



GALGOTIAS
UNIVERSITY

**School of Computing
Science and Engineering**

Program: B.Sc.

Course Code: BSCS2312

Course Name: Database Management
System

Vision

To be known globally as a premier department of Computer Science and Engineering for value-based education, multidisciplinary research and innovation.

Mission

- ❑ **M1:** Developing a strong foundation in fundamentals of computing science with responsiveness towards emerging technologies.
- ❑ **M2:** Establishing state-of-the-art facilities and adopt education 4.0 practices to analyze, develop, test and deploy sustainable ethical IT solutions by involving multiple stakeholders.
- ❑ **M3:** Establishing Centers of Excellence for multidisciplinary collaborative research in association with industry and academia.

Course Outcomes (COs)

CO Number	Title
CO1	Understand the basic concepts, modeling techniques and architecture of DBMS (K2).
CO2	Apply the concept of ER Model and SQL programming using DDL and DML commands (K3).
CO3	Able to store and analyze data into normalized format. (K4).
CO4	Analyze the transaction processing concept and recovery methods in database (K4)
CO5	Examine the concept of concurrency control techniques in database (K4).
CO6	List out the various contemporary research areas and database tools (K2).

Course Prerequisites

- Knowledge of Mathematics**
- Query Languages**

Syllabus

Unit 1 - Introduction

(6 hours)

- An Overview of Database Management System**
- Database System vs File System**
- Database System Concept and Architecture**
- Data Model Schema and Instances**
- Overall Database Structure**

Recommended Books

Text books

- ❑ Abraham Silberschatz, Henry F. Korth and S. Sudarshan- “Database System Concepts”, Fourth Edition, McGraw-Hill, 2002.

Reference Book

- ❑ Ramez Elmasri and Shamkant B. Navathe, “Fundamental Database Systems”, Third Edition, Pearson Education, 2003.
- ❑ Raghu Ramakrishnan, “Database Management System”, Tata McGraw- Hill Publishing Company, 2003.
- ❑ Hector Garcia–Molina, Jeffrey D.Ullman and Jennifer Widom- “Database System Implementation”- Pearson Education- 2000
- ❑ Peter Rob and Corlos Coronel- “Database System, Design, Implementation and Management”, Thompson Learning Course Technology- Fifth edition, 2003

Additional online materials

- ❑ Coursera - <https://www.coursera.org/learn/database-management>
- ❑ NPTEL- <https://nptel.ac.in/courses/106/105/106105175/>
- ❑ <https://www.coursera.org/learn/research-methods>
- ❑ <https://www.coursera.org/browse/physical-science-and-engineering/research-methods>

Data Model

- ❑ Data Model gives us an idea that how the final system will look like after its complete implementation. It defines the data elements and the relationships between the data elements.
- ❑ Some of the Data Models in DBMS are: Hierarchical Model, Network Model, Entity-Relationship Model, Relational Model, Object-Oriented Data Model, NoSQL, Object-Relational Data Model, Flat Data Model, Semi-Structured Data Model, Associative Data Model, Context Data Model.
- ❑ We will study the six data models such as Hierarchical Model, Network Model, Entity-relationship Model, Relational Model Object-Oriented Data Model and NoSQL in detail.

Hierarchical Data Model

- ❑ This database model organizes data into a tree-like-structure, with a single root, to which all the other data is linked.
- ❑ **One-to-many relationship:** The data here is organized in a tree-like structure where the one-to-many relationship is between the data types. Also, there can be only one path from parent to any node.
- ❑ **Parent-Child Relationship:** Each child node has a parent node but a parent node can have more than one child node. Multiple parents are not allowed.
- ❑ **Deletion Problem:** If a parent node is deleted then the child node is automatically deleted.
- ❑ Some examples of Hierarchical Databases are Information Management System (IMS), Raima Database Manager (RDM) Mobile etc.

