Database Management System 2
Data Model

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Data Model

Data Model

Data model is a collection of conceptual tools for describing data, data relationships, data semantics and consistency constraints. That means a data model provides a way to describe the design of a database

- It is relatively simple representation, usually graphical, of complex real-world data structures
- Data modeling is considered as the most important part of the database design process

Data Model Basic Building Blocks

Entity

An entity is anything about which data are to be collected and stored. An entity represents a particular type of object in the real world

Entity Set

Set of entities of the same type that share the same properties are called as entity sets

Attribute

An attribute is a characteristic of an entity

Constraints

A constraint is a restriction placed on the data. Constraints are important because they help to ensure data integrity

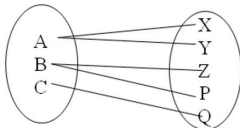# Data Model Basic Building Blocks...

Relationship

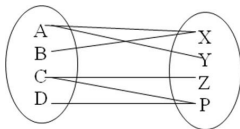A relationship describes an association among entities. Different types of relationship are:

- **One-to-One (1:1) Relationship**:
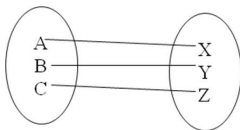
- **One-to-Many (1:M) Relationship**:

- **Many-to-Many (M:N) Relationship**:

Hierarchical Model

Hierarchical Model

The hierarchical model was developed in the 1960s to manage large amount of data for complex manufacturing projects. Its basic logical structure is represented by an *upside-down tree*. The hierarchical structure contains levels of segments. It depicts a set of 1:M relationships between a parent and its children segments
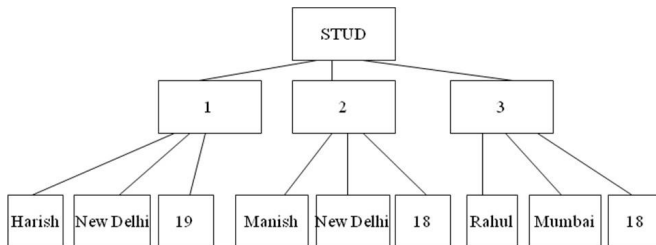
Hierarchical Model...

- **Advantages**:
  - Efficient storage for data that have a clear hierarchy
  - Parent/child relationship promotes conceptual simplicity & data integrity
  - It is efficient with 1:M relationships
  - It promotes data sharing
- **Disadvantages**:
  - It is complex to implement
  - It is difficult to manage
  - There are implementation limitations, that means it can't represent M:N relationships
  - There is no DDL and DML
  - There is lack of standards

Network Model

The network model was created to represent complex data relationships more effectively than the hierarchical model, to improve database performance, and to impose a database standard. A user perceives the network model as a collection of records in 1:M relationships
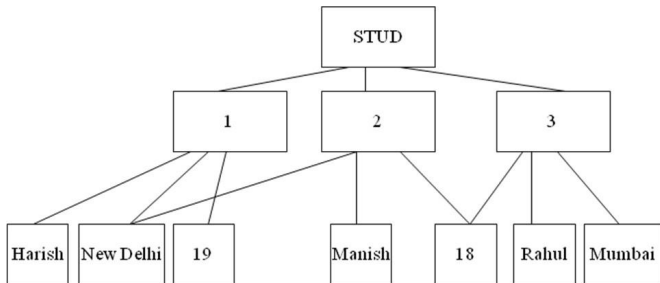
Network Model...

- **Advantages**:
    - It represents complex data relationships better than hierarchical models
    - It handles more relationship types, such as M: N and multi-parent
    - Data access is more flexible than hierarchical model
    - Improved database performance
    - It includes DDL and DML
- **Disadvantages**:
    - System complexity limits efficiency
    - Navigational system yields complex implementation and management
    - Structural changes require changes in all application programs
    - Database contains a complex array of pointers that thread through a set of records
    - Put heavy pressure on programmers due the complex structure
    - Networks can become chaotic unless planned carefully

Relational Model

Relational Model

The relational model was introduced by E. F. Codd in 1970. This data model is implemented through RDBMS; which is easier to understand and implement

The most important advantage of the RDBMS is its ability to hide the complexities of the relational model from the user. Another reason for the relational data model's rise to dominance is its powerful and flexible query language. Generally, SQL is used for this purpose

STUD

roll	name	city	age
1	Harish	New Delhi	19
2	Manish	New Delhi	18
3	Rahul	Mumbai	18

GRADE

regdno	roll	cgpa
S001	1	7.9
S002	2	8.5
s003	3	9.4

Relational Model...

