CSci 4707

Homework 4

Fall 2015

Chapter 16, 17, and 18
Due Tuesday, 12/15/2015 13:00

A. (5 Points) Submission Guidelines

- All homeworks **must be typed**
- All homeworks due at the **beginning of the class in paper**
- **No partial credit awarded for this section**

B. (50 Points) Chapter 16 & 17

1. **(10 Points)** Consider the following sequence of operations (this sequence shows the timeline of the operation):

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

   For each statement below, is the statement is True or False?

   a. In this schedule, there are conflicts between the following pairs of transactions: {T1,T2}, {T1,T3}, {T2,T3}.
   b. The schedule is conflict-serializable.
   c. The schedule could be generated by a scheduler using Strict 2PL. In other words, if we are using Strict 2PL, is the schedule will be executed and finished at the same time?

2. **(20 Points, 10 Points Each)** Consider the following two transaction schedules (this shows the sequence of the submission of the operation):

   (a) R1(X), W2(X), W2(Y), W3(Y), W1(Y), C1, C2, C3
   (b) R1(X), W2(Y), W2(X), W3(Y), W1(Y), C1, C2, C3

We will use Strict 2PL with deadlock detection (both wait-die policy and wound-wait policy). For each sequence, describe how the concurrency control mechanism handles the sequence on **both** wait-die and wound-wait policy in step by step which locks are granted to which transaction, which transactions block waiting on locks, which transactions commit, etc. If there exists deadlocks, also draw the wait-for graph. **Note:** the above sequence is showing the submission of the operation, the Strict 2PL might change the order of the execution.

3. **(20 Points, 4 Points each)** Consider the following five schedules (based on what the operations are submitted):
   (a) R1(A); R2(A); R3(B); W1(A); R2(C); R2(B); W2(B); W1(C); C1;C2;C3
   (b) R1(A); W1(B); R2(B); W2(C); R3(C); W3(A); C1;C2;C3
   (c) W3(A); R1(A); W1(B); R2(B); W2(C); R3(C); C1;C2;C3
   (d) R1(A); R2(A); W1(B); W2(B); R1(B); R2(B); W2(C); W1(D); C1;C2;C3
   (e) R1(A); R2(A); R1(B); R2(B); R3(A); R4(B); W1(A); W2(B); C1;C2;C3;C4
   For each of the schedules above, answer the following questions:
   (1) Show the **precedence graph** for the schedule
   (2) Is the schedule conflict-serializable? If so, what are all the equivalent serial schedules (i.e. T1 T2 T3 or T3 T2 T1, etc.)

C. (45 Points) Chapter 18

1. **(10 Points, 2.5 Points each)** Consider the recovery scenario described in the following, in which we use the ARIES recovery algorithm. At the beginning of time, there are no transactions active in the system and no dirty pages. A checkpoint is taken. After that, three transactions, T1, T2, T3 enter the system and perform various operations. The detailed log follows:

LSN	LAST_LSN	Transaction ID	Type	Page ID
1	-	-	Begin Check	-
2	-	-	End Check	-
3	NULL	T1	Update	P2
4	3	T1	Update	P1
5	NULL	T2	Update	P5
6	NULL	T3	Update	P3
7	6	T3	Commit	-
8	5	T2	Update	P5
9	8	T2	Update	P3
10	6	T3	END	-
CRASH				

For each statement below, is each of the following statement True or False?

a. The dirty page table reconstructed at the end of the Analysis pass contains the following page-LSN pairs: <P1, 4>, <P2, 3>, <P3, 6>, <P5, 5>. Thus, redo must start at LSN #6.

b. The earliest LSN in the log that the Undo pass must proceed back to is LSN #3.
c. The Undo pass must undo the effects of transactions T1 and T2 only.
d. Assuming no further crashes during recovery, after recovery completes, the log will contain 6 additional CLR log records.

2. **(10 Points)** Exercise 18.4 from the textbook

3. **(25 Points)** Consider the following recovery scenario, in which we use the ARIES algorithm. At the beginning, there are no transactions active in the system and none of the pages are dirty. As you can see in LSN 10 to 20, first a checkpoint is taken. Then three transactions, T1, T2, and T3, enter the system and perform various operations. The detailed log follows:

LSN	Type	Transaction ID	Page ID	LAST_LSN
10	Begin Check	-	-	-
20	End Check	-	-	-
30	Update	T1	P2	-
40	Update	T1	P1	30
50	Update	T2	P5	-
60	Update	T3	P3	-
70	Commit	T3	-	60
80	Update	T2	P5	50
90	Update	T2	P3	80
100	End	T3	-	-
110	Abort	T2	-	90

CRASH

a. **(8 Points)** Show the contents of the dirty page table and the transaction table after the analysis phase.
b. **(8 Points)** Show the contents of the dirty page table and the transaction table after the REDO phase.
c. **(9 Points)** Show the log records that are written during the UNDO phase. (Should contain LSN, prevLSN, undonextLSN, type, pageID, transactionID)