



程序代写代做 CS编程辅导

Week 10 Workshop - Database Transactions



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程序代写代做 CS编程辅导 **Transactions**

- A **transaction** is a sequence of database operations grouped together for execution as a logical unit of work.



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程序代写代做 CS编程辅导 Transactions

- A **transaction** is a sequence of database operations grouped together for execution as a logical unit.



Steps	Transaction
1	BEGIN TRANSACTION
2	SELECT balance FROM ACCOUNT WHERE name = 'Steve';
3	UPDATE ACCOUNT SET balance = balance-500 WHERE name='Steve';
4	SELECT balance FROM ACCOUNT WHERE name = 'Bob';
5	UPDATE ACCOUNT SET balance = balance+500 WHERE name = 'Bob';
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程序代写代做 CS编程辅导 Transactions

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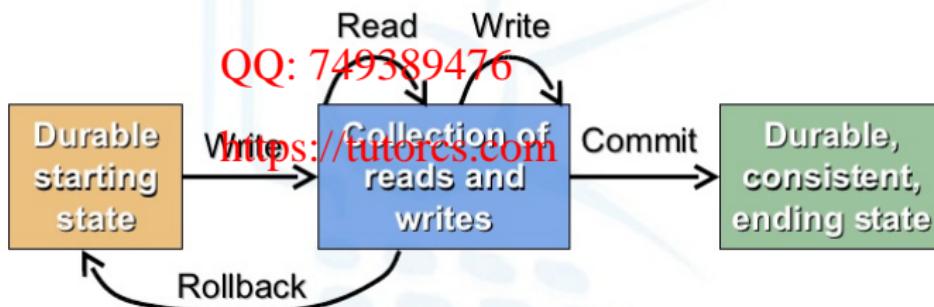


Steps	Transaction
1	BEGIN TRANSACTION
2	SELECT balance FROM ACCOUNT WHERE name = 'Steve';
3	UPDATE ACCOUNT SET balance = balance-500 WHERE name='Steve';
4	SELECT balance FROM ACCOUNT WHERE name = 'Bob';
5	UPDATE ACCOUNT SET balance = balance+500 WHERE name = 'Bob';
	COMMIT;

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Read Write
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程序代写代做 CS编程辅导 **Transactions**

- What's the difference between database transactions and programs written by a programming language like C, Java and Python?



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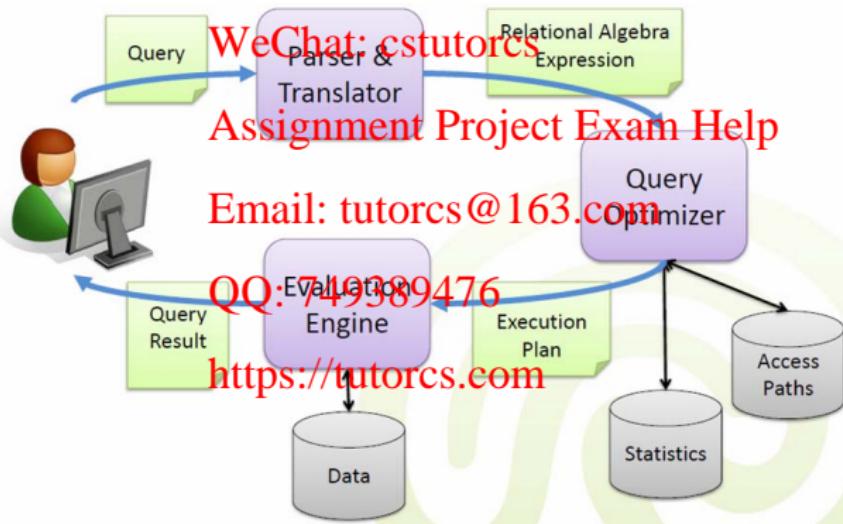


程序代写代做 CS编程辅导 Transactions

- What's the difference between database transactions and programs written by a programming language like C, Java and Python?
- How are transactions managed during the query processing?

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程序代写代做 CS编程辅导 Transaction Manager - A Simplified View





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Transactions - ACID Properties



Transactions

T_1 : BEGIN TRANSACTION

SELECT ...

UPDATE ...

COMMIT

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T_2 : SELECT ... Email: tutorcs@163.com

T_3 : INSERT ... QQ: 749389476

T_4 : BEGIN TRANSACTION https://tutorcs.com

SELECT ...

DELETE ...

ABORT



程序代写代做 CS编程辅导 Transactions - ACID Properties



Transactions

T_1 : BEGIN TRANSACTION

SELECT ...

UPDATE ...

COMMIT

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T_3 : INSERT ...

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T_4 : BEGIN TRANSACTION

SELECT ...

DELETE ...

ABORT

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ACID properties

Atomicity

Consistency

Isolation

Durability



程序代写代做 CS编程辅导 Transactions - ACID Properties



- Transactions are all or nothing

- Only valid data is saved

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Atomicity
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Isolation
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- Transactions do not affect each other

- Written data will not be lost



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Transactions - ACID Properties

ACID properties



Atomicity

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Consistency

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Isolation

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Durability

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Transactions - ACID Properties

ACID properties



Transaction Manager

Atomicity

Consistency

Isolation

Durability

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Transactions - ACID Properties

ACID properties



Atomicity

Consistency

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Transaction Manager

Recovery

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程序代写代做 CS编程辅导 Transactions - ACID Properties

ACID properties



Atomicity

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ACID properties



Atomicity

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Transaction Manager

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Consistency is the responsibility of an application developer.



