



Fundamentals of Relational Database

Yong Choi
School of Business
CSUB, Bakersfield



Study Objectives

- Understand the relational database model's basic components are entities and their attributes, and relationships among entities
- Identify how entities and their attributes are organized into tables
- Understand concept of integrity rules of relational database



Relational Model

- In the relational data model the database is represented as a group of related tables.
- The relational data model was introduced in 1970 by E. F. Codd of IBM.
- It is currently the most popular model. The mathematical simplicity and ease of visualization of the relational data model have contributed to its success.



Definitions of Terminology

Formal relational term	Informal equivalents
relation	table
tuple	row or record
cardinality	number of rows
attribute	column or field
degree	number of columns
(unique) identifier	Primary key
domain	pool of legal values



Characteristics of a Relation (table)

- Two-dimensional structure with rows and columns
- A relation represent a single entity
- Each table must have an attribute to uniquely identify each row
- Column values all have same data type
- Order of the rows and columns is immaterial to the DBMS



Properties of a Relation

- Based on the set theory

1. There are no duplicate tuples (rows).

- The body of the relation is a mathematical set (i.e., a set of tuples), and sets in mathematics by definition do not include duplicate elements.
- If a "relation" contains duplicate tuples, then it is not a relation.



Properties of a Relation

2. Tuples (rows) are unordered (top to bottom).

- Sets in mathematics are not ordered. So, even if a relation A's tuples are reversely ordered, it is still the same relation.
- Thus, **there is no such thing as "the 5th tuple" or the last tuple**. In other words, there is no concept of positional addressing.



Properties of a Relation

3. Attributes (columns) are unordered (left to right).
 - The heading of a relation is also defined as a set.
 - There is no such thing as "5th attribute (column)" or the last attribute.



Properties of a Relation

4. All attribute values are **atomic**.

- At every row-and-column position within the table, there always exists **precisely one value**, never a list of values. Or equivalently, relations do not contain repeating groups.
- A relation satisfying this condition is said to be in First Normal Form.



Primary Key

- A PK is an attribute, or collection of attributes, whose values **uniquely** identify each tuple in a relation.
- To being unique, a PK must be **minimal** (contain no unnecessary attributes)
- and must **not change in value**.
- And **cannot be Null**



Primary Key (con't)

- One attribute, or collection of attributes, that can serve as a PK is called **candidate key**,
- And the remaining keys that cannot be used as a PK are called **alternate key**.



Candidate Key and Alternate key

State

StateAbbrev	StateName	StateNumber	StateBird	StatePopulation
CT	Connecticut	5	American Robin	3,287,116.00
MI	Michigan	26	Robin	9,295,297.00
SD	South Dakota	40	Phesant	696,004.00
TN	Tennessee	16	Mockingbird	4,877,185.00
TX	Texas	28	Mockingbird	16,986,510.00

- Could any attribute (column) serve as the PK?
 - candidate key
- Is there any attribute that should not be served as the PK?
 - alternate key



Entity Integrity Rule

- Guarantees that each entity will have a unique identity and ensures that foreign key values can properly reference primary key values.
- Requirement
 - No component of the primary key is allowed to accept nulls.
 - By "null" here, we mean that information is missing for some reason.



Foreign Key

- An attribute in one table whose values must either match the primary key in another table or be null.
- Attribute FK of base relation R2 is a foreign key if and only if it satisfies the following two time-independent properties:
 - Each value of FK is either wholly null or wholly non-null.
 - Each non-null value of FK is identical to the value of PK in some tuple of R1.

Foreign Key (con't)

Table name: PRODUCT

Database name: CH2_SALE_CO

Primary key: PROD_CODE

Foreign key: VEND_CODE

	PROD_CODE	PROD_DESCRIPTOR	PROD_PRICE	PROD_ON_HAND	VEND_CODE
▶ +	001278-AB	Claw hammer	\$12.95	23	232
+	123-21UUY	Houselite chain saw, 16-in. bar	\$189.99	4	235
+	QER-34256	Sledge hammer, 16-lb. head	\$18.63	6	231
+	SRE-657UG	Rat-tail file	\$2.99	15	232
+	ZZX/3245Q	Steel tape, 12-ft. length	\$6.79	8	235

Table name: VENDOR

Primary key: VEND_CODE

Foreign key: none

link

	VEND_CODE	VEND_CONTACT	VEND_AREACODE	VEND_PHONE
▶ +	230	Shelly K. Smithson	608	555-1234
+	231	James Johnson	615	123-4536
+	232	Annelise Crystall	608	224-2134
+	233	Candice Wallace	904	342-6567
+	234	Arthur Jones	615	123-3324
+	235	Henry Ortozo	615	899-3425



Referential Integrity Rule

- The database must not contain any unmatched foreign key values.
- Just as primary key values represent entity identifiers, so foreign key values represent entity references.
- The referential integrity rule simply says that if B references A, then A must exist.

Referential Integrity Enforcement



- No action
 - Nothing happen in the reference value
- Restriction:
 - does not allow any deletion
- Nullification:
 - if value is deleted, reference value will set to be null.
- Cascading:
 - if value is deleted, reference value will also be deleted.
 - if value is updated, reference value will also be updated.
- Default value:
 - if value is deleted, reference value will be default value, which is provided by the system.



Access DB Referential Integrity

- Cascade Update Related Fields
 - Change of PK values in primary table → automatic change of FK values
- Cascade Delete Related Fields
 - Delete of a record in the primary table → automatic delete of all records in the related table that have a matching FK value