Q1

ANS If one process is executing in its critical section, no other process is allowed to execute in its critical section. Each process must request permission to enter its critical section. Decrementing the semaphore is called acquiring or locking it, incrementing is called releasing or unlocking.

semaphore
~~Sephmore~~ S is initialized to 2

Process W executes : S = 1, n = 1 but it doesn't update the n variable.

Then process Y executes S = 0, it decrement n, now n = -2 and signal semaphore S = 1

Now process Z executes. S = 0, n = -4, signal semaphore S = 1

Now process W updates n = 1, S = 2 then process X executes X = 2

∴ Max value of n = 2

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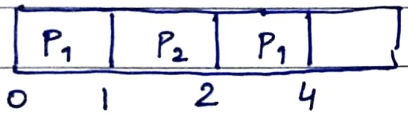
Q2

PROCESS	P_1	P_2	P_3	P_4
ARRIVAL TIME	0	1	3	4
CPU BURST TIME	3	1	3	z = ?

Average waiting time of the processors = 1 ms

ANS



Till t = 4, the waiting time of P_1 = 1 and P_2 = 0 and P_3 = 1 but P_3 has not started yet.

CASE 1: Note that if P_4 burst time is less than P_3 and P_4 will complete and after that P_3 will complete. Therefore waiting time of P_4 should be 0. And total waiting time of P_3 : 1 + {Burst time of P_4} because until P_4 completes P_3 does not get a chance.

$$\text{Average waiting time} = \frac{1 + 0 + (1+n) + 0}{4} = 1$$

$$\therefore n = 2$$

CASE 2: Note that if P_4 burst time is greater than P_3 then P_4 will complete after P_3 will complete. Therefore, waiting time of P_3 remains the same. And total waiting time of

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P_4 = (Burst time of P_3) because until P_3 completes P_4 does not get a chance.

Average waiting time $= \frac{1+0+1+3}{4} = 1$

But $\frac{5}{4} \neq 1$

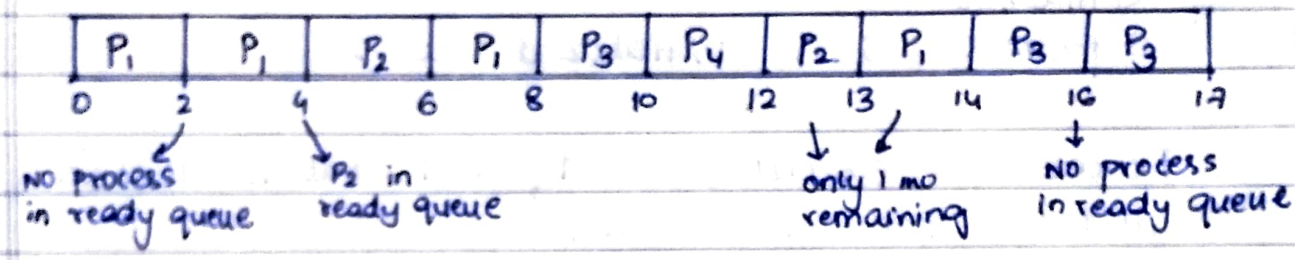
$\therefore$ case 2 ✗ invalid.

$\boxed{z = 2}$

Q3

PROCESS	ARRIVAL TIME	BURST TIME
P_1	0	7
P_2	3	3
P_3	5	5
P_4	6	2

calculate average waiting time using Round Robin Scheduling.
quantum = 2ms



Ready queue : ~~P_1~~ ~~P_2~~ ~~P_1~~ ~~P_3~~ P_4 ~~P_2~~ ~~P_1~~ P_3

PROCESS	ARRIVAL TIME	BURST TIME	COMPLETION TIME	TURN AROUND TIME	WAITING TIME
P_1	0	7	14	14	7
P_2	3	3	13	10	7
P_3	5	5	17	12	7
P_4	6	2	12	6	4
				42	25

∴ Average waiting time $= \frac{7+7+7+4}{4} = \frac{25}{4} = 6.25$ ms

∴ Average turn around time $= \frac{42}{4} = 10.5$ ms

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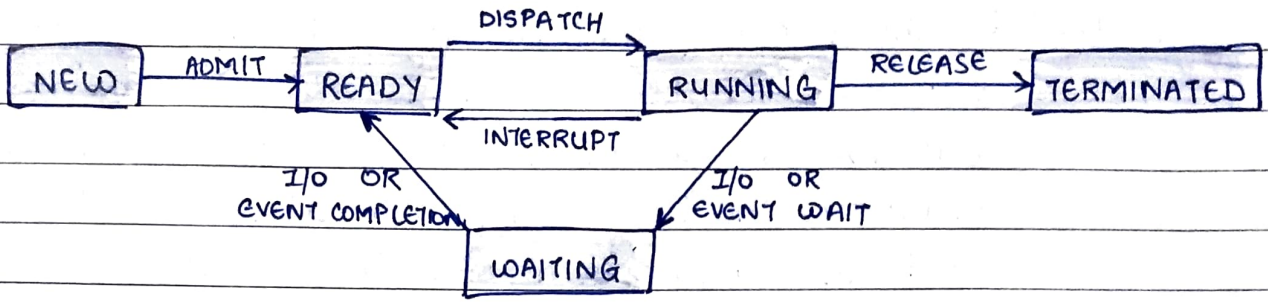
Q.4 Draw five state process model and explain each state in detail.

ANS



FIVE STATE PROCESS MODEL

Five state process model is an extension of the two-state model. The two-stage model is efficient if all the processes in the Not-running state are ready of execution but this may not be true. Some processes in the Not-running state might be waiting for some event of I/O operation. Thus, the dispatcher cannot simply select the process from the front of the queue. The dispatcher would have to scan the queue to search for the process to execute. This degrades performance. The best way to solve this problem is to split the Not-running state into two states : Ready state and blocked state.