程序代写代做 CS编程辅导 Transaction Manager - Common Techniques



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Recovery

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Control

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Transaction Manager - Common Techniques



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Recovery

Concurrency
Control

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- **Logging** for recovery – assuring **atomicity/durability** of transactions

e.g., Write-Ahead Log (WAL) Protocol.com



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Logging - Introduction



- A **transaction log** is an append-only file that records changes to objects made by transactions WeChat: cstutorcs

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程序代写代做 CS编程辅导
Logging - Introduction



- A **transaction log** is an append-only file that records changes to objects made by transactions

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- When multiple transactions run concurrently, log records are interleaved.

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程序代写代做 CS编程辅导 Logging - Introduction



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- A transaction log can be implemented as a separate file or set of files in the database.

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程序代写代做 CS编程辅导 Logging - Introduction



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程序代写代做 CS编程辅导 **Write-Ahead Log (WAL) Protocol**



- **Write-Ahead Log (WAL)** makes that a record of every change to a database is available for recovery attempt to recover from a crash.

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程序代写代做 CS编程辅导 Write-Ahead Log (WAL) Protocol



- **Write-Ahead Log (WAL)** makes that a record of every change to a database is available when attempting to recover from a crash.

- Any change to an object is first recorded in the log, i.e., a record containing both the old and new values for the object.

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- A record in the log must be written to persistent storage before committing the transaction

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程序代写代做 CS编程辅导 Write-Ahead Log (WAL) Protocol



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- A record in the log must be written to persistent storage before committing the transaction.

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- Accordingly, the definition of a **committed transaction** is:

“A transaction, all of whose log records, including a commit record, have been written to persistent storage”.

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程序代写代做 CS编程辅导 Write-Ahead Log (WAL) Protocol

- Typical fields in a log



log record has a unique id called **LSN** (Log Sequence Number).

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prevLSN is the LSN of the previous log record written by the same transaction.

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Possible **types** include: update, commit, abort,

end, etc.

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程序代写代做 CS编程辅导 Write-Ahead Log (WAL) Protocol

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Possible **types** include: update, commit, abort, end, etc.

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- Does WAL bring in some benefits for performance?

- Often results in a significantly reduced number of disk writes
- Supports one sync against the log file instead of potentially many against the data files
- Enables online backup and point-in-time recovery

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Transaction Manager - Recovery

- Key concepts to aid i



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Transaction Manager - Recovery

- Key concepts to aid i



- **Transaction log**: records of database operations

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Transaction Manager - Recovery

- Key concepts to aid i



- **Transaction log**: records of database operations

Write-Ahead Log (WAL): Recovery amounts to **either undoing or redoing changes from the log**:

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程序代写代做 CS编程辅导 Transaction Manager - Recovery

- Key concepts to aid in understanding:



- **Transaction log**: records of database operations

Write-Ahead Log (WAL): Recovery amounts to **either undoing or redoing changes from the log**:

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- **Undo** the operations that have not been committed;
- **Redo** the operations that have been committed but not yet been written to disk.

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程序代写代做 CS编程辅导 Transaction Manager - Recovery



- Key concepts to aid in recovery:

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Write-Ahead Log (WAL): Recovery amounts to **either undoing or redoing changes from the log**:

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- **Undo** the operations that have not been committed;
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- **Checkpoint**: tell the points from which to begin applying transaction logs during database recovery.
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(Widely used in practice, but not covered in this course)



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Transaction Manager - Common Techniques



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- **Logging** for recovery – assuring **atomicity/durability** of transactions

e.g., Write-Ahead Log (WAL) Protocol

- **Locking** for concurrency control – assuring **isolation** of transactions

e.g., Two-Phase Locking (2PL) Protocol



程序代写代做 CS编程辅导 Locking - Introduction



- A **lock** is associated with an object, e.g., file, table, record, page, etc.
- Two main types of locks:

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- **Read lock** for reading an object by a transaction
- **Write lock** for writing an object by a transaction

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(Note: there are other types of locks defined by different DBMSs)

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程序代写代做 CS编程辅导 Locking - Introduction



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(Note: there are other types of locks defined by different DBMSs)

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- Lock compatibility:

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Lock type	read-lock	write-lock
read-lock	Yes	No
write-lock	No	No



程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



- Locks are handled in two phases:

- **Expanding**: locks are acquired and no locks are released.
- **Shrinking**: locks are released and no locks are acquired.

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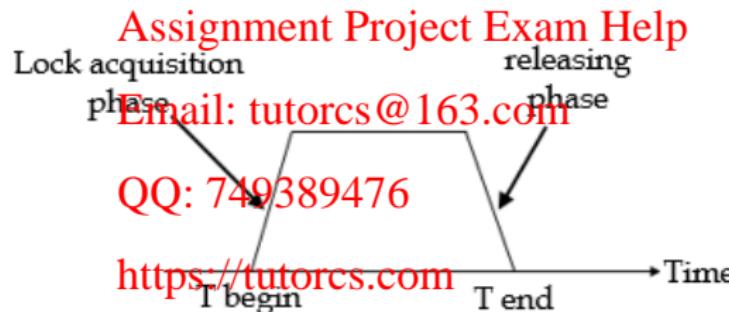
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程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol

Bad news:

- 2PL can radically limit concurrency among transactions in some cases ...



