UNIT-II
Chapter-1
Entity-Relationship Model

Q) Explain about Entity – Relationship diagram.

ER Model is a high-level data model. This model defines the data elements and relationships for a particular system. It is useful in developing a conceptual design for the database & is very simple and easy to design logical view of data.

Importance of ER Model

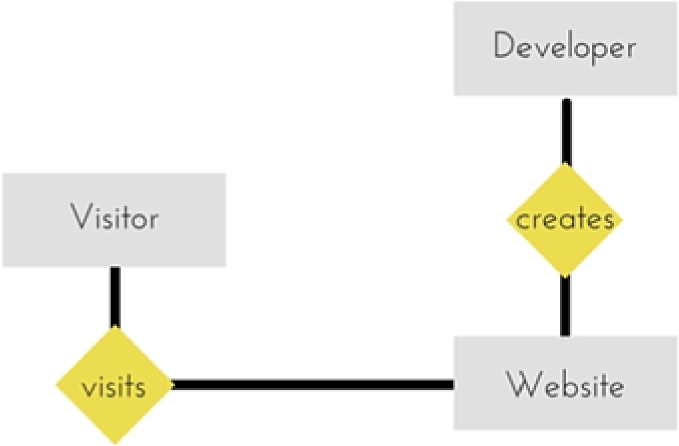
- ER Model is plain and simple for designing the structure.
- It saves time.
- Without ER diagrams you cannot make a database structure & write production code.
- It displays the clear picture of the database structure.

ER Diagrams

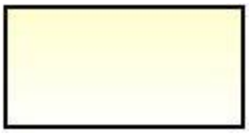
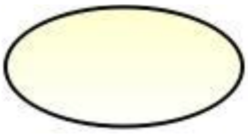
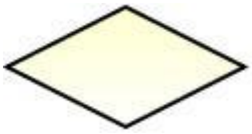
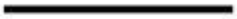
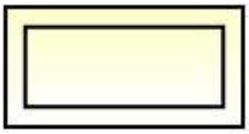
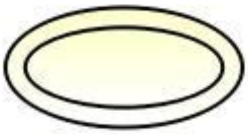
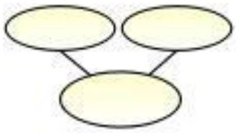
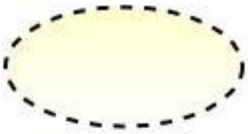
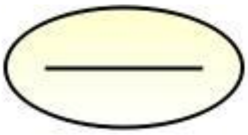
- ERD stands for Entity Relationship diagram.
- It is a graphical representation of an information system.
- ER diagram shows the relationship between objects, places, people, events etc. with in that system.
- It is a data modeling technique which helps in defining the business process.
- It used for solving the design problems.

E-R Diagram

ER-Diagram is a visual representation of data that describes how data is related to each other.



Following are the components of ER Diagram,

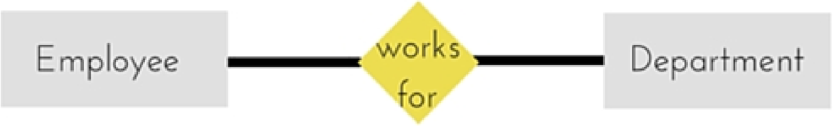
Notations	Representation	Description
	Rectangle	It represents the Entity.
	Ellipse	It represents the Attribute.
	Diamond	It represents the Relationship.
	Line	It represents the link between attribute and entity set to relationship set.
	Double Rectangle	It represents the weak entity.
	Multi valued Attribute	It represents multi valued attribute which can have many values for a particular entity. For eg. Mobile Number.
	Composite Attribute	It represents composite attribute which can be divided into subparts. For eg. Name can be divided into First Name and Last Name
	Derived Attribute	It represents the derived attribute which can be derived from the value of related attribute.
	Key Attribute	It represents key attribute of an entity which have a unique value in a table. For eg. Employee → EmpId (Employee Id is Unique).

E-R diagram mainly contains three components:

- **Entity**
- **Attribute**
- **Relationship**

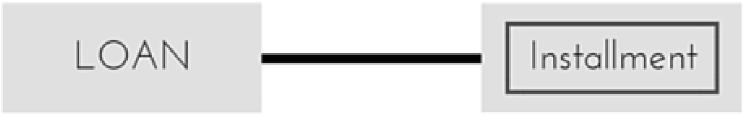
1) Entity(strong)

An Entity can be any object, place, person or class. In E-R Diagram, an entity is represented using rectangles. Consider an example of an Organization. Employee, Manager, Department, Product and many more can be taken as entities from an Organization.



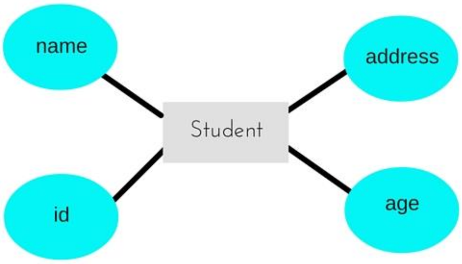
Weak Entity

Weak entity is an entity that depends on another entity. Weak entity doesn’t have key attribute of their own. Double rectangle represents weak entity.



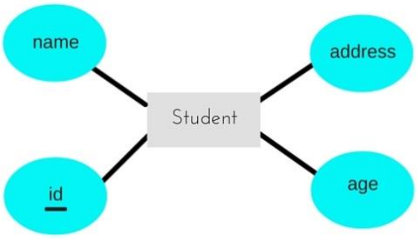
2) Attribute

An Attribute describes a property or characteristic of an entity. For example, Name, Age, Address etc can be attributes of a Student. An attribute is represented using eclipse.



