

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

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

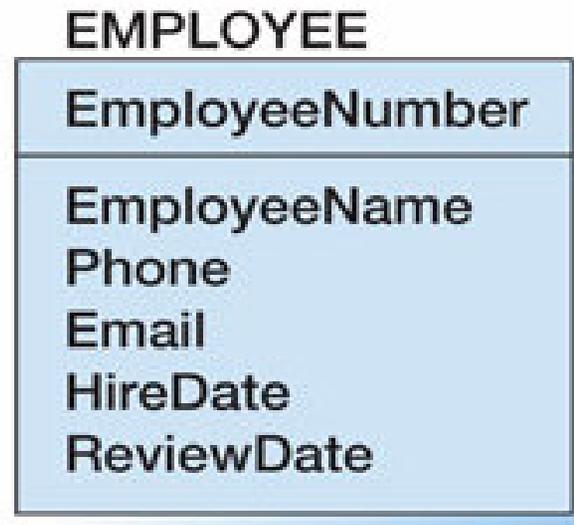


Two CUSTOMER Instances



Attributes

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

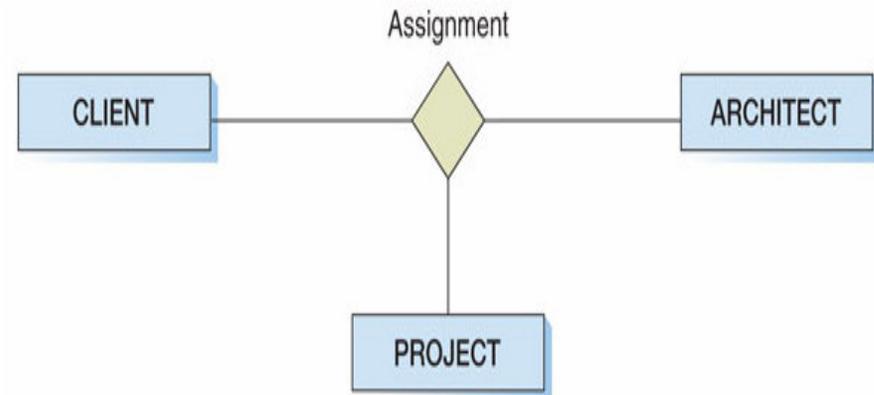


