{ ms}}{R}$

1 R - ?

Track Size = 100 * 500 B ⇒ 100 × 500 B — 100 ms

250 B — ?

$\frac{250\times 100}{100\times 500}$ ms = 0.5 ms

T.T

IO Time = (249.5 + 50 ms + 0.5 ms) = 300 ms

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#Q. Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively: **CS: 2016**

A. 256 Mbyte, 19 bits

B. 256 Mbyte, 28 bits

C. 512 Mbyte, 20 bits

D. 64 GB, 28 bits

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#Q. Consider a disk system with 100 cylinders. The request to access the cylinders occur in the following sequences
4, 37, 10, 7, 19, 73, 2, 15, 6, 20
Assuming the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first algorithm is used **CS: 2017**

A. 95 ms

B. 119 ms

C. 233 ms

D. 276 ms

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#Q. Consider a disk sequence with 100 cylinders. The request to access the cylinder occur in the following sequence :

4, 34, 10, 7, 19, 73, 2, 15, 6, 20

Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 2 ms to move from one cylinder to adjacent one and shortest seek time first policy is used? **CS: 2017**

A. 190

B. 238

C. 233

D. 276

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#Q. A particular disk unit uses a bit string to record the occupancy or vacancy of its tracks, with 0 denoting vacant and 1 for occupied. A 32-bit segment of this string has hexadecimal value D4FE2003. The percentage of occupied tracks for the corresponding part of the disk, to the nearest percentage is **CS: 2018**

A. 12

B. 25

C. 38

D. 44

9 → 1001
A → 1010
B → 1011
C → 1100
D → 1101
E → 1110
F → 1111

∴ 11010100111111000100000000001 1

% occupancy = $\frac{14}{32} = \frac{7}{16}$

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#Q. The operating system of a computer may periodically collect all the free memory space to form contiguous block of free space. This is called. **CS: 2016**

A. Concatenation

B. Garbage Collection

C. Collision

D. Dynamic Memory Allocation

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#Q. Disk requests come to a disk driver for cylinders in the order 10, 22, 20, 2, 40, 6, and 38 at a time when the disk drive is reading from cylinder 20. The seek time is 6 ms/cylinder. The total seek time, if the disk arm scheduling algorithms is first-come-first-served is

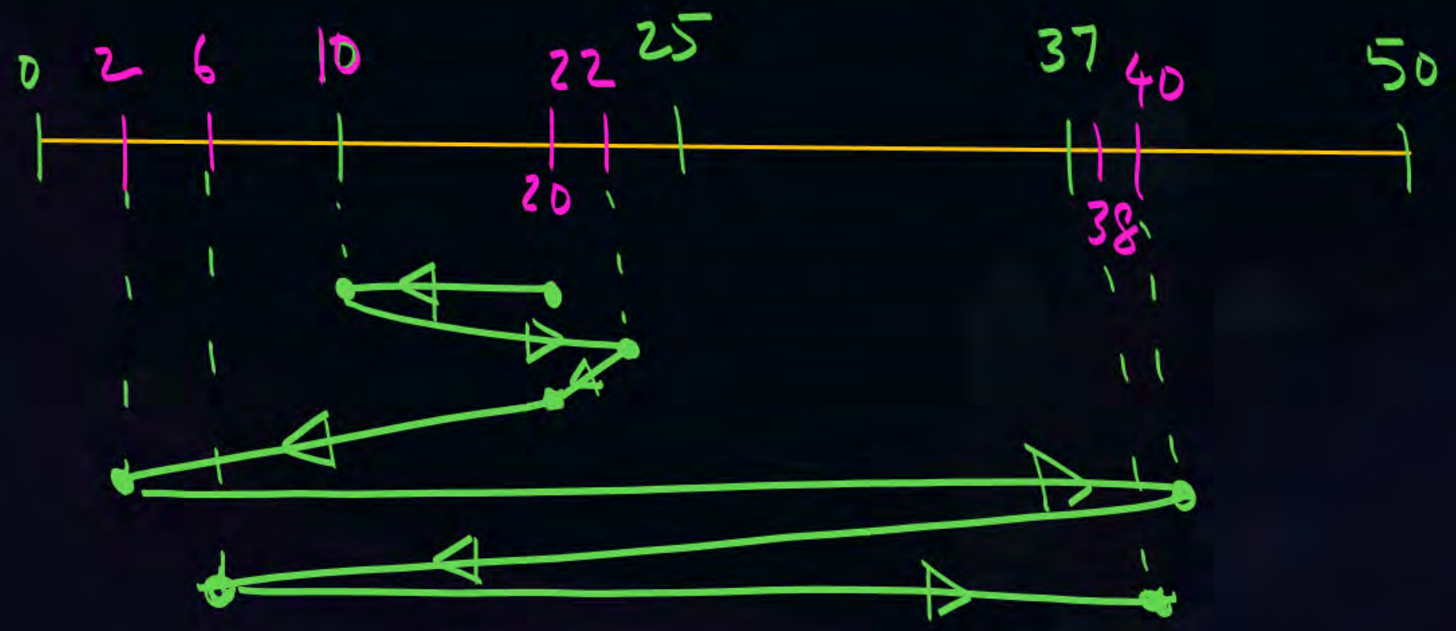
CS: 2018

A. 360 ms

B. 850 ms

C. 900 ms

D. None of the above



THANK - YOU