COURSE: DATABASE MANAGEMENT SYSTEMS
TOPIC: INTRODUCTION TO TRANSACTION MANAGEMENT AND ISSUES

COURSE CODE : 23AD2102R

CO-3
SESSION - 1

SESSION OBJECTIVES

At the end of the session students will understand about

a) *The concept of Transaction*

b) Main Operations in a Transaction

c) Popular Examples of Transaction Processing

d) Transaction Processing Issues

TRANSACTION CONCEPT

- The transaction is a set of logically related operations that contains a group of tasks.
- A transaction is an action or series of actions.
- Normally a transaction is performed by a single user to perform operations for accessing the contents of the database.
- When a transaction is done on the database then the database will be updated.
- These days we will come across various Transactions in our day to day life.

TRANSACTION CONCEPT

- ***A successful transaction can change the database from one CONSISTENT STATE to another***

TRANSACTION CONCEPT

- For example, a transfer of funds from a checking account to a savings account looks like a ***single operation*** from the customer's standpoint, but within the database system, however, it consists of several operations.

- Usually, a transaction is initiated by a user program written in a high-level data-manipulation language (typically SQL), or programming language (for example, C++, or Java), with embedded database accesses in JDBC or ODBC.

OPERATIONS IN A BANKING TRANSACTION

1. Read your account balance
2. Deduct the amount from your balance
3. Write the remaining balance to your account
4. Read your friend's account balance
5. Add the amount to his account balance
6. Write the new updated balance to his account

Note :The above SIX operations are logically related and forms as a single unit that constitutes a Transaction.

TRANSACTION-EXAMPLE 1

- Suppose account A has a balance of Rs 1000 and wants to transfer Rs 800 from A's account to B's account, that has a balance, say 2000 . This small transaction contains several low-level tasks:

A's Account

1. *Open_Account(A)*
2. *Old_Balance = A.balance*
3. *New_Balance = Old_Balance - 800*
4. *A.balance = New_Balance*
5. *Close_Account(A)*

Note : Five Operations on A's Account

TRANSACTIONS-EXAMPLE I

- **B's Account**

- *Open_Account(B)*
- *Old_Balance = B.balance*
- *New_Balance = Old_Balance + 800*
- *B.balance = New_Balance*
- *Close_Account(B)*

- *Note: Here FIVE Operations on B's Account.*

IN DATABASE TERMINOLOGY, THE ABOVE OPERATIONS CAN BE SUMMARIZED AS :

T_i : read(A);

A := A − 800;

write(A);

read(B);

B := B + 800;

write(B).

commit

HOW TRANSACTION IS BEING DONE INSIDE THE COMPUTER ?

- In the previous example, initially the balance in the database for A's account is Rs 1000 and it is present in the database means it is present in the Hard Disk.
- Now to perform any arithmetic operation , first of all that A's account has to be read for the available balance. For that read(A) operation is used. Remember this read operation is being performed on the Hard Disk(Database)
- After read operation, to perform arithmetic operation of A=A-800, the data of Rs 1000 has to be brought into RAM memory.
- After getting Rs 1000 into RAM, then the CPU will start its execution i.e performs subtraction of Rs 800 from Rs 1000.

HOW TRANSACTION IS BEING DONE INSIDE THE COMPUTER ?

- Now , to perform the transfer(addition) of Rs 800 to B's account of Rs 2000, then this Rs 2000 of B has to be ***read*** and brought into RAM again.
- After getting Rs 2000 of B's balance into RAM, the CPU again starts performing the addition operation i.e B=B+800.
- Remember all these operations are being done only inside RAM memory, but not in the Database(Hard Disk).

- Now , to save these changes into the Database finally, we have to use ***commit*** operation.

MAIN TECHNICAL OPERATIONS USED TO PERFORM TRANSACTION

Transactions access data using two operations:

- ***read(A)*** which transfers the data item A from the database to a variable, also called A, in a buffer in main memory belonging to the transaction that executed the read operation.

