Operating System

Date:

Page:

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 consumptio

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

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

For max efficiency, maximum threads

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

- Multithreading improves CPU utilization, parallelizes ~~independent~~ 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 ⇒

P_1	P_2	P_3	P_4

0 5 8 16 22

$$\text{Avg TAT} = \frac{5+8+16+22}{4} = \frac{\overset{10.25}{\cancel{41}}}{\cancel{4}_1} = 10.25\,s$$

$$\text{Avg WT} = \frac{0+5+8+16}{4} = \frac{\overset{7.25}{\cancel{29}}}{\cancel{4}_1} = 7.25\,s$$

FCFS

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 ⇒

P_2	P_1	P_4	P_3

0 3 8 14 22

$$Avg\ TAT = \frac{8+3+22+14}{4} = \frac{\overset{11.75}{\cancel{47}}}{\cancel{4}\,1} = 11.75\,s$$

$$Avg\ WT = \frac{3+14+8+0}{4} = \frac{\overset{6.25}{\cancel{25}}}{\cancel{4}\,1} = 6.25\,s$$

Process	AT	BT	CT	TAT	WT
P_1	0	~~5~~ ~~1~~	16	16	11
P_2	0	~~3~~	7	7	4
P_3	0	~~8~~ ~~4~~	20	20	12
P_4	0	~~6~~ ~~2~~	22	22	16

Round Robin ⇒ Ready Queue

⇓

P_1	P_2	P_3	P_4	P_1	P_3	P_4

⇒

P_1	P_2	P_3	P_4	P_1	P_3	P_4

0 4 7 11 15 16 20 22

T.Q. = 4

$$Avg\ TAT = \frac{16+7+20+22}{4} = \frac{\overset{16.25}{\cancel{65}}}{\cancel{4}\,1} = 16.25\,s$$

$$Avg\ WT = \frac{11+4+12+16}{4} = \frac{\overset{10.75}{\cancel{43}}}{\cancel{4}\,1} = 10.75\,s$$

Non premptive 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 premptive scheduling.

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