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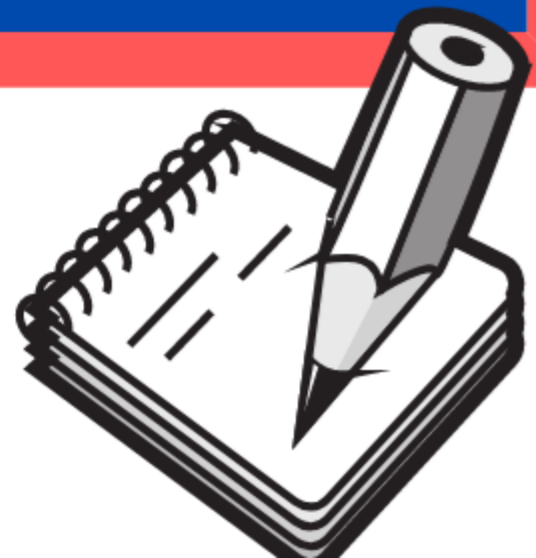

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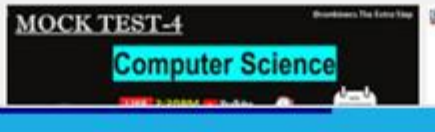

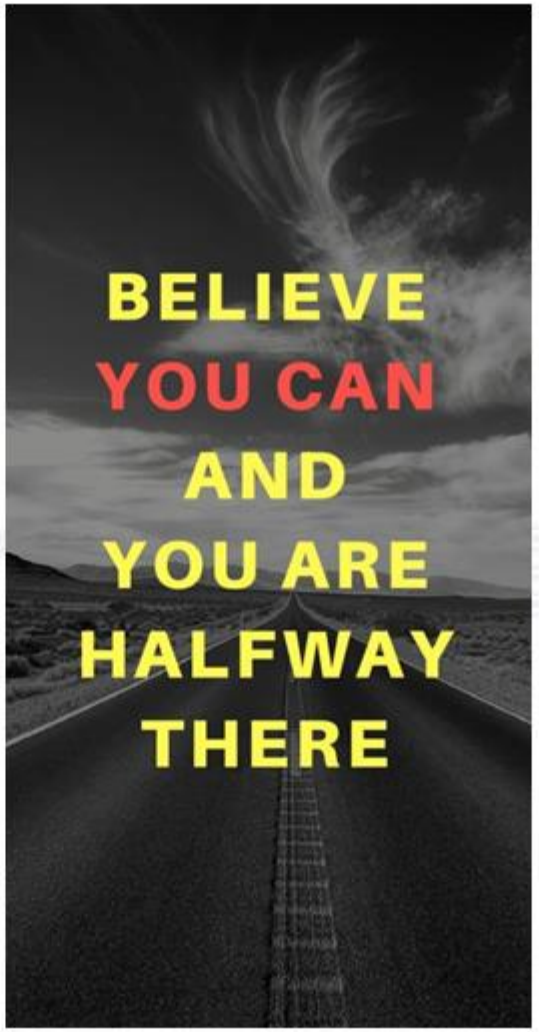

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The Extra...

External Level

Conceptual Level

Physical Level

Logical Data Independence

Physical Data Independence

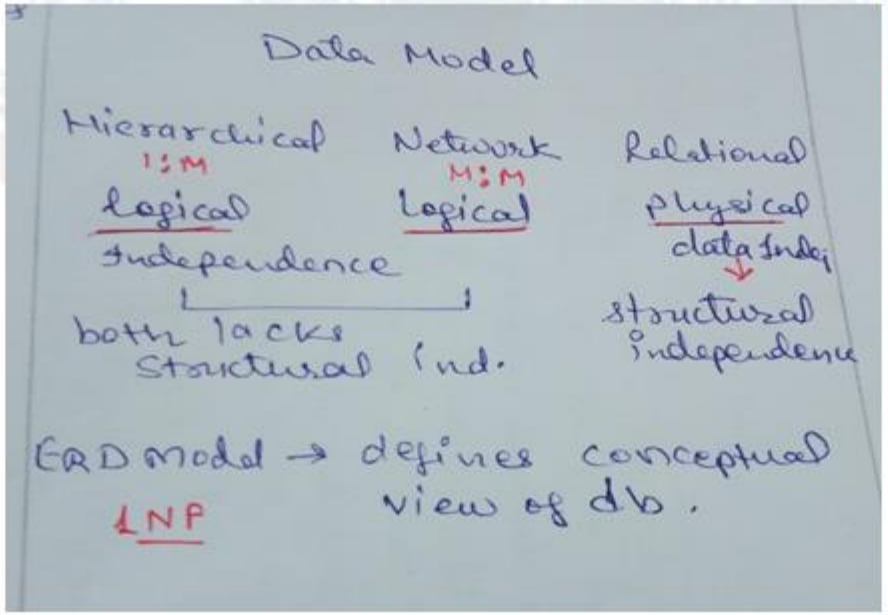
The DBMS (or Database Management System) is a kind of system software used for several operations such as creating tables/databases, storing data, managing databases. It also allows modifying the data stored in the database as well.