Hierarchical Data Model

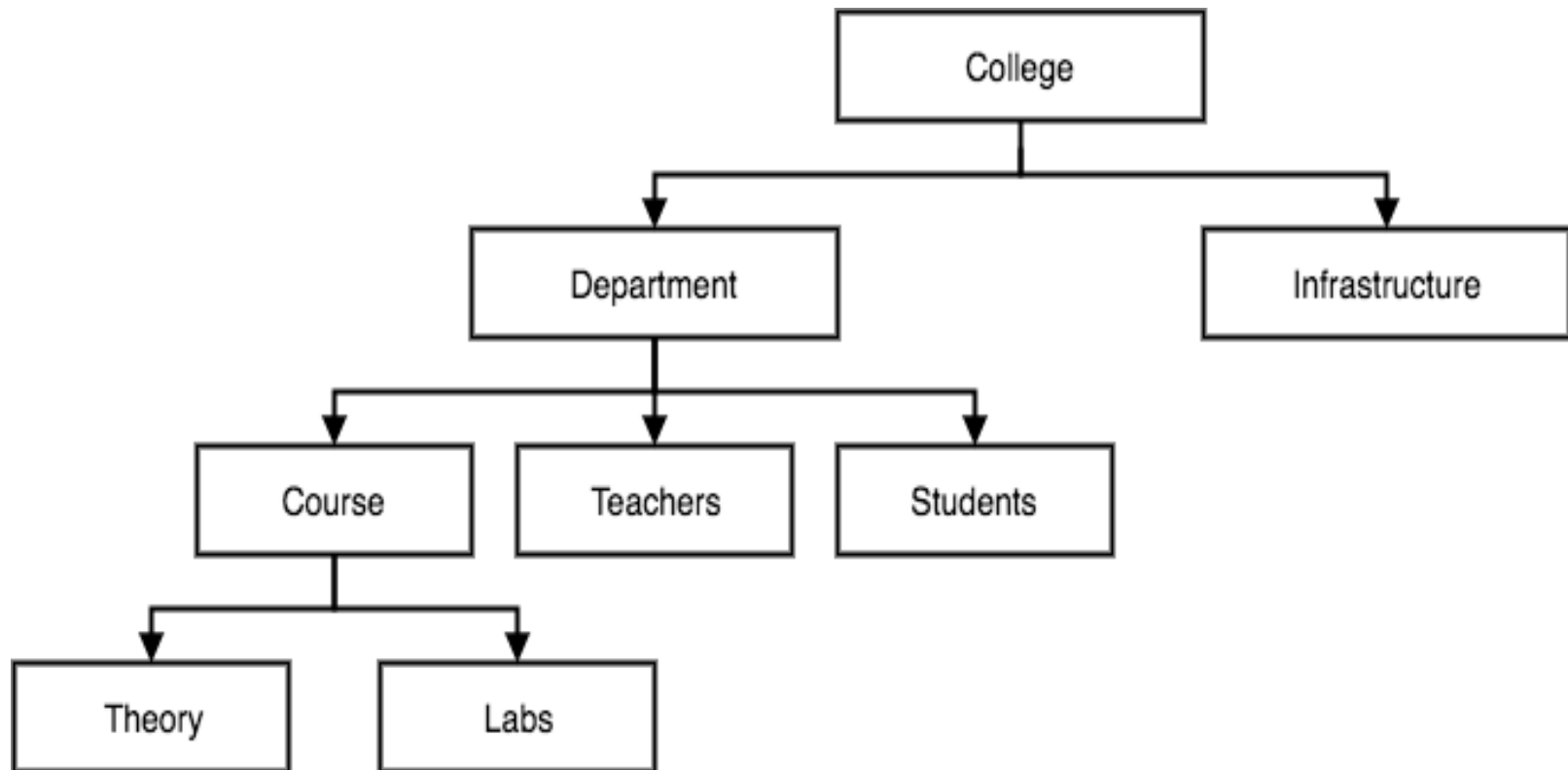


Figure 1: Example of Hierarchical Data Model

Hierarchical Data Model

Advantages of Hierarchical Data Model

- It is very simple and fast to traverse through a tree-like structure.
- Any change in the parent node is automatically reflected in the child node so, the integrity of data is maintained

Disadvantages of Hierarchical Data Model

- Complex relationships are not supported.
- As it does not support more than one parent of the child node so if we have some complex relationship where a child node needs to have two parent node then that can't be represented using this model.
- If a parent node is deleted then the child node is automatically deleted.

