Operating System

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Assignment 1

A-1 Modern systems use operating systems for core functions - managing hardware, providing a software interface, ensuring security and supporting multitasking.

A-2 A real time operating system (RTOS) would be ideal as it guarantees timely, predictable responses critical for health monitoring. It ensures low power consumption

A-3 I would avoid using a monolithic kernel. Although its fast, its lack of modularity risks system crashes due to bugs in any single component making it harder to maintain.

A-4 I refute this claim, OS structure does matter. Modularity, and abstraction enhance stability, maintainability and performance. Poor structuring can cause system wide crashes, increase overhead and impact scalability.

A-5)i) Analysing the PCB checks registers, states and pointers revealing misinitialized values and context switch bugs.

ii) When a process moves unexpectedly, context switcher saves the running state and loads the waiting process's state.

iii) For mid-execution allocation of I/O resources, non-blocking asynchronous system calls will allow the process to continue without stalling the scheduler.

A-6)

a) Total context switching time = 2+3+1 = 6 ms

b) Frequent context switching increases overhead, reduces effective CPU time and degrades multitasking performance.

A-7) Single threaded time = 40s

Execution time = $\frac{40}{n}$

For max efficiency, maximum threads

$\frac{40}{2} = 20s$, $\frac{40}{4} = 10s$, $\frac{40}{10} = 4s$, $\frac{40}{20} = 2s$, $\frac{40}{40} = 1s$

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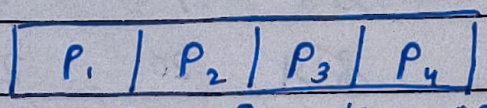
Multithreading improves CPU utilization, parallelizes independent tasks, hides I/O latency which boosts overall system throughput.

A-8

Process	AT	BT	CT	TAT	WT
P_1	0	5	5	5	0
P_2	0	3	8	8	5
P_3	0	8	16	16	8
P_4	0	6	22	22	16

FCFS

FCFS ⇒



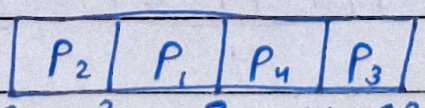
$$\text{Avg TAT} = \frac{5+8+16+22}{4} = \frac{41}{4} = 10.25 \text{ s}$$

$$\text{Avg WT} = \frac{0+5+8+16}{4} = \frac{29}{4} = 7.25 \text{ s}$$

Process	AT	BT	CT	TAT	WT
P_1	0	5	8	8	3
P_2	0	3	3	3	0
P_3	0	8	22	22	14
P_4	0	6	14	14	8

SJF

SJF ⇒



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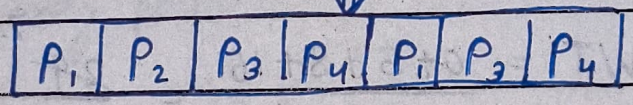
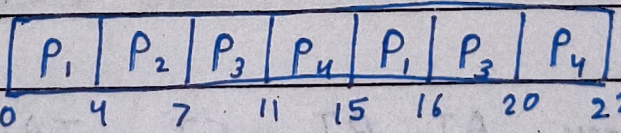
Avg TAT = $\frac{8+3+22+14}{4} = \frac{47}{4} = 11.75$ s

Avg WT = $\frac{3+14+8+0}{4} = \frac{25}{4} = 6.25$ s

Process	AT	BT	CT	TAT	WT
P_1	0	5	16	16	11
P_2	0	3	7	7	4
P_3	0	8	20	20	12
P_4	0	6	22	22	16

Round Robin ⇒ Ready Queue





T.Q. = 4

Avg TAT = $\frac{16+7+20+22}{4} = \frac{65}{4} = 16.25$ s

Avg WT = $\frac{11+4+12+16}{4} = \frac{43}{4} = 10.75$ s

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Non preemptive SJF best balances throughput & turnaround by minimizing average waiting and turnaround times due to optimal ordering of burst times.

A-9)

i)a) We will use a microkernel or layered OS architecture. Microkernel isolates core functions, securing critical services while layered design modularizes services management for cloud environments.

b) Virtual machines provide isolation, better resource control, and enable flexible service deployment and scaling during migration.

ii)a) OS ensures high priority tasks preempt lower priority tasks, uses priority or preemptive scheduling.

b) Algorithms like priority scheduling can be suitable for this scenario.