A table is known as the relation in the SQL, consist of rows & columns

rows are called the tuples/Entity

the numbers of columns are known as the attributes/Domain/Arity/Fields

cardinality represents the number of tuples (rows) in a relation (table).



Q) Which of the following refers to the level of data abstraction that describes exactly how the data actually stored?

a) Conceptual Level

b) Physical Level

c) File Level

d) Logical Level

Q4) Which of the following refers to the level of data abstraction that describes exactly how the data actually stored?

a) Conceptual Level (WHAT)

b) Physical Level (HOW)

c) File Level

d) Logical Level

- ERD
- Normalization
- Keys – Primary, Unique, Candidate, Alternate, Super key
- Constraint – Referential Integrity, Data Integrity
- FD
- Finding Minimal Cover
- Dependency Preserving
- Lossless Join

Primary Key: There can be more than one candidate key in relation out of which one can be chosen as the primary key.

Alternate Key: The candidate key other than the primary key is called an alternate key.

- **Candidate Key: The minimal set of attribute which can uniquely identify a tuple is known as candidate key. For Example, STUD_NO in STUDENT relation.**
- **The value of Candidate Key is unique and non-null for every tuple.**
- **There can be more than one candidate key in a relation. For Example, STUD_NO is candidate key for relation STUDENT.**
- **The candidate key can be simple (having only one attribute) or composite as well. For Example, {STUD_NO, COURSE_NO} is a composite candidate key for relation STUDENT_COURSE.**

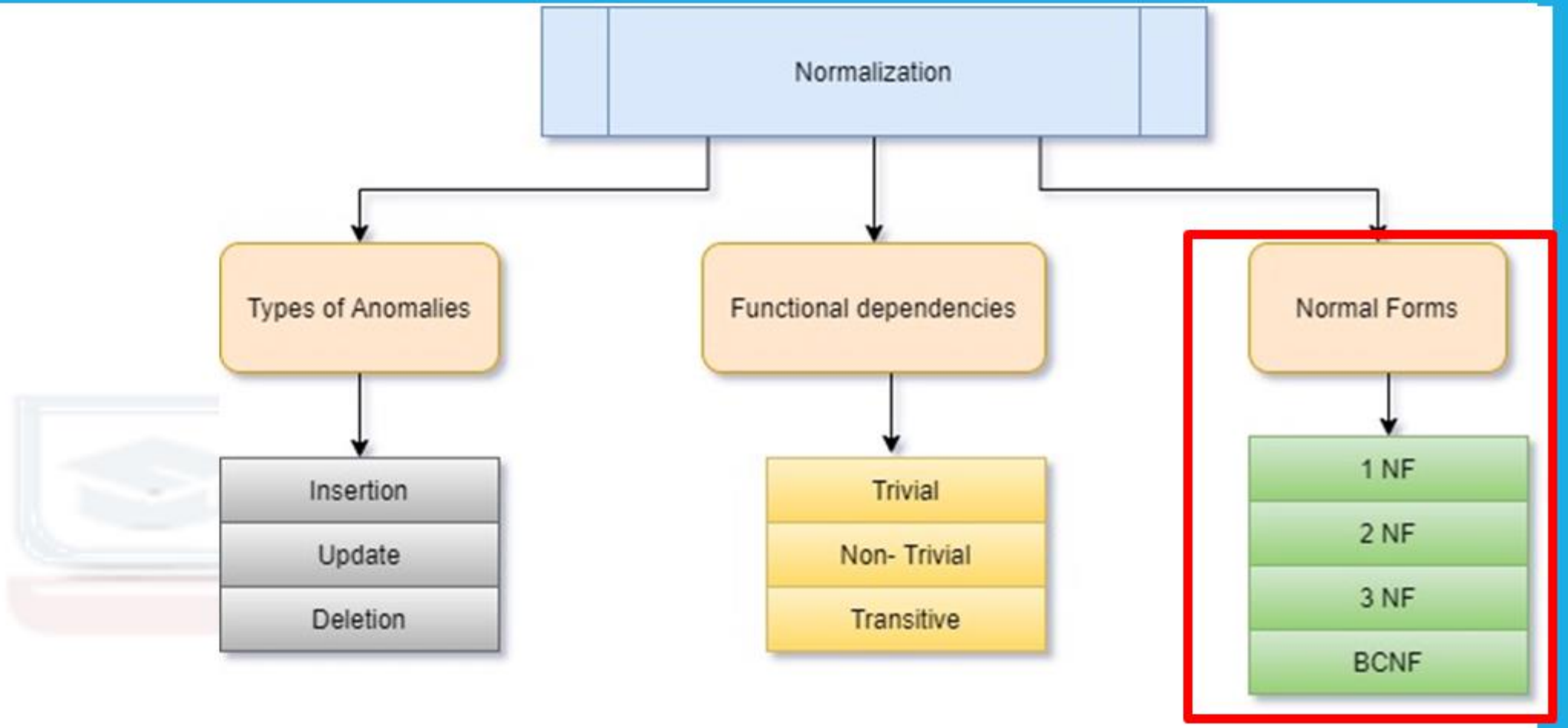
Super Key: The set of attributes which can uniquely identify a tuple is known as Super Key. For Example, STUD_NO, (STUD_NO, STUD_NAME) etc.

