Universität Freiburg
Institut für Informatik
Prof. Dr. P. Fischer/Prof. Dr. F. Kuhn

Georges-Köhler Allee, Geb. 51
D-79110 Freiburg
peter.fischer@informatik.uni-freiburg.de

Exercises
Distributed Systemes: Part 2
Summer Term 2015
14.7.2015

5. Exercise sheet: Paxos and Concurrency Control

Exercise 1
You are running a set of three numbered processes $p_i, i \in \{1;2;3\}$. They use Paxos to exchange values consistently over a network. Each of the processes can fail for some time, but will return eventually, never more than one process will fail at the same time. Provide an execution of the following setups and count the number of messages and round-trip times.

a) p1 wants to publish a value and no failures occur.

b) p1 uses and optimized version , where it only communicates with a quorum, again without failures!

c) Another iteration of b. optimized by using Multi-Paxos (System is already in a steady state).

d) The leader crashes in Multi-Paxos. What will happen?

e) A second proposer shows up in Multi-Paxos. What will happen?

f) p3 wants to publish a value and a failure occurs at the worst possible time. Maximise the number of messages!

g) An acceptor loses its memory after having made a promise. What could happen?

Exercise 2
Consider the following schedules.

S_1: $R_3X\ R_2Y\ W_2Y\ R_1Y\ W_1Y\ R_2X\ W_2X\ R_1X\ W_1X\ W_3Z$.
S_2: $R_3X\ R_2Y\ W_2Y\ R_1Y\ W_1Y\ R_2X\ W_2X\ R_1X\ W_1X\ W_3Y$.
S_3: $R_1Y\ W_1Y\ R_2Y\ W_2Y\ R_2X\ W_2X\ R_3Z\ W_3X\ R_1X\ W_1X$.

For each schedule give its conflict graph. Which schedules are serializable, which are not?

Exercise 3
Assume on a database three transactions are being executed.

a) The transactions are of the form:
$$\begin{array}{lll} T_1: & RA & WA \\ T_2: & RA & WA \\ T_3: & RA & WA \end{array}$$

(i) How many serial schedules do exist for T_1, T_2, T_3? Give the reasons!

(ii) How many serializable schedules do exist for T_1, T_2, T_3, which are not serial ones? Give the reasons!

b) The transactions are of the form:
$$\begin{array}{lll} T_1: & RA & WC \\ T_2: & RB & WA \\ T_3: & RC & WD \end{array}$$

(i) How many schedules do exist for T_1, T_2, T_3, which are not serializable? Give the reasons!

(ii) Applying 2-phase-locking, is it possible that all serializable schedules may occur? Give the reasons!