

Entity-Relationship Model

Chapter 3, Part 1

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

College of Business Mary B. Jefferson, Dean			
Phone: 232-1187		Campus Address: Business Building, Room 100	
<u>Department</u>	<u>Chairperson</u>	<u>Phone</u>	<u>Total Majors</u>
Accounting	Jackson, Seymour P.	232-1841	318
Finance	HeuTeng, Susan	232-1414	211
Info Systems	Brammer, Nathaniel D.	236-0011	247
Management	Tuttle, Christine A.	236-9988	184
Production	Barnes, Jack T.	236-1184	212

The Department Report

Information Systems Department College of Business		
Chairperson:	Brammer, Nathaniel D	
Phone:	236-0011	
Campus Address:	Social Science Building, Room 213	
<u>Professor</u>	<u>Office</u>	<u>Phone</u>
Jones, Paul D.	Social Science, 219	232-7713
Parks, Mary B	Social Science, 308	232-5791
Wu, Elizabeth	Social Science, 207	232-9112

The Department Major Report

Student Major List Information Systems Department		
Chairperson:	Brammer, Nathaniel D	Phone: 236-0011
<u>Major's Name</u>	<u>Student Number</u>	<u>Phone</u>
Jackson, Robin R.	12345	237-8713
Lincoln, Fred J.	48127	237-8713
Madison, Janice A.	37512	237-8713

The Student Acceptance Letter

Mr. Fred Parks
123 Elm Street
Los Angeles, CA 98002

Dear Mr. Parks:

You have been admitted as a major in the **Accounting** Department at Highline University, starting in the Fall Semester, 2005. The office of the Accounting Department is located in the **Business Building, Room 210**.

Your adviser is professor **Elizabeth Johnson**, whose telephone number is 232-8740 and whose office is located in the **Business Building, Room 227**. Please schedule an appointment with your adviser as soon as you arrive on campus.

Congratulations and welcome to Highline University!

Sincerely,

Jan P. Smathers
President

JPS/rkp

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.

CUSTOMER Entity

CustomerNumber
CustomerName
Street
City
State
Zip
ContactName
Email

Two CUSTOMER Instances

1234 Ajax Manufacturing 123 Elm Street Memphis TN 32455 P_Schwartz P_S@Ajax.com	99890 Jones Brothers 434 10th Street Boston MA 01234 Fritz Billingsley Fritz@JB.com
--	--

Attributes

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

EMPLOYEE

EmployeeNumber

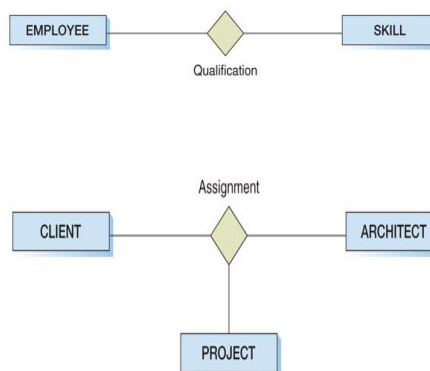
EmployeeName
Phone
Email
HireDate
ReviewDate

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**

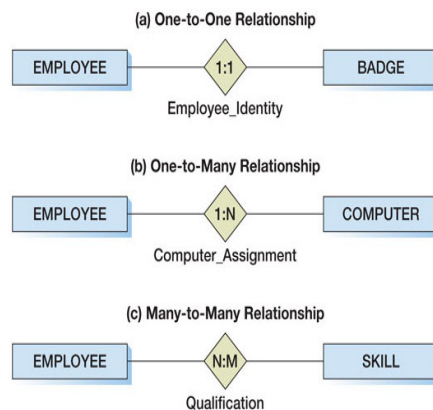


Cardinality

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

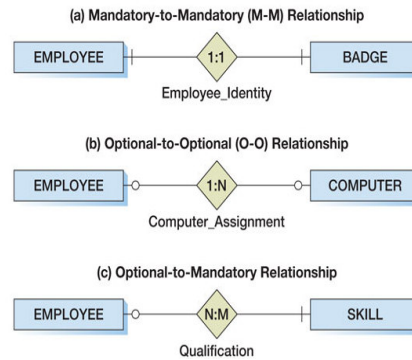
Maximum Cardinality

- **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**



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



ERwin Symbol Use	Meaning
Oval with hash mark	0 or 1 entities are allowed
Hash mark alone	Exactly 1 entity is allowed
Hash mark with crow's foot	1 or more entities are allowed
Oval, hash mark, and crow's foot	0, 1, or more entities are allowed