- Adding zero or more attributes to candidate key generates super key.
- A candidate key is a super key but vice versa is not true.

Data Integrity

There are the following categories of data integrity exist with each RDBMS:

1. **Entity integrity**: It specifies that there should be no duplicate rows in a table.
2. **Domain integrity**: It enforces valid entries for a given column by restricting the type, the format, or the range of values.
3. **Referential integrity**: It specifies that rows cannot be deleted, which are used by other records.
4. **User-defined integrity**: It enforces some specific business rules that are defined by users. These rules are different from entity, domain or referential integrity.



Finding Normal Forms

1. Types of Keys in Relational Model (Candidate, Super, Primary, Alternate and Foreign)
2. Finding Closure
3. Finding Candidate Key
4. Finding Prime & Non-prime attribute
5. Find Highest Normal Form (BCNF, 3NF, 2NF, 1NF)

Q) R(A,B,C,D,E)

BC -> D

AC -> BE

B -> E

Find Highest Normal Form: CK = {AC}

Q) R(A,B,C,D,E)

BC -> D

AC -> BE

B -> E

Find Highest Normal Form: CK = {AC}

2NF

Q3) R(A,B,C,D,E)

A -> BCD

BC -> DE

B -> D

D -> A

Find Highest Normal Form : CK = {AF, BF, DF}

Q3) R(A,B,C,D,E)

A -> BCD

BC -> DE

B -> D

D -> A

Find Highest Normal Form : CK = {AF, BF, DF}

1NF

1NF –
singled valued attribute/atomic
No multivalue attribute
No composite attribute

2NF –
No Partial Dependency

3NF –
No transitive dependency
A -> B
A must be super key or else
B must be Prime Attribute

BCNF –
X -> Y
X must be Super key

4NF – Multivalued attribute
5NF – Join Dependency

- A canonical cover of a set of functional dependencies F is a simplified set of functional dependencies that has the same closure as the original set F.
- **Important definitions:**

✓Remove redundant FDs or Remove trivial dependency

✓Remove Extraneous attributes

✓Union Simplification

Properties of a transaction

a) Atomicity : All or nothing rule
b) Consistency: before or after
c) Isolation : No interference
d) Durable : permanent

Atomicity two operations

1. Abort: If a transaction aborts, changes made to database are not visible.
2. Commit: If a transaction commits, changes made are visible.

Consistency

- ✓ It refers to the correctness of a database
- ✓ integrity constraints must be maintained

What is Transaction?

