Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2015-08-19
Sal (1)	TER2
Tid	8-12
Kurskod	TDDD25
Provkod	TEN1
Kursnamn/benämning **Provnamn/benämning**	Distribuerade system Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	14
Jour/Kursansvarig Ange vem som besöker salen	Petru Eles
Telefon under skrivtiden	0703681396
Besöker salen ca klockan	10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Carita Lilja, 1463
Tillåtna hjälpmedel	Ordbok
Övrigt	
Antal exemplar i påsen	4

LINKÖPINGS TEKNISKA HÖGSKOLA
Institutionen för datavetenskap
Petru Eles

Tentamen i kursen

Distribuerade System- TDDD25

2015-08-19, kl. 8-12

Hjälpmedel:

Engelsk ordbok.

Supporting material:

English dictionary.

Poänggränser:

Maximal poäng är 40.
För godkänt krävs sammanlagt 21 poäng.

Points:

Maximum points: 40.
In order to pass the exam you need a total of minimum 21 points.

Jourhavande lärare:

Petru Eles, tel. 0703681396

Good luck !!!

Tentamen i kursen Distribuerade System -TDDD25, 2015-08-19 kl. 8-12
Du kan skriva på svenska eller engelska!

1. What means transparency in a distributed system? We have defined seven aspects of transparency. Enumerate and explain at least five of them.

(3p)

2. Synchronous and asynchronous distributed systems. What are their main features and what are the consequences of these features?

(2p)

3. BitTorrent and Napster:
   a) Explain how each of them works; illustrate by a figure indicating the successive steps performed for access.
   b) Compare the two.

(3p)

4. How can *exactly once semantics* be achieved in the case of lost messages (assuming the server never crashes)?.

(2p)

5. Consider a system of four processes P_1, P_2, P_3, P_4. Consider the events *a* in P_1, *b* in P_2, *c* in P_3, and *d* in P_4.
   a) Let us consider a case such that the Lamport's logical clock timestamps associated to the events are the following:
   $C(a) = 1$; $C(b) = 3$; $C(c) = 2$; $C(d) = 2$;
   What can you say regarding the happened before relation between events *a, b, c, d* (consider each pair of events)?
   b) Let us consider a case such that the vector clock timestamps associated to the events are the following:
   $C^V(a) = (2,0,0,1)$; $C^V(b) = (2,3,1,1)$; $C^V(c) = (3,2,2,1)$; $C^V(d) = (2,3,1,2)$;
   What can you say regarding the happened before relation between events *a, b, c, d* (consider each pair of events)?

(3p)

6. We have introduced a theorem saying that a cut is consistent "if and only if no two cut events are causally related". Illustrate the theorem with two examples (one showing a consistent cut and the other an inconsistent one). Use figures! Show how the theorem applies.

(3p)

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7. Remote Method Invocation: trace the way of a request and of the reply from the client to a remote server and back. Illustrate with a figure.

(3p)

8. What is the basic idea behind the token based distributed mutual exclusion algorithm by Ricart-Agrawala (the second algorithm)? Consider how mutual exclusion is guaranteed and how the token is passed after a process has left the critical section. How many messages are passed in order a process to get permission to a critical section? Compare to the first algorithm by Ricart-Agrawala (which is not using a token).

(3p)

9. The Byzantine Generals Problem: show how agreement is not or is possible for three and for four participants respectively, in the case one of the generals (not the commander) is a traitor (illustrate the exchange of messages with figures).

(3p)

10. Consider a bully election with 6 processes, P_1, ..., P_6. P_6, the current coordinator, fails and P_3 starts the election. Illustrate the sequence of messages exchanged (use figures).

(3p)

11.

a. Define total and causal ordering of requests. Illustrate by an example.

b. How can total ordering be implemented using a central sequencer?

c. Consider total ordering based on distributed agreement (no central sequencer); consider one front end and several replica managers.

   In this case, the replica mangers, after receiving a request, send back to the front end a *cuid*. What does the front end send back to the replica managers after receiving the *cuid* from each replica manager? How does the front end calculate the value it sends back?

d. What happens if a replica manager crashes before sending to the front end the *cuid* for a request it received?

(4p)

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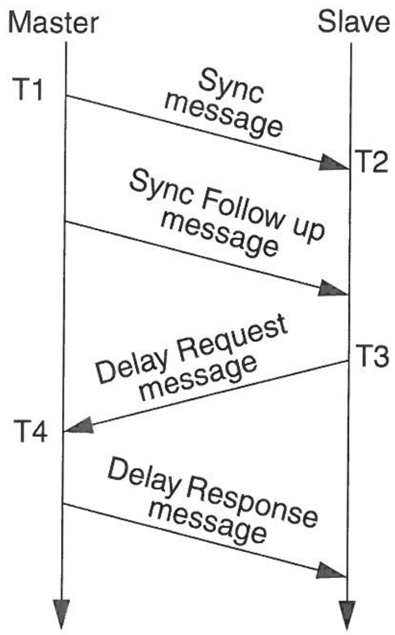
12. What is the basic idea with voting protocols for updating replicated data? How do they work? Consider a set of 12 replica managers. Define two voting protocols. One for a situation when the number of writes is relatively large compared to that of reads, and the other for the reverse situation. Give examples of read and write quorums (use figures).

(3p)

13. You know the maximum drift rate of the clocks on two processors and the maximal allowed skew between them. How do you determine the maximum interval between two successive synchronizations between the clocks? Consider both the case when after synchronisation the clocks are perfectly aligned and the case when after synchronisation there exists an offset Φ between the clocks.

(2p)



14. The figure shows the message exchange performed for clock synchronisation in the Precision Time Protocol (PTP).
    a) What is the role of the "Sync Follow up message"? Why is it needed?
    b) What information is the "Delay Response message" carrying?
    c) Once the values T1, T2, T3, T4 are given, how is the clock update performed?

(3p)