**28. Write a short essay talking about your understanding of transactions, locks and isolation levels.**

A **transaction** is a series of instructions, such as some DML, DDL operations. One transaction has two dynamic ones, one is COMMIT and the other is ROLLBACK. If a transaction is executed without errors, any changes made by this transaction will be stored permanently in the database. If errors occur while committing a transaction, it will automatically roll back to the beginning of the transaction. So these changes are not saved. A reliable database should follow a principle called ACID that works directly on transactions. ACID stands for atomicity, consistency, isolation and durability. Atomicity means that one transaction can fail or succeed. No transaction is executed. Consistency of data integrity is necessary for every transaction. Isolation means that two transactions cannot affect each other. This principle is determined by the insulation level. Durability includes that change becomes permanent in the database every transaction if a transaction becomes successful.

**Isolation** levels are designed to solve those concurrency problems above. There are four isolation levels, and they are read uncommitted, read committed, repeatable read and serializable. Read uncommitted can only solve lost update. Compared to read uncommitted, read committed can solve more concurrency problems, including dirty read and non-repeatable read. Serializable can solve all these concurrency problems, too. From read uncommitted to serializable level, we will suffer less from concurrency effects but with a worse concurrency efficiency.

**Lock** is a strategy of database to implement these four isolation levels. There seven lock modes in SQL Server. They are shared lock, update lock, exclusive lock, intent lock, schema lock, bulk update lock and key-range lock. Shared locks allow multiple transactions to read a resource but not do modifications. Update locks is to avoid deadlock. Exclusive locks prevent any other transactions from accessing some data. Intent locks to protect placing a shared lock or exclusive lock on a resource lower in the lock hierarchy. Schema locks are used during DDL operation. Bulk update locks allow multiple threads to bulk load data concurrently into the same table while preventing other processes that are not bulk loading data from accessing the table. Key-range locks are used to protect the range of rows of table while setting serializable isolation level.