Network Model Data Model

- ❑ In this model data is organized more like a graph, and are allowed to have more than one parent node.
- ❑ This database model was used to map many-to-many data relationships.
- ❑ This was the most widely used database model, before Relational Model was introduced.

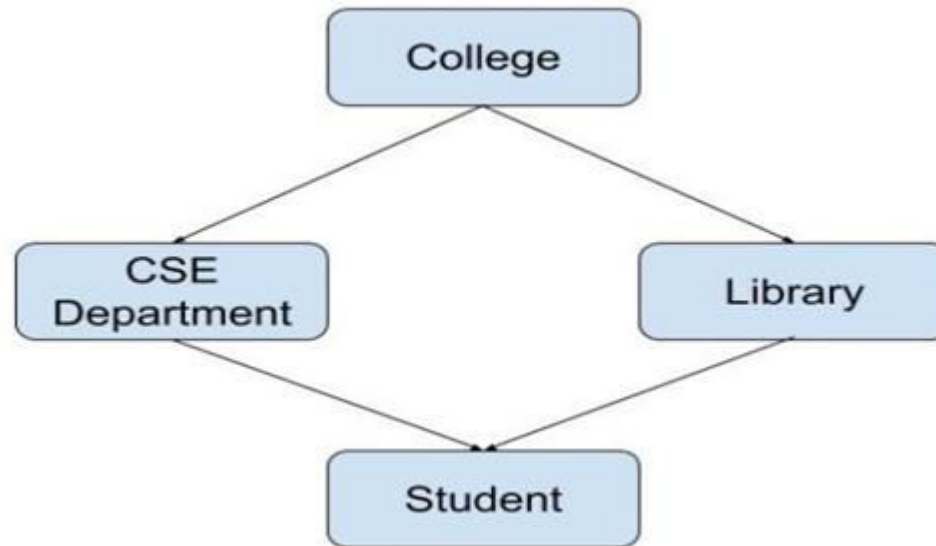


Figure 2: Example of Network Data Model

Network Model Data Model

- ❑ **Ability to Merge more Relationships:** In this model, as there are more relationships so data is more related. This model has the ability to manage **one-to-one relationships** as well as **many-to-many** relationships.
- ❑ **Many paths:** As there are more relationships so there can be more than one path to the same record. This makes data access **fast** and **simple**.
- ❑ **Circular Linked List:** The operations on the network model are done with the help of the circular linked list. The current position is maintained with the help of a program and this position navigates through the records according to the relationship.
- ❑ Some examples of Network Databases are Integrated Database Management System (IDMS), Integrated Data Store (IDS) etc.

Network Data Model

Advantages of Hierarchical Data Model

- The data can be accessed faster as compared to the hierarchical model.
- As there is a parent-child relationship so data integrity is present. Any change in parent record is reflected in the child record.

Disadvantages of Hierarchical Data Model

- As more and more relationships need to be handled the system might get complex. So, a user must be having detailed knowledge of the model to work with the model.
- Any change like updation, deletion, insertion is very complex.

Entity Relationship (ER) Data Model

- ❑ Entity-Relationship Model or simply ER Model is a high-level data model diagram.
- ❑ In this model, we represent the real-world problem in the pictorial form to make it easy for the stakeholders to understand.
- ❑ It is also very easy for the developers to understand the system by just looking at the ER diagram.

