Class Test — 01

1. (i) Data integrity problem

In traditional file system there is no mechanism to ensure or apply consistency constraints on data. So, enforcing rules such as valid values, unique identifiers, or correct relationship among data items becomes very hard. For example, salary of an employee can't be negative but there is no built-in mechanism to prevent automatic entering negative value or any automatic checking system. to enforce this rule. This is how traditional file system causes data integrity problem.

(ii) Atomicity problem

Atomicity means "all or none". In traditional file system it is difficult to ensure that operations are completed fully or not. Since, any system is subject to failure, restoring data to a consistent state after a crash becomes challenging.

For example, In a fund transfer money may be deducted from one account but not credited to another if the system fails midway, leaving data inconsistent and the transfer process being not atomic.

A = 1000	B = 500
Transfer 500 from account A to B	
A = 1000 − 500 = 500	B = 500
Failure	
Debited	Not credited

(iii) Concurrent access anomalies

In DBMS, concurrency means that multiple users or transaction can access and work with the database at the same time.

In traditional file system, multiple users try to access and modify the data at the same time without any control. Since, the file system lacks mechanisms like concurrency control, simultaneous operations leads to inconsistent data.

For example, two users try to withdraw money from the same account at the same time, both might see the old balance and withdraw more than what is actually available.

2. Extended Entity Relationship features :

(1) Specialization :

This is a top-down approach where a general entity is divided into more specific entities based on certain attributes or relationships.

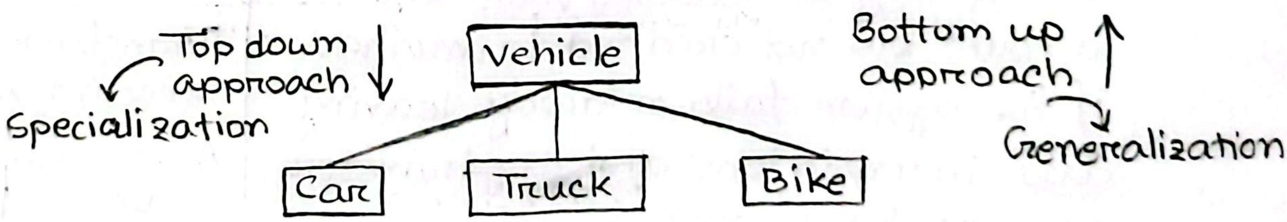


Fig: Specialization and Generalization

Follows the properties of inheritence meaning attributes of parent class are inherited by child classes.

(ii) Generalization:

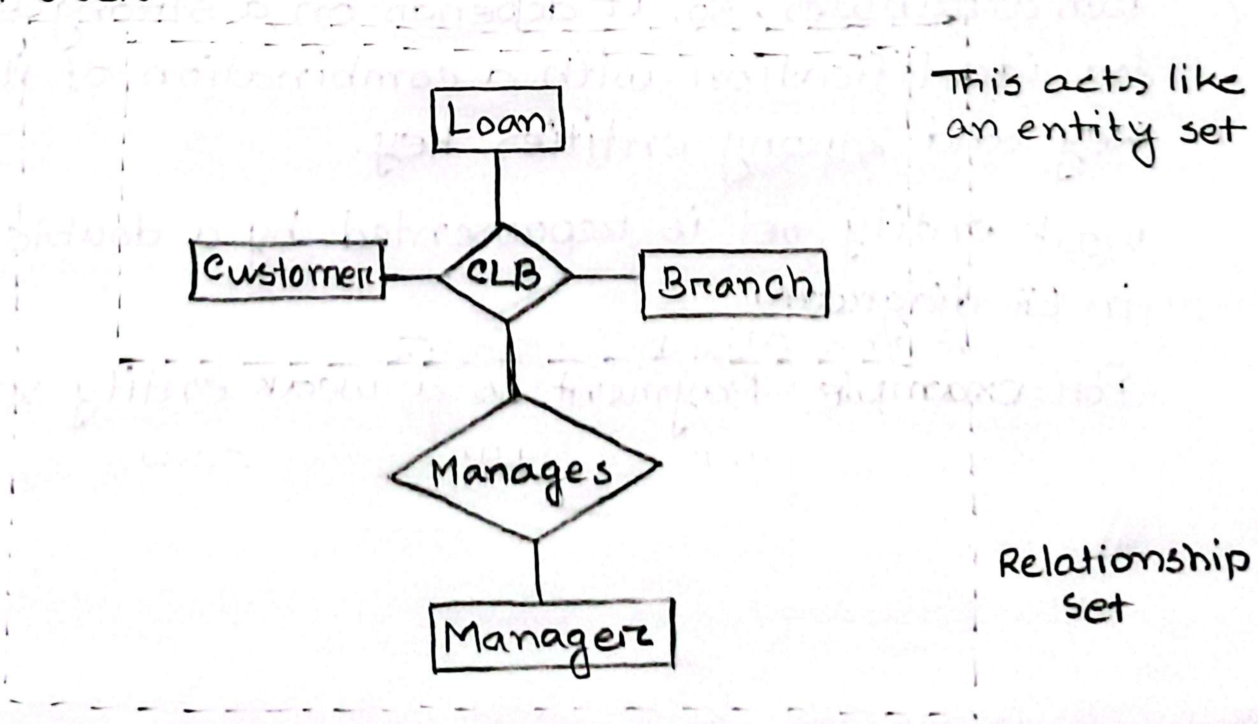
This is a bottom up approach where multiple specific entities are combined into a more general entity.

Generalization follows the property of abstraction some common attributes in child classes can be identified and be given to the parent class to reduce redundancy.

(iii) Aggregation:

In aggregation relationship is used as an entity set, creating a hierarchical structure in data modeling. It shows how a higher level entity is composed of lower level entities.

Aggregation also follows the property of abstraction, as multiple lower-level entities are combined into one higher-level entity, thereby abstracting complexity from user.

