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程序代写代做 CS编程辅导



Database Transactions – Part 2

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ACID Properties

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ACID Properties



- DBMSs ensure the following properties of transactions.

- Atomicity:**

- The execution of each transaction is atomic, i.e., **either all operations are completed or not done at all.**

- Consistency:** WeChat: cstutorcs

- The states of a database are consistent (w.r.t. defined business rules) **before and after each transaction.**

- Isolation:**

- Execution results of each transaction should be **unaffected by other concurrent executing transactions.**

- Durability:**

- Once a transaction has been successfully completed, **its effects should persist in the database.**

Note: These properties are not independent from one another, but **atomicity is the central property.**



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Atomicity



- **Atomicity** requires that a transaction to completion with only **two possibilities**:

- **ALL**: all the operations are executed;
- **NONE**: none of the operations are executed.

- If a transaction fails to complete for some reason, it may leave database in an inconsistent state. Thus a DBMS **must remove effects of partial transactions** to ensure atomicity.

Example: The money can only be taken from Steve's account if the money has been transferred into Bob's account.

Operations	Steve	Bob
before 1	\$1000	\$200
after 1	\$1000	\$200
after 2	\$500	\$200
after 3	\$500	\$200
after 4	\$500	\$700

None are executed.

All are executed.

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Atomicity



Everything is wrong! Rollback!

What? Are you kidding?

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Consistency



- **Consistency** requires that each transaction should **preserve the consistency of the** database.
- **Note:** Intermediate states may be inconsistent.

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Example: Suppose that we have

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Steve's account balance + Bob's account balance = \$1200,

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Operations	Steve	Bob
before 1	\$1000	\$200
after 1	\$1000	\$200
after 2	\$500	\$200
after 3	\$500	\$200
after 4	\$500	\$700

$\$1000 + \$200 = \$1200$

Not required to be consistent.

$\$500 + \$700 = \$1200$



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Consistency¹



- The database is in a consistent state before and after executing the transaction, but is not necessarily consistent in intermediate states.

¹ The figure is taken from <http://maxdb.sap.com>



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Isolation



- **Isolation** requires that transactions are **isolated from one another**.

Example: Other transactions can't see the changes on objects *A* (Steve's account balance) and *B* (Bob's account balance) until the transaction for the money transfer is completed.

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T_1
read(A)
write(A) ($A := A - 500$)
read(B)
write(B) ($B := B - 500$)
commit

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T_2
read(A)
write(A) ($A := A + 400$)
commit



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Isolation²



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² The figure is taken from <http://michaeljswart.com/>



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Durability



- **Durability** requires that once a transaction is successfully completed, its changes to the database **must be persistent despite failures.**

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- The decision is irrevocable: once committed, the transaction cannot revert to abort. **Changes are durable.**

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- **Example:** Once Steve received the notification:

"\$500 has been successfully transferred to Bob's account",

the money can't go back to Steve's account and must appear in Bob's account.

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Durability³



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³ The figure is taken from <http://toyhouse.cc/profiles/blogs/the-acid-properties-of-transactions>