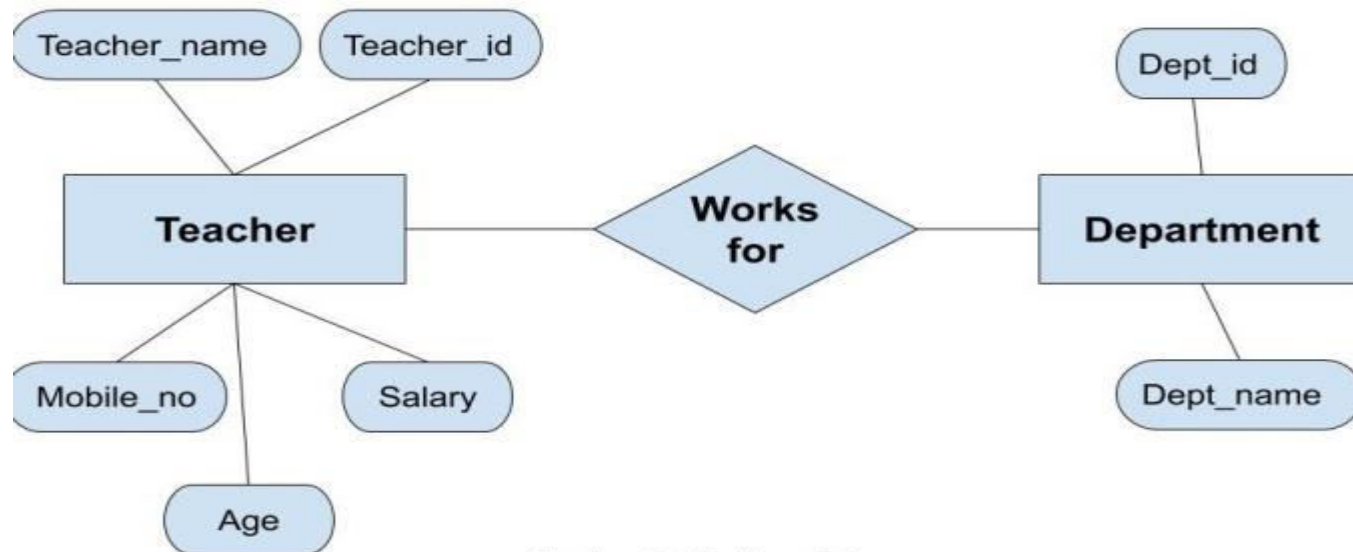


Figure 3: Example of ER Data Model

Entity Relationship (ER) Data Model

Advantages of ER Data Model

- ❑ **Simple:** Conceptually ER Model is very easy to build. If we know the relationship between the attributes and the entities we can easily build the ER Diagram for the model.
- ❑ **Effective Communication Tool:** This model is used widely by the database designers for communicating their ideas.
- ❑ **Easy Conversion to any Model:** This model maps well to the relational model and can be easily converted relational model by converting the ER model to the table. This model can also be converted to any other model like network model, hierarchical model etc.

Entity Relationship (ER) Data Model

Disadvantages of ER Data Model

- ❑ **No industry standard for notation:** There is no industry standard for developing an ER model. So one developer might use notations which are not understood by other developers.
- ❑ **Hidden Information:** Some information might be lost or hidden in the ER model. As it is a high-level view so there are chances that some details of information might be hidden.

Relational Data Model

- ❑ Relational Model is the most widely used model.
- ❑ Data is maintained in the form of a two-dimensional table.
- ❑ The basic structure of a relational model is tables. So, the tables are also called relations in the relational model.
- ❑ A table consists of attributes (columns), tuples (rows) and provides a way to uniquely identify each tuple. Tables are related to each other through parent child relationships.

