

The Relational Model

3

Database Models

Generally databases are based on one of the three models:

- *hierarchical* model
- *network* model
- *relational* model



- A database is a collection of interrelated data and the way data is related to each other depends upon the model being used.
- A database based on the network or hierarchical model is a non-relational database and a database based on the relational model is a relational database.
- A relational database is a persistent storage mechanism consisting of relations (or two-dimensional tables) having unique names.

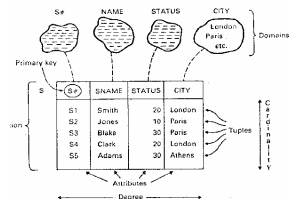
4

Foundation of Relational Model

- The relational model is based on *set theory* and *predicate logic*.
- Relational Algebra defines operations on relations.

5

Relations: Basic of Relational Model



- The relational model represents both data and the relationships among those data using *relations*.
- A **relation** is used to represent information about any entity (such as book, publisher, author, etc.) and its relationship with other entities in the form of *attributes* (or columns) and *tuples* (or rows).
- A relation is comprised of a *relation schema* and a *relation instance*.
- A relation schema (relation intension) defines the attributes of a table.
- A relation instance (relation extension) is a two-dimensional table with a time-varying set of *tuples*.

6

Components of Relational Model

- The relational model is based on three components:
 - *structural*
 - entities and their relationships
 - *manipulative*
 - operations on relations (tables)
 - relational algebra
 - *integrity*
 - rules on entities and relationships

Relation Schema

A **relation schema** consists of a relation name R and a set of attributes (or fields) A_1, A_2, \dots, A_n . Each attribute A_i has a value from its domain D_i .

Example relation schemas of a relational database:

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Project (pname, budget, pmgrID)
Employee (EmplID, name, email)
Assignment (pname, EmplID)
```

Relation Instances

- Relation instances or tuples are sets of values for each attribute A_i from its domain D_i of the relation R .

Tuples (instances, rows)	Relation/Table: <i>Project</i>		
	Attributes (columns)		
	pname	budget	pmgr
	GOTAM	153,000	4553
	MONTESAT	75,450	4598
	NASA-B	789,500	3387

9

Properties of Relations

- The number of attributes in a relation is referred as its **degree** or **arity**.
- The number of tuples in a relation is called the relation's **cardinality**.
- Since a relation is a set of tuples and a set is unordered, tuples in a relation do not have any specific order.

10

Atomicity of Values & *Null* Values

- The relational model assumes that the tuples in a relation contain atomic values, *i.e.*, each A_i is a single value from its domain D_i .
- A relation does not allow composite and multivalued attributes.
- A non-existent or unknown value of an attribute is denoted as *null*.



11

Attribute Domain

- The domain of an attribute is the set of values that an instance of the attribute can take.
- Examples of domains:
 - all positive numbers
 - whole numbers greater than 1
 - name of a city in Germany
 - sequence of alphabetic characters
 - course number of scheduled classes



12

Uniqueness of Tuples

No two tuples can be identical in a relation.

- Since a relation is a set of tuples and a set cannot have duplicate elements, each tuple in a relation must be uniquely identified by its contents.
- Let $R(A_1, A_2, \dots, A_n)$ and let $r_1(a_{11}, a_{12}, \dots, a_{1n})$ and $r_2(a_{21}, a_{22}, \dots, a_{2n})$ be two instances of the relation R . If $a_{1i} = a_{2i}$ for each attribute A_i , then $r_1 = r_2$.

13



Summary, Review, & Questions...

14