TUTORIAL-09

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U19CS009

Qs-1 Explain clock skew and how to deal with it.

→ In practice when a system has 'n' computers, all 'n' crystals will run at slightly different rates causing the software clocks gradually to get out of synch and give different values when read out. This difference in time values is called clock skew.

As a consequence of this clock skew, programs that expect the time associated with a file object, process or message to be correct and independent of the machine on which it was generated can fail.

Qs2 Why do we need synchronization in distributed system?

→ We need synchronization for the following.

(i) It is important to know when events happened and in what order.

(ii) Required to understand the temporal ordering of events produced by concurrent processes.

(iii) It is useful for synchronizing senders and receivers messages, controlling joint activity and then serializing concurrent access to shared objects.

(iv) Ensure multiple unrelated process running on different machines should be in agreement with and be able to make consistent decisions about the ordering of events in sytems

(v) Ensure machines can report the same time regardless of how imprecise their clocks may be or what the network latencies are between the machines.

(k) Using Lampeert's clock.

for P_0 → $\phi_1 = 1$ (Assuming values starts from 1 & increment by 1)
$\phi_2 = 2$
$\phi_3 = 3$

for P_2 $\phi_{10} = 1$
$\phi_{11} = 2$
$\phi_{12} = 3$

Now $\phi_1 \rightarrow \phi_6$ ∴ $\phi_6 > 1$

thus $\phi_6 = \max(\phi_6, \phi_1 + 1)$
$= \max(1, 2)$
∴ $\phi_6 = 2$ & all later values will be incremented

Now $\phi_{12} \rightarrow \phi_7$ ∴ $\phi_7 > 3$

$\boxed{∴ \phi_7 = 4}$

now $\phi_2 \rightarrow \phi_{13}$, $\phi_{13} > \phi_{12}$
∴ $\phi_{13} > 3$

so $\boxed{\phi_{13} = 4}$

∴ $\boxed{\phi_{14} = 5}$
& $\boxed{\phi_8 = 5}$

$\phi_8 \rightarrow \phi_{15}$ ∴ $\phi_{15} > 5$

$\boxed{∴ \phi_{15} = 6.}$

→ $\phi_{14} \rightarrow \phi_9$ ∴ $\phi_9 > 5$

∴ ~~ϕ_{10}~~ $\boxed{\phi_9 = 6}$

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$\rightarrow \phi_9 \rightarrow \phi_4$

$\therefore \phi_4 = \max(4, \phi_9 + 1)$
$= \max(4, 6+1)$
$= \max(4, 7)$

$\phi_4 = 7$

$\downarrow$

$\phi_5 = 8$

$\phi_{16} = 7.$

$\therefore$ Lamports value

P_0	P_1	P_2
$\phi_1 = 1$	$\phi_6 = 2$	$\phi_{10} = 1$
$\phi_2 = 2$	$\phi_7 = 3$	$\phi_{11} = 2$
$\phi_3 = 3$	$\phi_8 = 5$	$\phi_{12} = 3$
$\phi_4 = 7$	$\phi_9 = 6$	$\phi_{13} = 4$
$\phi_5 = 8$		$\phi_{14} = 5$
		$\phi_{15} = 6$
		$\phi_{16} = 7$

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→ Using vector clock

Initially

P_0	P_1	P_2
$\phi_1 = [1,0,0]$	$\phi_6 = [0,1,0]$	$\phi_{10} = [0,0,1]$
$\phi_2 = [2,0,0]$	$\phi_7 = [0,2,0]$	$\phi_{11} = [0,0,2]$
$\phi_3 = [3,0,0]$	$\phi_8 = [0,3,0]$	$\phi_{12} = [0,0,3]$
$\phi_4 = [4,0,0]$	$\phi_9 = [0,4,0]$	$\phi_{13} = [0,0,4]$
$\phi_5 = [5,0,0]$		$\phi_{14} = [0,0,5]$
		$\phi_{15} = [0,0,6]$
		$\phi_{16} = [0,0,7]$

$\phi_1 \to \phi_6$

$\phi_6 = max([0,1,0], [1,0,0])$

$\therefore \phi_6 = [1,1,0]$

$\phi_7 = [1,2,0]$ & $\phi_8 = [1,3,0]$

$\phi_9 = [1,4,0]$

$\phi_{12} \to \phi_7$

$\phi_7 = max([1,2,0], [0,0,3])$

$\phi_7 = [1,2,3]$

$\phi_8 = [1,3,3]$

$\phi_9 = [1,4,3]$

$\phi_2 \to \phi_{13}$

$\phi_{13} = max([0,0,4], [2,0,0])$

$\phi_{13} = [2,0,4]$

$\to \phi_{14} = [2,0,5]$

$\phi_{15} = [2,0,6]$

$\phi_{16} = [2,0,7]$

$\phi_{14} \rightarrow \phi_9$

$$\phi_9 = \max([1,4,3],[2,0,5])$$
$$\phi_9 = [2,4,5]$$

$\phi_8 \rightarrow \phi_{15}$

$$\phi_{15} = \max([2,0,6],[1,3,3])$$
$$= [2,3,6]$$
$$\phi_{16} = [2,3,7]$$

$\phi_9 \rightarrow \phi_4$

$$\phi_4 = \max([4,0,0],[2,4,5])$$
$$\phi_4 = [4,4,5]$$
$$\phi_5 = [5,4,5]$$

vector clock values

P_0	P_1	P_2
$\phi_1 = [1,0,0]$	$\phi_6 = [1,1,0]$	$\phi_{10} = [0,0,1]$
$\phi_2 = [2,0,0]$	$\phi_7 = [1,2,3]$	$\phi_{11} = [0,0,2]$
$\phi_3 = [3,0,0]$	$\phi_8 = [1,3,3]$	$\phi_{12} = [0,0,3]$
$\phi_4 = [4,4,5]$	$\phi_9 = [2,4,5]$	$\phi_{13} = [2,0,4]$
$\phi_5 = [5,4,5]$		$\phi_{14} = [2,0,5]$
		$\phi_{15} = [2,3,6]$
		$\phi_{16} = [2,3,7]$

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Q-8) Explain the following algorithms:-

a) Berkeley Algorithm → it is also called active time server algorithm.

It is an algorithm for internal synchronization of a group of computers. A master polls to collect clock values from other (slaves). The master then uses round trip time to estimate the slaves clock values. It obtains average from participating computers. It sends the required adjustment to the slaves. If master fails a new master is elected to take over.

b) Christian's Algorithm — It assumes that in a certain machine the time server is synchronized ~~with time server. other machines send a message to time server~~ to the UTC in some fashion called T. Periodically all clocks are synchronized with time server. Other machines send a message to time server which responds with T in a response as fast as possible. The interval $(T1-T0)$ is calculated multiple times. Those intervals whose value exceed a specific threshold values are considered to be unreliable and discarded. Only these values whose range lies in $(T1-T0-2T_{min})$ are considered for calculating correct time. For all remaining measurements an average is calculated which is added to T. Alternatively, measurement for which value of $(T1-T0)$ is minimum is considered most accurate and half it's value is added to T.