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程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol

Bad news:

- 2PL can radically limit parallelism among transactions in some cases ...
- 2PL may be subject to **deadlocks**, i.e., the mutual blocking of two or more transactions.



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程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



Bad news:

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Step	T_1	Assignment Project Exam Help
1	r-lock(A)	Email: tutorcs@163.com
2	read(A)	
3		QQ: 749389476
4		read(B)
5	w-lock(B)	
6	write(B)	https://tutorcs.com
7		w-lock(A)
8		write(A)



程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



Bad news:

- 2PL can radically limit parallelism among transactions in some cases ...
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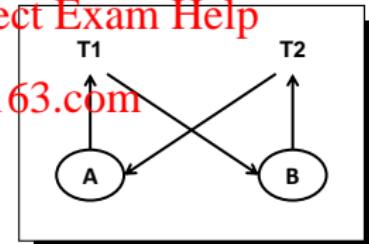
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w-lock(A)
write(A)



Step	T_1	T_2
1	r-lock(A)	
2	read(A)	
3		r-lock(B)
4		read(B)
5	w-lock(B)	
6	write(B)	
7		w-lock(A)
8		write(A)



程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol

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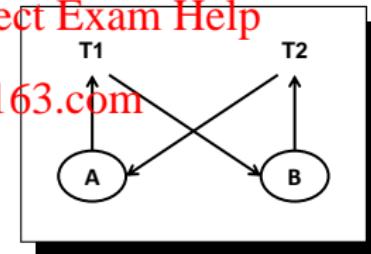
Step	T_1	T_2
1	r-lock(A)	
2	read(A)	
3		r-lock(B)
4		read(B)
5	w-lock(B)	
6	write(B)	
7		w-lock(A)
8		write(A)

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- T_1 is waiting for T_2 to get a write-lock on B . T_2 is waiting for T_1 to get a write-lock on A .



程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



Good news:

- 2PL makes interleaving safe, i.e., guarantee the serializability property for transactions.

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程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



Good news:

- 2PL makes interleaving safe, i.e., guarantee the serializability property for transactions.

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- **Serializability** means that a resulting database state is equal to a database state of running transactions serially.

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程序代写代做 CS编程辅导 Two-Phase Locking (2PL) Protocol



Good news:

- 2PL makes interleaving safe, i.e., guarantee the serializability property for transactions.

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- **Serializability** means that a resulting database state is equal to a database state of running transactions serially.
- Serializability is the major **correctness criterion** for concurrent transactions.

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程序代写代做 CS编程辅导 Serializability - Example

- Consider $A = 200$ and we have two concurrent transactions:

T1	A+=100	B-=10
T2	A*=3	B*=2



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- Serializable transactions:

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程序代写代做 CS编程辅导 Serializability - Example

- Consider $A = 200$ and we have two concurrent transactions:

T1	A+=100	B-=10
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- Serializable transactions:

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Case 1:



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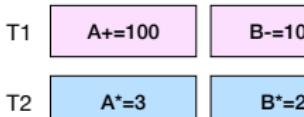
time

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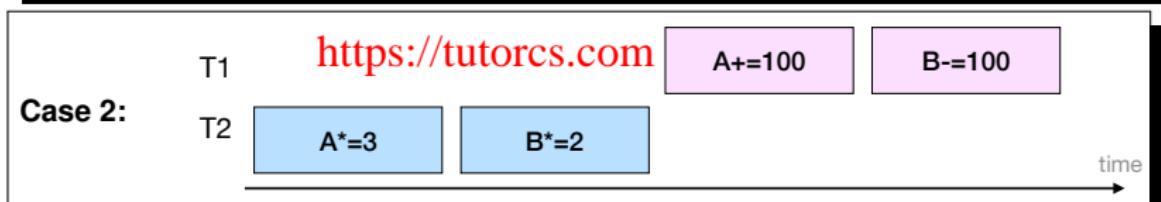
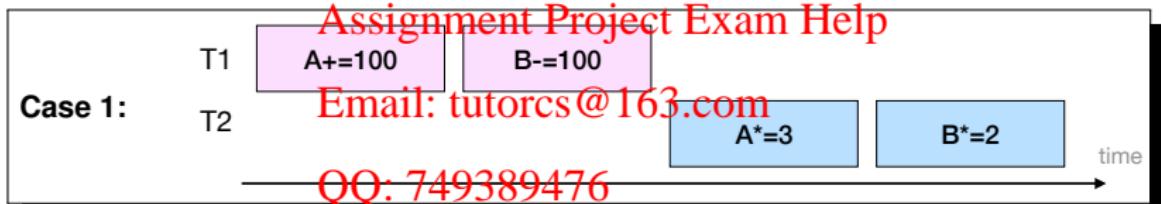
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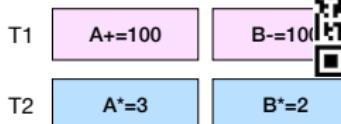
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程序代写代做 CS编程辅导 Serializability - Example