Identifiers

- **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**

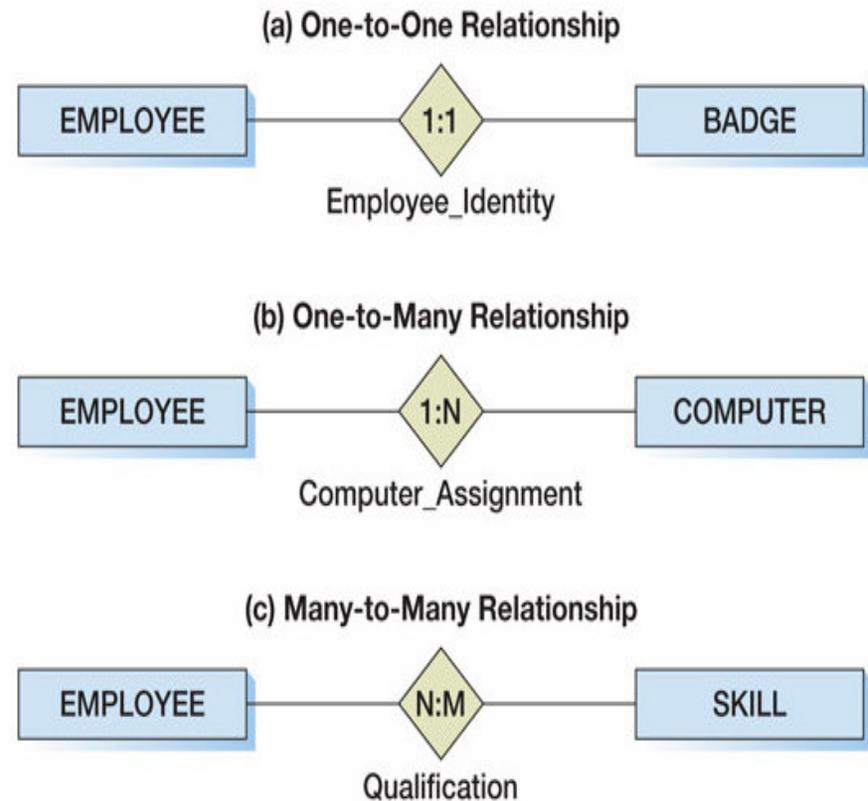


Cardinality

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

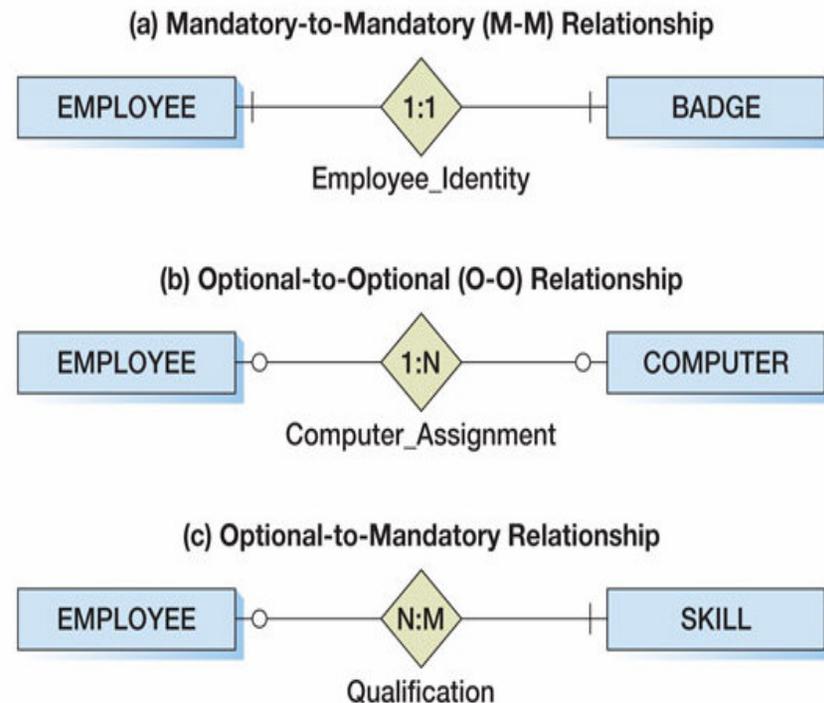
Maximum Cardinality

