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Grade	Not yet graded

Question **1**
Complete
Points out of 10.00

Consider the following transactions:

S: [X := X + 10; Y := Y - 10]

T: [X := X * 2; Y := Y * 2]

U: [Y := Y + 10; X := X - 10]

Assuming initial values of X = 15 and Y = 25, serializable schedules of these three transactions can leave the database in various states. Submit the final values of X and Y after a successful execution of a serializable schedule of S, T, and U, and submit a detailed explanation of your derivations. You must assume that this serializable schedule is conflict equivalent to a serial execution of T followed by S followed by U.

1. In a serializable transaction, each transaction works on its copy of data.
2. **For T-S-U ANS are X=30 and y=50**
3. So, all possible combination has to be considered. For the given set of 3 transactions, there are around $3! = 6$ ways in which disk might get updated.
4. All the possible transactions are mentioned below- STU, SUT, TSU, TUS, UST, and UTS.
5. Lets, take an example of STU here, after S $x = 25$, $y = 15$, after T $x = 50$, $y = 30$ and after U $x = 40$, $y = 40$.
6. Similarly for the remaining 5 transactions.
7. After calculating all the possible ways the values of X can be 30 or 40 or 20.
8. Y can be 40 or 50 or 60.
9. More particularly
10. Transactions (X, Y)
11. STU 40, 40
12. SUT 30, 50
13. TSU 30, 50
14. TUS 30, 50
15. UST 30, 50
16. UTS 20, 60

Question **2**

Complete

Points out of
10.00

At the time of a system crash, let the log segment (in the undo/redo logging scheme) be as follows:

(START S);

(S, X, 10, 20);

(COMMIT S);

(START T);

(T, X, 20, 30);

(START CKPT(T));

(T, Y, 10, 20);

(START U);

(COMMIT T);

(END CKPT);

(U, Y, 20, 30);

(START V);

(START CKPT(U,V));

(COMMIT U);

(V, Y, 30, 40)

Assume that there has been a system crash, and recovery is about to begin based on the log given to you. Return all the possible values of X and Y after the system crash but before the recovery started. You are required to submit detailed explanations of your solution.

1. Let's perform value updates step by step
2. Initial x=10 and y=10. (START S);
3. then x=10 or 20 and y=10 (S, X, 10, 20);
4. (T, X, 20, 30); x=10 or 20 or 30 and y=10
5. START CKPT(T)); Dirty buffer will be for only A and latest value will be flushed to disk till (END CKPT);
6. (T, Y, 10, 20); x= 10 or 20 or 30 and y=10 or 20
7. X=30 and Y= 10 or 20 (END CKPT);
8. (U, Y, 20, 30); x=30 and y=10 or 20 or 30
9. (V, Y, 30, 40) x=30 and y=10 or 20 or 30 or 40.
10. so ANS x=30 and y= 10 or 20 or 30 or 40.

Question **3**
Complete
Points out of 10.00

Consider the relation R(ABCDEFG) with functional dependencies

$AB \rightarrow C$, $CD \rightarrow E$, $EF \rightarrow G$, $FG \rightarrow E$, $DE \rightarrow C$, and $BC \rightarrow A$

Determine whether the set BDFG of attributes of R is a key; your response must be "yes" (is a key) or "no" (is not a key), along with a detailed explanation of your reasoning in making the determination.

- 1. **BDFG is a Key.**
- 2. A set of attributes is called key when the same set of attributes gives all other attributes here R(ABCDEFG) and the subset of key attributes should not be superkey.
- 3. The key should be a minimal set of attributes.
- 4. In this case closure of attributes, BDFG gives all other attributes which are ABCDEFGH.
- 5. To verify the second condition lets take the closure of all possible combination such as
- 6. $B^+ = B$
- 7. $D^+ = D$
- 8. $F^+ = F$
- 9. $G^+ = G$
- 10. $BD^+ = BD$
- 11. $BF^+ = BF$
- 12. $BG^+ = BG$
- 13. $DF^+ = DF$
- 14. $DG^+ = DG$
- 15. $FG^+ = FGE$
- 16. $BDF^+ = BDF$
- 17. $BDG^+ = BDG$
- 18. $DFG^+ = DFGEC$
- 19. Hence, BDFG is key.

