1. Try to answer the following questions about concurrency in database systems.

1) **What is concurrency?**
2) **Why concurrency?**
3) **What problems will concurrency bring?**
4) **What kind of concurrent execution is correct?**
5) **How to avoid problems caused by concurrency?**

2. Describe the necessity of the commit rule and the log ahead rule for updating transactions.

3. What is the basic idea of the locking protocol and how does it ensure that concurrent transactions are executed correctly? What are the problems that must be solved after the adoption of the locking protocol?

1. Try to answer the following questions about concurrency in database systems.

1) What is concurrency?

The DBMS can accept multiple transactions at the same time, and the transactions can overlap in time.

2) Why concurrency?

Purpose:

a. Improving system utilization & response time.

b. Different transaction may access to different parts of database.

3) What problems will concurrency bring?

Problem: Lost update; read dirty data; read value cannot be repeated

4) What kind of concurrent execution is correct?

Serializable.

5) How to avoid problems caused by concurrency?

Concurrency control methods such as locking method and time stamp method can be used

2. Describe the necessity of the commit rule and the log ahead rule for updating transactions.

The commit rule is to ensure that the A.I(after image) is written into the non-volatile memory before the transaction is committed, so that even if a failure occurs after the transaction enters the commit stage, the recorded A.I can still be used to redo and update, so as to ensure that the transaction meets the ACID principle.

The log ahead rule means that if the A.I is directly written to the database before the transaction is committed, the corresponding B.I(before image) must be written to the log before the transaction is committed, so that undo can be done when a failure occurs before the transaction enters the commit stage, and the execution of the transaction meets the ACID principle.

3. What is the basic idea of the locking protocol and how does it ensure that concurrent transactions are executed correctly? What are the problems that must be solved after the adoption of the locking protocol?

Before a concurrent transaction operates on the same data object, it sends a request to the system to lock the operation object. After the transaction's lock request is approved, it has certain control over the object. Before the transaction releases its lock, other transactions cannot obtain the lock request of the data object and operate on it, thus avoiding access conflict and ensuring the correct execution of concurrent transactions.

After adopting the locking protocol, there may be problems such as live lock and deadlock, among which the problem must be solved is the deadlock problem caused by the circular waiting between transactions.