- **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

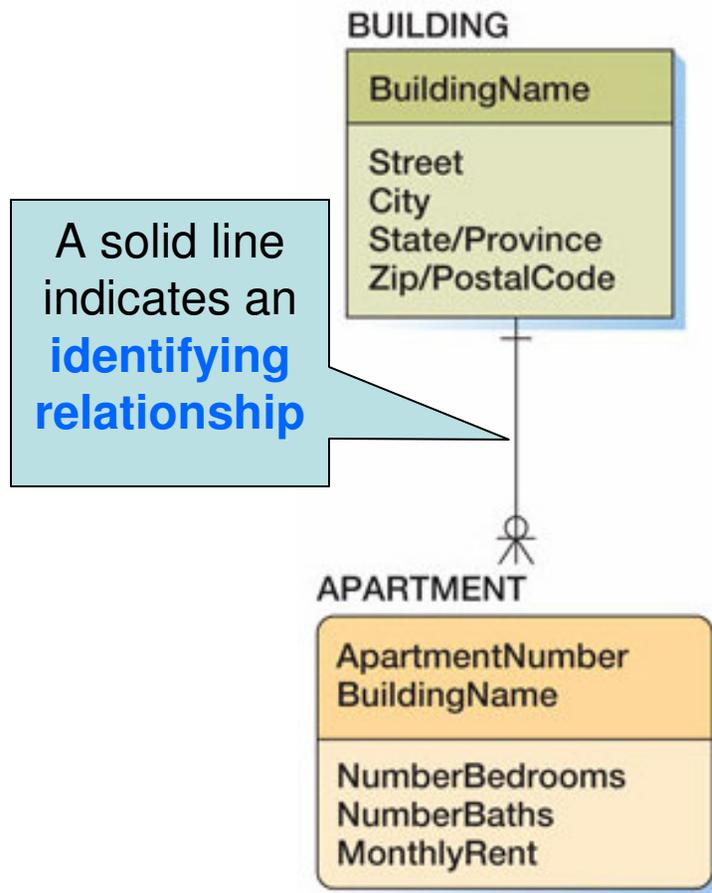
Class Exercise

- 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

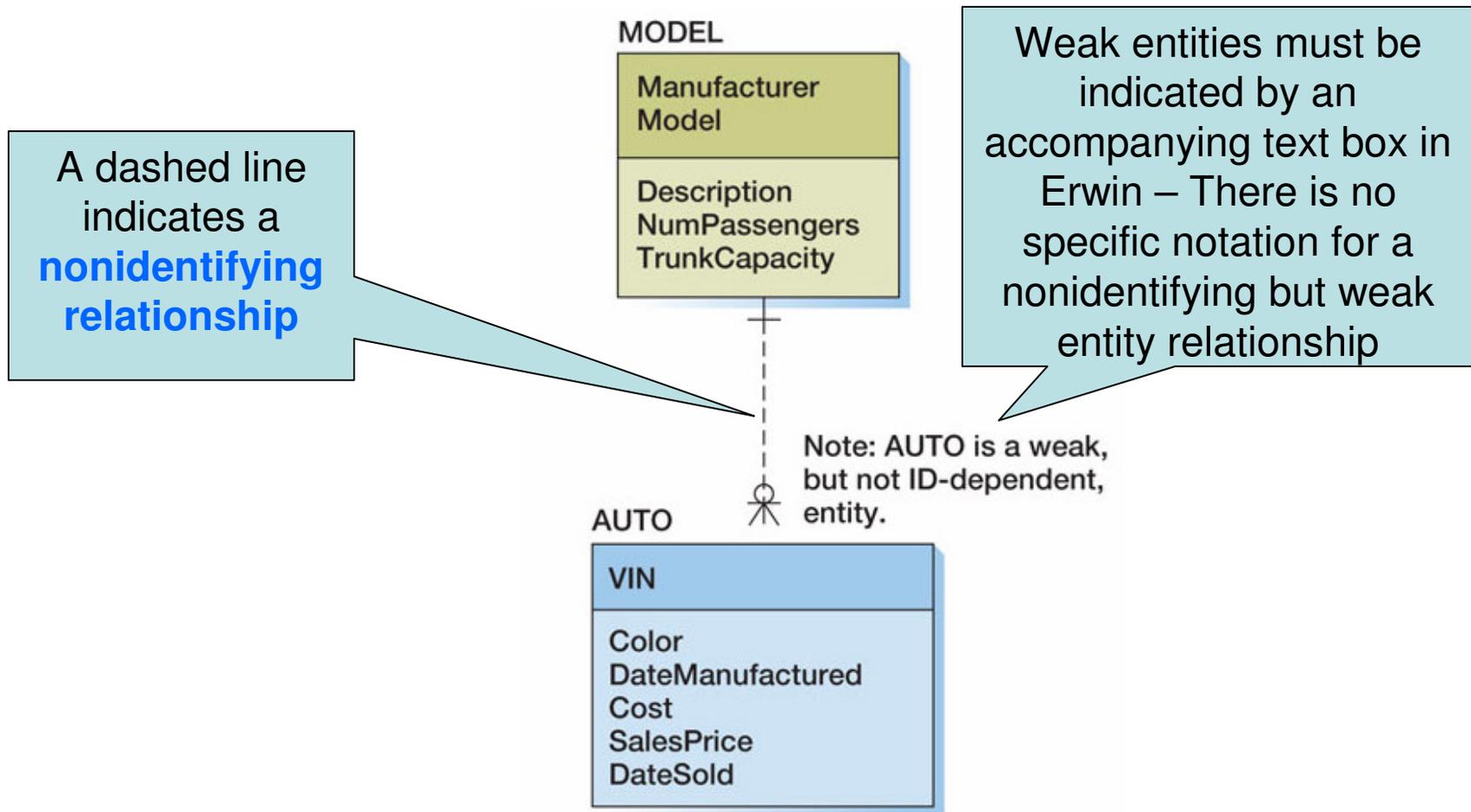
ID-Dependent Entities



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)