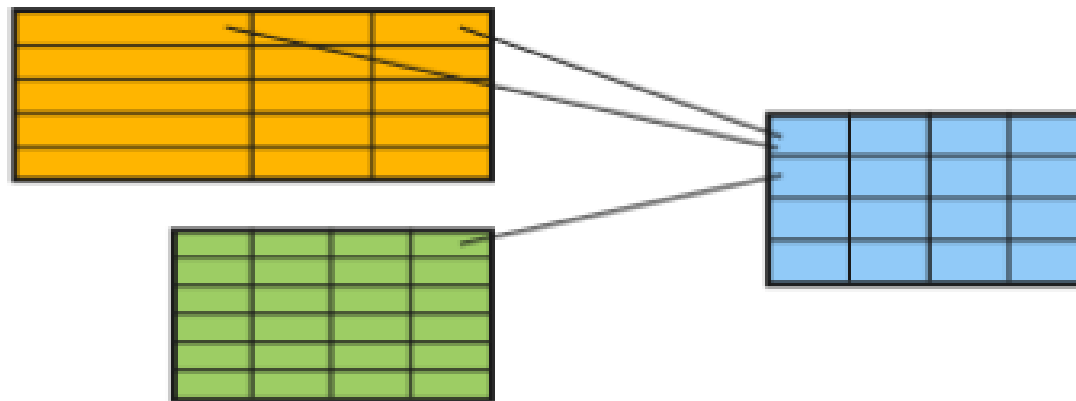


Figure 4: Example of Relational Data Model

Relational Data Model

- ❑ **Tuples:** Each row in the table is called tuple. A row contains all the information about any instance of the object.
- ❑ **Attribute or field:** Attributes are the property which defines the table or relation. The values of the attribute should be from the same domain.
- ❑ Some examples of Relational Databases are DB2, Oracle, SQL Server etc.

Advantages of Relational Data Model

- ❑ **Simple:** This model is more simple as compared to the network and hierarchical model.
- ❑ **Scalable:** This model can be easily scaled as we can add as many rows and columns we want.
- ❑ **Structural Independence:** We can make changes in database structure without changing the way to access the data.

Relational Data Model

Disadvantages of Relational Data Model

- ❑ **Hardware Overheads:** For hiding the complexities and making things easier for the user this model requires more powerful hardware computers and data storage devices.
- ❑ **Bad Design:** As the relational model is very easy to design and use. So the users don't need to know how the data is stored in order to access it. This ease of design can lead to the development of a poor database which would slow down if the database grows.

Object Oriented Data Model

- ❑ The real-world problems are more closely represented through the object-oriented data model
- ❑ In this model, both the data and relationship are present in a single structure known as an object.