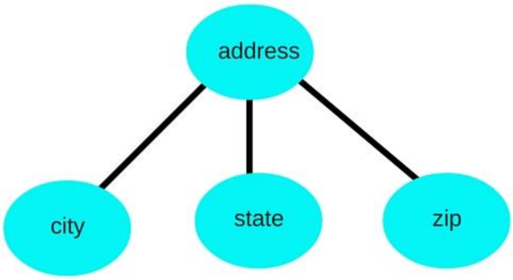
Key Attribute

Key attribute represents the main characteristic of an Entity. It is used to represent Primary key. Ellipse with underlying lines represent Key Attribute.



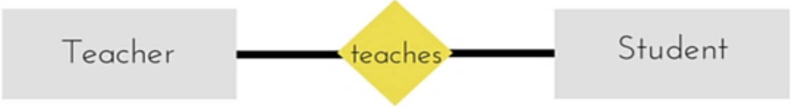
Composite Attribute

An attribute can also have their own attributes. These attributes are known as Composite attribute.



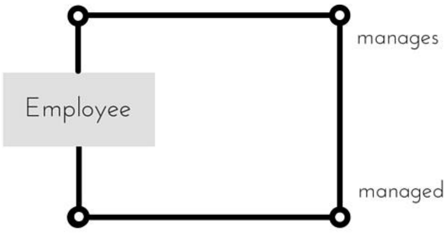
3) Relationship

A Relationship describes relations between entities. Relationship is represented using diamonds.



Recursive Relationship

When an Entity is related with itself it is known as Recursive Relationship.



Q) Explain about advantages and disadvantages of E-R model.

ER Models have some advantages and disadvantages. The advantages of ER Model are :

Advantages of ER Model:-

- Conceptually it is very simple
- Better visual representation
- Effective Communication Tool
- Easy conversion to any Data Model

Conceptually it is very simple –

Making the ER Diagram is a very easy process. You just know about the notations about various types of entities, their attributes and the relationships between these entities.

Better visual representation –

The E-R model gives graphical and diagrammatical representation of various entities, their attributes and relationships between entities. So, It helps in the clear understanding of the data structure and in minimizing redundancy and other problems.

Effective Communication Tool –

It is an effective communication tool among users, domain experts and database designers.

It is highly integrated with relational model, so converting ER Diagrams to tables is very simple.

Easy conversion to any Data Model –

Conversion of ER Diagram to any other data model like network model, hierarchical model and the relational model is very easy.

Disadvantages of ER Model

- Limited Constraints and Specifications – Example : minimum Cardinality
- Loss of Information Content.
- Limited Relationship Representation – (only Binary Relationship)
- No industry standard for notation – i.e. there is no industry standard notation for developing an E-R diagram.
- No representation of data manipulation

Q) What is an entity? Explain about types of entity.

Entity

An entity can be a real-world object that can be easily identifiable. For example, in a school database, students, teachers, classes, and courses offered can be considered as entities. All these entities have some attributes or properties that give them their identity.

Entities are represented with rectangles

Student
Teacher
Projects

Entity set:-

An entity set is a collection of similar types of entities. An entity set may contain entities with attribute sharing similar values.

For example:

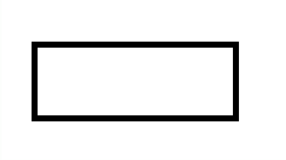
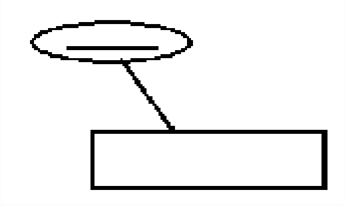
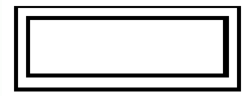
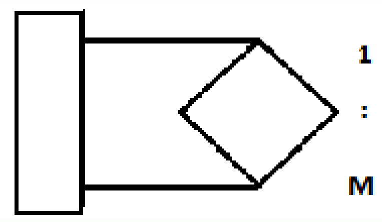
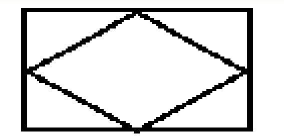
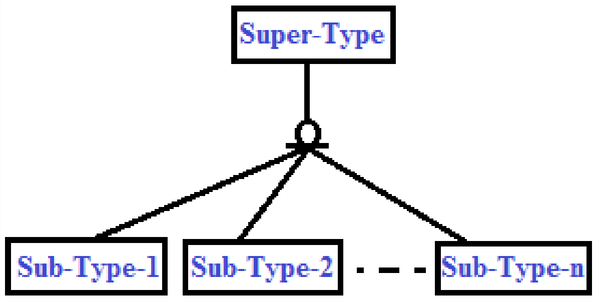
A Students set may contain all the students of a school; likewise a Teachers set may contain all the teachers of a school from all faculties. Entity sets need not be disjoint.

. Rectangles are named with the entity set they represent.

