

5DV052 Advanced Data Models and Systems Spring 2011
Class Exercises on Recovery

The following questions will be solved in class, as illustrations of techniques for database recovery (most likely on May 3).

- Given are the following four schedules for three transactions, each ending with an abort or a crash.

Begin $\langle T_1 \rangle$
Read $\langle T_1, x \rangle$
Write $\langle T_1, x \rangle$
Begin $\langle T_2 \rangle$
Read $\langle T_2, x \rangle$
Write $\langle T_2, x \rangle$
Begin $\langle T_3 \rangle$
Read $\langle T_3, y \rangle$
Read $\langle T_3, z \rangle$
Write $\langle T_3, z \rangle$
Commit $\langle T_3 \rangle$
Read $\langle T_2, z \rangle$
Write $\langle T_2, z \rangle$
Commit $\langle T_2 \rangle$
Read $\langle T_1, w \rangle$
Abort $\langle T_1 \rangle$

Begin $\langle T_1 \rangle$
Read $\langle T_1, y \rangle$
Write $\langle T_1, y \rangle$
Begin $\langle T_2 \rangle$
Read $\langle T_2, x \rangle$
Write $\langle T_2, x \rangle$
Begin $\langle T_3 \rangle$
Read $\langle T_3, y \rangle$
Read $\langle T_3, z \rangle$
Write $\langle T_3, z \rangle$
Commit $\langle T_3 \rangle$
Read $\langle T_2, z \rangle$
Write $\langle T_2, z \rangle$
Commit $\langle T_2 \rangle$
Read $\langle T_1, w \rangle$
Abort $\langle T_1 \rangle$

Begin $\langle T_1 \rangle$
Read $\langle T_1, x \rangle$
Write $\langle T_1, x \rangle$
Begin $\langle T_2 \rangle$
Read $\langle T_2, x \rangle$
Write $\langle T_2, x \rangle$
Begin $\langle T_3 \rangle$
Read $\langle T_3, y \rangle$
Read $\langle T_3, z \rangle$
Write $\langle T_3, z \rangle$
Commit $\langle T_3 \rangle$
Read $\langle T_2, z \rangle$
Write $\langle T_2, z \rangle$
Commit $\langle T_2 \rangle$
Read $\langle T_1, w \rangle$
SystemCrash

Begin $\langle T_1 \rangle$
Read $\langle T_1, y \rangle$
Write $\langle T_1, y \rangle$
Begin $\langle T_2 \rangle$
Read $\langle T_2, x \rangle$
Write $\langle T_2, x \rangle$
Begin $\langle T_3 \rangle$
Read $\langle T_3, y \rangle$
Read $\langle T_3, z \rangle$
Write $\langle T_3, z \rangle$
Commit $\langle T_3 \rangle$
Read $\langle T_2, z \rangle$
Write $\langle T_2, z \rangle$
Commit $\langle T_2 \rangle$
Read $\langle T_1, w \rangle$
SystemCrash

For each schedule, answer the following questions. In the case of a system crash, assume that the database is restored to its state before T_1 began but that all log entries are intact.

- Describe the recovery process in the cases of pure immediate update.
- Repeat (a) in the case of pure deferred update.
- Explain why the schedule is or is not recoverable.

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2. Shown below is a sequence of log entries. Suppose that the system crashes at the point shown.

Begin $\langle T_1 \rangle$
Read $\langle T_1, w \rangle$
Read $\langle T_1, z \rangle$
Write $\langle T_1, z \rangle$
Commit $\langle T_1 \rangle$
CheckPoint
Begin $\langle T_2 \rangle$
Read $\langle T_2, x \rangle$
Write $\langle T_2, x \rangle$
Begin $\langle T_3 \rangle$
Read $\langle T_3, z \rangle$
Write $\langle T_3, z \rangle$
Begin $\langle T_4 \rangle$
Write $\langle T_4, w \rangle$
Read $\langle T_3, w \rangle$
Write $\langle T_3, w \rangle$
Commit $\langle T_3 \rangle$
Read $\langle T_2, z \rangle$
Write $\langle T_2, z \rangle$
SystemCrash

- (a) For the cases of pure immediate update and pure deferred update, describe the recovery process in the case that the crash leaves the stable database and the checkpoint intact.
- (b) Repeat (a) in the case that the crash does not leave the stable database intact, but leaves the checkpoint intact.
- (c) Repeat (a) in the case that the crash leaves neither the stable database nor the checkpoint intact. Assume that the latest version of the stable database which is available is that which was in force when T_1 began.