AML140830

HOMEWORK 6
Due Wed, Nov 11 at 11:30 pm

Transaction Processing
Objectives: Introduction to Transaction Processing Concepts

20.16. Add the operation commit at the end of each of the transactions *T*1 and *T*2 in Figure 20.2, and then list all possible schedules for the modified transactions. Determine which of the schedules are recoverable, which are cascadeless, and which are strict.

(5+3)! / (5! * 3!) = 8*7*6*5*4*3*2*1/ 5*4*3*2*1*3*2*1 = 56.

You don’t need to list all 56 possible schedules; only list 2 strict, 2 recoverable, 2 non-recoverable, and 2 cascadeless schedules.
Below are the 56 possible schedules, and the type of each schedule:

S 1 : r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); C 1 ; r 2 (X); w 2 (X); C 2 ; strict

S 21 : r 1 (X); r 2 (X); w 1 (X); r 1 (Y); w 1 (Y); C 1 ; w 2 (X); C 2 ; strict

S 2 : r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); r 2 (X); C 1 ; w 2 (X); C 2 ; recoverable

S 3 : r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); r 2 (X); w 2 (X); C 1 ; C 2 ; recoverable

S 9 : r 1 (X); w 1 (X); r 1 (Y); r 2 (X); w 2 (X); w 1 (Y); C 2 ; C 1 ; non-recoverable

S 10 : r 1 (X); w 1 (X); r 1 (Y); r 2 (X); w 2 (X); C 2 ; w 1 (Y); C 1 ; non-recoverable

S 22 : r 1 (X); r 2 (X); w 1 (X); r 1 (Y); w 1 (Y); w 2 (X); C 1 ; C 2 ; cascadeless

S 23 : r 1 (X); r 2 (X); w 1 (X); r 1 (Y); w 1 (Y); w 2 (X); C 2 ; C 1 ; cascadeless

20.17. List all possible schedules for transactions T_1 and T_2 in Figure 20.2, and determine which are conflict serializable (correct) and which are not.

Below are the 15 possible schedules, and the type of each schedule:

S 1 : r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); r 2 (X); w 2 (X); serial (and hence also serializable)

S 2 : r 1 (X); w 1 (X); r 1 (Y); r 2 (X); w 1 (Y); w 2 (X); (conflict) serializable

S 3 : r 1 (X); w 1 (X); r 1 (Y); r 2 (X); w 2 (X); w 1 (Y); (conflict) serializable

S 4 : r 1 (X); w 1 (X); r 2 (X); r 1 (Y); w 1 (Y); w 2 (X); (conflict) serializable

S 5 : r 1 (X); w 1 (X); r 2 (X); r 1 (Y); w 2 (X); w 1 (Y); (conflict) serializable

S 6 : r 1 (X); w 1 (X); r 2 (X); w 2 (X); r 1 (Y); w 1 (Y); (conflict) serializable

S 7 : r 1 (X); r 2 (X); w 1 (X); r 1 (Y); w 1 (Y); w 2 (X); not (conflict) serializable

S 8 : r 1 (X); r 2 (X); w 1 (X); r 1 (Y); w 2 (X); w 1 (Y); not (conflict) serializable

S 9 : r 1 (X); r 2 (X); w 1 (X); w 2 (X); r 1 (Y); w 1 (Y); not (conflict) serializable

S 10 : r 1 (X); r 2 (X); w 2 (X); w 1 (X); r 1 (Y); w 1 (Y); not (conflict) serializable

S 11 : r 2 (X); r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); w 2 (X); not (conflict) serializable

S 12 : r 2 (X); r 1 (X); w 1 (X); r 1 (Y); w 2 (X); w 1 (Y); not (conflict) serializable

S 13 : r 2 (X); r 1 (X); w 1 (X); w 2 (X); r 1 (Y); w 1 (Y); not (conflict) serializable

S 14 : r 2 (X); r 1 (X); w 2 (X); w 1 (X); r 1 (Y); w 1 (Y); not (conflict) serializable

S 15 : r 2 (X); w 2 (X); r 1 (X); w 1 (X); r 1 (Y); w 1 (Y); serial (and hence also serializable)

20.23. Consider the three transactions T_1, T_2, and T_3, and the schedules S_1 and S_2 given below.

Draw the serializability (precedence) graphs for S_1 and S_2, and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s).

T_1: $r_1(X)$; $r_1(Z)$; $w_1(X)$;
T_2: $r_2(Z)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;
T_3: $r_3(X)$; $r_3(Y)$; $w_3(Y)$;
S_1: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;
S_2: $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$;

20.23

T1	T2	T3
R(x)	R(z)	R(x)
R(z)	R(y)	R(y)
W(x)	W(z)	W(y)
	W(y)	

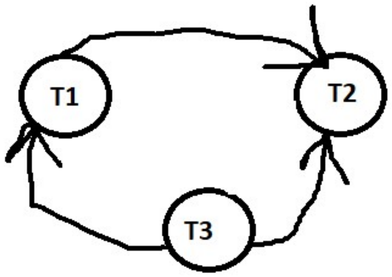
S1

T1	T2	T3
R(x)		
	R(z)	
R(z)		
		R(x)
		R(y)
W(x)		
		W(y)
	R(y)	
	W(z)	
	W(y)	

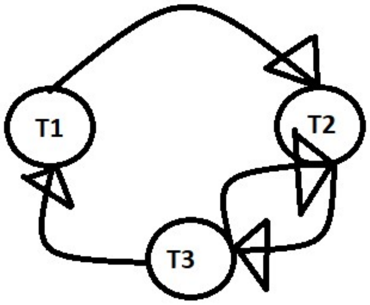
S2

T1	T2	T3
R(x)		
	R(z)	
		R(x)
R(z)		
	R(y)	
		R(y)
W(x)		
	W(z)	
		W(y)
	W(y)	

S1



S2



S1is conflict serializable because there is NOT a cycle.

