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Assignment - 03

Operating system & deadlock

deadlock detection & avoidance

deadlock prevention

Any 1

A race condition occurs when two or more entities try to change a shared resource simultaneously leading to unpredictable results

e.g. - (real world) - two people editing the same

document at once - one saves changes while the other overwrites them

Any 2

Aspect

Peterson's Solⁿ

Semaphore

Implementation - Software based algorithm - for 2 processes
+ probability of race condition - implemented in as

complexity

simpler logic but limited to 2 processes

more flexible,
supports multiple
process

Hardware
dependency

works purely in
software

depends on hardware
supported atomic
operations

Ans 3 Advantage -

monitors provide automatic synchronization through mutual exclusion within the monitor. In multi core system, they are easier to implement & maintain as synchronization is handled at a higher level, reducing the chance of programming errors.

Ans 4

Starvation - occurs when writers keep waiting indefinitely because continuous readers hold access to shared data to read.

Prevention - use writer priority - once a writer is waiting, block new readers until the writer finishes.

Ans 5

Drawback - Process must request all resources at once before execution begin, leading to resources underutilization & reduced concurrency since some resources remain idle for long periods.

drawback no specific
simply bottleneck
workload

in phased extreme
scenarios

concurrent
parallel

Case-Study → Air Traffic Control system

$(S, E, S) \rightarrow (E, S) \rightarrow (S, E)$

a Critical sections

- Radar data acquisition
- Flight path calculation
- Communication Channel updates

IDC mechanism: use message queue for real-time data synchronization and minimal latency

$(S, E, S) \rightarrow (S, S, S) \rightarrow (S, E, S)$

b Deadlock handling

If deadlock occurs b/w data acquisition and path calculations.

Ans Dining Philosopher problem

using semaphores

- Each philosopher has one chopstick
- To each, philosopher needs both left & right chopstick

Deadlock scenario - All philosopher picks up their left chopstick & wait for the right one.

Solⁿ - use one semaphore monitor to limit maximum philosophers eating it to $4(n-1)$ max.

Ans. Available = Total - Σ Allocation
 $(10, 5, 7) - (7, 2, 5) = (3, 3, 2)$

Now check safe sequence using Banker's algorithm

Safe sequence = $P_1 \rightarrow P_3 \rightarrow P_4 \rightarrow P_0 \rightarrow P_2 \rightarrow P_1$

- Q) If P_1 requests $(1, 0, 2)$ would it be safe?
 New need for $P_1 = (1, 2, 2) - (1, 0, 2) = (0, 2, 0)$
 Available $(3, 3, 2) - (1, 0, 2) = (2, 3, 0)$
 Check if safe \rightarrow Sequence still possible - Yes

Any Given

Total Instances $A = 10, B = 5, C = 7$

Allocation & Max table

Process	Need (A, B, C)
P_0	$(7-0, 5-1, 3-0)$
P_1	$(3-2, 2-0, 2-0)$
P_2	$(9-3, 0-0, 2-0)$
P_3	$(4-2, 2-1, 2-1)$
P_4	$(5-0, 3-0, 3-2)$

b) Available = Total - Σ Allocation

$$(10, 5, 7) - (7, 2, 5) = (3, 3, 2)$$

- show $(I-N) P$