Types of Entity –

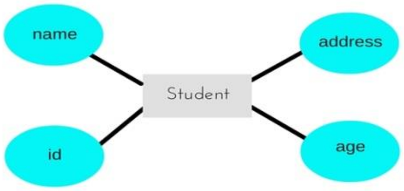
- Strong Entity Types
- Recursive Entity Types
- Weak Entity Types
- Composite Entity Types or Associative Entity Types
- SuperType and SubType Entities

Notations Of different Entity Type in ER Diagram :-

	Entity
	Strong Entity Type
	Weak Entity Type
	Recursive Entity Type
	Composite Entity Type (or) Associative Entity
	Subtypes and Super types

Q) What is an attribute? Explain it types?

An Attribute describes a property or characteristic of an entity. For example, Name, Age, Address etc can be attributes of a Student. An attribute is represented using eclipse.



Types of Attributes

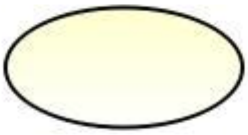
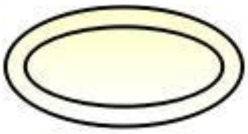
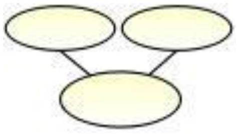
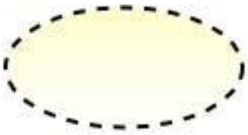
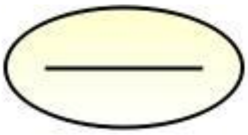
Simple attribute – Simple attributes are atomic values, which cannot be divided further. For example, a student's phone number is an atomic value of 10 digits.

Composite attribute – Composite attributes are made of more than one simple attribute. For example, a student's complete name may have first_name and last_name.

Derived attribute – Derived attributes are the attributes that do not exist in the physical database, but their values are derived from other attributes present in the database. For example, average_salary in a department should not be saved directly in the database, instead it can be derived. For another example, age can be derived from data_of_birth.

Multi-value attribute – Multi-value attributes may contain more than one values. For example, a person can have more than one phone number, email_address, etc.

Notations Of Attributes in ER Diagram

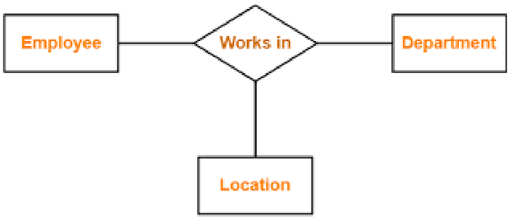
	Ellipse	It represents the Attribute.
	Multi valued Attribute	It represents multi valued attribute which can have many values for a particular entity. For eg. Mobile Number.
	Composite Attribute	It represents composite attribute which can be divided into subparts. For eg. Name can be divided into First Name and Last Name
	Derived Attribute	It represents the derived attribute which can be derived from the value of related attribute.
	Key Attribute	It represents key attribute of an entity which have a unique value in a table. For eg. Employee → EmpId (Employee Id is Unique).

Q) What is a relationship? Explain degree of relationship

Relationship:-

The association among entities is called a relationship. For example, an employee works in a department, a student enrolled in a course. Here, **Works in** and **Enrolled** are called relationships.

Ex:-

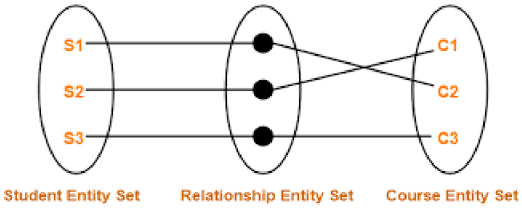


Ternary Relationship Set

Relationship Set

A set of relationships of similar type is called a relationship set

Ex:- no of students enrolled in a courses



Set Representation of ER Diagram

Degree of Relationship:-

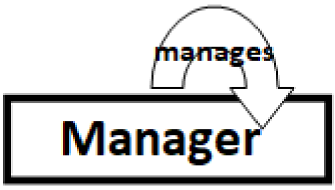
In the above example, the relation between College and Course is acting as an Entity in Relation with Student.

The number of participating entities in a relationship defines the degree of the relationship.

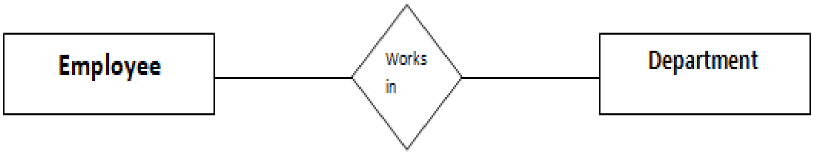
Unary	= degree 1
Binary	= degree 2
Ternary	= degree 3
Quaternary	=degree 4

Unary relationship:- The unary relationship is known as recursive relationship. An entity related with itself and also participated only one entity.

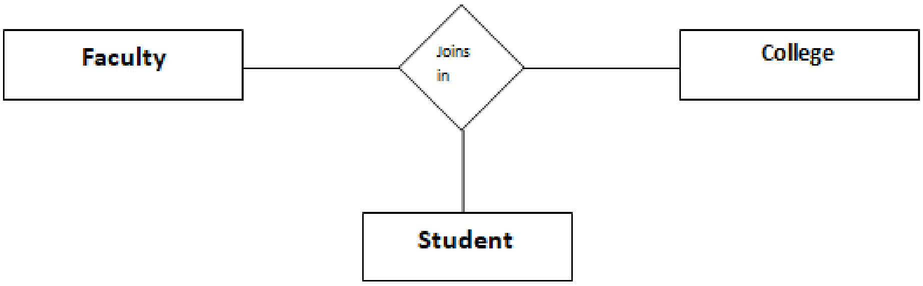
Consider an example:-Generally an employee managed by manager. a manager managed by him only. Then it is called recursive relationship.