- ***write(A)*** which transfers the value in the variable A in the main-memory buffer of the transaction

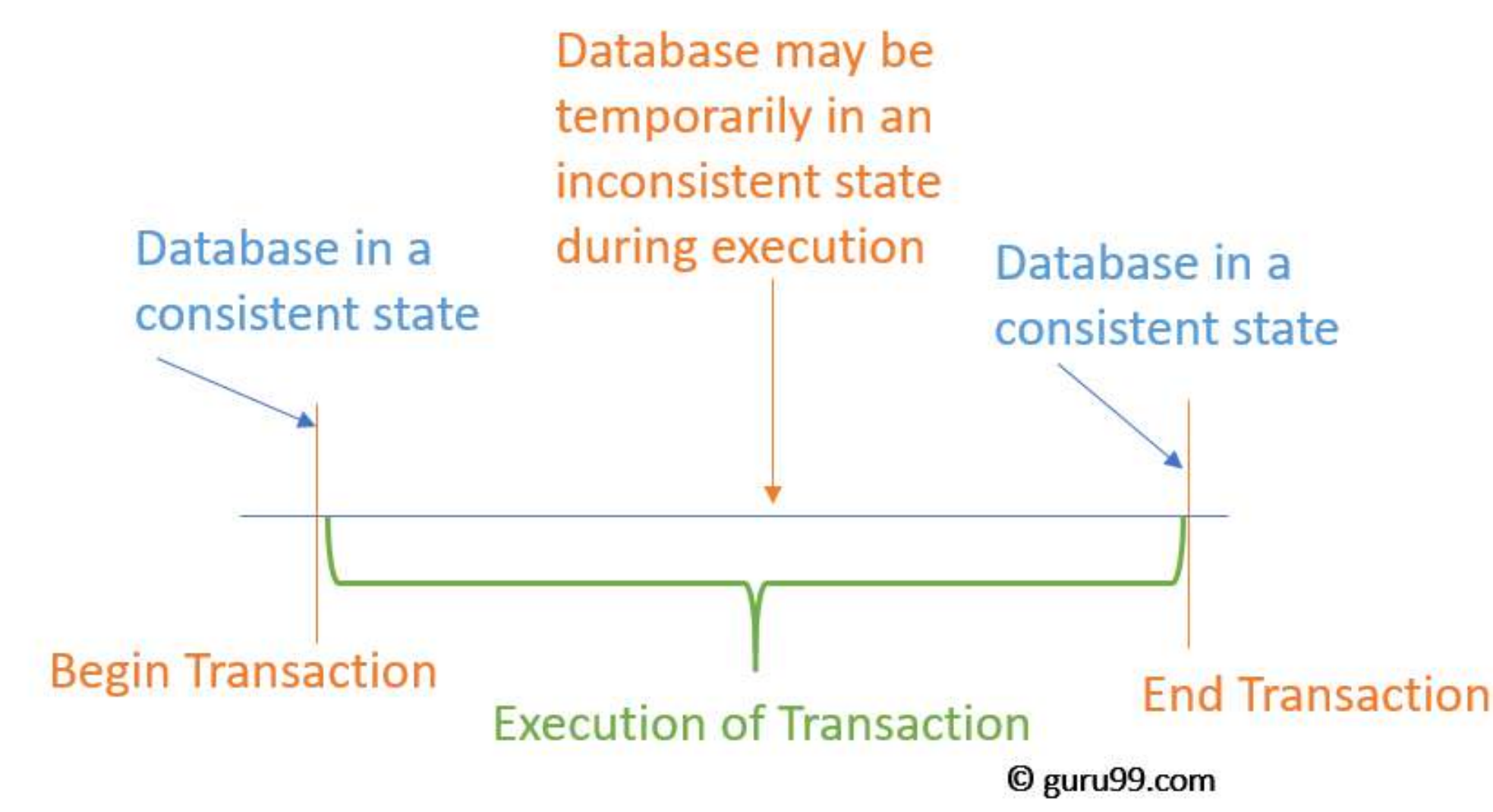
Apart from the above TWO, every transaction concludes with ***commit () operation*** to successfully save the updates

- Read operation means ***accessing the database*** and write operation means ***changing the data inside RAM***

DON'T CONFUSE……

- ***Operation is NOT a Transaction but Transaction is a set of logically related operations.***

TRANSACTION-TIMING DIAGRAM



TRANSACTION-EXAMPLE 2(E-COMMERCE)

Placing an Order in Flipkart/Amazon

- ***Transaction Start***
- ***Selecting the item/product***
- ***Selecting a Payment Method(Net Banking/Gpay/Pay Later etc.,)***
- ***If it is Net Banking, then Select the Bank***
- ***Enter the User ID & Password on that Bank Net Banking Portal***
- ***Approve the Amount***
- ***Enter the High Security Password***
- ***Check the amount Payment is Successful or not***
- ***Return to Merchant Website***
- ***Transaction Completed***

EXAMPLE 3-TRANSACTION TO BE PERFORMED TO WITHDRAW CASH FROM AN ATM

- Consider the following example for transaction operations as follows.

