

# CSE 414 Section 7 Worksheet

1. Consider a concurrency control manager that uses strict two phase locking that schedules three transactions:

- $T1 : R1(A), R1(B), W1(A), W1(B), Co1$
- $T2 : R2(B), W2(B), R2(C), W2(C), Co2$
- $T3 : R3(C), W3(C), R3(A), W3(A), Co3$

Each transaction begins with its first read operation, and commits with the Co statement. Answer the following questions for each of the schedules below:

- Is this schedule possible under a strict 2PL protocol?
- If strict 2PL does not allow this schedule because it denies a read or write request, is the system in a deadlock at the time when the request is denied?

Note: A common question is if conflict serializability implies the schedule is possible under a strict 2PL protocol, and the answer is Conflict Serializable  $\nrightarrow$  strict 2PL but strict 2PL  $\rightarrow$  Conflict Serializable

a. Schedule 1:

$R2(B), W2(B), R3(C), W3(C), R3(A), W3(A), Co3, R2(C), W2(C), Co2, R1(A), R1(B), W1(A), W1(B), Co1$

i. Is it possible under strict 2PL?

Yes

ii. Does strict 2PL lead to a deadlock?

No

b. Schedule 2:

$R2(B), W2(B), R3(C), W3(C), R1(A), R1(B), W1(A), W1(B), Co1, R2(C), W2(C), Co2, R3(A), W3(A), Co3$

i. Is it possible under strict 2PL?

No: T2 holds L(B) thus R1(B) is not possible before Co2.

ii. Does strict 2PL lead to a deadlock?

Yes: T1 holds L(A), T2 holds L(B), T3 holds L(C) and none can make progress.

2. A read-only transaction is a transaction that only reads from the database, without writing/inserting deleting. Answer the questions below by circling the correct answer.

i. If all transactions are read-only, then every schedule is serializable.

TRUE or FALSE

ii. Only one transaction can hold a shared lock on the same item at any time.

TRUE or FALSE

iii. Only one transaction can hold an exclusive lock on the same item at any time.

TRUE or FALSE

3. Given the following three transactions:

- $T1: R(A), W(B), I(D), R(C)$
- $T2: R(B), R(D), W(C)$
- $T3: R(D), R(C), R(D), W(A)$

Assume that  $R(X)$  reads all tuples in table  $X$ ,  $W(X)$  updates all tuples in  $X$ , and  $I(X)$  inserts one new tuple in  $X$ .

Does there exist a schedule of the above transactions that would result in a deadlock if executed under strict 2PL with **only exclusive table locks**? If so, write such a schedule with lock and unlock operations and indicate why the transactions are deadlocked. Otherwise write "No". Use  $L1(A)$  to refer to  $T1$  locking table  $A$ , and  $U1(A)$  for unlocking.

$L1(A); R1(A); L2(B); R2(B); L3(D); R3(D); L3(C); R3(C); <deadlock>$

$T1$  holds lock on  $A$  and is waiting for lock on  $B$ , which is held by  $T2$

$T2$  holds lock on  $B$  and is waiting for lock on  $D$ , which is held by  $T3$

$T3$  holds lock on  $D$  and is waiting for lock on  $A$ , which is held by  $T1$

To get full points, students will need to show both a schedule, explain which transaction holds which lock, and how that leads to a deadlock.