A set of logically related operations is known as transaction. The **main operations** of a transaction are:

a) **Read(A):** Read operations Read(A) or R(A) reads the value of A from the database and stores it in a buffer in main memory.

b) **Write (A):** Write operation Write(A) or W(A) writes the value back to the database from buffer.

c) **Commit:** After all instructions of a transaction are successfully executed, the changes made by transaction are made permanent in the database.

d) **Rollback:** If a transaction is not able to execute all operations successfully, all the changes made by transaction are undone.

Q) Which of the following scenarios may lead to an irrecoverable error in a database system ?

A. A transaction writes a data item after it is read by an uncommitted transaction

B. A transaction reads a data item after it is read by an uncommitted transaction

C. A transaction reads a data item after it is written by a committed transaction

D. A transaction reads a data item after it is written by an uncommitted transaction

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C. A transaction reads a data item after it is written by a committed transaction

D. A transaction reads a data item after it is written by an uncommitted transaction

What is a Schedule?

A schedule is a series of operations from one or more transactions.

A schedule can be of two types:

Serial Schedule: When one transaction completely executes before starting another transaction, the schedule is called serial schedule.

Properties :-

1. always consistent
2. low throughput and
3. less resource utilization

Concurrent Schedule: When operations of a transaction are interleaved with operations of other transactions of a schedule, the schedule is called Concurrent schedule.

Properties :-

1. lead to inconsistency in the database
2. High throughput and
3. high resource utilization

Serializable is of two types:

a) Conflict Serializable:

A schedule is called conflict serializable if it can be transformed into a serial schedule by swapping non-conflicting operations. Two operations are said to be conflicting if all conditions satisfy:

- ✓ They belong to different transactions
- ✓ They operate on the same data item
- ✓ At Least one of them is a write operation

b) View Serializable:

A conflict schedule is a view serializable but if the serializability contains blind writes, then the view serializable does not conflict serializable.

Gate PYQ

Q) Consider the following schedules involving two transactions. Which one of the following statement is true?

S1: $R_1(X)$ $R_1(Y)$ $R_2(X)$ $R_2(Y)$ $W_2(Y)$ $W_1(X)$
S2: $R_1(X)$ $R_2(X)$ $R_2(Y)$ $W_2(Y)$ $R_1(Y)$ $W_1(X)$

a) Both S1 and S2 are conflict serializable

b) Only S1 is conflict serializable

c) Only S2 is conflict serializable

d) None

Gate PYQ

Q) Consider the following schedules involving two transactions. Which one of the following statement is true?

S1: $R_1(X)$ $R_1(Y)$ $R_2(X)$ $R_2(Y)$ $W_2(Y)$ $W_1(X)$
S2: $R_1(X)$ $R_2(X)$ $R_2(Y)$ $W_2(Y)$ $R_1(Y)$ $W_1(X)$

a) Both S1 and S2 are conflict serializable

b) Only S1 is conflict serializable

c) Only S2 is conflict serializable

d) None

Check for Cycle
If cycle present then
NOT CS

Q) Which one of the schedules below is the correct serialization of the above? GATE 2010

A	T1->>T3->>T2
B	T2->>T1->>T3
C	T2->>T3->>T1
D	T3->>T1->>T2

T1	T2	T3
Read (X)		
	Read (Y)	
		Read (Y)
	Write (Y)	
Write (X)		
		Write (X)
	Read (X)	
	Write (X)	

Q) Which one of the schedules below is the correct serialization of the above? GATE 2010

A	T1->>T3->>T2
B	T2->>T1->>T3
C	T2->>T3->>T1
D	T3->>T1->>T2

T1	T2	T3
Read (X)		
	Read (Y)	
		Read (Y)
	Write (Y)	
Write (X)		
		Write (X)
	Read (X)	
	Write (X)	

Is it possible to have partially executed program: **Yes**

Is it possible to have partially executed instruction: **No**

Which component to dbms ensures:-

a) Atomicity : Transaction management Protocol
b) Consistency: programmer
c) Isolation : Concurrency Control techniques
d) Durable : Recovery management Techniques

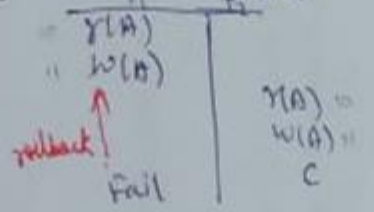
Committed transaction can be rollbacked: **No**

Lock Based Concurrency Control Protocol in DBMS

- Concurrency control techniques are used to ensure that the *Isolation* (or non-interference) property of concurrently executing transactions is maintained.
- What is a Recoverable Schedule?
- What are Cascading Rollbacks and Cascadeless schedules?
- Determining if a schedule is Conflict Serializable.

