Optimistic concurrency control

CSE 444, Winter 2011 — section 6 worksheet
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Our notation for actions in a schedule:

- \text{st}_k$: transaction $T_k$ begins
- \text{r}_k(X)$: $T_k$ reads database element $X$
- \text{w}_k(X)$: $T_k$ writes database element $X$
- \text{com}_k$: $T_k$ commits

Other notation will be introduced as needed.

1 Timestamps

Each of the following schedules is presented to a timestamp-based scheduler. Assume that the read and write timestamps of each element start at 0 ($\text{RT}(X) = \text{WT}(X) = 0$), and the commit bits for each element are set ($\text{C}(X) = 1$). Please tell what happens as each schedule executes.

1. \text{st}_1, \text{st}_2, \text{st}_3, \text{r}_1(A), \text{r}_2(B), \text{w}_1(C), \text{r}_3(B), \text{r}_3(C), \text{w}_2(B), \text{w}_3(A)
2. \( st_1, st_3, st_2, r_1(A), r_2(B), w_1(C), r_3(C), w_2(B), w_3(A) \)

3. \( st_1, st_2, st_3, r_1(A), r_2(B), r_2(C), r_3(B), \text{com}_2, w_3(B), w_3(C) \)
4. $s_1, s_2, r_1(A), r_2(B), w_2(A), \text{com}_2, w_1(B)$

5. $s_1, s_3, s_2, r_1(A), r_2(B), r_3(B), w_3(A), w_2(B), \text{com}_3, w_1(A)$
6. $s_{t_1}$, $r_1(A)$, $w_1(A)$, $s_{t_2}$, $r_2(C)$, $w_2(B)$, $r_2(A)$, $w_1(B)$
2 Multi-version timestamps

Tell what happens during the following schedules if we use a multi-version timestamp scheduler. What happens if the scheduler does not maintain multiple versions?

1. \(st_1, st_2, st_3, st_4, w_1(A), com_1, w_2(A), w_3(A), com_3, r_2(A), com_2, r_4(A), com_4\)

2. \(st_1, st_2, st_3, st_4, w_1(A), com_1, w_3(A), com_3, r_4(A), com_4, r_2(A), com_2\)
3. \( st_1, st_2, st_3, st_4, w_1(A), com_1, w_4(A), com_4, r_3(A), com_3, w_2(A), com_2 \)
3 Validation

For the following schedules:

- $R_k(X)$ means “transaction $T_k$ starts, and its read set is the list of database elements $X$,”
- $V_k$ means “$T_k$ tries to validate,” and
- $W_k(x)$ means “$T_k$ finished, and its write set was $X$.”

Note: Remember that each transaction must inform the scheduler of both its read and write sets when it begins, or when it validates (at the latest). While the notation we use implies otherwise, and hence is slightly confusing, we use it to be consistent with your textbook’s notation.

Tell what happens when each schedule is processed by a validation-based scheduler.

1. $R_1(A,B)$, $R_2(B,C)$, $R_3(C)$, $V_1$, $V_2$, $V_3$, $W_1(A)$, $W_2(B)$, $W_3(C)$
2. \( R_1(A, B), R_2(B, C), R_3(C), V_1, V_2, V_3, W_1(C), W_2(B), W_3(A) \)

3. \( R_1(A, B), R_2(B, C), R_3(C), V_1, V_2, V_3, W_1(A), W_2(C), W_3(B) \)
4. $R_1(A, B), R_2(B, C), V_1, R_3(C, D), V_3, W_1(C), V_2, W_2(A), W_3(D)$