

Data Models

- The role of Data Model
- Hierarchical Model
- Network Model
- Relational Model



Definition

- An integrated collection of concepts for describing and manipulating data, relationships between data and constraints on the data in an organisation.
- A model is a representation of real world objects and events and their associations.
- It represents the organisation itself.

Components Of Data Model

- Structural Part
 - Consists of a set of rules according to which a database can be constructed.
- Manipulative Part
 - Defines the type of operations that are allowed on the data (updating, retrieving data etc)

Components Of Data Model

- Set of integrity rules.
 - These ensures that the data is accurate

The role of a data model

- To make it easier to understand the meaning of the data ie
 - each user's perspective of the data
 - The nature of the data
 - The use of the data across user views
- It is used to design a database

Data Model Categories

- Object Based, Record Based, Physical
- The first two are used to describe data at the conceptual and external levels.
- The later at the internal level, it describes details of how data is stored in the computer

Record Based

- There are three types.
 - Relational Data Model
 - Network Data Model
 - Hierarchical Data Model

Hierarchical Data Model

- Data is represented in tree like structure
- Records appear as nodes or segments
- It allows segments to have only one parent
- The parent is sometimes known as the root
- The relationship between records is represented by sets which are implemented as pointers

Hierarchical Data Model

- Access to a record is through a parent record.

Network Data Model

- This model is similar to the hierarchical model.
- It allows segments to have more than one parent

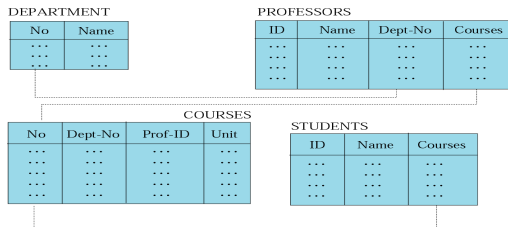
example

Object Based

- Object Oriented Data Model (Details in Future Lectures)

Relational model

- Data are organized in two-dimensional tables called relations.
- The tables are related to each other.



RELATIONAL MODEL

Introduction to Relational Databases

- The relational approach was originally proposed in 1970's .
- The first project that proved the practicality of the relational model is System R, developed at IBM's San Jose Research Laboratory in 1976. examples oracle, Sybase, access

Introduction to Relational Databases cont:

- The model was proposed as a disciplined way of handling data using the rigour of mathematics, particularly set theory.
- This would enhance the concept of program-data independence
- and improve programmer activities.

Introduction to Relational Databases cont:

- The relational model will have only values.
- Even references between data in different sets (relations) are represented by means of values.
- In the hierarchical and network model there are explicit references (pointers), which make them more complicated.

Relational Data structure

- The Relational approach is based on elementary mathematical relation theory.
- Its basic construct is a relation. A relation is also called a table.
- The data is organized in tables. The table has columns and rows.

Relational Model Terminology

- A relation is a table with columns and rows.
 - Only applies to logical structure of the database, not the physical structure.
 - This doesn't mean that data are stored as tables; the physical storage of the data is independent of the way the data are logically organized.

Relational Model Terminology

- Attribute is a named column of a relation.
- Domain is the set of allowable values for one or more attributes.

Relational Model Terminology Cont:

- Tuple is a row of a relation.
- Degree is the number of attributes in a relation.
- Cardinality is the number of tuples in a relation.
- Relational Database is a collection of normalized relations with distinct relation names.

Instances of Courses table

Attributes

| No | Course-Name | Unit |
|-------|---------------|------|
| CIS15 | Intro to C | 5 |
| CIS17 | Intro to Java | 5 |
| CIS19 | UNIX | 4 |
| CIS51 | Networking | 5 |

Tuples

COURSES

Examples of Attribute Domains

| Attribute | Domain Name | Meaning | Domain Definition |
|-----------|---------------|--|---|
| branchNo | BranchNumbers | The set of all possible branch numbers | character: size 4, range B001–B999 |
| street | StreetNames | The set of all street names in Britain | character: size 25 |
| city | CityNames | The set of all city names in Britain | character: size 15 |
| postcode | Postcodes | The set of all postcodes in Britain | character: size 8 |
| sex | Sex | The sex of a person | character: size 1, value M or F |
| DOB | DatesOfBirth | Possible values of staff birth dates | date, range from 1-Jan-20, format dd-mmm-yy |
| salary | Salaries | Possible values of staff salaries | monetary: 7 digits, range 6000.00–40000.00 |

Alternative Terminology for Relational Model

Table 3.1 Alternative terminology for relational model terms.

| Formal terms | Alternative 1 | Alternative 2 |
|--------------|---------------|---------------|
| Relation | Table | File |
| Tuple | Row | Record |
| Attribute | Column | Field |

Database Relations

- Relation schema
 - Named relation defined by a set of attribute and domain name pairs.
- Relational database schema
 - Set of relation schemas, each with a distinct name.

Properties of Relations

- Relation name is distinct from all other relation names in relational schema.
- Each cell of relation contains exactly one atomic (single) value.
- Each attribute has a distinct name.
- Values of an attribute are all from the same domain.

Properties of Relations

- Each tuple is distinct; there are no duplicate tuples.
- Order of attributes has no significance.
- Order of tuples has no significance, theoretically.

Relational Keys

- Superkey
 - An attribute, or a set of attributes, that uniquely identifies a tuple within a relation.
- Candidate Key
 - Superkey (K) such that no proper subset is a superkey within the relation.
 - In each tuple of R, values of K uniquely identify that tuple (uniqueness).
 - No proper subset of K has the uniqueness property (irreducibility).

Relational Keys

- Primary Key
 - Candidate key selected to identify tuples uniquely within relation.
- Alternate Keys
 - Candidate keys that are not selected to be primary key.
- Foreign Key
 - Attribute, or set of attributes, within one relation that matches candidate key of some (possibly same) relation.

Relational Integrity

- Null
 - Represents value for an attribute that is currently unknown or not applicable for tuple
 - Deals with incomplete or exceptional data.
 - Represents the absence of a value and is not the same as zero or spaces, which are values.

Relational Integrity

- Entity Integrity
 - In a base relation, no attribute of a primary key can be null.
- Referential Integrity
 - If foreign key exists in a relation, either foreign key value must match a candidate key value of some tuple in its home relation or foreign key value must be wholly null.

Relational Integrity

- Enterprise Constraints
 - Additional rules specified by users or database administrators.