Question **4**
Complete
Points out of 10.00

Evaluate the boolean expression

$$x \leq 3 \text{ OR NOT } (y \geq 1 \text{ AND } z = 5)$$

for the given values of x, y, and z: $x = 4$, $y = 4$, $z = 5$.

Submit the value of the expression, along with detailed explanations.

- 1. **The value of the given expression is 0.**
- 2. $X \leq 3$ becomes 0 because given $x = 4$
- 3. $y \geq 1$ becomes 1 because given $y = 4$
- 4. $z = 5$ becomes 1 because given $z = 5$
- 5. $(y \geq 1 \text{ AND } z = 5)$ becomes $\min(1, 1) = 1$
- 6. but NOT will make is 0.
- 7. so, from line 2 and 6,
- 8. final answer will be $\max(0, 0)$ equals 0.

Question **5**
Complete
Points out of 10.00

Suppose we have a relation with schema

R(A, B, C, D, E, F, G)

If we issue a query of the form

```
SELECT ???  
  
FROM R  
  
WHERE ... [this part of the query is not relevant to the assignment]  
  
GROUP BY C, D
```

Explain whether each of the two following terms can appear in the SELECT list (represented by ??? in the above query). Submit a detailed explanation for each term.

(i) MAX(B)

(ii) E

- 1. So, this question is performing group by operation i.e. GROUP BY C, D
- 2. Hence aggregation function can be used.
- 3. **MAX(B) = YES** because aggregation function on group by.
- 4. **E = NO** because after performing group by E can not be group as there might be multiple distinct values of E for the same (C, D).

Question **6**
Complete
Points out of 10.00

Suppose relation R(A,B) has the tuples:

A B

1 3

3 5

6 6

and the relation S(B,C,D) has tuples:

B C D

2 8 9

4 5 7

5 6 8

Compute the outerjoin of R and S, with the theta-join condition $R.A > S.B$ AND $R.B < S.C$. Return all the dangling tuples of R - that is, the tuples of R that need to be padded in the outerjoin. Submit a detailed justification of your solution.

Dangling tuple - R (1, 3)

R.A, R.B, S.B, S.C, S.D

1, 3, N, N, N

3, 5, 2, 8, 9

6, 6, 2, 8, 9

N, N, 4, 5, 7

N, N, 5, 6, 8

Question **7**

Complete

Points out of 10.00

Here are declarations of two relations R and S:

```
CREATE TABLE S(  
    c INT PRIMARY KEY,  
    d INT  
);  
  
CREATE TABLE R(  
    a INT PRIMARY KEY,  
    b INT REFERENCES S(c)  
);
```

R(a,b) currently contains the four tuples (0,4), (1,5), (2,4), and (3,5). S(c,d) currently contains the four tuples (2,10), (3,11), (4,12), and (5,13). As a result, certain insertions and deletions on R and S are illegal. Indicate for each of the following two modifications whether it will or will not violate any constraint, and provide a detailed explanation of each of your two responses.

- (i) Deleting (0,4) from R.
- (ii) Deleting (5,13) from S.

1. (i) Deleting (0,4) from R = **YES** because the tuple from the reference table (here R where R(b) is referencing S(C)) can be deleted.
2. (ii) Deleting (5,13) from S = **NO** because S(c) is referenced table from R so first tuples from a child has to be deleted and for this operation SQL will throw an error saying tuple from table R is referencing the tuples in table S. To delete those referencing tuples from table R has to be deleted first.