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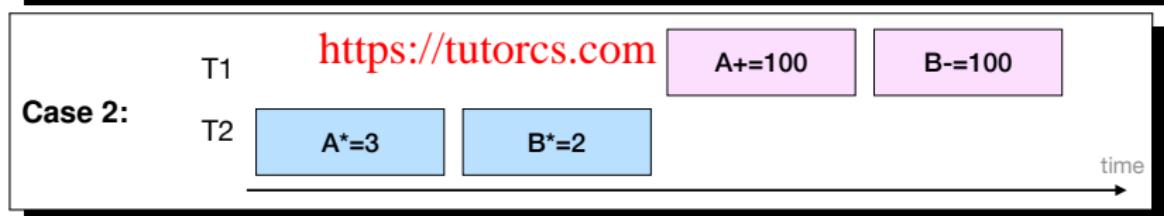
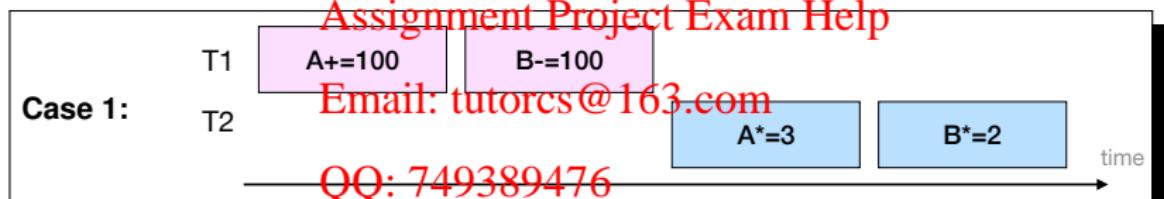


and we have two concurrent transactions:

- Case 1: $A=900$ and $B=800$
- Case 2: $A=700$ and $B=900$

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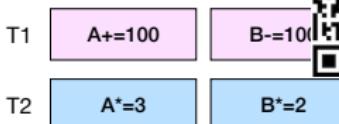
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程序代写代做 CS编程辅导 Serializability - Example

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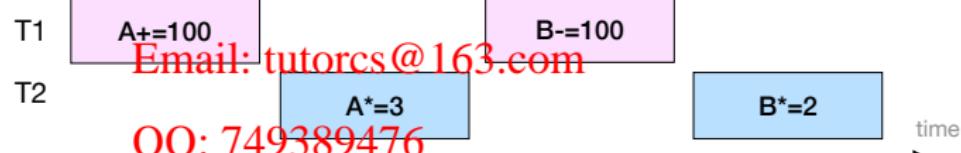
- Case 1: A=900 and B=800
- Case 2: A=700 and B=900

- Are the following transactions serializable?

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Case 3:



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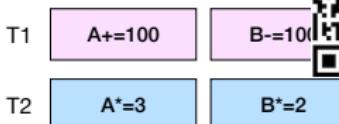
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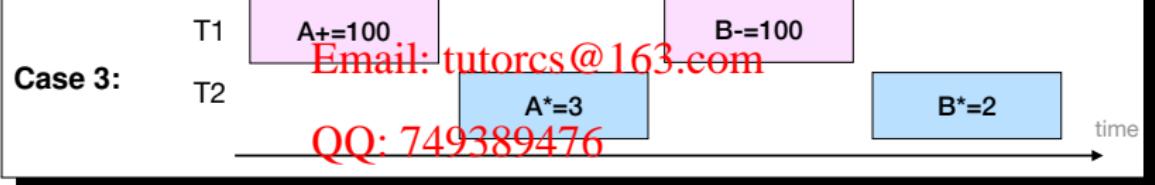
- Consider $A = 200$ and we have two concurrent transactions:



- Case 1: A=900 and B=800
- Case 2: A=700 and B=900

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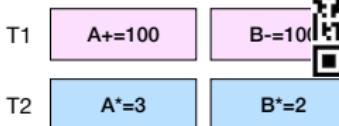
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- Yes. A=900 and B=800 \rightarrow equivalent to Case 1!



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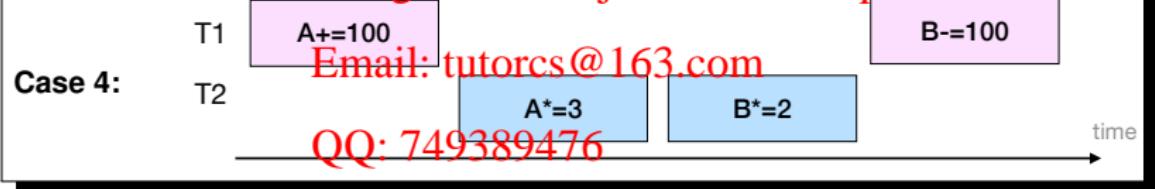
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- Case 2: A=700 and B=900

- Are the following transactions serializable?

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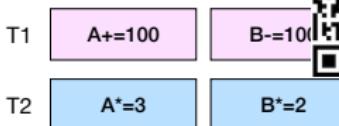


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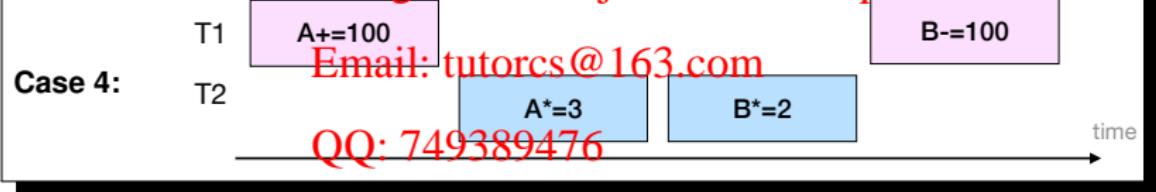
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- Case 2: A=700 and B=900

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- No. A=900 and B=900 \rightarrow not equivalent to Case 1 or Case 2!



