ACID database design

ACID, Defined

Each of the four ACID attributes follows well-defined standards:

Atomicity states that database modifications must follow an all-or-nothing rule. Each transaction is said to be atomic. If one part of the transaction fails, the entire transaction fails. It is critical that the database management system maintains the atomic nature of transactions in spite of any DBMS, operating system, or hardware failure.

Consistency states that only valid data will be written to the database. If a transaction is executed that violates the database's consistency rules, the entire transaction is rolled back, and the database is restored to a state consistent with those rules. On the other hand, if a transaction successfully executes, it takes the database from one state that is consistent with the rules to another state that is also consistent with the rules.

Isolation requires that multiple transactions occurring at the same time not impact each other's execution. For example, if Joe issues a transaction against a database at the same time that Mary issues a different transaction, both transactions should operate on the database in an isolated manner. The database should either perform Joe's transaction before executing Mary's or vice-versa. This prevents Joe's transaction from reading intermediate data produced as a side effect of part of Mary's transaction that will not eventually be committed to the database. The isolation property does not ensure which transaction executes first—only that transactions will not interfere with each other.

Durability ensures that any transaction committed to the database is not lost. Durability is ensured by using database backups and transaction logs that facilitate the restoration of committed transactions despite any subsequent software or hardware failures.