

1. Define the notion of view-equivalence.
2. Explain why serializability is a correctness criterion for interleaved execution schedules.

3. Solve the following problems:

a. Consider schedule S below:

T1	T2	T3
R(A)	W(F)	
R(B)	R(A)	W(B)
	W(A)	
W(F)	R(D)	
		W(A)
		R(C)
		R(B)
		R(D)

(1p)

2. Consider the log fragment below:

LSN	prevLSN	transID	type	pageID
1		T1	update	P1
2	1	T2	update	P1
3	2	T3	update	P18
4	3	T1	update	P2
5	4	T2	update	P2
6	5	T3	update	P12
7	6	T2	update	P12

Show the Transaction Table and the Dirty Page table.

compute the conflict relation of S.

is conflict serializable? Justify your answer.

is conflict serializable, find a serial schedule S_{ser} such that

and q be 2 secret numbers used to compute a public encryption key: $p = 5$, $q = 7$. Encrypt the message 1 (integer number 1) using the RSA encoding scheme.

Let T1 and T2 be 2 relations. T1 has 100.000 records; a page can hold 50 T1 records. T2 has 50.000 records; a page can hold 100

available. T1 and T2 are not sorted. Compute the cost of $T2 \bowtie_{T1.D1=T2.D2} T1$ using block nested loops join and

are available. Compute the cost of $\pi_{D1,C1,C2}(T1)$ using projection based on sorting (basic version, without

cost). The size of a tuple in the result of $\pi_{D1,C1,C2}(T1)$ is $\frac{1}{4}$ times the size of a tuple in T1.

stored at Cluj-Napoca, T2 is stored at Bucharest. Compute the cost of $T2 \bowtie_{T1.D1=T2.D2} T1$ using page-oriented nested loops join

est, without caching. T2 is the outer relation, the query site is Craiova and the result of $T2 \bowtie_{T1.D1=T2.D2} T1$ has 2942 pages.

the correct answer(s) for the following 14 multiple choice questions. Each question has at least one correct answer. Fill in

data for question 15. Enter all answers in the table below.

2.	3.	4.
6.	7.	8.
10.	11.	12.
14.		

- d. an arc from T1 to T2 if an action in T2 precedes and conflicts with one of the actions in T1
- e. none of the above answers is correct.

3. In ARIES, the analysis phase:

- a. reconstructs the state (of the database) at the most recent checkpoint.
- b. scans the log forward from the most recent checkpoint.
- c. removes a transaction T from the Transaction Table when it encounters an end log record for T.
- d. adds a transaction T to the Transaction Table when it encounters an end log record for T.
- e. none of the above answers is correct.

4. I is an index with select key $\{K1, K2, K3\}$. $R1 \bowtie I$

- a. hash index, I matches condition $K1=2 \wedge K2=1 \wedge K3=2$
- b. hash index, I matches condition $K1=2 \wedge K2=1 \wedge K3=2$
- c. B+ tree index, I matches condition $K1=2$
- d. B+ tree index, I matches condition $K1=2$
- e. none of the above answers is correct

5. A query block

- a. contains only FROM clause.
- b. contains only WHERE clause.
- c. contains only SELECT clause.
- d. contains only JOIN clause.

context of transaction processing, the acronym

- a. consistency, idealism, durability.
- b. consistency, idiosyncrasy, durability.
- c. durability, isolation, durability.
- d. consistency, isolation, durability.

6. Consider for a schedule S contains:

- a. a transaction T1 that reads data from S
- b. a transaction T2 that writes data to S
- c. a transaction T3 that reads data from S
- d. a transaction T4 that writes data to S

Database Management Systems - Written Exam - I
Computer Science in English, 2nd year

2p

1. Define the notion of *view-equivalence*.
2. Explain why *serializability* is a correctness criterion for interleaved execution schedules.

4p

II. Solve the following problems:

(1p)

1. Consider schedule S below:

(1p)

T1	T2	T3
R(A)	W(F)	
R(D)		W(B)
	R(A)	
	W(A)	
W(E)	R(D)	
		W(A)
		R(C)
		R(B)
		R(D)

Compute the conflict relation of S.

Is S conflict serializable? Justify your answer.

If S is conflict serializable, find a serial schedule S_{ser} such that $S \equiv_c S_{ser}$.

2. Consider the log fragment below:

LSN	prevLSN	transID	type	pageID	...
1	*	T1	update	P1	
2	*	T2	update	P1	
3	*	T3	update	P10	
4	1	T1	update	P2	
5	2	T2	update	P2	
6	3	T3	update	P11	
7	5	T2	commit		

Show the Transaction Table and the Dirty Page table.

3. Let p and q be 2 secret numbers used to compute a public encryption key: $p = 5$, $q = 7$. Encrypt the message I (integer number 1) using the RSA encoding scheme. (0.5p)

4. Let T1 and T2 be 2 relations. T1 has 100,000 records; a page can hold 50 T1 records. T2 has 50,000 records; a page can hold 100 T2 records. (1.5p)

- a. 52 buffer pages are available. T1 and T2 are not sorted. Compute the cost of $T2 \bowtie_{(12,10-11,10)} T1$ using block nested loops join and sort-merge join; T2 is the outer relation. Assume each partition is scanned once during the merging phase of sort-merge join.
- b. 52 buffer pages are available. Compute the cost of $\Pi_{(P1,P2)}(T1)$ using projection based on sorting (basic version, without improvement). The size of a tuple in the result of $\Pi_{(P1,P2)}(T1)$ is $\frac{1}{4}$ times the size of a tuple in T1.
- c. T1 is stored in Bucharest, T2 is stored at Bucharest. Compute the cost of $T2 \bowtie_{(12,10-11,10)} T1$ using page-oriented nested loops join in Bucharest. Nothing. T2 is the outer relation, the query site is Craiova and the result of $T2 \bowtie_{(12,10-11,10)} T1$ has 2942 pages.

