Entity-Relationship Model

From Chapter 5, Kroenke book

Database Design Process

- Requirements analysis
- Conceptual design → data model
- Logical design
- Schema refinement: Normalization
- Physical tuning

Problem: University Database

- Divisions (Colleges)
- Departments
- Faculty
- Students

The College Report

<table>
<thead>
<tr>
<th>Department</th>
<th>Chairperson</th>
<th>Phone</th>
<th>Total Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>Jackson, Seymour P.</td>
<td>232-1841</td>
<td>318</td>
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<tr>
<td>Finance</td>
<td>HeuTeng, Susan</td>
<td>232-1414</td>
<td>211</td>
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<tr>
<td>Info Systems</td>
<td>Brammer, Nathaniel D.</td>
<td>236-0011</td>
<td>247</td>
</tr>
<tr>
<td>Management</td>
<td>Tutte, Christine A.</td>
<td>236-9988</td>
<td>184</td>
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<tr>
<td>Production</td>
<td>Barnes, Jack T.</td>
<td>236-1184</td>
<td>212</td>
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</tbody>
</table>

College of Business
Mary B. Jefferson, Dean
Phone: 232-1187
Campus Address:
Business Building, Room 100
The Department Report

Information Systems Department
College of Business
Chairperson: Brammer, Nathaniel D
Phone: 236-0011
Campus Address: Social Science Building, Room 213

<table>
<thead>
<tr>
<th>Professor</th>
<th>Office</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones, Paul D.</td>
<td>Social Science, 219</td>
<td>232-7713</td>
</tr>
<tr>
<td>Parks, Mary B</td>
<td>Social Science, 308</td>
<td>232-5791</td>
</tr>
<tr>
<td>Wu, Elizabeth</td>
<td>Social Science, 207</td>
<td>232-9112</td>
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</table>

The Department Major Report

Student Major List
Information Systems Department
Chairperson: Brammer, Nathaniel D Phone: 236-0011

<table>
<thead>
<tr>
<th>Major's Name</th>
<th>Student Number</th>
<th>Phone</th>
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<tr>
<td>Jackson, Robin R.</td>
<td>12345</td>
<td>237-8713</td>
</tr>
<tr>
<td>Lincoln, Fred J.</td>
<td>48127</td>
<td>237-8713</td>
</tr>
<tr>
<td>Madison, Janice A.</td>
<td>37512</td>
<td>237-8713</td>
</tr>
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</table>

The Student Acceptance Letter

Mr. Fred Parks
123 Elm Street
Los Angeles, CA 90002

Dear Mr. Parks,

You have been admitted as a major in the Accounting Department at Hignite University, starting in the Fall Semester, 2009. The office of the Accounting Department is located in the Business Building, Room 218. Your adviser is professor Elizabeth Johnson, whose telephone number is 230-8760 and whose office is located in the Business Building, Room 220. Please schedule an appointment with your adviser as soon as you arrive on campus.

Congratulations and welcome to Hignite University!

Sincerely,

Jan P. Smothers
President

JPSChip

Conceptual Design Overview

- Entity-Relationship (ER) Model
- What are the entities and relationships for given problem?
- What information about these entities and relationships should we store?
- What are the integrity constraints or business rules that hold?
Entities

- Something that can be identified and the users want to track
  - Entity class
  - Entity instance
- There are usually many instances of an entity in an entity class.

Attributes

- **Attributes**: describe the characteristics of an entity
- Entity instances:
  - Same attributes
  - Different values

Identifiers

- **Identifiers** = attributes that identify entity instances
- **Composite identifiers**: Identifiers that consist of two or more attributes

Relationships

- **Relationships**: associations between entities
  - No attributes
  - Relationship degree
Cardinality

- **Cardinality** means “count” - a number
- **Maximum cardinality**
- **Minimum cardinality**

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Maximum Cardinality

- **Maximum cardinality**: maximum number of entity instances that can participate in a relationship
  - One-to-One [1:1]
  - One-to-Many [1:N]
  - Many-to-Many [N:M]

---

Minimum Cardinality

- **Minimum cardinality**: minimum number of entity instances that must participate in a relationship.
  - zero [0] → optional
  - one [1] → mandatory

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HAS-A Relationships

- Previous relationships: **HAS-A relationships**:
  - Each entity instance has a relationship with another entity instance:
    - An EMPLOYEE has one BADGE
    - A BADGE has an assigned EMPLOYEE.
Data Modeling Notation:
ERwin

Class Exercise
- Give examples of the following relationships:
  - Maximum cardinality:
    - One-to-One
    - One-to-Many
    - Many-to-Many
  - Minimum cardinality
    - Optional-Optional
    - Mandatory-Optional
    - Mandatory-Mandatory

ID-Dependent Entities
- **ID-dependent entity**: entity (child) whose identifier includes the identifier of another entity (parent)
- Example:
  - BUILDING : APARTMENT
  - Minimum cardinality from the ID-dependent entity to the parent is always one

ID-Dependent Entities
A solid line indicates an identifying relationship
Weak Entities

- A **weak entity** is an entity whose existence depends upon another entity.
- All ID-Dependent entities are considered weak.
- But there are also non-ID-dependent weak entities.
  - The identifier of the parent does not appear in the identifier of the weak child entity.

Weak Entities (Continued)

A dashed line indicates a nonidentifying relationship. Weak entities must be indicated by an accompanying text box in Erwin - There is no specific notation for a nonidentifying but weak entity relationship.

ID-Dependent and Weak Entities

- **ID-Dependent** entity: Identifier depends (includes) another identifier
  - Identifying relationship
  - Ex: BUILDING:APARTMENT
- **Weak** entity: existence depends on another entity
  - Ex: MODEL:CAR
- ID-Dependent → Weak
- Weak does NOT imply ID-Dependent

Subtype Entities

- **Subtype entity**: special case of a **supertype entity**:
  - STUDENT: UNDERGRADUATE or GRADUATE
- Supertype:
  - all common attributes
  - [discriminator attribute]
- Subtypes:
  - specific attributes
Subtypes: Exclusive or Inclusive

- If subtypes are **exclusive**, one supertype relates to at most one subtype.
- If subtypes are **inclusive**, one supertype can relate to one or more subtypes.

Subtypes: IS-A relationships

- **IS-A relationships**: a subtype IS A supertype.
- Supertype and subtypes identifiers are **identical**
- Use subtypes if
  - Have attributes that make sense only for subtypes
  - Want to specify a relationship only for subtype or supertype

ER Summary

- Entities, attributes, identifiers
- HAS-A Relationships
  - Degree: binary, ternary
  - Maximum cardinality
  - Minimum cardinality
- ID-dependent entities; identifying relationships
- IS-A Relationships
  - Inclusive, Exclusive
Class Exercise

- Draw ER diagram for a database used to manage IT360 class (at least 3 entities)
  - Specify entities, attributes, identifiers
  - Specify relationships
  - Specify cardinalities for relationships

Class Exercise

- Drugwarehouse.com has offered you a free lifetime supply of prescription drugs (no questions asked) if you design its database schema. Given the rising cost of health care, you agree. Here is the information that you gathered:
  - Patients are identified by their SSN, and we also store their names and age
  - Doctors are identified by their SSN, and we also store their names and specialty
  - Each patient has one primary care physician
  - Each doctor has at least one patient