Northeastern University
CS5200 – DBMS
Spring 2025
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Apr 03, 2025

Homework 7 Solution

This assignment has two (2) problems (equally weighted). Notes:

- Submit to Canvas **a a single PDF** document, containing your responses to all the problems.
- You must typeset all responses – hand-drawn/written work will receive 0% credit.

Problem 1. Consider the following constraint: X < Y

For each of the following transactions, state whether or not they preserve the consistency of the database. If not, supply an example of initial values (that adhere to the constraint) and what they result in after the transaction completes (that violates the constraint).

a. $X = 5X;\ Y = 5\,Y$
b. $X = X$ - 10; $Y = Y + X$

Problem 1. Solution

a. $X = 5X;\ Y = 5\,Y$

- WILL preserve
- Scaling both variables by a constant factor preserves the inequality.
- If $X < Y$, then $5X < 5Y$.
- Example: Start with $X = 2,\ Y = 3 \Rightarrow X < Y$
- After transaction: $X = 10,\ Y = 15 \Rightarrow X < Y$

b. $X = X$ - 10; $Y = Y + X$

- Will not always preserve
- The new value of X is used to compute Y, which can violate the constraint.
- Example: Start with $X = -1,\ Y = 0 \Rightarrow X < Y$

- After transaction: X = -1 - 10 = -11, Y = 0 + (-11) = -11
- Result: $X = Y = -11 \Rightarrow X \not< Y$

Problem 2. At the time of a system failure, let the following reflect the UNDO/REDO log on disk. . .

```
<T1, START>
<T1, X, 110, 8>
<T1, COMMIT>
<T2, START>
<T2, X, 8, 2>
<START CKPT(T2)>
<T2, Z, 120, 9>
<T3, START>
<T2, COMMIT>
<T3, X, 2, 6>
<END CKPT>
<T3, Z, 9, 30>
<T4, START>
<START CKPT(T3, T4)>
<T3, COMMIT>
<T4, Z, 30, 7>
```

What are the values of X and Z in the database at the end of recovery?

Problem 2. Solution

- Committed transactions: T1, T2, T3
- Uncommitted transaction: T4
- Recovery begins at: `<START CKPT(T2)>`, since it is followed by `<END CKPT>`
- REDO T1, T2, T3:
  - T1: $X = 110 \rightarrow 8$
  - T2: $X = 8 \rightarrow 2,\ Z = 120 \rightarrow 9$
  - T3: $X = 2 \rightarrow 6,\ Z = 9 \rightarrow 30$
- UNDO T4:
  - T4 wrote: $Z = 30 \rightarrow 7$
  - Must undo: restore $Z = 30$
- Final values:
  - X = 6, Z = 30