Exercises
Distributed Systemes: Part 2
Summer Term 2014
3.7.2014

4. Exercise sheet: Refresh Concurrency Control and Recovery

Exercise 1

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 2

Assume on a database three transactions are being executed.

a) The transactions are of the form: T_1 : RA WA
T_2 : RA WA
T_3 : RA WA

  (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: T_1 : RA WC
T_2 : RB WA
T_3 : RC WD

  (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 of T_1, T_2, T_3 may occur? Give the reasons!

Exercise 3

Consider the schedule S:

$$
\begin{array}{llllll}
T_1 : & & R(X) & & W(Y) & \\
T_2 : & & & R(Y) & & W(Y) \\
T_3 : & R(Z) & W(Y) & & &
\end{array}
$$

(a) Demonstrate that S is not (conflict-) serializable.

(b) We call two schedules equivalent, whenever (i) they are built out of the same transactions, (ii) in both schedules the transactions read the same values, and (iii) both schedules produce the same final state of the database. Demonstrate that the serial schedule T_1 T_3 T_2 and schedule S are equivalent.

Exercise 4

(a) Give an example of three transactions, which obey 2PL and have the following properties: (i) When being executed a deadlock may occur. (ii) For each pair of the three trnsactions and for any execution of such a pair, no deadlock can occur.

(b) Make suggestions for deadlock-free variants of the 2PL-protocol.

Exercise 5

Consider the following schedule.

```
                                                  System-
                                                  failure
T₁   LA RA          WA
T₂      LB RB           LD RD WB      CO UD,B
T₃                            LC RC          WC
```

Assume that actions W_1A, W_2B are not materialized in the database, however action W_3C is.

(i) Give the state of the database, the systembuffer and the log file when the system failure occurs.

(ii) Describe the operations done when executing the restart algorithm and give the resulting state of the database.