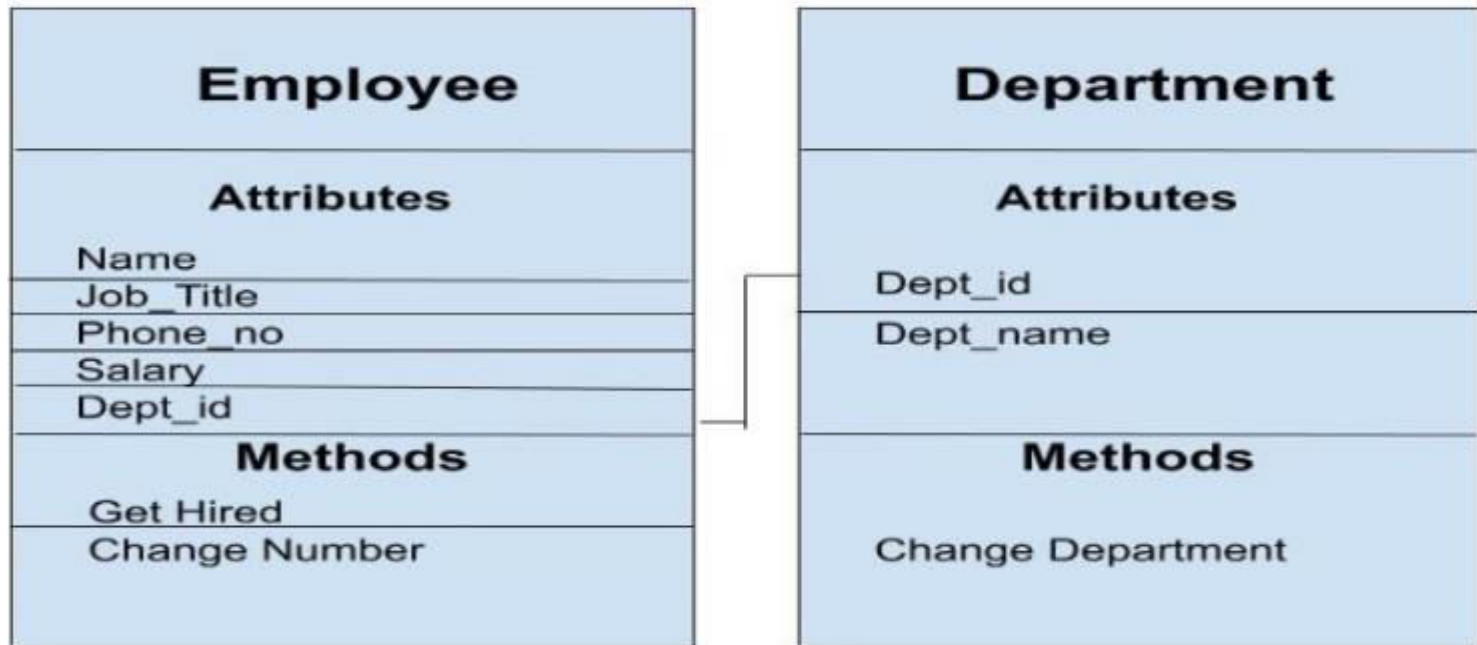


Figure 5: Example of Object Oriented Data Model

NoSQL Data Model

- ❑ NoSQL (Not only SQL) database uses key-value, graph or document data structures to store data. These databases aim for simplicity of design, horizontal scaling and finer control over availability.
- ❑ Some examples on No Sql databases are Cassandra, MongoDB, CouchDB, OrientDB, HBASE etc.

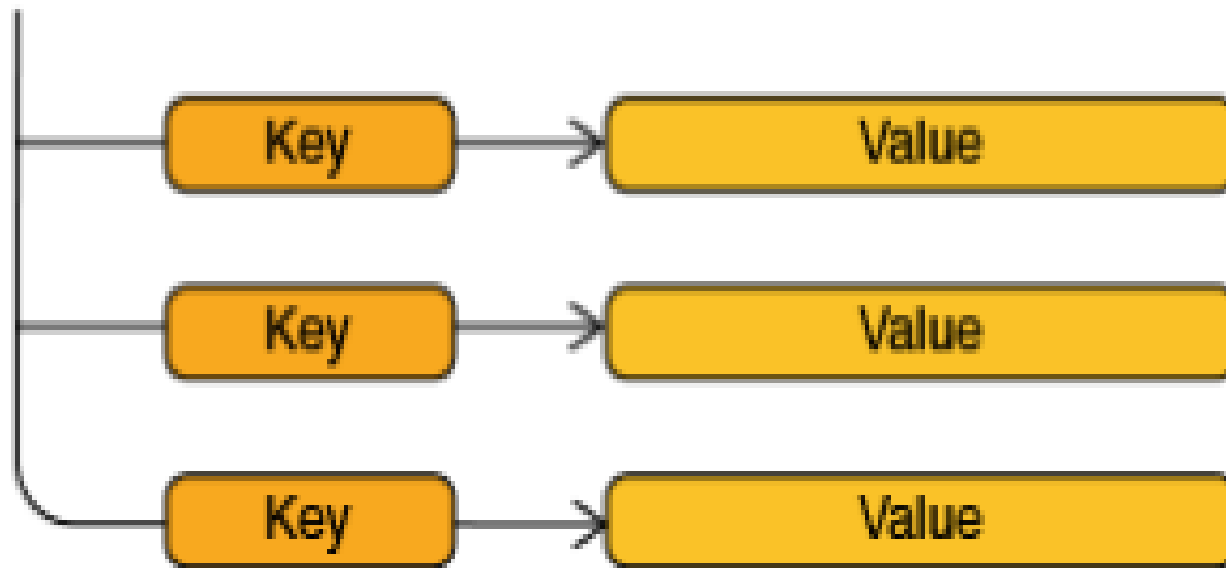


Figure 5: Example NoSQL Data Model

Questions

- Briefly explain the term by Data Modeling?
- Explain your understanding of different data models?
- List down various types of data models and explain Hierarchical data model with example.
- List down various types of data models and explain Network data model with example.
- List down various types of data models and explain Entity Relationship data model with example.
- List down various types of data models and explain Relational data model with example.
- List down various types of data models and explain Object Oriented data model with example.
- List down various types of data models and briefly explain NoSQL data model.



Thank You