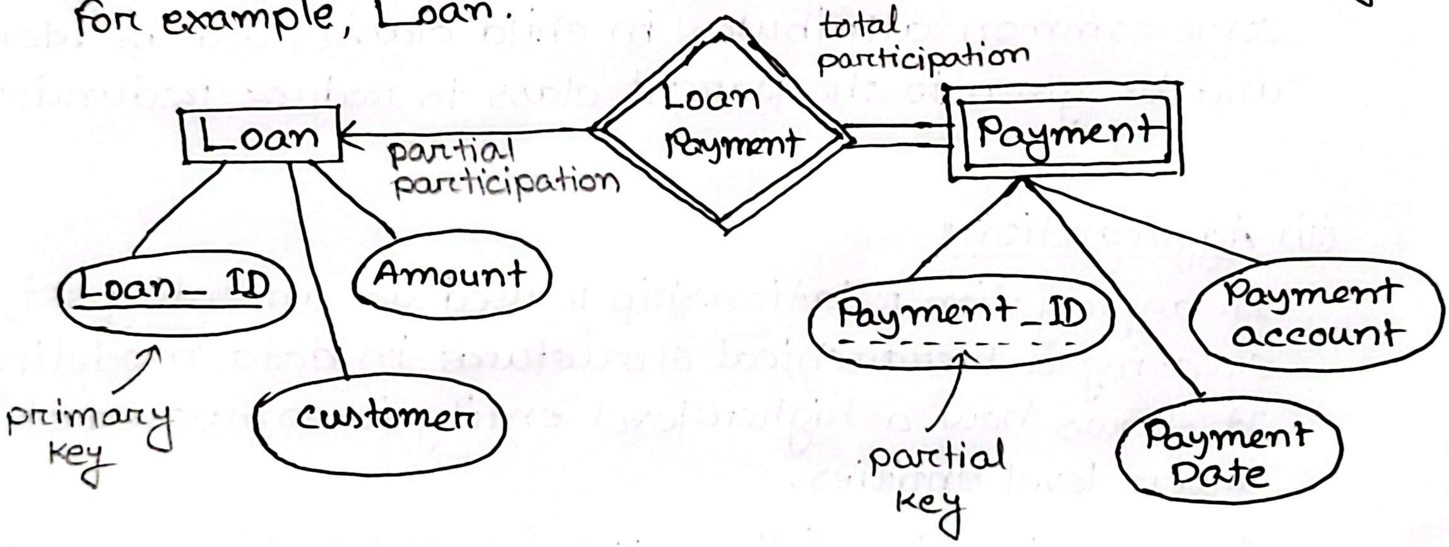


3. **Strong entity set**

An entity set that can be uniquely identified by its own attributes (called a primary key).

It is represented by a single rectangle in a ER diagram.

For example, Loan.



Weak entity set

Weak entity set can't be uniquely identified by its own attributes. So, it depends on a strong entity set for identification with a combination of its partial key and strong entities key.

Weak entity set is represented by a double rectangle in ER diagram.

For example, Payment is a weak entity set.

4. Total participation:

Total participation means every entity in the entity set must participate in a relationship.

It is represented by a double line between entity and relationship in an ER diagram.

For example, in the loan-payment system above payment must be assigned to a loan.

Partial Participation:

Partial participation means some entities in the entity set may or may not participate in a relationship.

It is represented by a single line in an ER diagram.

For example, Not every customer in a bank system has a loan. so, the participation of loan is partial.

5.

