Deepika Gupta

Assistant Professor, CSE Department

ACID Properties

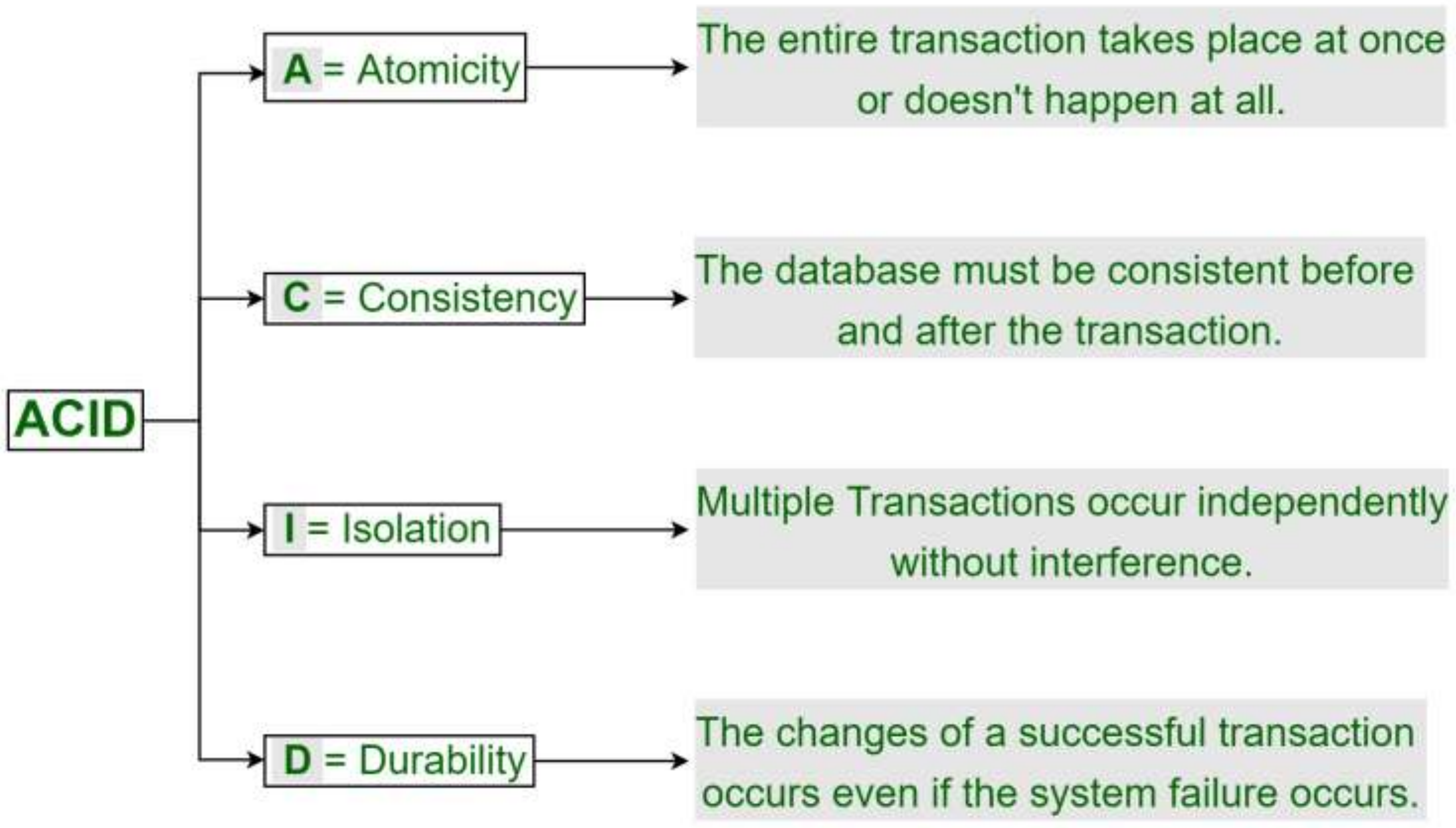
Introduction:

ACID (Atomicity, Consistency, Isolation, and Durability) is a set of properties that guarantee the reliability of database transactions [2]. ACID properties were initially developed with traditional, business-oriented applications (e.g., banking) in mind. Hence, they do not fully support the functional and performance requirements of advanced database applications such as computer-aided design, computer-aided manufacturing, office automation, network management, multidatabases, and mobile databases. For instance, transactions in computer-aided design applications are generally of long duration and preserving the traditional ACID properties in such transactions would require locking resources for long periods of time. This has lead to the generalization of ACID properties as Recovery, Consistency, Visibility and Permanence. The aim of such generalization is to relax some of the constraints and restrictions imposed by the ACID properties. For example, visibility relaxes the isolation property by enabling the sharing of partial results and hence promoting cooperation among concurrent transactions. Hence, the more generalized are ACID properties, the more flexible is the corresponding transaction model.

