Lesson 3: Relational Model and Relational Algebra – Part -I

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Learning Objectives:

Student should be able to:

1. Understand the why relational model so important
2. Be able to describes the essential features of the relational model
3. Map an EER model into a relational model
4. Read and understand the meaning of a query expressed in relational algebra
5. Understand how a relational algebra expression interrogates a relational database
3.0 Relational Model and Relational Algebra

Concepts and Components of a Relation

1. Relation
2. Attributes
3. Domain
4. Tuple
5. Cardinality
6. Degree
Definition of Keys

Candidate Key: is a set of one or more attributes whose value can uniquely identify an entity in the entity set, and any attribute in the candidate key cannot be omitted without destroying the uniqueness property of the candidate key.

Example,

DEPARTMENT

<table>
<thead>
<tr>
<th>Dept Name</th>
<th>DeptNo</th>
<th>OfficePhone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>111</td>
<td>1234</td>
</tr>
<tr>
<td>Accountancy</td>
<td>112</td>
<td>1235</td>
</tr>
<tr>
<td>Economics</td>
<td>113</td>
<td>1236</td>
</tr>
</tbody>
</table>

In this example, both DeptName and DeptNo are candidate keys of Department Table (Entity Set).
In building a database in a database software, the software will only allow to use one candidate key to be the unique identifier of an entity for an entity set.

**Primary Key:** is the candidate key whose values will be used to uniquely identify the records in the relation. In other words, the key that is chosen by the database designer as the unique identifier of an entity. The database designer chooses only one candidate key as the primary key in building the system.

DeptName and DeptNo are both candidate keys of Department entity set. The database designer can choose either one as the primary key.
**Composite Key:** Composite keys are primary keys that are made of more than one attribute.

Primary Key of the **Room** Entity is combination of *Name* and *Room_No* which is called composite Key (*Name, Room_No*)
**Super Key:** Overall, super key is the broadest unique identifier; candidate key is a subset of super key; and primary key is a subset of candidate key.

*In other words, Candidate Key with some super flow attributes.*

In practice, we would *first look for super keys*. Then we look for *candidate keys* based on experience and common sense. If there is only one candidate key, it naturally will be designated as the *primary key*. If we find more than one candidate key, then we can designate any one of them as primary key.
For example, think about the mental process of finding the primary key of the following entity set.

CAR

- Reg_No
- Chasse No
- Model
- Color
- Year
Concept of NULL Values

• **NULLS are intended to deal with missing information**
• **A NULL does not mean a zero, a blank, or a space. Most of the times it means “not defined” or “not applicable”**
• **Integrity rules will define which attributes can take NULL and which cannot**
**Integrity Rules**

- **Entity Integrity Constraint**
  The values in primary key cannot be NULL and cannot be duplicated

- **Referential Integrity Constraints**
  The value in the foreign key must be either NULL or must have a corresponding value in the referenced primary key

*Note: Foreign keys are the primary key of another entity to which an entity has a relationship*
Constructing a Relational Database using an EER Model: Conversion to Relations

1) Mapping regular entity types

➢ Composite attributes: use only their simple, component attributes
➢ Multi-valued attributes: become a separate relation with a foreign key taken from the superior entity
2) **Mapping weak entity types**

➢ Becomes a separate relation with a foreign key taken from the superior entity
3)  Mapping of Binary (one to one relationship)

We can do either:

(1) put the primary key of one entity set into the table of the other side.

**Exception**
If one entity set occurs prior to the other entity set, you can only put the primary key of the first entity set into the table of the second entity set, and NOT the other way around.

Or

(2) create a new table that contains the primary keys of both entity sets.
**Manager**

- **Emp No**
- **Name**
- **Start Date**

**Department**

- **Dept No**
- **DName**
- **Emp No**

The diagram shows a relationship between **Manager** and **Department** with a 1:1 relationship indicated by the diamond shape labeled "Manages."
4) **Mapping of Binary (1-M relationship)**

Put the primary key of the entity set on the “one” side into the table of the entity set on the “many” side.
5) Mapping of Binary (M-N relationship)

Requires a separate table (bridge) to represent the relationship. The primary key of this bridge table consists of the primary keys of the entity sets on both sides of the relationship.
6) **Mapping a Unary relationship**

![Diagram of a Unary relationship]

**EMPLOYEE**

<table>
<thead>
<tr>
<th>Emp_No</th>
<th>Name</th>
<th>Address</th>
<th>Emp_No</th>
</tr>
</thead>
</table>

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7) Mapping a Ternary relationship (N-ary)
8) Mapping of Super/Subtype relationship

- Create a separate relation for the supertype and each of the subtypes
- Assign common attributes to supertype
- Assign primary key and unique attributes to each subtype
- Assign an attribute of the supertype to act as subtype discriminator
EMPLOYEE

- Employee_Number
- Employee_Name
- Address
- Employee_Type
- Date_Hired

HOURLY_EMPLOYEE

- H_Employee_Number
- Hourly_Rate

SALARIED_EMPLOYEE

- S_Employee_Number
- Annual_Salary
- Stock_Options

CONSULTANT

- C_Employee_Number
- Contract_Number
- Billing_Rate