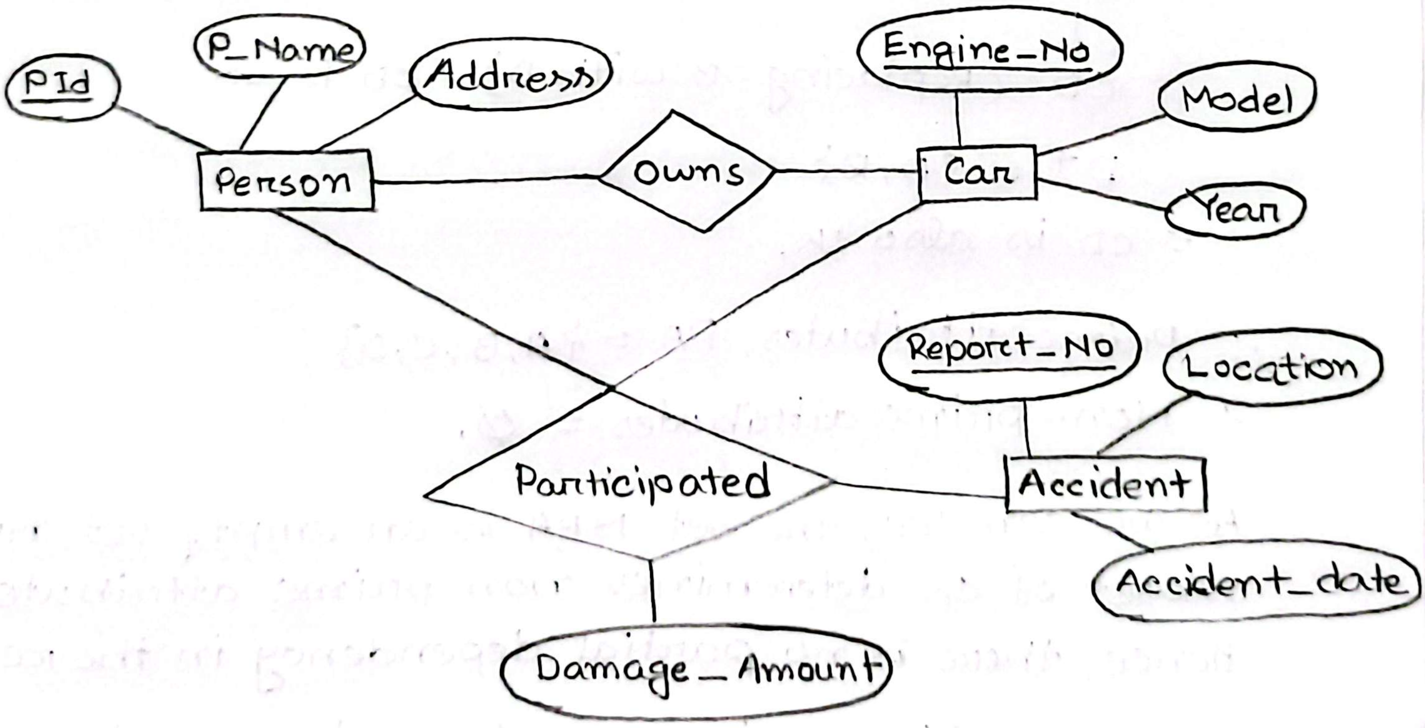


Fig: Complete ER Diagram of the highway police database.

Class Test – 02

1. Given relation, $R(A, B, C, D)$

and functional dependency, $FD = \{AB \rightarrow CD, C \rightarrow A, D \rightarrow B\}$

$AB \rightarrow C$
$AB \rightarrow D$

$AB\cancel{CD}^+ = \{A, B, C, D\}$

$AB^+ = \{A, B, C, D\}$

$\therefore$ AB is SK. (super key).

Now, $A^+ = \{A\}$

$B^+ = \{B\}$

So, AB is CK. (Candidate key)

$\downarrow$

CB (Replacing A with C). CB is SK.

$C^+ = \{C, A\}$

$\therefore$ CB is also CK.

$\downarrow$

CD (Replacing B with D). CD is SK.

$D^+ = \{D, B\}$

$\therefore$ CD is also CK.

$\therefore$ Prime attributes, $PA = \{A, B, C, D\}$

$\therefore$ Non-prime attributes $= \emptyset$.

As we can see, the set NPA is an empty set, no proper subset of CK determines non-prime attributes.
Hence, there is no partial dependency in the relation R.

$\therefore$ The relation is in 2NF (Second Normal Form).

[Proved]

CamScanner

2. Given Relation, R(A,B,C)

and functional dependency, FD = {A → B, B → C, C → A}

$AB\cancel{C}^+ = \{A, B, C\}$

$A^+ = \{A, B, C\}$

So, A is SK. and it is minimal so A is also CK.

Replacing A with B and then replacing B with C, we also get B and C as CK.

Hence, PA = {A, B, C}

NPA = ∅.

As we can see, for each non-trivial FD given above L.H.S of each of them is SK. Hence, the relationship is in Third Normal Form (3NF) as well as in Boyce-Codd Normal Form (BCNF).

[Proved]

3. Given Relation, R(A, B, C), R₁ (A, B), R₂ (A, C)

R

A	B	C
1	1	1
2	1	2
3	2	1
4	3	2

R_1

A	B
1	1
2	1
3	2
4	3

R_2

A	C
1	1
2	2
3	1
4	2

Lets do cross product $(R_1 \times R_2)$:

A	B	A	C
1	1	1	1
1	1	2	2
1	1	3	1
1	1	4	2
2	1	1	1
2	1	2	2
2	1	3	1
2	1	4	2
3	2	1	1
3	2	2	2
3	2	3	1
3	2	4	2
4	3	1	1
4	3	2	2
4	3	3	1
4	3	4	2

Now, we will do Natural join $(R_1 \bowtie R_2)$ that is we will only consider those tuples where $R_1 \cdot A = R_2 \cdot A$.

$R_1 \bowtie R_2$

A	B	C
1	1	1
2	1	2
3	2	1
4	3	2

As we can observe, $R_1 \bowtie R_2 \equiv R$. For this relation A is CK and is common in both relation; $R_1 \cup R_2 = R$ and $R_1 \cap R_2 \neq \phi$. Hence, the relation is a lossless joint dec.