程序代写代做 CS编程辅导 Problems in Concurrent Transactions



- If no concurrency control for transactions, some problems may occur:

Lost update

write \curvearrowright write

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程序代写代做 CS编程辅导 Problems in Concurrent Transactions



- If no concurrency control for transactions, some problems may occur:

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Lost update

write \curvearrowright write

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read

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write \curvearrowright read

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程序代写代做 CS编程辅导 Problems in Concurrent Transactions



- If no concurrency control for transactions, some problems may occur:

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Lost update

write \curvearrowright write

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read

read

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write \curvearrowright read

read \curvearrowright write

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程序代写代做 CS编程辅导 Problems in Concurrent Transactions



- If no concurrency control for transactions, some problems may occur:

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Lost update

write \curvearrowright write

Dirty assignment

read

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write \curvearrowright read

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Unrepeatable read

read

read \curvearrowright write

(read)

Help Phantom read

read \curvearrowright write

(read)



程序代写代做 CS编程辅导 Problems in Concurrent Transactions

- If no concurrency control is used in concurrent transactions, some problems may occur:



Lost update

$\text{write} \curvearrowright \text{write}$

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Dirty
read

$\text{write} \curvearrowright \text{read}$

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$\text{read} \curvearrowright \text{write}$

(read)

Phantom read

$\text{read} \curvearrowright \text{write}$
(read)

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Dirty write

$\text{write} \curvearrowright \text{write}$



程序代写代做 CS编程辅导 Problems in Concurrent Transactions



- If no concurrency control is applied to concurrent transactions, some problems may occur:

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Lost update

write \curvearrowright write

object

Dirty read

write \curvearrowright read

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object

Unrepeatable read

read \curvearrowright write
(read)

object

Phantom read

read \curvearrowright write
(read)

a set of objects



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The Lost Update Problem - Another Example

- Ben and Amy have the same salary. T_1 sets their salaries to \$80,000, and T_2 sets their salaries to \$100,000.



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程序代写代做 CS编程辅导

The Lost Update Problem - Another Example

- Ben and Amy have the same salary. T_1 sets their salaries to \$80,000, and T_2 sets their salaries to \$90,000.



- ① If executing T_1 and T_2 sequentially,
 - for $T_1; T_2$, both receive \$90,000.
 - for $T_2; T_1$, both receive \$80,000.

→ Either ~~Assignment from Project Transaction Help~~ point.

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程序代写代做 CS编程辅导

The Lost Update Problem - Another Example

- Ben and Amy have the same salary. T_1 sets their salaries to \$80,000, and T_2 sets their salaries to \$90,000.



- If executing T_1 and T_2 sequentially,
 - for $T_1; T_2$, both receive \$90,000.
 - for $T_2; T_1$, both receive \$80,000.

→ Either ~~Assignment from Project Transaction Help~~

- If executing T_1 and T_2 concurrently, we may have:

	T_1	T_2
1	write(A) (A:=80000)	QQ: 749389476
2		write(A) (A:=90000)
3		write(B) (B:=90000)
4		commit
5	write(B) (B:=80000)	
6	commit	

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→ It is not acceptable!



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The Dirty Read Problem - Another Example

- Both Ben and Amy are given a bonus \$5,000 and a pay rise 5%. T_1 increases their salaries by \$5,000 and T_2 increments their salaries by 5%.



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程序代写代做 CS编程辅导

The Dirty Read Problem - Another Example

- Both Ben and Amy are given a bonus \$5,000 and a pay rise 5%. T_1 increases their salaries by 5%.
- ① If executing T_1 and T_2 sequentially, they would have Also, T_1 or T_2 could abort for some reasons. → all are acceptable from the transaction viewpoint.
- 
- 
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程序代写代做 CS编程辅导

The Dirty Read Problem - Another Example

- Both Ben and Amy are given a bonus \$5,000 and a pay rise 5%. T_1 increases their salaries by 5%.
-  
- If executing T_1 and T_2 sequentially, they would have Also, T_1 or T_2 could abort for some reasons. → all are acceptable from the transaction viewpoint.
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 - If executing T_1 and T_2 concurrently we may have:

	T_1	T_2
1	read(A)	Email: tutorcs@163.com
2	write(A) ($A := A + 5000$)	
3		read(A)
4	read(B)	QQ: 749389476
5	write(B) ($B := B + 5000$)	
6	abort	https://tutorcs.com
7		write(A) ($A := A + A \times 5\%$)
8		read(B)
9		write(B) ($B := B + B \times 5\%$)
10		commit

→ It is not acceptable!



程序代写代做 CS编程辅导 The Dirty Write Problem - An Example

- Both Ben and Amy are entitled to a bonus \$5,000 and a pay rise 5%. T_1 increases their salaries by \$5,000 and T_2 increments their salaries by 5%.



① If executing T_1 and T_2 sequentially, they would have Also, T_1 or T_2 could abort for some reasons. → all are acceptable from the transaction viewpoint.

② If executing T_1 and T_2 concurrently we may have:

	T_1	T_2
1	read(A)	Email: tutorcs@163.com
2	write(A) ($A:=A+5000$)	
3		read(A)
4		write(A) ($A:=A+A \times 5\%$)
5	read(B)	
6	write(B) ($B:=B+5000$)	
7	abort	
8		read(B)
9		write(B) ($B:=B+B \times 5\%$)
10		commit

→ It is not acceptable!



