The University of Melbourne
School of Computing and Information Systems
COMP90020 Distributed Algorithms

Tutorial Week 9: Transactions and Concurrency Control

Notes

Strict executions of transactions: Generally, it is required that transactions delay both their read and write operations so as to avoid both dirty reads and premature writes. The executions of transactions are called strict if the service delays both read and write operations on an object until all transactions that previously wrote that object have either committed or aborted. The strict execution of transactions enforces the desired property of isolation. [Coulouris pp.690]

Exercises

42. A server manages the objects $a_1, a_2, ..., a_n$. The server provides two operations for its clients:

    - $read(i)$: returns the v of a_i
    - $write(i, v)$: assigns v to a_i

The transactions T and U are defined as follows:

- $T : x = read(j); y = read(i); write(j, 44); write(i, 33);$
- $U : x = read(k); write(i, 55); y = read(j); write(k, 66).$

(a) Give serially equivalent interleavings of T and U that are strict

(b) Give serially equivalent interleavings of T and U that are not strict but **could not produce** cascading aborts

(c) Give serially equivalent interleavings of T and U that **could produce** cascading aborts

43. The transfer transactions of T and U are defined as:

- $T : a.withdraw(4); b.deposit(4);$
- $U : c.withdraw(3); b.deposit(3);$

Suppose that they are structured as a pair of nested transactions

- $T_1 : a.withdraw(4); T_2 : b.deposit(4);$
- $U_1 : c.withdraw(3); U_2 : b.deposit(3);$

(a) Compare the number of serially equivalent interleavings of T_1, T_2, U_1, U_2 with the number of serially equivalent interleavings of T and U.

(b) Explain why the use of these nested transactions generally permits a larger number of serially equivalent interleavings than non-nested ones.

44. Consider the recovery aspects of the nested transactions defined in the exercise above, assume that a withdraw operation will abort if the account will be overdrawn and that in this case the parent will also abort.

(a) Describe serially equivalent interleavings of T_1, T_2, U_1, U_2 that are strict

(b) Describe serially equivalent interleavings of T_1, T_2, U_1, U_2 that are not strict

(c) To what extent does the criterion of strictness reduce the potential concurrency gain of nested transactions?

45. The transactions T and U are defined as follows:

- $T : x = read(i); write(j, 44);$
- $U : write(i, 55); write(j, 66);$

Initial values $a_i = 10, a_j = 20$. Which of the following interleavings are serially equivalent, and which could occur with two-phase locking?

(a)

T	U
x= read (i);	
	write(i, 55);
write(j, 44);	
	write(j, 66);

(b)

T	U
x= read (i);	
write(j, 44);	
	write(i, 55);
	write(j, 66);

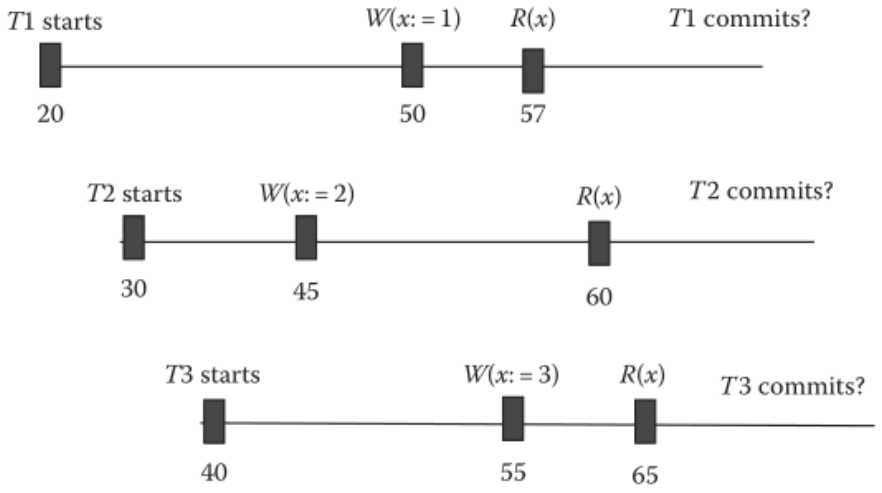
(c)

T	U
	write(i, 55);
	write(j, 66);
x= read (i);	
write(j, 44);	

(d)

T	U
	write(i, 55);
x= read (i);	
	write(j, 66);
write(j, 44);	

46. Consider three concurrent transactions below



Consider concurrency control by timestamp ordering. Which of these three concurrent transactions will commit?