Chaper 3 The Relational Model And Normalization

1. Relational Model Terminology

Terms	Info
Relation	关系
Functional dependency . Determinant	函数依赖.行列式
Candidate key	候选码
Composite key	复合码
Primary key	主码
Surrogate key	代理码
Foreign key	外码
Referential integrity constraint.Normal form	参照完整性约束.范式
Multivalued dependency	多值依赖

1. Relation
    - In fact, a relation is a special case of a table. This means that all relations are tables, but not all tables are relations.

Characteristics of Relations
Rows contains data about an entity
Columns contain data about attributes of the entities
All entries in a column are of the same kind. Each column has a unique name
Cells of the tables hold a single value
The order of the column is unimportant
The order of the rows is unimportant
No two rows may be identical

> A relation has a specific definition, there is description:
>
> - First, the rows of the table must store data about an entity and the columns of the table must store data about the character-istics of those entities.
> - Further, in a relation all of the values in a column are of the same kind.
> - Also, the names of the columns are unique; no two columns in the same relation may have the same name.
> - Each cell of a relation has only a single value or item; multiple entries are not allowed.
> - In a relation, the order of the rows and the order of the columns are immaterial. No information can be carried by the ordering of rows or columns.
> - For a table to be a relation no two rows can be identical.
>
> > Even though every cell of a relation must have a single value, this does not mean that all values must have the same length.

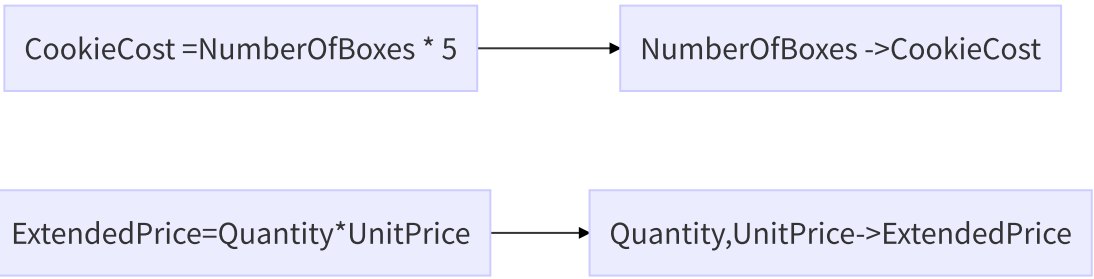
2. Alternative Terminology

> The columns of a relation are called attributes, and the rows of a relation are called tuples

Table	Column	Row
Relation	Attribute	Tuple
File	Field	Record

3. Functional Dependencies

- Functional dependencies are the heart of the database design process



> NumberOfBoxes determines CookieCost

1. Functional Dependencies That Are Not Equations
    - In general, a functional dependency exists when the value of one or more attributes determines the value of another attribute. Many functional dependencies exist that do not involve equations.
    - The only reason for having relations is to store instances of functional dependencies.

2. Composite Functional Dependencies
    + The determinant of a functional dependency can consist of more than one attribute

4. Finding Functional
5. Keys

- In general, a key is a combination of one or more columns that is used to identify particular rows in a relation. Keys that have two columns or more are called composite keys.

1. Candidate keys

- A candidate key is a determinant that determines all of the other columns in a relation.
- Candidate keys identify a unique row in a relation. Given the value of a candidate key, we can find one and only one row in the relation that has that value.

2. Primary Keys

- When designing a database, one of the candidate keys is selected to be the primary key.
- The primary key can have one column or it can be a composite.

> we will underline the column(s) that comprise the primary key
>
> > What do you do if a table has no candidate keys? In that case, define the primary key as the collection of all of the columns in the table.
> >
> > Thus, the combination of all columns is always a candidate key.

3. Surrogate Keys

- A surrogate key is an artificial column that is added to a table to serve as the primary key. The DBMS assigns a unique value to a surrogate key when the row is created. The assigned value never changes. Surrogate keys are used when the primary key is large and unwieldy.
- Create a surrogate key to use numeric key

> Note that surrogate key values are artificial and have no meaning to the users. In fact, surrogate key values are normally hidden in forms and reports.

4. Foreign Keys

- A foreign key is a column or composite of columns that is the primary key of a table other than the one in which it appears.
- We need to ensure that the values of a foreign key match a valid value of a primary key.Thus, we create a referential integrity constraint, which is a statement that limits the values of the foreign key.
    - SKU in ORDER_ITEM must exist in SKU in SKU_DATA

2. Normal Forms

1. Modification Anomalies
    1. Deletion anomaly
    - When we delete one row, the structure of this table forces us to lose facts about two different things
    2. Insertion anomaly
    - The structure of this table forces us to enter facts about two entities when we just want to enter facts about one.

3. Update anomaly
    - It might be very difficult to detect this error.
2. Normalization Categories
    - Normalization theory can be divided into three major categories.
        - Some anomalies arise from functional dependencies

> BCNF, 3NF, and 2NF, are all concerned with anomalies that are caused by functional dependencies. A relation that is in BCNF has no modification anomalies from functional dependencies.

        - Some arise from multivalued dependencies

> Those anomalies can be eliminated by placing each multivalued dependency in a relation of its own, a condition known as 4NF.

        - Some arise from data constraints and odd conditions

> These problems involve specific, rare, and even strange data constraints.

Source of Anomally	Normal Forms	Design Principles
Functional dependencies	1NF,2NF,3NF,BCNF	BCNF:Design tables so that every determinant is a candidate key
multivalued dependencies	4NF	4NF:Move each multivalued dependencies to table of its own
Data constraints and oddities	5NF,DK/NF	DK/NF:Make every constraint a logical consequence of candidate keys and domains

3. From First Normal Form to Boyce-Codd Normal

- This means that:
- The cells of a table must be a single value, and neither repeating groups nor arrays are allowed as values
- All entries in a column must be of the same data type
- Each column must have a unique name, but the order of the columns in the table is not significant
- No two rows in a table may be identical, but the order of the rows is not significant

4. Second Normal Form

- A relation is 2NF if and only if it is in 1NF and all non-key attributes are determined by the entire primary key.
- This means that if the primary key is a composite primary key, then no non-key attribute can be determined by an attribute or set of attrib- utes that make up only part of the key.

> Note that the only way a non-key attribute can be dependent on part of the primary key is if there is a composite primary key. This means that relations with single-attribute primary keys are automatically in 2NF

5. Third Normal Form

- A relation is in 3NF if and only if it is in 2NF and there are no non-key attributes determined by another non-key attribute.

> A relation is in 3NF if and only if it is in 2NF and it has no transitive dependencies.

- To put the relation into 3NF, we will have to move the columns of the functional dependency into a separate relation while leaving the determinant in the original relation as a foreign key.

6. Boyce-Codd Normal Form

- A relation is in BCNF if and only if it is in 3NF and every determinant is a candidate key.