Question **8**

Complete

Points out of 10.00

Consider three transactions T1, T2, T3 with the following sequences of operations:

```
T1: r1(A), w1(B)  
T2: r2(B), w2(D)  
T3: r3(C), w3(A)
```

Determine whether the given schedule S of these six steps, see below, is possible under the two-phase locking protocol. Your final answer should be "possible" or "not possible"; your solution must include a detailed derivation of your final answer. (Hint: See if you can introduce lock and unlock requests in accordance with the three 2PL rules.)

S: r1(A), r3(C), w3(A), r2(B), w2(D), w1(B)

1. T1: r1(A), w1(B)
2. T2: r2(B), w2(D)
3. T3: r3(C), w3(A)

In 2PL locking, the transaction first locks the resource than before unlocking the same it make sure to again lock in the future resource which helps to avoid lack of resource and hence results in more efficient locking.

Adding locks and unlocks, T1(2PL): l1(A), r1(A), l1(B), u1(A), w1(B), u1(B) T2(2PL): l2(B), r2(B), l2(D), u2(B), w2(D), u2(D) T3(2PL): l3(C), r3(C), l3(A), u3(C), w3(A), u3(A)

- 1.
2. S(2PL) = l1(A), r1(A), l1(B), u1(A), w1(B), u1(B), l2(B), r2(B), l2(D), u2(B), w2(D), u2(D), l3(C), r3(C), l3(A), u3(C), w3(A), u3(A)
3. Possible because lets draw precedence graph
4. A - r1, w3
5. B - w1, r2
6. C - r3
7. D - w2
8. After topological sorting
9. T1 - T2 - T3 or T1 - T3 - T2
10. ANS: 2PL is possible

Question **9**
Complete
Points out of 10.00

The table Arc(x,y) currently has the following tuples (note that there are duplicates): (1,2), (1,2), (2,3), (3,4), (3,4), (4,1), (4,1), (4,1), (4,2). Based on the answer to the query:

```
SELECT a1.x, a2.y, COUNT(*)  
FROM Arc a1, Arc a2  
WHERE a1.y = a2.x  
GROUP BY a1.x, a2.y;
```

Explain which of the two following tuples is in the result. For each "yes" ("is in the result") or "no" ("is not in the result") response, you are required to submit a detailed explanation of your reasoning.

- (i) (4,2,1)
- (ii) (3,1,6)

- 1. NO, because this tuple does not exist in the output relation but there exists (4, 2, 6)
- 2. YES

Question **10**
Complete
Points out of 10.00

For the following schedule S, determine whether it:

- (i) is serializable?;
- (ii) is recoverable?;
- (iii) avoids cascading rollback?

S: r2(X), r1(X), w2(Y), r2(Z), r1(Y), w2(Z), c2, w1(X), c1

Submit a detailed explanation of each of your answers.

- 1. (i) is serializable?; **YES** After drawing precedence graph for the given schedule it can be seen that there is not cycle.
- 2. X = r2, r1, w1
- 3. Y = w2, r1
- 4. Z = r2, w2
- 5. So after topological sorting, there will be more conflict equivalent schedules.
- 6. (ii) is recoverable?; **YES** It can be seen that the first write is W2(Y) followed by R1(Y) and here Commit 2 is followed by commit 1. Hence, this transaction is recoverable.
- 7. (iii) avoids cascading rollback? **NO**, Because r1(y) is not reading from the w2(y) hence it is not ACR (Avoid Cascading Rollback).

Question **11**
Incorrect
0.00 points out of 1.00

Please respond by True or False concerning yourself on this exam:
On my honor: I affirm that I have not and will not use any external sources of assistance (another student’s exam, etc.) other than my own materials during the examination. I have not sought, used, or plan to use information obtained from student(s) who took a CSC 540 exam earlier, nor will I give information about this exam to any student taking a CSC 540 exam after mine. I am the student whose name appears on this exam.

Select one:

- ☒ True **✗**
- ☐ False

The correct answer is 'False'.

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