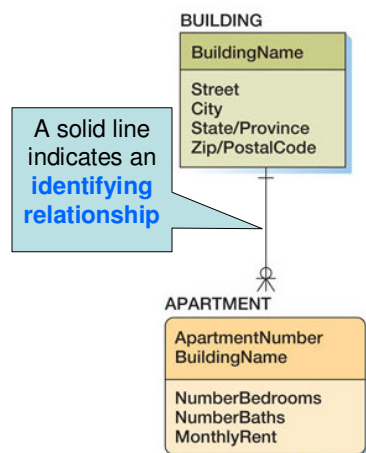
Class Exercise

- 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

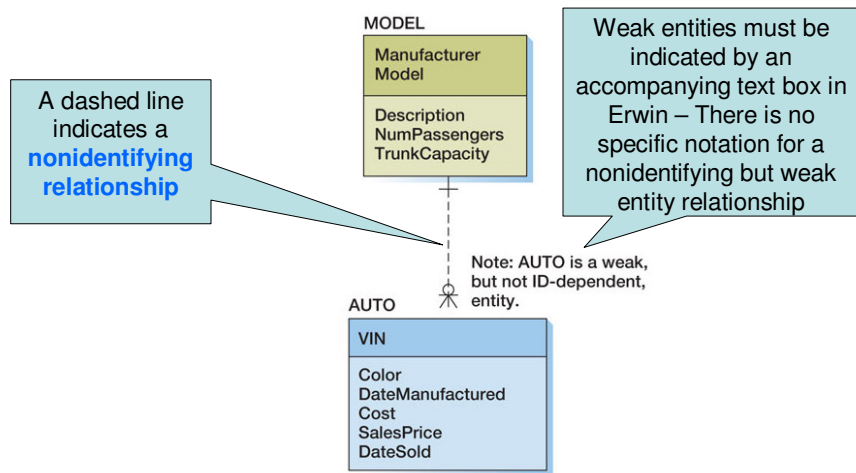
ID-Dependent Entities



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)

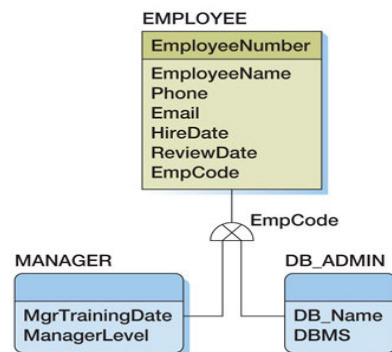


ID-Dependent and Weak Entities

- **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

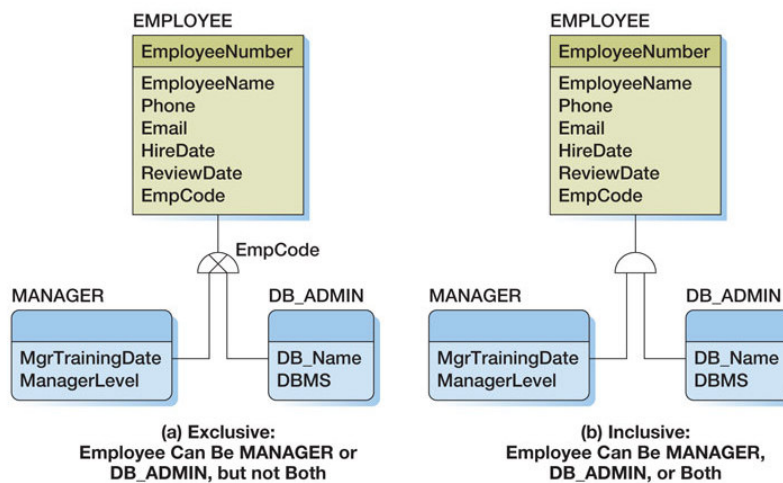
- **Subtype entity**: special case of a **supertype entity**:
 - STUDENT : UNDERGRADUATE or GRADUATE
- **Supertype**:
 - all common attributes
 - [**discriminator** attribute]
- **Subtypes**:
 - specific attributes



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: Exclusive or Inclusive



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 life-time 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