

Homework 6

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Question 1. Serializability and Recoverability

Consider the following classes of schedules: *serializable*, *conflict-serializable*, *recoverable*, *avoids-cascading-aborts* (same as *cascadeless*), and *strict*. For the following schedule, state which of the preceding classes it belongs to.

(It is important to note that serializability concerns only committed transactions while recoverability concerns both committed and aborted transactions.)

The actions are listed in the order they are scheduled and prefixed with the transaction name.

T1:R(A), T2:W(A), T1:W(A), T2:Abort, T1:Commit

Question 2. Serializable Schedules

Consider the following schedule involving three transactions T1, T2 and T3:

	1	2	3	4	5	6	7	8	9	10
T1:	W(A)	R(B)	R(C)		W(B)					
T2:							R(C)	W(B)	W(C)	
T3:				W(B)		W(C)				R(A)

(1) Draw the precedence graph for this schedule.

(2) Is this schedule conflict serializable? Why or why not? If it is conflict serializable, give the equivalent serial schedule (just write the order of the transactions).

(3) Write down all instances where one transaction “reads from” another transaction.
(If T2 reads from T1, write $T1 \rightarrow T2$.)

Now swap the 4th and 5th actions in the schedule.

(4) Is the new schedule conflict serializable? Why or why not? If it is conflict serializable, give the equivalent serial schedule (just write the order of the transactions).

Question 3. Concurrency Control Protocols

Consider three transactions, T1, T2, and T3, with timestamps 1, 2, 3, respectively. Now consider the following sequences of actions, listed in the order that they are produced from user queries:

T1:	R(A)		W(B)	(Commit)
T2:		W(A)	W(B)	(Commit)
T3:			W(B)	(Commit)

Explain how this sequence of actions will be executed using the **Strict Two Phase Locking** protocol (2PL). The following table is designed for you to specify in time order the activities that take place in the lock manager and in access to the database. The activities include:

- S(O) or X(O): *the lock requested for access to a database object, O;*
- R(O) or W(O): *the read or write access to a database object, O;*
- Ti blocked: *which transaction may be blocked under this protocol;*
- Ti resumed: *until when a blocked transaction can resume, with its lock request granted; and*
- Ti commits and releases locks: *when a transaction can commit and release locks.*

The first few actions are already given below. Please complete the other actions for this schedule.

Time stamp	Action: please choose one action at a time
1	T1: S(A)
2	T1: R(A)
3	T2: X(A)
4	T2: blocked
5	...
6	
7	
8	
9	
10	
11	
12	
13	

Question 4. Recovery

Examine the schedule given below. There are three transactions, T1, T2, and T3. Initially, the salary = 1 and the tax = 2. The assignments happen within the local memory space of the transactions and the effects of these assignments are not reflected in the database until the WRITE operation.

	T1	T2	T3
0			start
1			READ tax
2			tax := tax + 1
3	start		
4	READ salary		
5	salary := salary + 1		
6			WRITE tax
7			commit
8		start	
9		READ tax	
10		READ salary	
11		tax := tax + salary	
12		WRITE tax	
13		commit	
14	READ tax		
15	tax := tax + salary		
16	WRITE tax, salary		
17	----- system crashes -----		

(1) Show the log entries that would be generated by this execution. Use the same notation used in class. For each log entry, indicate what line above generates it.

(2) When the system is rebooted and tries to recover from the crash, which transaction(s) should be undone and which may be redone?

Question 5. The ARIES Recovery Algorithm

Consider the execution shown in the following figure.

LSN	Log Record
00	Update: T1 writes P2
10	Update: T1 writes P1
20	Update: T2 writes P5
30	Update: T3 writes P3
40	T3 commits
50	Update: T2 writes P5
60	Update: T2 writes P5
70	T2 aborts

(1) For the above log records, complete the table below with

- the prevLSN value, and
- the undonextLSN value if it is a compensation log record, otherwise simply with “—”.

LSN	prevLSN	undonextLSN (of a CLR)
00		
10		
20		
30		
40		
50		
60		
70		

(2) Describe the actions taken to rollback transaction T2.

(3) Assume that the system crashed right after generating the log record 70. Now the system wakes up and runs the ARIES recovery algorithm. Please show all new log entries generated in the recovery process, where each log record includes the LSN, type of log record, transaction ID, page ID, prevLSN, and undonextLSN.

LSN	Type	Xact ID	Page ID	prevLSN	undonextLSN
80					
90					
100					
110					
120					
130					
140					