S2 is NOT conflict serializable because there is a cycle.

20.24. Consider schedules S_3, S_4, and S_5 below. Determine whether each schedule is strict, cascadeless, recoverable, or nonrecoverable. (Determine the strictest recoverability condition that each schedule satisfies.)

S_3: $r_1 (X)$; $r_2 (Z)$; $r_1 (Z)$; $r_3 (X)$; $r_3 (Y)$; $w_1 (X)$; c_1; $w_3 (Y)$; c_3; $r_2 (Y)$; $w_2 (Z)$; $w_2 (Y)$; c_2;

S_4: $r_1 (X)$; $r_2 (Z)$; $r_1 (Z)$; $r_3 (X)$; $r_3 (Y)$; $w_1 (X)$; $w_3 (Y)$; $r_2 (Y)$; $w_2 (Z)$; $w_2 (Y)$; c_1; c_2; c_3;

S_5: $r_1 (X)$; $r_2 (Z)$; $r_3 (X)$; $r_1 (Z)$; $r_2 (Y)$; $r_3 (Y)$; $w_1 (X)$; c_1; $w_2 (Z)$; $w_3 (Y)$; $w_2 (Y)$; c_3; c_2;

Strict schedule: A schedule is strict if it satisfies the following conditions:

1. Tj reads a data item X ***after*** Ti has written to X and Ti is terminated (aborted or committed)
2. Tj writes a data item X ***after*** Ti has written to X and Ti is terminated (aborted or committed)

S3

- **is not strict** because T3 reads X (r3(X)) ***before*** T1 has written to X (w1(X)) but T3 commits ***after*** T1

S4

- **is not strict** because T3 reads X (r3(X)) ***before*** T1 has written to X (w1(X))but T3 commits ***after*** T1.

S5

- **is not strict** because T3 reads X (r3(X)) ***before*** T1 has written to X (w1(X))but T3 commits ***after*** T1.

Cascadeless schedule: A schedule is cascadeless if the following condition is satisfied:

1. Tj reads X only ***after*** Ti has written to X and terminated (aborted or committed).

S3

- is ***not cascadeless*** because T3 reads X (r3(X)) before T1 commits.

S4

- is ***not cascadeless*** because T3 reads X (r3(X)) before T1 commits.

S5

- is ***not cascadeless*** because T3 reads X (r3(X)) ***before*** T1 commits or T2 readsY (r2(Y)) ***before*** T3 commits.

Recoverable schedule: A schedule is recoverable if the following condition is satisfied:

1. Tj commits after Ti if Tj has read any data item written by Ti.
2. Abort operations will be used in place of commits, one at a time
3. Notations Used:
    a. Commit Notation: Ci > Cj means Ci happens ***before*** Cj.
    b. Abort Notation: Ai denotes abort Ti.
    c. Strictness:
        i. a transaction neither reads nor writes to a data item, which was written to by a transaction that has not committed yet.

S3.

- If A1>C3>C2, then S3 is ***recoverable*** because rolling back of T1 does not affect T2 and T3.
- If C1>A3>C2. S3 is ***not recoverable*** because T2 read the value of Y (r2(Y)) ***after*** T3 wrote X (w3(Y)) and T2 committed but T3 rolled back. Thus, T2 used non- existent value of Y.
- If C1>C3>A3, then S3 is ***recoverable*** because roll back of T2 does not affect T1 and T3.
- Strictest condition of S3 is C3>C2.

S4

- If A1>C2>C3, then S4 is ***recoverable*** because roll back of T1 does not affect T2 and T3.
- If C1>A2>C3, then S4 is ***recoverable*** because the roll back of T2 will restore the value of Y that was read and written to by T3 (w3(Y)). It will not affect T1.
- If C1>C2>A3, then S4 is ***not recoverable*** because T3 will restore the value of Y which was not read by T2.
- Strictest condition of S4 is C3>C2, but it is not satisfied by S4.

S5

- If A1>C3>C2, then S5 is ***recoverable*** because neither T2 nor T3 writes to X, which is written by T1. If C1>A3>C2, then S5 is ***not recoverable*** because T3 will restore the value of Y, which was not read by T2. Thus, T2 committed with a non-existent value of Y.
- If C1>C3>A2, then S5 is ***recoverable*** because it will restore the value of Y to the value, which was read by T3. Thus, T3 committed with the right value of Y.
- Strictest condition of S3 is C3>C2, but it is not satisfied by S5.