Five-state process model states :-

1. RUNNING : The currently executing process
2. WAITING / BLOCKED : Process waiting for some event such as completion of I/O operation, waiting for other processes, synchronization signal, etc.

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3. READY : A process that is waiting to be executed.

4. NEW : The process that is just being created. The program control block is already being made but the program is not yet loaded in the main memory. The program remains in the new state until the long term schedulex moves the process to the xready state.

5. TERMINATED / EXIT : A process that is finished or aborted due to some reason.

Qs Describe objectives of operating system in detail.

ANS Modern operating system generally accomplish following three major goals by running processes in low priviledge and providing service calls that invoke the operating system kernel in high privilege state.

1. TO HIDE THE DETAILS OF HARDWARE BY CREATING ABSTRACTION : Abstraction is a software that hides lower details and provides a set of higher level functions. An operating system transforms physical world of devices, instructions, memory and time into virtual world that is the result of abstraction built by the operating system.

2. TO ALLOCATE RESOURCES TO PROCESS (Manage Resources) : An operating system controls how processes may access resources.

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3. PROVIDE A PLEASANT AND EFFECTIVE USER INTERFACE :

The user interacts with the operating system through the user interface and usually interested in the "look and feel" of the operating system.

Important content of the user interface :-

- command interpreter
- the file system
- online help
- application integration.

6.6 Explain different system calls

ANS In computing, a system call is the programmatic way in which a computer program requests a service from the kernel of the operating system it is executed on.

A system call is a way for programs to interact with the operating system. A computer program makes a system call when it makes a request to the operating system's kernel system calls are the only entry points into the kernel system. All programs needing resources must use system calls.

SERVICES PROVIDED BY SYSTEM CALLS :

- Process creation and management
- Main memory management.
- File Access, Directory and File system management
- Device handling (I/O)
- Protection
- Networking, etc.

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TYPES OF SYSTEM CALLS:

There are 5 categories of system calls

1 PROCESS CONTROL : This system calls perform the task of process creation, process termination, etc.

Functions :-

→ End and Abort
→ Load and Execute
→ Wait and signed event
→ Create process & terminate process
→ Allocate and free memory.

2 FILE MANAGEMENT : File management system calls handle file manipulation jobs like creating a file, reading and writing, etc.

Functions :-

→ Create a file
→ Delete file
→ Open and close file
→ Read, write and reposition
→ Get & set file attributes.

3 DEVICE MANAGEMENT : Device management does the job of device manipulation like reading from device buffers

Functions :

→ Request and release device
→ Logically attach / detach devices
→ Get and set device attributes

4 INFORMATION MAINTAINANCE : It handles information and its transfer between the OS and the user program.

Functions :

→ Get or set time and date
→ Get process and device attributes

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5

Q7 Differentiate between monolithic kernel and microkernel

ANS.

BASIS FOR COMPARISON	MICROKERNEL	MONOLITHIC KERNEL
Basic	In microkernel user services and kernel, services are kept in seperate address space.	In monolithic kernel, both user services and kernel services are kept in the same address space
Size	Microkernel are smaller in size	Monolithic kernel is larger than microkernel.
Execution	Slow execution	Fast execution
Extendible	The microkernel is easily extendible	The monolithic kernel is hard to extend.
Security	If a service crashes, it does effect on working of microkernel.	If a service crashes, the whole system crashes in monolithic kernel.
Code	To write a microkernel, more code is required.	To write a monolithic kernel, less code is required.
Example	QNX, symbian, L4Linux, Singularity, K42, Mac OS, Integrity, Minix, etc.	Linux, BSD's, Microsoft Windows, Solaris, HP-UX, etc.

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Q8 If a set of n tasks with known runtimes $x1, x2, \ldots xn$ are to be run on a uniprocessor machine, which processor scheduling algorithms will generate the maximum throughput.

ANS. SHORTEST JOB FIRST.

- Throughput means total number of tasks executed per unit time. i.e. sum of waiting time and burst time.
- Shortest Job First (SJF) scheduling is a scheduling policy that selects the waiting process with the smallest execution time to execute next.
- Thus, in shortest job first scheduling, shortest jobs are executed first. This means CPU utilization is maximum. so maximum number of tasks are completed.

Q9 What is content switching? How content switching is done by the operating system.

ANS. CONTEXT SWITCHING: When CPU switches from one process to another, a content switch occurs. A content switch is the switching of CPU from one process or thread to another.

THE operating system performs the following steps for content switching:-

1) Save the content of the process that is currently running on the CPU. update the process control block and other important fields.
2) Move the process control block of the above process into the relevent queue such as the ready queue, I/O queue, etc.

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3) Select the new process for execution.
4) Update the process control block of selected process. This includes updating the process state to running.
5) Update the memory management data structures as required.
6) Restore the context of the process that was previously running when it is loaded again on the processor. This is done by loading the previous values of the process control block and registers.

Q10 Differentiate between User level thread and Kernel Level Thread.

ANS:

USER LEVEL THREAD	KERNEL LEVEL THREAD
• User level threads are faster to create and manage.	• Kernel-level threads are slower to create and manage
• Implementation is by a thread library at the user level	• operating system supports creation of Kernel threads.
• User-level thread is generic and can run on any operating system.	• Kernel-level thread is specific to the operating system.
• Multi-threaded applications cannot take advantage of multiprocessing.	• Kernel routines themselves can be multithreaded.
• Context switch time is less.	• Context switch time is more.
• Context switch requires no hardware.	• Hardware is required.

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