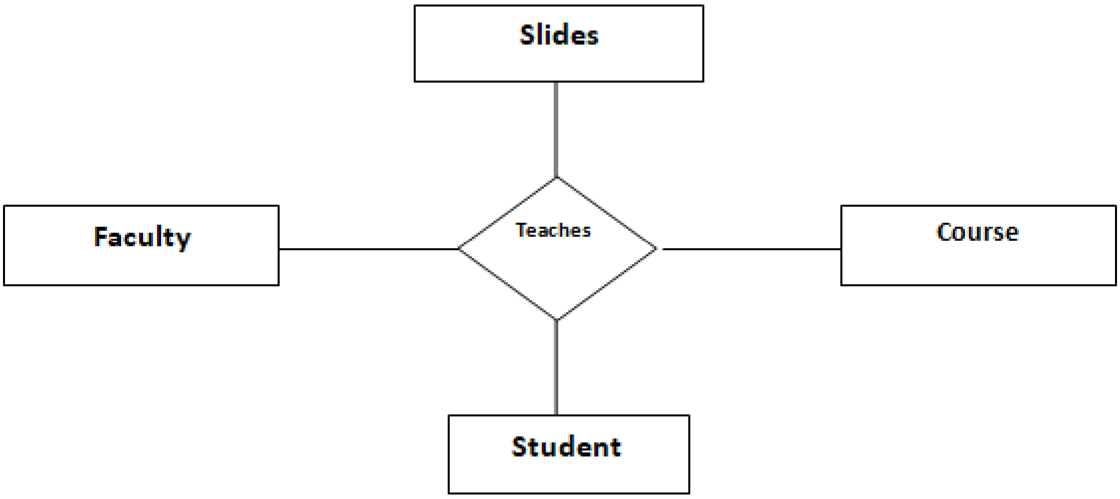
Binary relationship:- In a binary relationship, two entities are involved. Consider an example an employee works in particular department.



Ternary Relationship:- In a ternary relationship three entities are involved in a particular relationship. Consider an example:- student joins in the college and faculty is also joins in the college.



Quaternary Relationship:- In a quaternary relationships four entities are involved in the particular relationship. Consider an example of relationship is a **professor, slides, course and student in the teach relationship.**



Q) Explain about constraints in ER model?

Constraints are used for modeling limitations on the relations between entities.

There are two types of constraints on the Entity Relationship (ER) model –

1. **Mapping cardinality or cardinality ratio.**
2. **Participation constraints.**

1. Mapping Cardinality:-

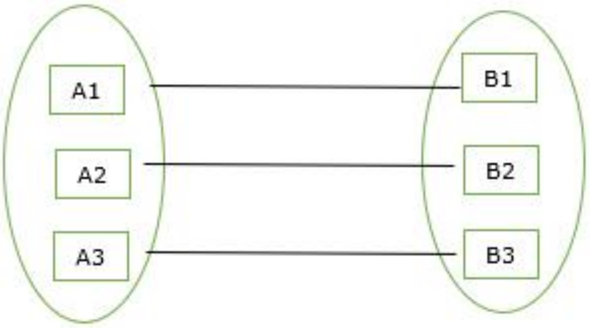
It is expressed as the number of entities to which another entity can be associated via a relationship set.

For the binary relationship set there are entity set A and B then the mapping cardinality can be one of the following –

- One-to-one
- One-to-many
- Many-to-one
- Many-to-many

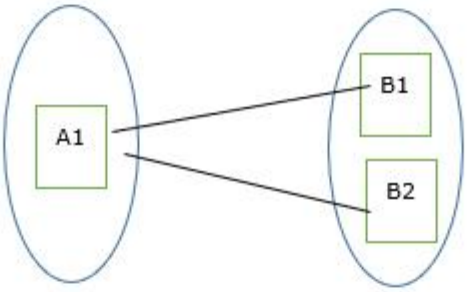
One-to-one relationship

An entity set A is associated with at most one entity in B and an entity in B is associated with at most one entity in A.



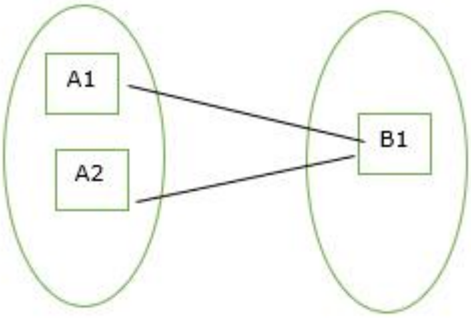
One-to-many relationship

An entity set A is associated with any number of entities in B with a possibility of zero and an entity in B is associated with at most one entity in A.



Many-to-one relationship

An entity set A is associated with at most one entity in B and an entity set in B can be associated with any number of entities in A with a possibility of zero.