- Different categories of protocols:
- **Lock Based Protocol**
  - Basic 2-PL
  - Conservative 2-PL
  - Strict 2-PL
  - Rigorous 2-PL
- **Graph Based Protocol**
- **Time-Stamp Ordering Protocol**
  - **Timestamp ordering**
  - **Thomas Write Rule**
- **Multiple Granularity Protocol**
- **Multi-version Protocol**

① Dirty Read | Uncommitted Read

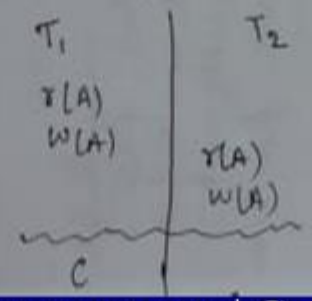


Dirty Read → reading uncommitted data.

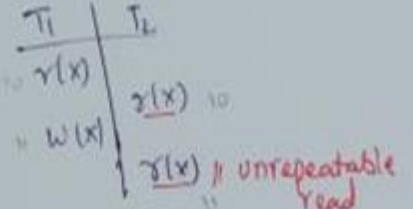
* It may cause problem but not always.

Case 1: T_2 transaction, Commits data & T_1 rollback → causes Dirty Read.

Resolve: T_2 Commit always after T_1

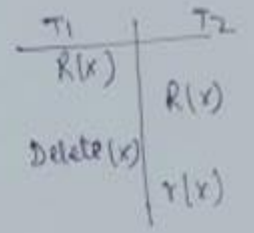


② Unrepeatable Read



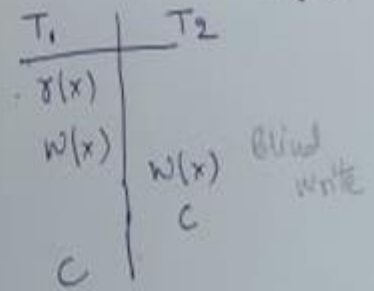
when we are reading two different values of read

③ Phantom Read



Variable (x) is deleted by T_1 transaction, every transa-n is running in isolati- So, T_2 transaction was expecting to read value o (x), But variable doesn't exist in database.

④ lost Update (Write-Write) conflict



A transaction isolation level is defined as:-

1. **Dirty Read (uncommitted read problem)** – A Dirty read is the situation when a transaction reads a data that has not yet been committed.
2. **Non Repeatable read (Unrepeatable Read problem)** – Non Repeatable read occurs when a transaction reads same row twice, and get a different value each time.
3. **Phantom Read** – A transaction t1 deletes a data item, while other transaction t2 was reading / writing on same data item. After deleting lets say variable x, for t2 it will arise undefined variable x error.
4. **Lost Update Problem (write-write conflict)** – Blind writing a data item, if any transaction fails it will rollback, but on another transaction it will cause a problem.