- **Advantages**:
    - Changes in a table's structure do not affect data access or application programs
    - Tabular view substantially improves conceptual simplicity, thereby promoting easier database design, implementation, management and use
    - Have referential integrity controls ensure data consistency
    - RDBMS isolates the end-users from physical level details and improves implementation and management simplicity
- **Disadvantages**:
    - Conceptual simplicity gives relatively untrained people the tools to use a good system poorly
    - It may promote *islands of information* problems as individuals and departments can easily develop their own applications

Entity-Relationship(ER) Model
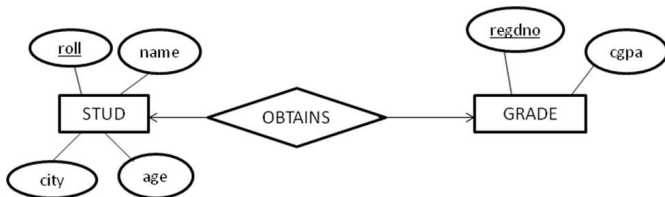
Entity-Relationship(ER) Model

Peter Chen first introduced the ER data model in 1976; it was the graphical representation of entities and their relationships in a database structure that quickly became popular. Thus, the ER-model has become a widely accepted standard for data modeling

ER models are normally represented in an ER diagram

Entity-Relationship(ER) Model...

- **Advantages**:
    - Visual modeling yields exceptional conceptual simplicity
    - Visual representation makes it an effective communication tool
    - It is integrated with dominant relational model
- **Disadvantages**:
    - There is limited constraint representation
    - There is limited relationship representation
    - There is no DML
    - Loss of information content when attributes are removed from entities to avoid crowded displays

Object-Oriented(OO) Model

Object-Oriented(OO) Model

In object-oriented data model, both data and their relationships are contained in a single structure called an *object*. Like the relational model's entity, an object is described by its factual content. But quite unlike an entity, an object includes information about relationships between the facts within the object, as well as information about its relationships with other

Attributes describe the properties of an object. Objects that share similar characteristics are grouped in classes. Thus, a *class* is a collection of similar objects with shared structure (attributes) and methods

STUD
roll: Integer
name: Char
city: Char
age: Integer
stud_info()

Object-Oriented(OO) Model...

- **Advantages**:
    - Semantic content is added
    - Support for complex objects
    - Visual representation includes semantic content
    - Inheritance promotes data integrity
- **Disadvantages**:
    - It is a complex navigational system
    - High system overheads slow transactions
    - Slow development of standards caused vendors to supply their own enhancements, thus eliminating a widely accepted standard

Object-Relational(OR) Model

Object-Relational(OR) Model

The object-oriented data model is somewhat spherical in nature, allowing access to unique elements anywhere within a database structure, with extremely high performance. But, it performs extremely poorly when retrieving more than a single data item

The relational data model is best suited for retrieval of groups of data, but can also be used to access unique data items fairly efficiently

Thus, by combining the features of relational data model and object-oriented data model, object-relational data model was created

Semi-structured Model
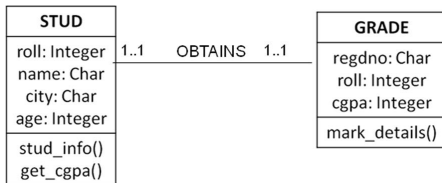
Semi-structured Model

The semi-structured data model permits the specification of data where individual data items of the same type may have different sets of attributes. The XML (Extensible Markup Language) is widely used to represent semi-structured data. It supports unstructured data