Many-to-many relationship

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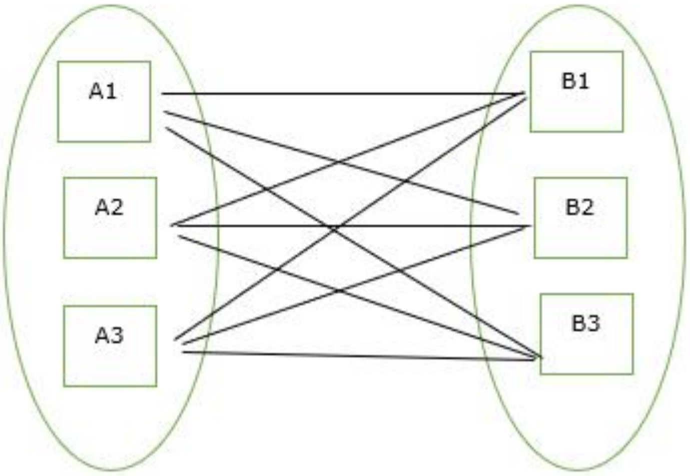
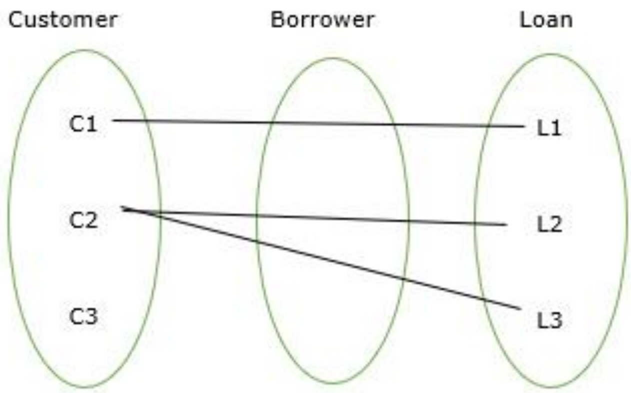


2. Participation Constraints

Participate constraints are two types as mentioned below −

- Total participation
- Partial Participation

The participation constraints are explained in the diagram below −



Here, the customer to Loan is partial participation and the loan to the customer is total participation.

Total participation

The participation of an entity set E in a relationship set R is said to be total if every entity in E Participates in at least one relationship in R.

For Example − Participation of loan in the relationship borrower is total participation.

Partial Participation

If only some of the entities in E participate in relationship R, then the participation of E in R is said to be partial participation.

For example − Participation of customers in the relationship borrower is partial participation.

Q) Explain about Enhanced Entity –Relational model (EER).

EER Model:-

EER is a high-level data model that provides the extensions to the original ER model.

The EER concepts are:-

- Sub Class and Super Class
- Specialization and Generalization
- Union or Category
- Aggregation

Features of EER Model:-

- EER creates a design more accurate to database schemas.
- It reflects the data properties and constraints more precisely.
- It includes all modeling concepts of the ER model.
- Diagrammatic technique helps for displaying the EER schema.
- It includes the concept of specialization and generalization.
- It is used to represent a collection of objects that is union of objects of different of different entity types.

1). Sub Class and Super Class

- Sub class and Super class relationship leads the concept of Inheritance.
- The relationship between sub class and super class is denoted with ⓓ symbol.

a. Super Class

- Super class is an entity type that has a relationship with one or more subtypes.
- An entity cannot exist in database simply by being member of any super class.
  For example: Shape super class is having sub classes as Square, Circle, Triangle.

b. Sub Class

- Sub class is a group of entities with unique attributes.
- Sub class inherits attributes from its super class.
  For example: Square, Circle, Triangle are the sub class of Shape super class.

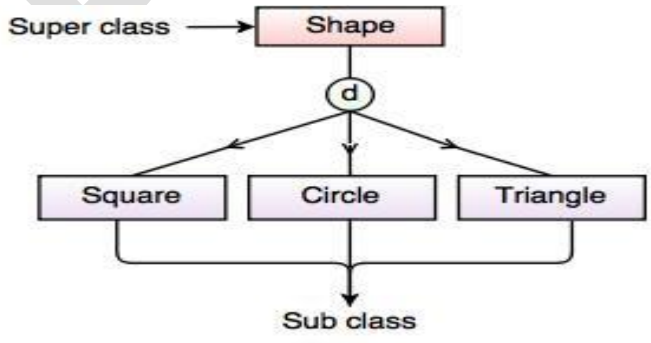


Fig. Super class/Sub class Relationship

2). Specialization and Generalization

a. Generalization

- Generalization is the process of generalizing the entities which contain the properties of all the generalized entities.
- It is a bottom approach, in which two lower level entities combine to form a higher level entity.
- Generalization is the reverse process of Specialization.
- It defines a general entity type from a set of specialized entity type.
- It minimizes the difference between the entities by identifying the common features.