程序代写代做 CS编程辅导

The Unrepeatable Read Problem - Another Example

- Amy and Ben are using the same program to book flight tickets to Brisbane.



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The Unrepeatable Read Problem - Another Example



- Amy and Ben are using the same computer to book flight tickets to Brisbane.
 - Amy signs on first to see that only one ticket is left, and finds it expensive.

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程序代写代做 CS编程辅导

The Unrepeatable Read Problem - Another Example



- Amy and Ben are using the same website to book flight tickets to Brisbane.
 - Amy signs on first to see that only one ticket is left, and finds it expensive.
 - Amy takes time to decide. Ben signs on later and also finds one ticket left, orders it instantly, and logs off.

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程序代写代做 CS编程辅导

The Unrepeatable Read Problem - Another Example



- Amy and Ben are using a shared system to book flight tickets to Brisbane.
 - Amy signs on first to see that only one ticket is left, and finds it expensive.
 - Amy takes time to decide. Ben signs on later and also finds one ticket left, orders it instantly, and logs off.
 - Amy decides to buy a ticket, and finds no tickets left.

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程序代写代做 CS编程辅导

The Unrepeatable Read Problem - Another Example



- Amy and Ben are using a shared database to book flight tickets to Brisbane.
 - Amy signs on first to see that only one ticket is left, and finds it expensive.
 - Amy takes time to decide. Ben signs on later and also finds one ticket left, orders it instantly, and logs off.
 - Amy decides to buy a ticket, and finds no tickets left.

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	T ₁ (from Amy)	T ₂ (from Ben)
1	read(X)	
2		read(X)
3	QQ: 749389476	write(X) (X:=X-1)
4		commit
5	https://tutorcs.com	



程序代写代做 CS编程辅导

The Unrepeatable Read Problem - Another Example



- Amy and Ben are using a system to book flight tickets to Brisbane.
 - Amy signs on first to see that only one ticket is left, and finds it expensive.
 - Amy takes time to decide. Ben signs on later and also finds one ticket left, orders it instantly, and logs off.
 - Amy decides to buy a ticket, and finds no tickets left.

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	T ₁ (from Amy)	T ₂ (from Ben)
1	read(X)	
2		read(X)
3	QQ: 749389476	write(X) (X:=X-1)
4		commit
5	https://tutorcs.com	

- This situation can never arise in a serial execution of T₁ and T₂.



程序代写代做 CS编程辅导

The Phantom Read Problem - Another Example

- Amy is 30 years old, as 40. Ben is 28 years old. In the table players is mistakenly recorded as age is correctly recorded in players.



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The Phantom Read Problem - Another Example

- Amy is 30 years old, in the table players is mistakenly recorded as 40. Ben is 28 years old, his age is correctly recorded in players.
- Two concurrent transactions



T_1 :
SELECT * FROM players
WHERE age<32;
...
SELECT * FROM players
WHERE age<32;
COMMIT;

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T_2 :
UPDATE players
SET age=30
WHERE rating=8 and name='Amy';
COMMIT;

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程序代写代做 CS编程辅导

The Phantom Read Problem - Another Example

- Amy is 30 years old, in the table players is mistakenly recorded as 40. Ben is 28 years old, his age is correctly recorded in players.
- Two concurrent transactions



T_1 : SELECT * FROM players

WHERE age<32;

...

SELECT * FROM players

WHERE age<32;

COMMIT;

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T_2 : UPDATE players

SET age=30

WHERE rating=8 and name='Amy';

COMMIT;

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	T_1	T_2
1	read(players)	
2	QQ: 749389476	read(players)
3		write(players)
4		commit
5	read(players)	
6	commit	



程序代写代做 CS编程辅导

The Phantom Read Problem - Another Example

- Amy is 30 years old, in the table players is mistakenly recorded as 40. Ben is 28 years old, his age is correctly recorded in players.
- Two concurrent transactions



T_1 : SELECT * FROM players

WHERE age<32;

...

SELECT * FROM players

WHERE age<32;

COMMIT;

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T_2 : UPDATE players

SET age=30

WHERE rating=8 and name='Amy';

COMMIT;

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	T_1	T_2
1	read(players)	
2	QQ: 749389476	read(players)
3		write(players)
4		commit
5	read(players)	
6	commit	

- This situation can never arise in a serial execution of T_1 and T_2 .



程序代写代做 CS编程辅导 Discussion



- What are the differences between “unrepeatable read” and “phantom read”?

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程序代写代做 CS编程辅导 Discussion



- What are the differences between “unrepeatable read” and “phantom read”?

- **Unrepeatable**

- Executing the same SELECT twice yields the same tuples, but attribute values might be different;
- May occur when reading objects that are affected by **UPDATE** from another transaction;
- Can be prevented using record-level locking.

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程序代写代做 CS编程辅导 Discussion



- What are the differences between “unrepeatable read” and “phantom read”?

- **Unrepeatable read**

- Executing the same SELECT twice yields the same tuples, but attribute values might be different;
- May occur when reading objects that are affected by UPDATE from another transaction;
- Can be prevented using record-level locking.

- **Phantom read**

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- Executing the same SELECT twice yields two different sets of tuples;
- May occur when querying a set of tuples that are affected by INSERT/DELETE/UPDATE from another transaction;
- Can be prevented using table-level locking.



程序代写代做 CS编程辅导 What Should We lock?

