What is database modeling?

A database model is a type of data model that determines the logical structure of a database. It fundamentally determines in which manner data can be stored, organized and manipulated. The most popular example of a database model is the relational model, which uses a table-based format.

It shows the relationships and constraints that determine how data can be stored and accessed. Most data models can be represented by an accompanying database diagram.

Types of database models
There are many kinds of data models.

Relational model
The most common model, the relational model sorts data into tables, also known as relations, each of which consists of columns and rows. Each column lists an attribute of the entity in question, such as price, zip code, or birth date. Together, the attributes in a relation are called a domain. A particular attribute or combination of attributes is chosen as a primary key that can be referred to in other tables, when it's called a foreign key.

Hierarchical model
The hierarchical model organizes data into a tree-like structure, where each record has a single parent or root. Sibling records are sorted in a particular order. That order is used as the physical order for storing the database.

Network model
The network model builds on the hierarchical model by allowing many-to-many relationships between linked records, implying multiple parent records.

Object-oriented database model
This model defines a database as a collection of objects, or reusable software elements, with associated features and methods. There are several kinds of object-oriented databases: Multimedia database, Hypertext database.

Entity-relationship model
This model captures the relationships between real-world entities much like the network model, but it isn't as directly tied to the physical structure of the database. Instead, it's often used for designing a database conceptually.

NoSQL database models

The graph database model, which is even more flexible than a network model, allowing any node to connect with any other.

The multivalue model, which breaks from the relational model by allowing attributes to contain a list of data rather than a single data point.

The document model, which is designed for storing and managing documents or semi-structured data, rather than atomic data.

Benefits of data modeling

- Reduce errors in software and database development.
- Increase consistency in documentation and system design across the enterprise.
- Improve application and database performance.
- Ease data mapping throughout the organization.
- Improve communication between developers and business intelligence teams.

Explain normalization with an example?

- Normalization is the process of organizing the data in the database.
- Normalization is used to minimize the redundancy from a relation or set of relations. It is also used to eliminate undesirable characteristics like Insertion, Update, and Deletion Anomalies.
- Normalization divides the larger table into smaller and links them using relationships.
- The normal form is used to reduce redundancy from the database table.

The main reason for normalizing the relations is removing these anomalies. Failure to eliminate anomalies leads to data redundancy and can cause data integrity and other problems as the database grows. Normalization consists of a series of guidelines that helps to guide us in creating a good database structure.

Database Normalization Forms:

There are following Four Normal Forms used in Database Normalization:

1.First Normal Form

2.Second Normal Form

3.Third Normal Form

4. Boyce-code Normal Form(BCNF)

1.First Normal Form/1st Normal Form:

The first normal form is the normal form of database where data must not contain repeating groups.The database is in First normal form If,

1.It contains only automic values.

2.Each Record needs to be unique and there are no repeating groups.

Example:

Consider following table which is not normalized:

Employee Table:

Employee No.	Employee Name	Department
1	Amit	CS,IT
2	Divya	Mechanical
3	Ram	Civil

To bring it in to first normal form We need to split table into 2 tables.

First table:Employee Table

Employee No.	Employee Name
1	Amit
2	Divya
3	Ram

Second Table: Department table

Employee No.	Department
1	CS
1	IT
2	Mechanical
3	Civil

2.Second Normal Form/2nd Normal Form:

The data is said to be in second normalized form If,

1.It is in First normal form

2.There should not be any partial dependency of any column on primary key.Means the table have concatanated primary key and each attribute in table depends on that concatanated primary key.

3.All Non-key attributes are fully functionally dependent on primary key.If primary is is not composite key then all non key attributes are fully functionally dependent on primary key.

Example:

Let us consider following table which is in first normal form:

Employee No.	Department No.	Employee Name	Department
1	101	Amit	CS
2	102	Divya	Civil
3	101	Ram	CS

In above example we can see that department .Here We will see that there is composit key as{ Employee No,Department No}.Employee No is dependent on Employee Name and Department is dependent on Department No.We can split the above table into 2 different tables:

Table 1:Employee_NO table

Employee No.	Department No.	Employee Name
1	101	Amit
2	102	Divya
3	101	Ram

Table 2:Department table

Department No.	Department Name
101	CS
102	Civil

Third Normal Form/3rd Normal Form:

The database is in Third normal form if it satisfies following conditions:

1.It is in Second normal form

2.There is no transitive functional dependency

Example:

Consider following table:

Employee No.	Salary slip no.	Employee name	Salary
1	001	Amit	50000
2	002	Divya	40000
3	003	Ram	45000

In above table Employee No determines the Salary Slip No.And Salary Slip no Determines Employee name.Therefore Employee No determines Employee Name.We have transitive functional dependency so that this structure not satisfying Third Normal Form.

For That we will Split tables into following 2 tables:

Employee table:

Employee No	Salary Slip No	Employee Name
1	0001	Amit
2	0002	Divya
3	0003	Rama

Salary Table:

Salary Slip No	Salary
0001	50000
0002	40000
0003	57000

Following are 2 Advantages of 3rd normal form:

1.Amount of data duplication is removed because transitive dependency is removed in third normal form.

2.Achieved Data integrity

4.BCNF(Boyce-Codd Normal Form)
BCNF Normal form is higher version of third normal form.This form is used to handle analomies which are not handled in third normal form.BCNF does not allow dependencies between attributes that belongs to candidate keys.It drops restriction of the non key attributes from third normal form.

Third normal form and BCNF are not same if following conditions are true:

1.The table has 2 or more candidate keys

2.At least two of candidate keys are composed of more than 1 attribute

3.The keys are not disjoint.

Example:

Address-> {City,Street,Zip}

Key 1-> {City,Zip}

Key 2->{City,Street}

No non key attribute hence this example is of 3 NF.

{City,Street}->{zip}

{Zip}->{City}

There is dependency between attributes belonging to key.Hence this is BCNF.