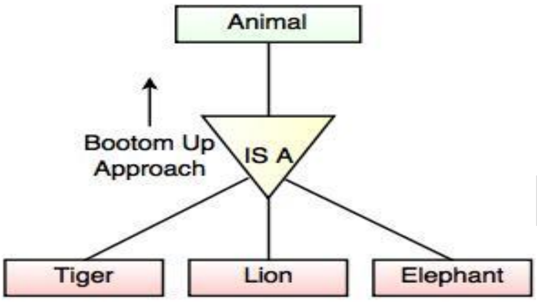
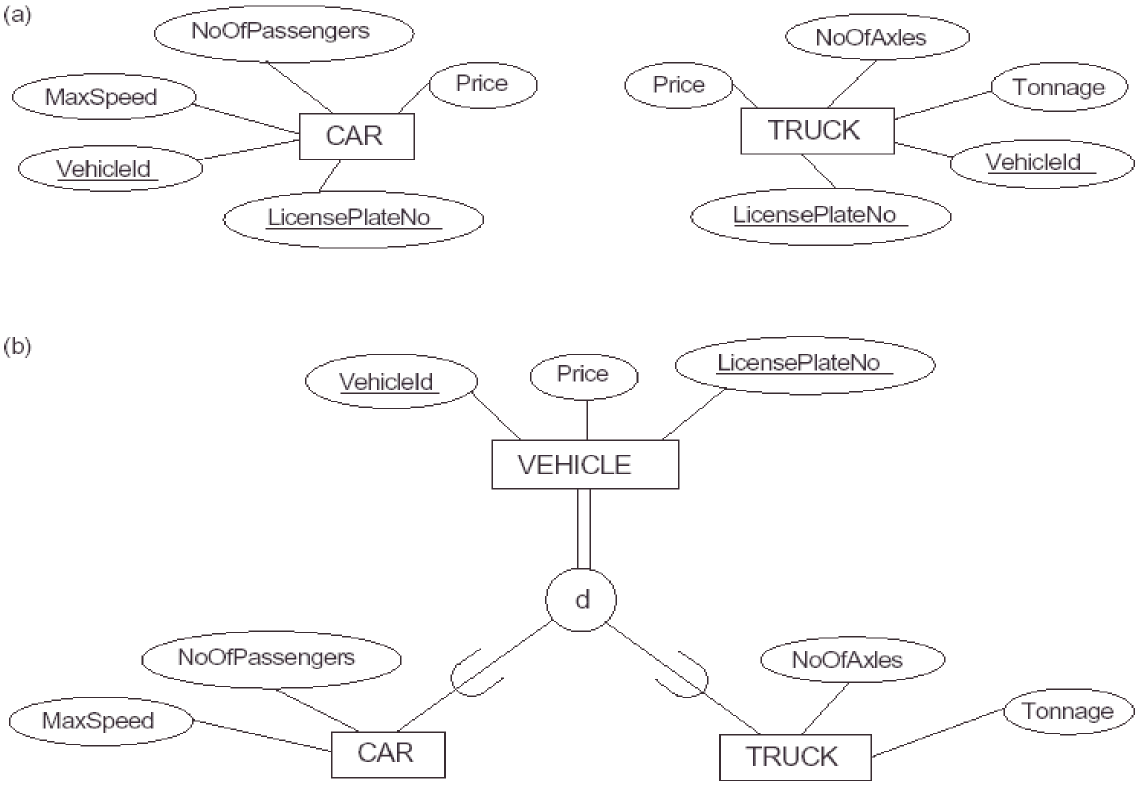


Fig. Generalization

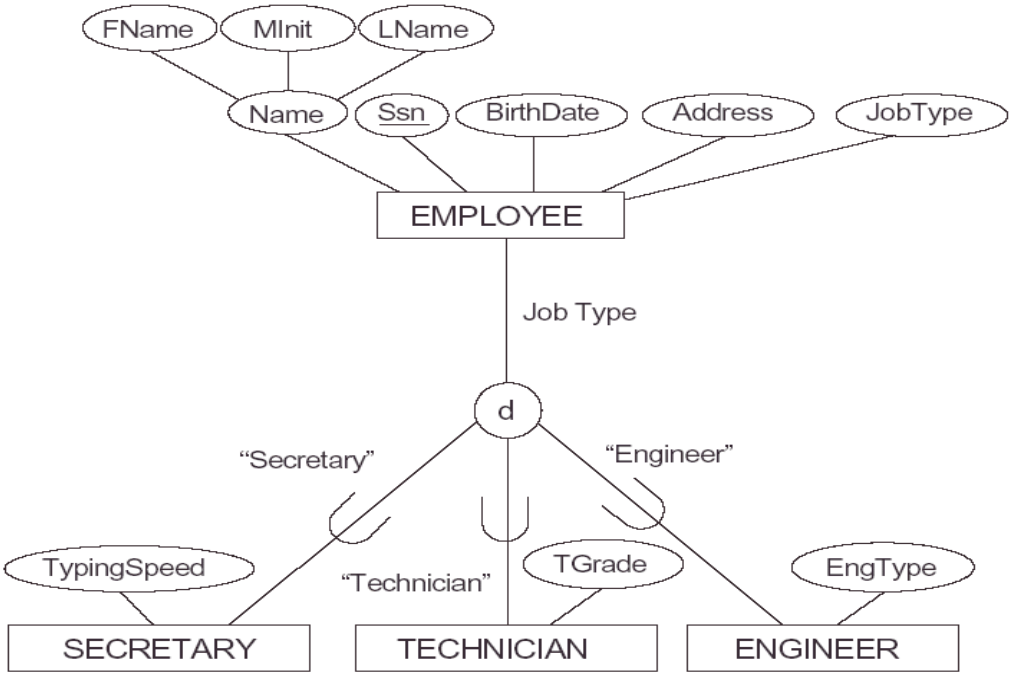
In the above example, Tiger, Lion, Elephant can all be generalized as Animals.

Example 1:- CAR and TRUCK can be generalized into VEHICLE

Generalization can be viewed as the inverse of specialization.



Example2:-



b. Specialization

- Specialization is a process that defines a group entities which is divided into sub groups based on their characteristic.
- It is a top down approach, in which one higher entity can be broken down into two lower level entity.
- It maximizes the difference between the members of an entity by identifying the unique characteristic or attributes of each member.
- It defines one or more sub class for the super class and also forms the superclass/subclass relationship.

