Chalmers Techniska Högskola	CTH TDA297
Datavetenskap	GU DIT290

Distribuerade system fk - Distributed systems, advanced course
Tentamen 2015-08-21

Dag, Tid, Sal: August 21st 2015, 14:00-18:00, M

Kursansvarig: Philippas Tsigas (Tel: 772 5409)

Hjälpmedel: Inga

Totalt Poängtal: 60

Betygsgränser:

CTH: 3:a 30 p, 4:a 38 p, 5:a 48 p

GU: Godkänd 30p, Väl godkänd 48 p

Instructions

- Please answer in English, if possible.
  If you have very big difficulty with that, though, you may answer in Swedish.
- **Do not forget to write your personal number and if you are a GU or CTH student and at which "linje"**
- Please start answering each assignment on a new page; number the pages and use only one side of each sheet of paper.
- Please write in a tidy manner and explain (briefly) your answers.
- Students must **not** write their personal number on the answer sheets since the exam is anonymous; they shall write that **only** on the name slip area that they will seal.

LYCKA TILL !!!!

1. *10 marks*

   Two processes, A and B, both share a concurrent stack. Consider the following history that your system can give to concurrent accesses to the stack objects by the two processes A and B (all following events are executed in the order described below):

   A invokes a push(5). A successfully finishes the push(5) operation. B invokes a push(6) operation, B successfully finishes the push(6) opeartion. A invokes a pop operation. A successfully finishes the pop operation that returns 5.

   (a) Is the execution linearizable? Is the execution sequential consistent? Please provide an explanation for that.

   (b) Give the definitions of linearizability and sequential consistency. Explain the difference between linearizability and sequential consistency.

2. *10 marks*

   Assume that your system provides a reliable, totally ordered (atomic) multicast. Design a replication scheme based on the state machine approach that quarantees that all replicas go exactly through the same sate transitions. Implement a highly availiable concurrent Stack on top of this replication scheme.

3. *15 marks*

   (a) Which type of faults are called Byzantine faults?

   (b) Prove that it is impossible to reach agreement in a system with three processes if one of them is Byzantine faulty.

   (c) How can the above proof be generalised for a system with n processes?

   (d) Is it possible to reach agreement in a system with three processes if one of them is Byzantine faulty by using authentication (unforgeable signatures)? If your answer is yes, describe an algorithm. If your answer is no give a proof to support your answer.

4. *5 marks*

   Define the specification of the i) Reliable Broadcast, ii) FIFO Broadcast and iii) Causal Broadcast.

5. *10 marks*

   Describe an algorithm that computes a spanning tree of a network $G(V, E)$. How nodes of the network can use the existence of such a spanning tree in order to perform broadcasting? Is this a good solution to be used on wireless sensor networks with battery constraints?

6. *10 marks*

   For solving the dinning philosophers problem the following solution has been proposed: All philosophers except from philoshopher P_0 seek their right fork first. Philoshopher P_0 seek her left fork first.

Does this solution solve the dinning philosophers problem? If your answer is yes provide a proof and an analysis of the time complexity of the algorithm.

If your answer is no provide a counterexample.