- ***Transaction Start.***
- ***Insert your ATM card.***
- ***Select language for your transaction.***
- ***Select Savings Account option.***
- ***Enter the amount you want to withdraw.***
- ***Enter your secret PIN.***
- ***Wait for some time for processing.***
- ***Collect your Cash.***
- ***Transaction Completed.***

POPULAR EXAMPLES OF TRANSACTION PROCESSING

- Automated Teller Machines(ATMs)
- Credit card authorizations
- Online bill payments
- Self-checkout stations at grocery stores
- Trading of stocks over the Internet and
- Various other forms of Electronic Commerce.

TRANSACTION PROCESSING ISSUES

Failure of Operations in the middle of a transaction.

- Can be due to power failure, system crash etc. This is a serious problem that can leave database in an inconsistent state.

- Assume that transaction fail after entering the PIN number in ATM , then the account statement shows that the amount is deducted from but we wont receive the cash from the machine outlet or our friend will not receive it. This is called as inconsistent database.

TRANSACTION PROCESSING ISSUES

- ***Ensuring Data Consistency before and after the transaction***

For example, for amount transfer transaction from Account A to Account B, then the total should be the same before and after the transaction.

- ***Handling Concurrent Transactions***

- ***Once a transaction completes successfully, the updates should be reflected permanently, even during power/network failures etc.,***

CONCURRENT EXECUTION OF TRANSACTIONS

- In a multi-user system, multiple users can access and use the same database at one time, which is known as the concurrent execution of the database.
- It means that the ***same database*** is executed simultaneously on a multi-user system by different users.
- While working on the database transactions, there occurs the requirement of using the database by multiple users for performing different operations, and in that case, concurrent execution of the database is performed.

CONCURRENT EXECUTION OF TRANSACTIONS

- The thing is that the simultaneous execution that is performed should be done in an interleaved manner, and no operation should affect the other executing operations, thus maintaining the consistency of the database.
- Thus, on making the concurrent execution of the transaction operations, there occur several challenging problems that need to be solved

CONCURRENT EXECUTION OF TRANSACTIONS

- In a database transaction, the two main operations are ***READ*** and ***WRITE*** operations.
- So, there is a need to manage these two operations in the concurrent execution of the transactions as if these operations are not performed in an interleaved manner, and the data may become inconsistent

SUMMARY

- Collections of operations that form a single logical unit of work
- The transaction is a set of logically related operation. It contains a group of tasks.
- A transaction is an action or series of actions.
- A transaction is performed by a single user to perform operations for accessing the contents of the database.
- Every Transaction starts with ***read ( )*** operation and ends with ***write( )*** Operation, followed by ***commit*** operation.
- Transaction processing is designed to maintain database integrity (the consistency of related data items) in a known, consistent state.

SELF-ASSESSMENT QUESTIONS

1. The fields on which clustering index is defined are of type_____

(a) Key and non-ordering
(b) Non-key and ordering
(c) Key and ordering
(d) Non-key and non-ordering

2. If a block can hold either 3 records or 10 key pointers and a database contains "n" records, then how many blocks do we need to hold the data file and the dense index?

(a) 13n/30
(b) N/10
(c) N/30
(d) N/3

TERMINAL QUESTIONS

1. What is an index in a database and what is its purpose?
2. What are the common types of index structures used in database management systems? Describe the advantages and disadvantages of each.
3. How does a B-tree index work and what are its properties? How is it different from other index structures?
4. Explain the concept of clustering and non-clustering indexes.What are the differences between these two types of indexes and when would you use each one?

REFERENCES FOR FURTHER LEARNING OF THE SESSION

Reference Books:

1. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke - This book covers the basics of database management systems, including the concept of index structures.
2. "Database Systems: Design, Implementation, and Management" by Carlos Coronel, Steven Morris, and Peter Rob - This book provides a comprehensive introduction to database systems, including index structures and their importance in optimizing database performance.
3. "Database Indexing: A Practical Guide for Developers" by Will Iverson - This book focuses specifically on the concept of indexing in database management systems, providing practical advice and examples for developers.

Sites and Web links:

1. https://docs.microsoft.com/en-us/sql/relational-databases/indexes/indexes?view=sql-server-ver15
2. https://dev.mysql.com/doc/refman/8.0/en/mysql-indexes.html
3. https://www.postgresql.org/docs/current/indexes.html

THANK YOU

Team – DBMS