For example

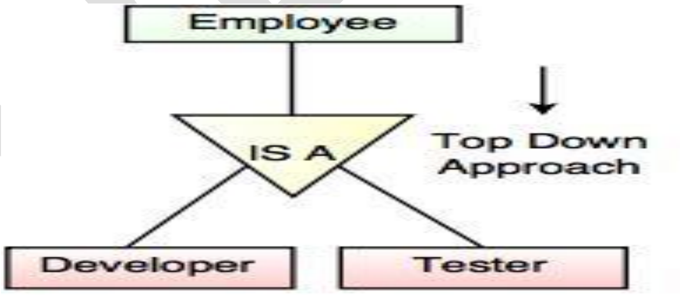
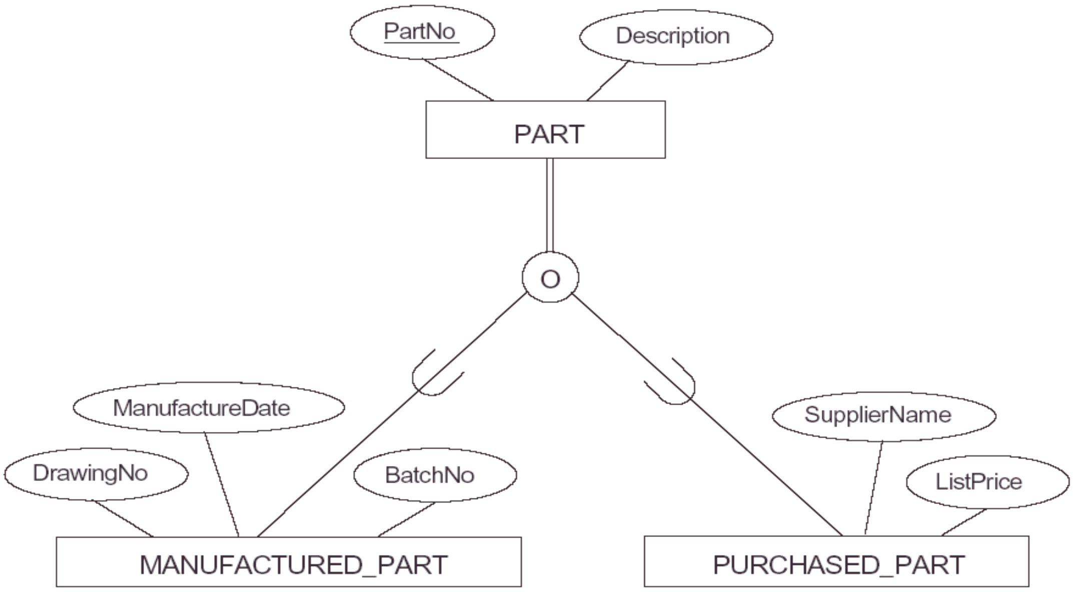


Fig. Specialization



3). Category or Union:-

Category represents a single super class or sub class relationship with more than one super class. It can be a total or partial participation.

For example

Category (sub class) → Owner is a subset of the union of the three super classes → Company, Bank, and Person. A Category member must exist in at least one of its super classes.

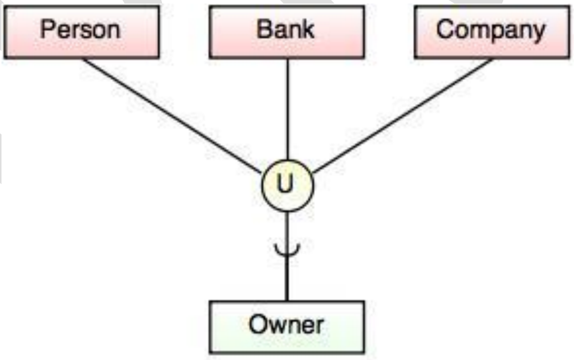


Fig. Categories (Union Type)

4). Aggregation:-

- Aggregation is a process that represents a relationship between a whole object and its component parts.
- It abstracts a relationship between objects and viewing the relationship as an object.
- It is a process when two entities is treated as a single entity.

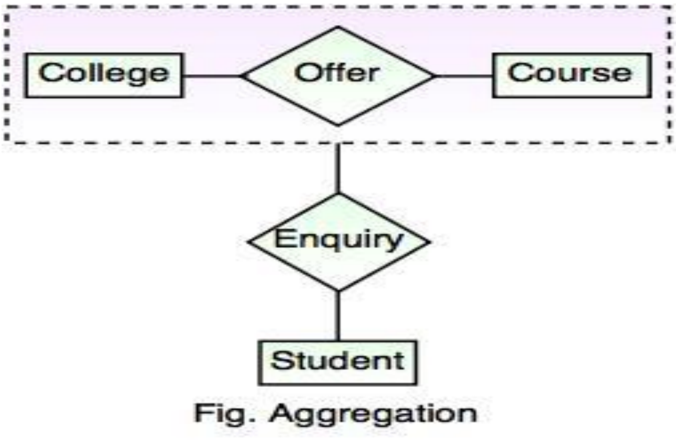


Fig. Aggregation

Chapter-2

RELATIONAL MODEL

Q) Explain Relational model and its terminology

Introduction to Relational model:-

- Relational Model was proposed by E.F. Codd to model data in the form of relations or tables.
- After designing the conceptual model of Database using ER diagram, we need to convert the conceptual model in the relational model.
- Relational model can be implemented using any RDBMS languages like Oracle SQL, MySQL etc