ACID Properties in DBMS

A **transaction** is a single logical unit of work which accesses and possibly modifies the contents of a database. Transactions access data using read and write operations.
In order to maintain consistency in a database, before and after the transaction, certain properties are followed. These are called **ACID** properties.

ACID Properties in DBMS



The entire transaction takes place at once or doesn't happen at all.

The database must be consistent before and after the transaction.

Multiple Transactions occur independently without interference.

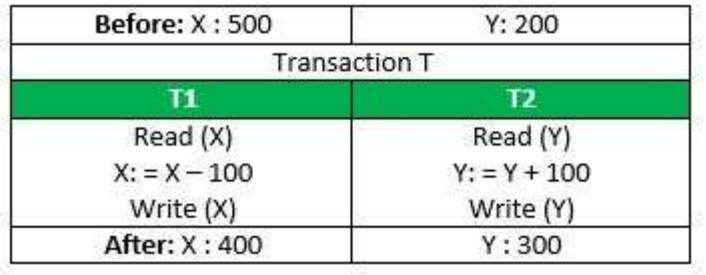
The changes of a successful transaction occurs even if the system failure occurs.

Atomicity

By this, we mean that either the entire transaction takes place at once or doesn't happen at all. There is no midway i.e. transactions do not occur partially. Each transaction is considered as one unit and either runs to completion or is not executed at all. It involves the following two operations.

—**Abort**: If a transaction aborts, changes made to database are not visible.
—**Commit**: If a transaction commits, changes made are visible.
Atomicity is also known as the 'All or nothing rule'.

Consider the following transaction **T** consisting of **T1** and **T2**: Transfer of 100 from account **X** to account **Y**.



Before: X : 500	Y: 200
Transaction T	
T1	**T2**
Read (X) X: = X – 100 Write (X)	Read (Y) Y: = Y + 100 Write (Y)
After: X : 400	Y : 300

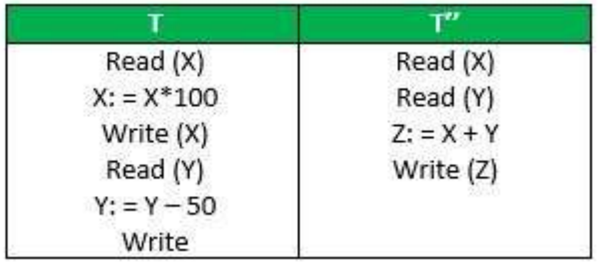
If the transaction fails after completion of **T1** but before completion of **T2**.(say, after **write(X)** but before **write(Y)**), then amount has been deducted from **X** but not added to **Y**. This results in an inconsistent database state. Therefore, the transaction must be executed in entirety in order to ensure correctness of database state.

Consistency

This means that integrity constraints must be maintained so that the database is consistent before and after the transaction. It refers to the correctness of a database. Referring to the example above,
The total amount before and after the transaction must be maintained.
Total **before** **T** occurs = **500** **+** **200** **=** **700**.
Total **after** **T** **occurs** = **400** **+** **300** **=** **700**.
Therefore, database is **consistent**. Inconsistency occurs in case **T1** completes but **T2**fails. As a result T is incomplete.

Isolation

This property ensures that multiple transactions can occur concurrently without leading to the inconsistency of database state. Transactions occur independently without interference. Changes occurring in a particular transaction will not be visible to any other transaction until that particular change in that transaction is written to memory or has been committed. This property ensures that the execution of transactions concurrently will result in a state that is equivalent to a state achieved these were executed serially in some order.
Let **X**= 500, **Y** = 500.
Consider two transactions **T** and **T".**



T	T''
Read (X) X: = X*100 Write (X) Read (Y) Y: = Y – 50 Write	Read (X) Read (Y) Z: = X + Y Write (Z)

Suppose **T** has been executed till **Read (Y)** and then **T''** starts. As a result , interleaving of operations takes place due to which **T''** reads correct value of **X** but incorrect value of **Y** and sum computed by **T'': (X+Y = 50, 000+500=50, 500)** is thus not consistent with the sum at end of transaction: **T: (X+Y = 50, 000 + 450 = 50, 450)**. This results in database inconsistency, due to a loss of 50 units. Hence, transactions must take place in isolation and changes should be visible only after they have been made to the main memory.

Durability:

This property ensures that once the transaction has completed execution, the updates and modifications to the database are stored in and written to disk and they persist even if a system failure occurs. These updates now become permanent and are stored in non-volatile memory. The effects of the transaction, thus, are never lost.

The **ACID** properties, in totality, provide a mechanism to ensure correctness and consistency of a database in a way such that each transaction is a group of operations that acts a single unit, produces consistent results, acts in isolation from other operations and updates that it makes are durably stored.

Conclusion

It is really important for database to have the ACID properties to perform Atomicity, Consistency, Isolation and Durability in transactions. It ensures all data in scientific research and business field to be a correct and valid state use, without them, database will be in a mess.