Universität Freiburg
Institut für Informatik
Prof. Dr. P. Fischer

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

Exercises
Distributed Systemes: Part 2
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5. Exercise sheet: Distributed Concurrency Control and Recovery

Exercise 1
Consider the following local schedules:

- $S_1: \; R_1A \;\; W_1A \;\; R_2A \;\; W_2A$
  $S_2: \; R_2B \;\; W_2B \;\; R_1B \;\; W_1B$
- $S_1: \; R_1A \;\; W_2A$
  $S_2: \; R_3B \;\; W_1B \;\; R_2C \;\; W_3C$
- $S_1: \; R_1A \;\; R_3A \;\; R_3B \;\; W_3A \;\; W_3B \;\; R_2B$
  $S_2: \; R_4D \;\; W_4D \;\; R_1D \;\; R_2C \;\; R_4C \;\; W_4C$
- $S_1: \; W_1A \;\; c_1 \;\; R_3A \;\; R_3B \;\; c_3 \;\; W_2B \;\; c_2$
  $S_2: \; W_2C \;\; c_2 \;\; R_4C \;\; R_4D \;\; c_4 \;\; W_1D \;\; c_1$

(1) Verify whether or not the schedules are serializable.
(2) Demonstrate that by applying Distributed 2PL (Timestamp Protocol) the non-serializable schedules could not have occured.
(3) Check whether or not the schedules are rigourous and commit-deferred.
(4) Demonstrate that by applying a Ticket-based concurrency control the not serializable schedules could not have occured.

Exercise 2
Think about a distributed database management system that runs 2PC and how it deals with failures

(a) What happens when a participant votes abort in phase 1? Use the state transition graphs shown in the slides to explain your answer.
(b) What happens when a participant fails in phase 2 without sending anything to the coordinator (e.g. a kernel freeze)? Again use the state transition graphs to further explain your answer.
(c) How would using 3PC change the situation of b)

Exercise 3
(a) Describe the communication topology of centralized, decentralized and linear 2PC.
(b) Give the state diagrams of decentralized 2PC, in analogy to the state diagramm of centralized 2PC.

Exercise 4
Characterize centralized 2PC and linear 2PC with respect to

(1) message and time complexity,
(2) possibilities of processes to become uncertain.