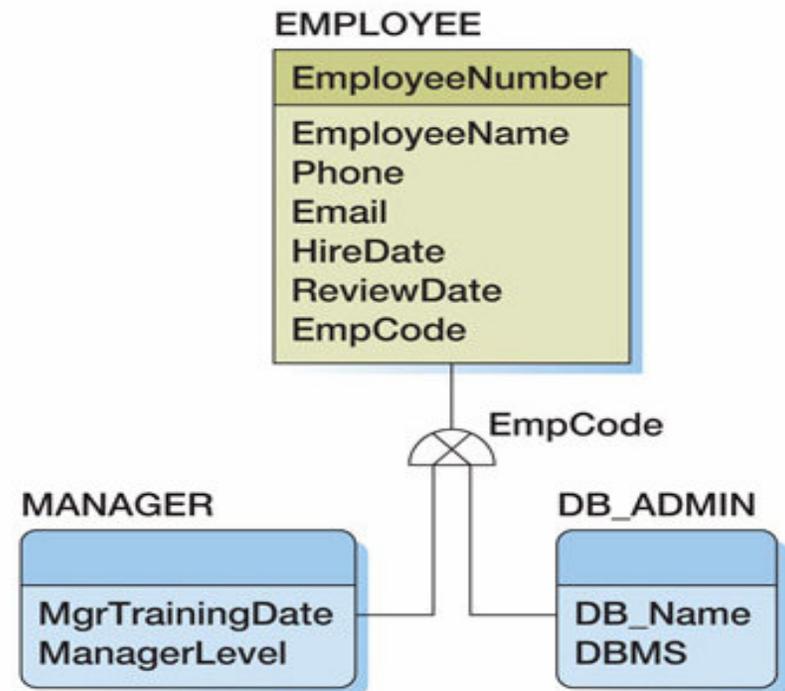


ID-Dependent and Weak Entities

- **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

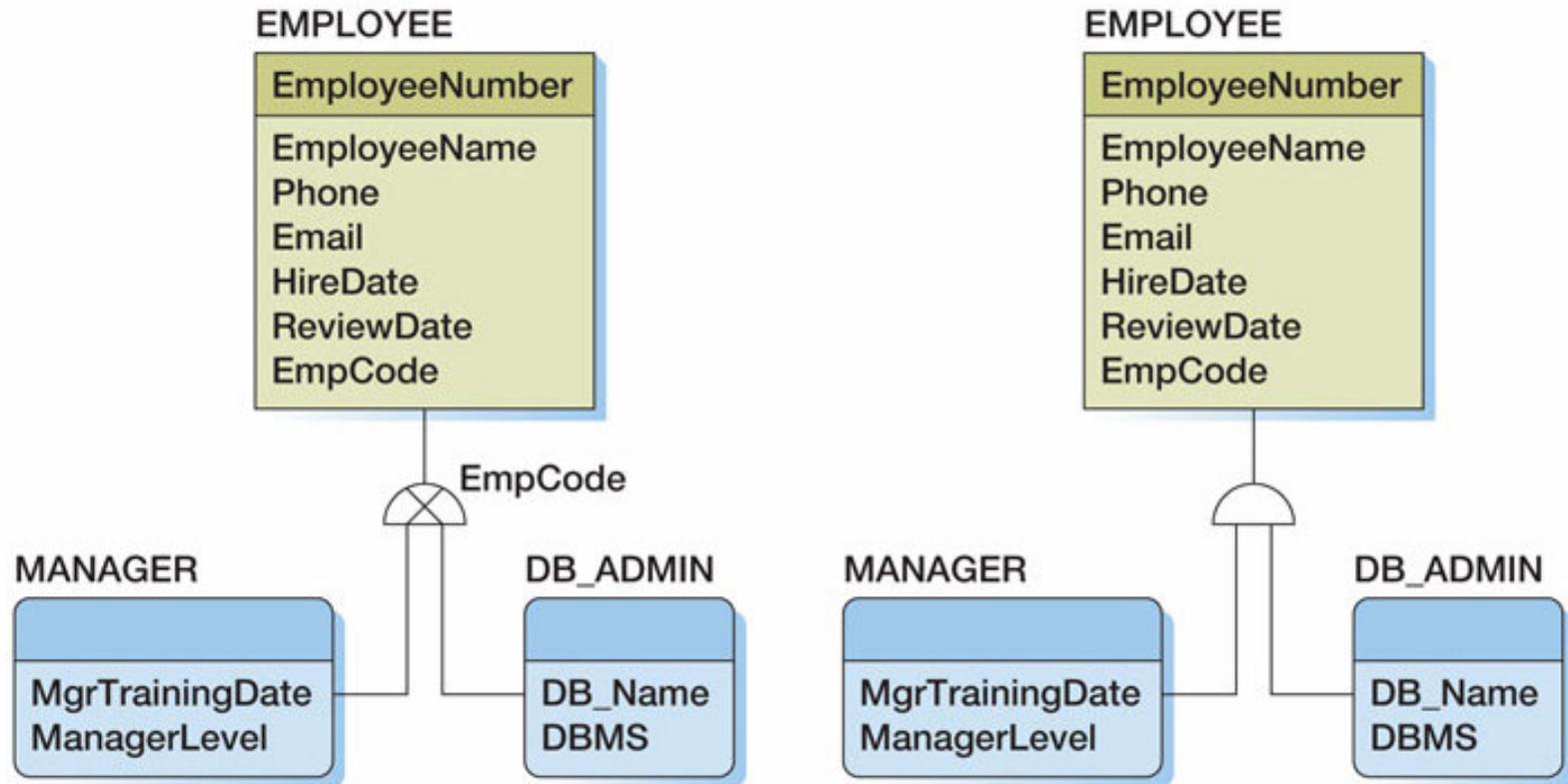
- **Subtype entity:** special case of a **supertype entity**:
 - STUDENT :
 UNDERGRADUATE or
 GRADUATE
- Supertype:
 - all common attributes
 - [**discriminator** attribute]
- Subtypes:
 - specific attributes



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



(a) Exclusive:
Employee Can Be MANAGER or
DB_ADMIN, but not Both

(b) Inclusive:
Employee Can Be MANAGER,
DB_ADMIN, or Both

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
- Weak entities
 - 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