- Consider the following two transactions again:

T_1 : SELECT * FROM players



WHERE age<32;

...

SELECT * FROM players

WHERE age<32;

COMMIT;

T_2 : UPDATE players

SET age=30

WHERE rating=8 and name='Amy';

COMMIT;

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- What objects should the DBMS lock in order to avoid the phantom read problem?

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- Table-level locks**

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e.g., read-lock on players for T_1 , write-lock on players for T_2

- Record-level locks**

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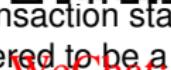
e.g., read-lock on every record with age<32 for T_1 , write-lock on every record with rating=8 and name='Amy' for T_2

- ...



程序代写代做 CS编程辅导 Transaction Support in SQL

- An explicit transaction must be ended with either no **BEGIN TRANSACTION** statement, but must **ABORT (ROLLBACK)** statement.
- When no explicit transaction statements are given, each single SQL statement is considered to be a transaction.



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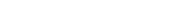
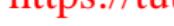
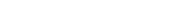
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程序代写代做 CS编程辅导 Transaction Support in SQL

- An explicit transaction must be ended with either no **BEGIN TRANSACTION** statement, but must **ABORT (ROLLBACK)** statement.
- When no explicit transaction statements are given, each single SQL statement is considered to be a transaction.
- To give programmers more control over transaction overhead, SQL allows them to specify **isolation level**, i.e., the degree of interference that a transaction is prepared to tolerate on concurrent transactions.





程序代写代做 CS编程辅导 Transaction Support in SQL

- An explicit transaction must be ended with either no **BEGIN TRANSACTION** statement, but must **ABORT (ROLLBACK)** statement.
- When no explicit transaction statements are given, each single SQL statement is considered to be a transaction.
- To give programmers more control over transaction overhead, SQL allows them to specify **isolation level**, i.e., the degree of interference that a transaction is prepared to tolerate on concurrent transactions.

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- Key idea:

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To trade off **consistency** (i.e., increased risk of violating database integrity) with **performance** (i.e., greater concurrent access to data)

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程序代写代做 CS编程辅导 Isolation Levels

- SQL-92 defines four levels:

- 1 Read Uncommitted
- 2 Read Committed
- 3 Repeatable Reads
- 4 Serializable



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- To specify an isolation level, e.g.,