3p

5. Answer(s) for the following 14 multiple choice questions. Each question has at least one correct answer. Fill in question 15. Enter all answers in the table below.

2.	C	3.	4.
6.		7.	8.
10.		11.	12.
13.	14.		
15.			

1. In the context of transaction processing, the acronym ACID stands for:

- a. atomicity, consistency, isolation, durability.
- b. atomicity, consistency, idiosyncrasy, durability.
- c. atomicity, cardinality, isolation, durability.
- d. acidity, consistency, isolation, durability.
- e. none of the above answers is correct.

E

2. A precedence graph for a schedule S contains:

- a. a node for every aborted transaction in S.
- b. a node for every committed transaction in S.
- c. an arc from T1 to T2 if an action in T1 precedes and conflicts with one of the actions in T2.

C

- d. an arc from T1 to T2 if an action in T2 precedes and conflicts with one of the actions in T1.
- e. none of the above answers is correct.

3. In ARIES, the analysis phase:

- a. reconstructs the state (of the database) at the most recent checkpoint.
- b. scans the log forward from the most recent checkpoint.
- c. removes a transaction T from the Transaction Table when it encounters an end log record for T.
- d. adds a transaction T to the Transaction Table when it encounters an end log record for T.
- e. none of the above answers is correct.

B

4. I is an index with search key $\langle K1, K2, K3 \rangle$. If I is a:

- a. hash index, I matches condition $K1=2 \wedge K2=3 \wedge K3=1$.
- b. hash index, I matches condition $K1=2 \wedge K2=3 \wedge K3>1$.
- c. B+ tree index, I matches condition $K1 > 10$.
- d. B+ tree index, I matches condition $K1 < 10$.
- e. none of the above answers is correct.

?

5. A query block:

- a. contains one FROM clause.
- b. can contain one WHERE clause.
- c. can contain one GROUP BY clause.

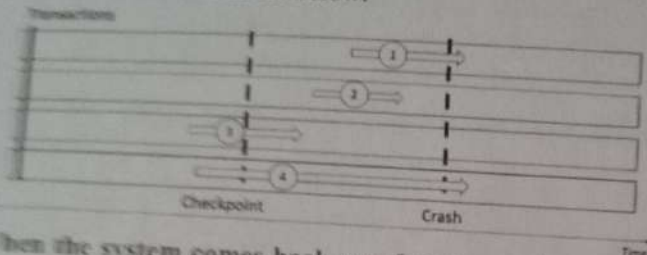
A B, C, D

- d. can contain one HAVING clause.
e. none of the above answers is correct.

6. The reduction factor for condition $Age = 30$, assuming data is uniformly distributed and there is an index I on Age , can be estimated by:

- a. $NPages(I)$
b. $1/NPages(I)$
c. $1/NKeys(I)$
d. $NKeys(I)$
e. none of the above answers is correct.

7. Consider the execution below.



When the system comes back up after the crash, it must ensure that:

- a. T1, T2 are durable; T3, T4 are undone.
b. T1, T2 are undone; T3, T4 are durable.
c. T1, T3 are undone; T2, T4 are durable.
d. T1, T3 are durable; T2, T4 are undone.
e. none of the above answers is correct.

8. Phantom deadlocks: ??

- a. are detected using the Wound-Wait policy.
b. can lead to unnecessary aborts.
c. are detected using the Wait-Die policy.
d. are detected due to delays in propagating local information.
e. none of the above answers is correct.

9. Let R , S and T be 3 relations. If fields are identified by name:

- a. $R \times S \equiv S \times R$
b. $R \cdot S \equiv S \cdot R$
c. $R \times (S \times T) \equiv (R \times S) \times T$
d. $R \cdot (S \cdot T) \equiv (R \cdot S) \cdot T$
e. none of the above answers is correct.

10. Regarding concurrency anomalies:

- a. dirty reads can occur under READ COMMITTED.
b. dirty reads can occur under REPEATABLE READ.
c. unrepeatable reads can occur under READ COMMITTED.
d. unrepeatable reads can occur under REPEATABLE READ.
e. none of the above answers is correct.

11. If a relation R is fragmented into 3 horizontal fragments $R1, R2, R3$:

- a. only $R1$ and $R2$ can be replicated.
b. only $R1$ and $R3$ can be replicated.
c. only $R2$ and $R3$ can be replicated.
d. none of the 3 fragments can be replicated.
e. none of the above answers is correct.

12. The execution below:

T1: $R(X) R(Y)$

T2: $R(X) W(X) Commit$

- a. results in a read write conflict.
b. results in a write read conflict.
c. results in a write write conflict.
d. doesn't generate any conflicts.
e. none of the above answers is correct.

13. The selectivity of an access path is measured in:

- a. seconds.
b. decibels.
c. pages.
d. disks.
e. none of the above answers is correct.

14. In the centralized approach to distributed deadlock detection:

- a. there is a single site responsible for global deadlock detection.
b. phantom deadlocks can occur.
c. a transaction is aborted if it lasts longer than a specified interval.
d. the Wait-Die policy is used to detect deadlocks.
e. none of the above answers is correct.

un semn, un term de altul using the secret encryption key *anaastan* and the table of codes:

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	.
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

(0.2p / question)