

Premia Kanapar  
23010102S1  
Btech CSE - 'D'

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## Assignment D4

Ques1. To form the global wait-for graph (combined) :-

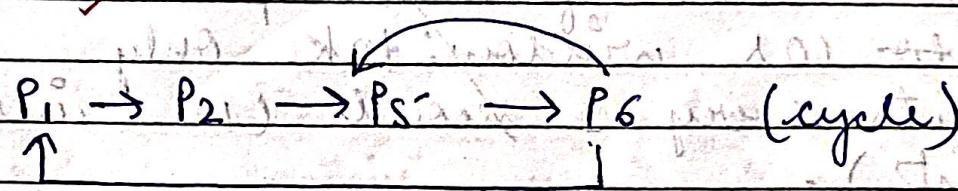
given :-

from all 3 sites

~~local edges~~

S<sub>1</sub>: P<sub>1</sub> → P<sub>2</sub>, P<sub>3</sub> → P<sub>4</sub>  
S<sub>2</sub>: P<sub>2</sub> → P<sub>5</sub>, P<sub>5</sub> → P<sub>6</sub>  
S<sub>3</sub>: P<sub>6</sub> → P<sub>1</sub>

graph :-



P<sub>3</sub> → P<sub>4</sub> (not part of cycle)

(b) There is a cycle.

P<sub>1</sub> → P<sub>2</sub> → P<sub>5</sub> → P<sub>6</sub> → P<sub>1</sub>

Hence, deadlock exists and processes involved P<sub>1</sub>, P<sub>2</sub>, P<sub>5</sub>, P<sub>6</sub>. Processes P<sub>3</sub> & P<sub>4</sub> are not part of the deadlock.

- (c) chandy-mishra - has probe-based deadlock detection algorithm is a suitable algorithm :-
- Each site sends a probe message along wait-for edges.
  - If a probe returns to its origin, a cycle is detected.
  - works well in distributed environments where no single site has the entire graph

ques 2 Expected access time =  $0.3 \times 2.5 \text{ ms} + 0.7 \times 5 \text{ ms}$   
 $\Rightarrow 7.5 + 3.5$   
 $\Rightarrow 11 \text{ ms}$

The caching strategy to improve performance is popular files are served locally. Leases keep caches reasonably consistent without excessive invalidation traffic giving a good tradeoff b/w latency and correctness.

- ques 3 (a) Recommended Schedule (over los) :
- If a recent full checkpoint exists before the 10s window: take only incremental checkpoints every second (10 incremental checkpoints).
  - If no prior full exists : take one full checkpoint at the start, then incremental checkpoints every 1 second (1 full + 10 increments across the period).

overhead calc :  $10 \leftarrow 10 \leftarrow 10 \leftarrow 10 \leftarrow 10 \leftarrow 10$   
with prior full =  $10 \times 50 = 500 \text{ ms}$   
without prior full =  $200 + 10 \times 50 = 700 \text{ ms}$

- b) RPO  $\rightarrow$  1s means you must capture changes at least every second. Incremental checkpoints are much cheaper (50ms) so scheduling them every second minimizes overhead while meeting RPO. A full checkpoints is only needed occasionally to bound restore complexity - otherwise pure incrementals plus an earlier full give the lowest cost.

Ques 4 \* Scheduling Challenges are :-

sudden traffic spikes, hot product partitions, cross-region latency, uneven load, data locality vs consistency tradeoffs.

Suggested algorithm uses power-of-d-choice (P2C) front-end routing combined with Rendezvous / consistent hashing for session affinity & data locality, P2C gives very low queuing imbalance, consistent hashing routes requests user data to reduce latency.

\* Fault tolerance strategy includes :-

- deploy active-active multi-region services
- critical metadata / state
- Bulk data / catalogs
- using periodic full + incremental backups
- For RTO :-

automate failover and word standbys so services in another failover region take traffic in seconds.

For RPO :-  
ensure critical data is synchronously replicated or use cross-region commit protocols.

Sticky  
21/11/25

AM1B = Amsterdam ←