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```
SET TRANSACTION ISOLATION LEVEL serializable;
```

- The SQL standard does not impose a specific locking scheme or mandate particular behaviors.



程序代写代做 CS编程辅导 Isolation Levels

- The intention is to prevent concurrent problems:



Isolation Level	Dirty Read	Unrepeatable Read	Phantom Read
READ UNCOMMITTED	Yes	Yes	Yes
READ COMMITTED	No	Yes	Yes
REPEATABLE READ	No	No	Yes
SERIALIZABLE	No	No	No

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¹ https://drtom.ch/posts/2011/11/12/The_Lost_Update_Problem_-_Part_1/



程序代写代做 CS编程辅导 Isolation Levels



- The intention is to prevent certain problems:

Isolation Level	Dirty Read	Unrepeatable Read	Phantom Read
READ UNCOMMITTED	Yes	Yes	Yes
READ COMMITTED	No	Yes	Yes
REPEATABLE READ	No	No	Yes
SERIALIZABLE	No	No	No

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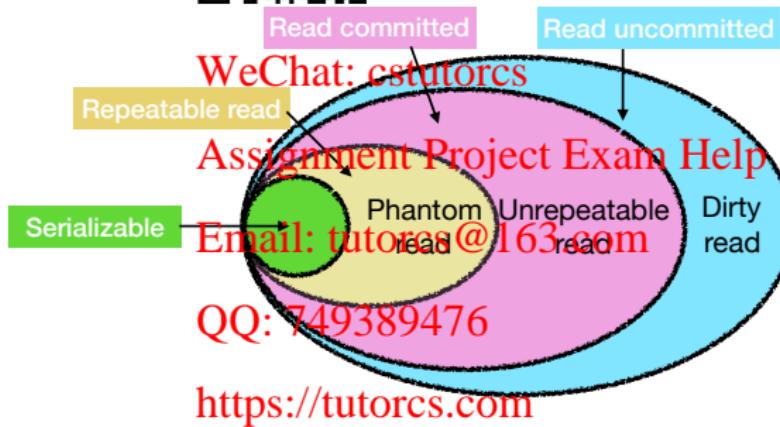
- Different DBMSs implement isolation levels quite differently.
- The isolation level required for **Lost Update** is debatable (depending on a DBMS's implementation). But in general, it may require the highest level SERIALIZABLE to prevent it.¹

¹ https://drtom.ch/posts/2011/11/12/The_Lost_Update_Problem_-_Part_1/



程序代写代做 CS编程辅导 Isolation Levels - Concurrency Control

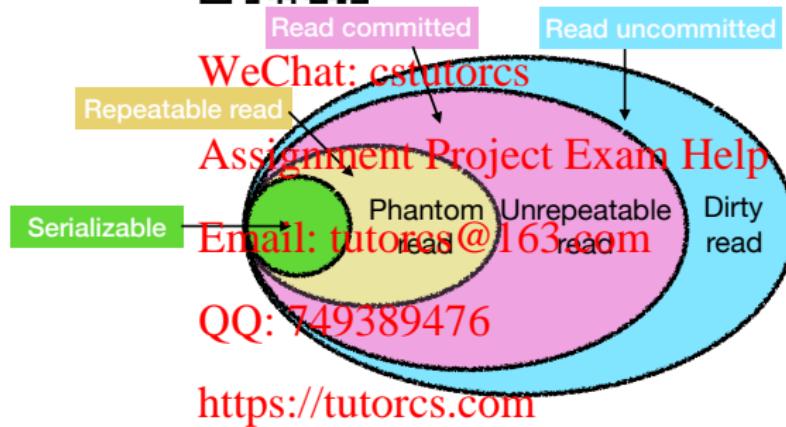
- A DBMS provides different levels of isolation → different degrees of concurrency control to solve different problems.





程序代写代做 CS编程辅导 Isolation Levels - Concurrency Control

- A DBMS provides different levels of isolation → different degrees of concurrency control to solve different problems.



- Concurrency control is **NOT** binary in a database system.

NO **YES**



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Isolation Levels - Read Uncommitted

- **Read Uncommitted**



restrictive isolation level.

- One transaction can see uncommitted changes made by other transactions which are not yet committed. This can be quite dangerous.
- Use it when executing queries over read-only data or if it does not matter whether a query returns uncommitted data.

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程序代写代做 CS编程辅导 Isolation Levels - Read Committed

- **Read Committed:** Customer 1's transaction only sees committed changes by other transactions.
- It is the most common isolation level in database applications.
- Use it when you want to maximize concurrency between applications but do not want queries to see uncommitted data.



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- **Repeatable Reads:** objects touched by a transaction are locked and cannot be updated or seen by another concurrent transaction.
- Use it when you want some level of concurrency between applications but do not expect individual objects to be changed during a transaction.

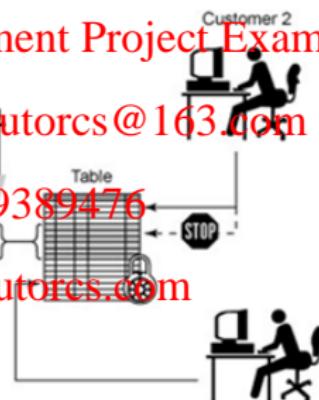


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程序代写代做 CS编程辅导 Isolation Levels - Serializable



- **Serializable** is the highest isolation level. All transactions are totally isolated from other transactions but may cause significant performance hit.
- Use it when you want some level of concurrency between applications but do not expect that a query returns different sets of results when running at different times.

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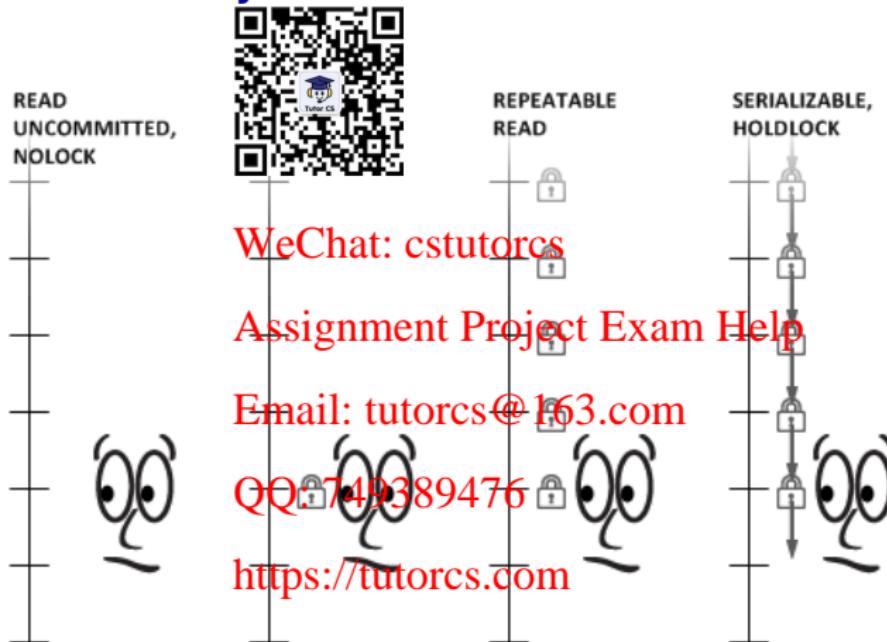
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程序代写代做 CS编程辅导

Locks Taken by SQL Server for Isolation Levels²



²<http://michaeljswart.com/2012/06/visualizing-transaction-isolations-for-sql-server/>



程序代写代做 CS编程辅导 Wrap-up - Isolation Levels



- A lower isolation level **increases the ability of many users to access data at the same time**, but **increases the number of concurrency effects** (such as dirty reads or lost updates) users might encounter.

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- Conversely, a higher isolation level **reduces the types of concurrency effects that users may encounter**, but requires more system resources and increases the chances that one transaction will block another.

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- Choosing the appropriate isolation level depends on **balancing**

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- **the data integrity requirements of the application**

against

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- **the overhead of each isolation level.**



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Research Topics
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程序代写代做 CS编程辅导 Research Topics



- This is an active research area covering many interesting research topics.
- Historically, much of the work has been done in the context of relational database systems. **WeChat: cstutorcs**
- However, the ideas in general are independent of whether the underlying system is a relational database system or something else.

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- Distributed database systems
- Graph database systems
- Document-oriented database systems
- ...

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程序代写代做 CS编程辅导 Research Topics

- Distributed transaction

