Chapter 9 Outline

- Relational Database Design Using ER-to-Relational Mapping

Review of Relation Schemas

- A relation schema \( R = (A_1, \ldots, A_n) \)

\[
\begin{align*}
\text{Student} &: \text{string}, \\
\text{SSN} &: \text{string}, \\
\text{HomePhone} &: \text{string}, \\
\text{Address} &: \text{string}, \\
\text{OfficePhone} &: \text{string}, \\
\text{Age} &: \text{integer}, \\
\text{GPA} &: \text{real}
\end{align*}
\]
Review of Relation Schemas

- A relation $r$ of the relation schema $R(A_1, A_2, \ldots, A_n)$ is a set of tuples $r=\{t_1, \ldots, t_n\}$
  - Each tuple $t = (v_1, \ldots, v_n)$
    - such that $v_i$ is in $\text{dom}(A_i)$
    - or $v_i$ is null
  - The $i$-th component of $t$ is $t[i]$

Mapping ER to Database Schema

Mapping ER to Database Schema
Mapping ER to Database Schema

- Fundamental building blocks in ER-diagrams:
  - Entities
    - Strong
    - Weak
  - Attributes
    - Simple
    - Composite
    - Multi-valued
  - Relationships
    - Cardinality
    - Participation

- Fundamental building blocks in relational databases:
  - Tables
  - Attributes
    - Primary keys
    - Secondary keys
    - Foreign keys
    - Non-key attributes
  - Data types

- Map entities and relationships from ER to tables in database schema
- Map attributes from ER to attributes in database schema
Mapping ER to Database Schema

- Mapping of entities
  - Regular
  - Weak
- Mapping of relationships
  - 1:1
  - 1:N
  - M:N
- Mapping of multivalued attributes
- Mapping of N-ary Relationship Types

Mapping of Regular Entities

- Create a table for each regular entity
- Use only simple attribute or the simple component of a composite attribute
- Determine a primary key
- If multiple keys, determine secondary keys
  - Can be useful for indexing

Example
Mapping of Weak Entities

- Create a table for each weak entity
- Use only simple attribute or the simple component of a composite attribute
- Include a foreign key attribute to owner entity
- Determine a primary key
  - Partial key plus foreign key to owner entity
- If the owner is also a weak entity, then append its owner’s primary key
Example

Mapping of M:N Relationship

- Create a table
- Include foreign key to the participating entities
  - These foreign keys form the primary key of the relationship

Example
Example

Mapping of 1:N Relationship

- Method 1:
  - Treat as M:N (is this a good way?)
- Method 2:
  - Make a foreign key for the entity on the N-side to point to the primary key of the entity on the 1-side.

Example
Example

Mapping of 1:1 Relationship

- Method 1:
  - Treat as M:N (is this a good way?)
- Method 2:
  - Treat as 1:N (is this a good way?)
- Method 3:
  - Make a foreign key in one entity to the primary key of another entity (is this a good way?)
  - Put all attributes of the relationship to the table describing the entity with the foreign key

Example
Mapping of Multivalued Attribute

- Create a table for each such attribute
  - Make a foreign key to the entity which this attribute belongs
  - Combine the foreign key and the attribute itself as the primary key of the table
Example

Mapping of N-ary Relationship

- Like binary relationship
  - Create a table
  - Make foreign key attributes to each of the participating entity
  - Combine these foreign keys to form the primary key

Example
ER to Relational Models

<table>
<thead>
<tr>
<th>ER/MODEL</th>
<th>RELATIONAL MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entity type</td>
<td>Entity relation</td>
</tr>
<tr>
<td>1:N or M:N relationship type</td>
<td>Foreign key (in relationship relation)</td>
</tr>
<tr>
<td>M:N relationship type</td>
<td>Relationship relation and two foreign keys</td>
</tr>
<tr>
<td>N:N relationship type</td>
<td>Relationship relation and n foreign keys</td>
</tr>
<tr>
<td>Simple attribute</td>
<td>Attribute</td>
</tr>
<tr>
<td>Composite attribute</td>
<td>Set of simple component attributes</td>
</tr>
<tr>
<td>Individual attribute</td>
<td>Relation and foreign key</td>
</tr>
<tr>
<td>Value set</td>
<td>Domain</td>
</tr>
<tr>
<td>Key attribute</td>
<td>Primary (or secondary) key</td>
</tr>
</tbody>
</table>

Example