Relational Model:-

- Relational Model represents how data is stored in Relational Databases.
- A relational database stores data in the form of relations (tables).
- Consider a relation STUDENT with attributes ROLL_NO, NAME, ADDRESS, PHONE and AGE shown in Table 1.
  STUDENT TABLE

ROLL_NO	NAME	ADDRESS	PHONE	AGE
1	RAM	DELHI	9455123451	18
2	RAMESH	GURGAON	9652431543	18
3	SUJIT	ROHTAK	9156253131	20
z4	SURESH	DELHI		18

IMPORTANT TERMINOLOGIES

- **Attribute:** Attributes are the properties that define a relation.

  e.g:- **ROLL_NO**, **NAME**

- **Relation Schema:** A relation schema represents name of the relation with its attributes.

  e.g:-STUDENT (ROLL_NO, NAME, ADDRESS, PHONE and AGE) is relation schema for STUDENT.

  If a schema has more than 1 relation, it is called Relational Schema.

- **Tuple:-** Each row in the relation is known as tuple. The above relation contains 4 tuples, one of which is shown as:

  1 RAM DELHI 9455123451 18

- **Relation Instance:** The set of tuples of a relation at a particular instance of time is called as relation instance.

  Table 1 shows the relation instance of STUDENT at a particular time. It can change whenever there is insertion, deletion or updation in the database.

- **Degree:** The number of attributes in the relation is known as degree of the relation.

  The **STUDENT** relation defined above has degree 5.

- **Cardinality:** The number of tuples in a relation is known as cardinality.

  The **STUDENT** relation defined above has cardinality 4.

- **Column:** Column represents the set of values with particular attribute.

  The column **ROLL_NO** is extracted from relation STUDENT.

ROLL_NO
1
2
3
4

- **NULL Values:** The value which is not known or unavailable is called NULL value. It is represented by blank space.

  e.g.: PHONE of STUDENT having ROLL_NO 4 is NULL.

- **Relation key** – it is an attribute that helps to uniquely identify a row in a relation

  Ex:-roll no is relation key in the student table.

  - **Attribute domain** – the set of possible values of an attribute is known as attribute domain

Ex:-domain of student age can be from 18 to 40

Advantages of relational model:-

1. **Simplicity:-** A relational data model is simpler than the hierarchical and network model.
2. **Structural independence:-**The relational database is only concerned with data and not with structure. It improves efficiency.
3. **Easy to use:-**This relational model is easy as tables consisting of rows and column is quite easy to understand.
4. **Data independence:-** The structure of database can be changed without having to change any application.
5. **Scalability:-**Regarding no of rows and no of fields in a database should be enlarged to enhance its usability

Disadvantages of relational model:-

1. Few relational databases have limits on field lengths which cannot be exceeded.
2. Relational database can sometime become complex as the amount of data grows and the relationships between tables more complicated.

Q) Define constraint in relational model. Explain its types

"While designing Relational Model, we define some conditions which must hold for data present in database are called **Constraints"**.

These constraints are checked before performing any operation (insertion, deletion and updation) in database. If there is a violation in any of constrains, operation will fail.

The following are the constraints supported by ER model.

1. Domain constraint
2. Key integrity constraint
3. Referential integrity constraint

1. Domain Constraints: These are attribute level constraints. An attribute can only take values which lie inside the domain range.

Example:- If a constrains AGE>0 is applied on STUDENT relation, inserting negative value of AGE will result in failure.

2. Key Integrity: Every relation in the database should have at least one set of attributes which defines a tuple uniquely. Those set of attributes is called key.

Example:- ROLL_NO in STUDENT is a key. No two students can have same roll number.

So a key has two properties:

- It should be unique for all tuples.
- It can't have NULL values.

3. Referential Integrity: When one attribute of a relation can only take values from other attribute of other relation, it is called referential integrity.

Example:-Let us suppose we have 2 relations STUDENT AND BRANCH TABLES

STUDENT TABLE

ROLL_NO	NAME	ADDRESS	PHONE	AGE	BRANCH_CODE
1	RAM	DELHI	9455123451	18	CS
2	RAMESH	GURGAON	9652431543	18	CS
3	SUJIT	ROHTAK	9156253131	20	ECE
4	SURESH	DELHI		18	IT

BRANCH TABLE

BRANCH_CODE	BRANCH_NAME
CS	COMPUTER SCIENCE
IT	INFORMATION TECHNOLOGY
ECE	ELECTRONICS AND COMMUNICATION ENGINEERING
CV	CIVIL ENGINEERING

BRANCH_CODE of STUDENT can only take the values which are present in BRANCH_CODE of BRANCH which is called referential integrity constraint. The relation which is referencing to other relation is called REFERENCING RELATION (STUDENT in this case) and the relation to which other relations refer is called REFERENCED RELATION (BRANCH in this case).

Q) Null Values in a Relational Model

Every column in a table should contain a value, though there may be sometimes when the value is unknown.

For example, consider the following table, which stores data related to CD suppliers.

SUPPLIER				
SupplierId	SupplierName	SupplierAddress	SupplierPhone	SupplierFax

To communicate with suppliers you will need their name, address, phone number, and fax. If you do not know one or more of those pieces of data, you will not know what to enter into its corresponding column.

- **When the value to enter into a field is unknown, it is called a *null value*.**
- **A null is different from a *blank* or a *zero*.**
- **A blank is the value used when a column contains no value.**

For instance, if the supplier you met with does not have a fax number, you would enter a **blank value** into that column.