Chapter 3 – Part 2
Data Modeling Using the Entity-Relationship (ER) Model

SUMMARY OF ER-DIAGRAM NOTATION FOR ER SCHEMAS

COMPANY ER DIAGRAM
The COMPANY conceptual scheme in UML class diagram notation.

Structural Constraints – one way to express semantics of relationships

Structural constraints on relationships:
- Cardinality ratio (of a binary relationship): 1:1, 1:N, N:1, or M:N
  SHOWN BY PLACING APPROPRIATE NUMBER ON THE LINK.
- Participation constraint (on each participating entity type): total (called existence dependency) or partial.
  SHOWN BY DOUBLE LINING THE LINK

NOTE: These are easy to specify for Binary Relationship Types.

Alternative (min, max) notation for relationship structural constraints:
- Specified on each participation of an entity type E in a relationship type R
- Specifies that each entity e in E participates in at least min and at most max relationship instances in R
- Default (no constraint): min=0, max=n
- Must have min ≤ max, min ≥ 0, max ≥ 1
- Derived from the knowledge of mini-world constraints

Examples:
- A department has exactly one manager and an employee can manage at most one department.
  - Specify (0,1) for participation of EMPLOYEE in MANAGES
  - Specify (1,1) for participation of DEPARTMENT in MANAGES
- An employee can work for exactly one department but a department can have any number of employees.
  - Specify (1,1) for participation of EMPLOYEE in WORKS_FOR
  - Specify (0,n) for participation of DEPARTMENT in WORKS_FOR
Relationships of Higher Degree

- Relationship types of degree 2 are called **binary**
- Relationship types of degree 3 are called **ternary** and of degree n are called **n-ary**
- In general, an n-ary relationship **is not** equivalent to n binary relationships
Data Modeling Tools

A number of popular tools that cover conceptual modeling and mapping into relational schema design. Examples: ERWin, S- Designer (Enterprise Application Suite), ER- Studio, etc.

POSITIVES: serves as documentation of application requirements, easy user interface - mostly graphics editor support

Problems with Current Modeling Tools

- DIAGRAMMING
  - Poor conceptual meaningful notation.
  - To avoid the problem of layout algorithms and aesthetics of diagrams, they prefer boxes and lines and do nothing more than represent (primary-foreign key) relationships among resulting tables. (a few exceptions)

- METHODOLOGY
  - lack of built-in methodology support.
  - poor tradeoff analysis or user-driven design preferences.
  - poor design verification and suggestions for improvement.

Some of the Currently Available Automated Database Design Tools

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<thead>
<tr>
<th>COMPANY</th>
<th>TOOL</th>
<th>FUNCTIONALITY</th>
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<tr>
<td>Embarcadero</td>
<td>ER Studio</td>
<td>Database Modeling, Object Modeling, Structural</td>
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<td>Analysis/Design</td>
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<td>DB Artisan</td>
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<td>Oracle</td>
<td>Developer 2000 and</td>
<td>Database modeling, application development</td>
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<td></td>
<td>Designer 2000</td>
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<td>Popsin Software</td>
<td>System Architect 2001</td>
<td>Data modeling, object modeling, structural</td>
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<tr>
<td>Platinum Technology</td>
<td>Enterprise Modeling Suite, Erwin, BPWin, Paradigm Plus</td>
<td>Data process and component modeling</td>
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<td>Persistence Inc.</td>
<td>Powerwin</td>
<td>Mapping from O-O to relational model</td>
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<tr>
<td>Rational</td>
<td>Rational Rose</td>
<td>Modeling in UML and application generation in C++ and JAVA</td>
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<tr>
<td>Rogue Ware</td>
<td>RW Metro</td>
<td>Mapping from O-O to relational model</td>
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<td>Revolution Ltd.</td>
<td>Kcase</td>
<td>Conceptual modeling up to code maintenance</td>
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<tr>
<td>Sybase</td>
<td>Enterprise Application Suite</td>
<td>Data modeling, business logic modeling</td>
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<tr>
<td>Vico</td>
<td>Vico Enterprise</td>
<td>Data modeling, design and reengineering Visual Basic and Visual C++</td>
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The entity relationship model in its original form did not support Specialization, Generalization, and Abstraction.
Extended Entity-Relationship (EER) Model

- Incorporates Set-subset relationships
- Incorporates Specialization/Generalization Hierarchies

NEXT CHAPTER ILLUSTRATES HOW THE ER MODEL CAN BE EXTENDED WITH
- Set-subset relationships and
- Specialization/Generalization Hierarchies and how to display them in EER diagrams