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Summary

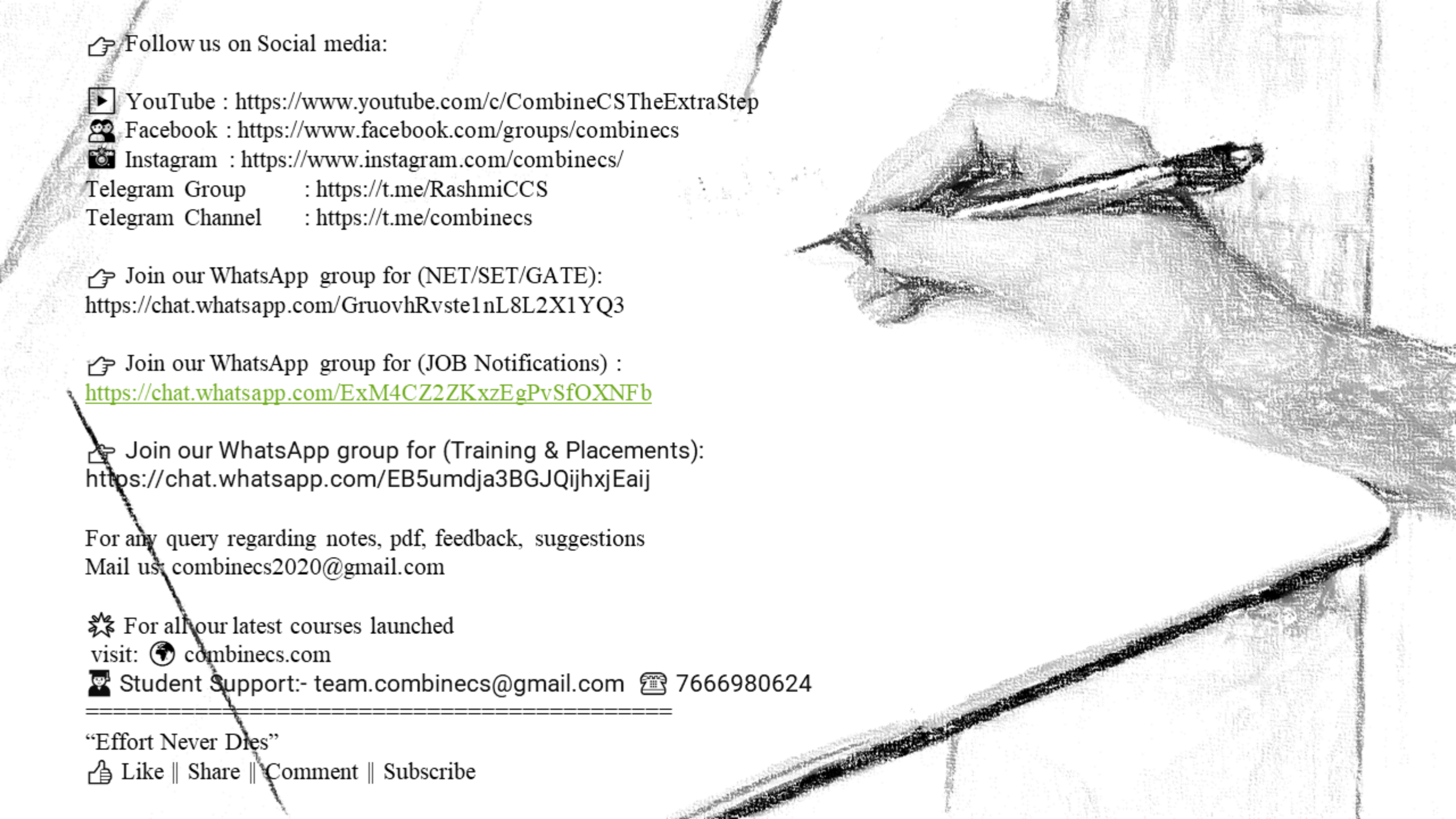
1. Shared-Exclusive lock
2. 2 Phase lock → Serializable achieve
3. strict 2PL → acquire all Exclusive locks → Cascadeless " } exclusive
4. Rigorous 2PL → acquire all Share (R) / Exclusive (W) lock → Recoverable " } share/exclusive
5. Conservative 2PL → No Deadlock
   ↳ acquire all locks at beginning.
6. Timestamp → ensure Serializability
   ensure ↳ deadlock

DDL (Data Definition Language) which deals with database schemas and descriptions, of how the data should reside in the database.

1. CREATE: to create a database and its objects like (table, index, views, store procedure, function, and triggers)
2. ALTER: alters the structure of the existing database
3. DROP: delete objects from the database
4. TRUNCATE: remove all records from a table, including all spaces allocated for the records are removed
5. COMMENT: add comments to the data dictionary
6. RENAME: rename an object

DML (Data Manipulation Language) which deals with data manipulation and includes most common SQL statements such SELECT, INSERT, UPDATE, DELETE, etc., and it is used to store, modify, retrieve, delete and update data in a database.

1. SELECT: retrieve data from a database
2. INSERT: insert data into a table
3. UPDATE: updates existing data within a table
4. DELETE: Delete all records from a database table
5. MERGE: UPSERT operation (insert or update)
6. CALL: call a PL/SQL or Java subprogram
7. EXPLAIN PLAN: interpretation of the data access path
8. LOCK TABLE: concurrency Control



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