Information And Database Management Systems (CSE 227)

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Acknowledgements

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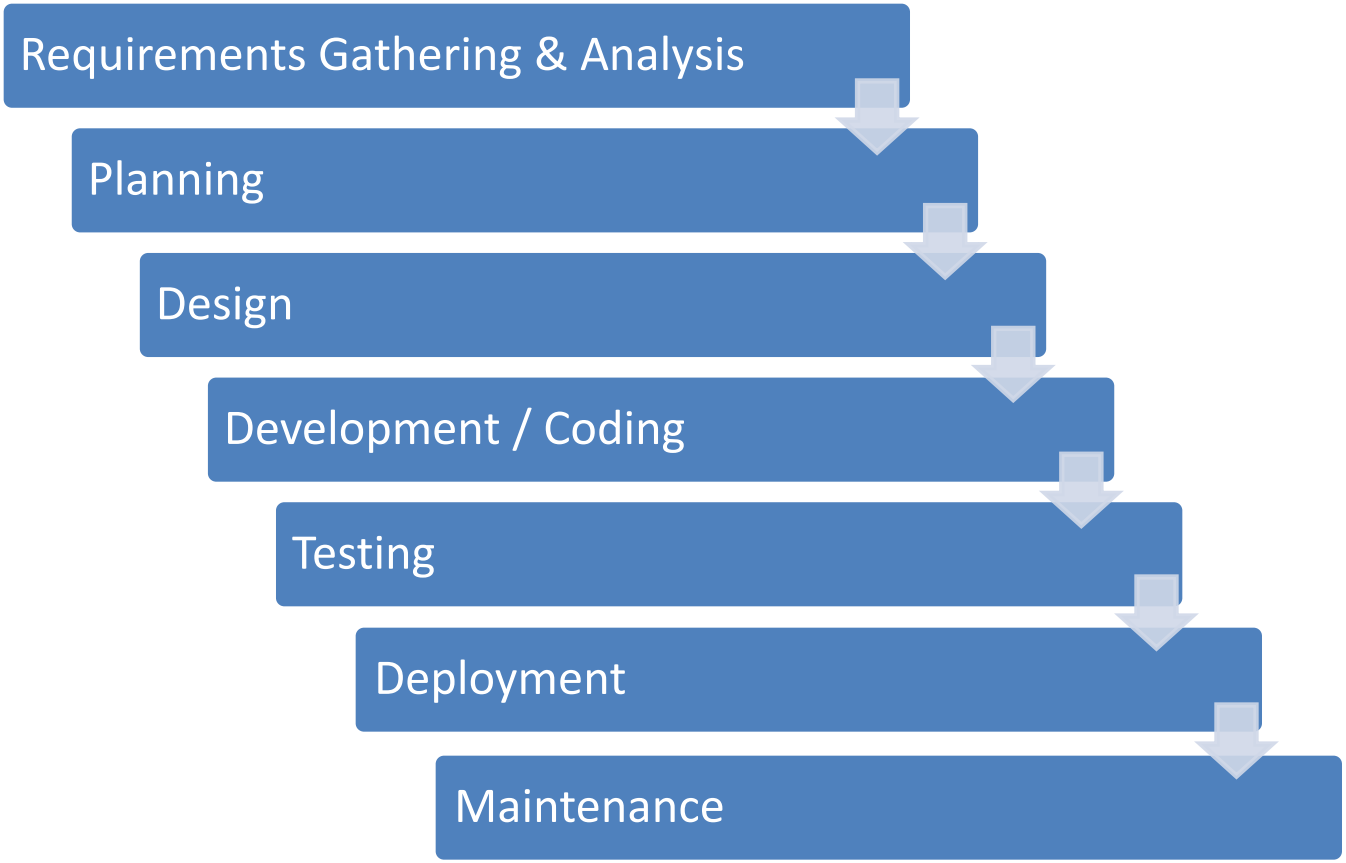
Software Development Life-Cycle (SDLC)

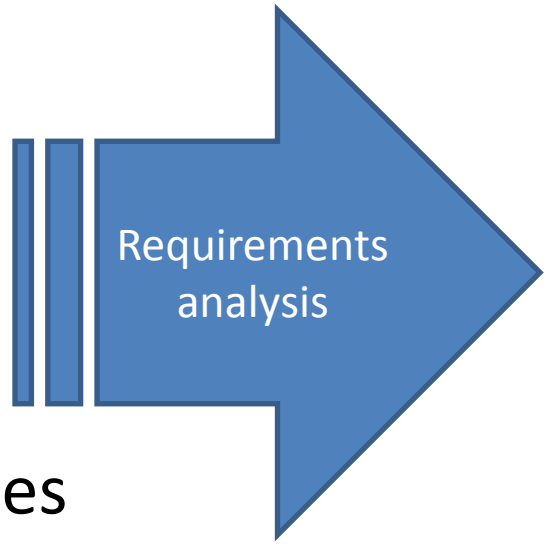


Three stages of Database Development:

1. Requirements Analysis stage
2. Component Design Stage
3. Implementation stage

1. Requirements Analysis stage

- Sources of requirements:
  - User Interviews
  - Forms
  - Reports
  - Queries
  - Use case
  - Business rules
  - Observation
  - JAD sessions



Requirements become the E-R Data Model

- After requirements gathering, these requirements are transformed into an Entity Relationship (E-R) Data Model.
- E-R model is one of the most popular data model.

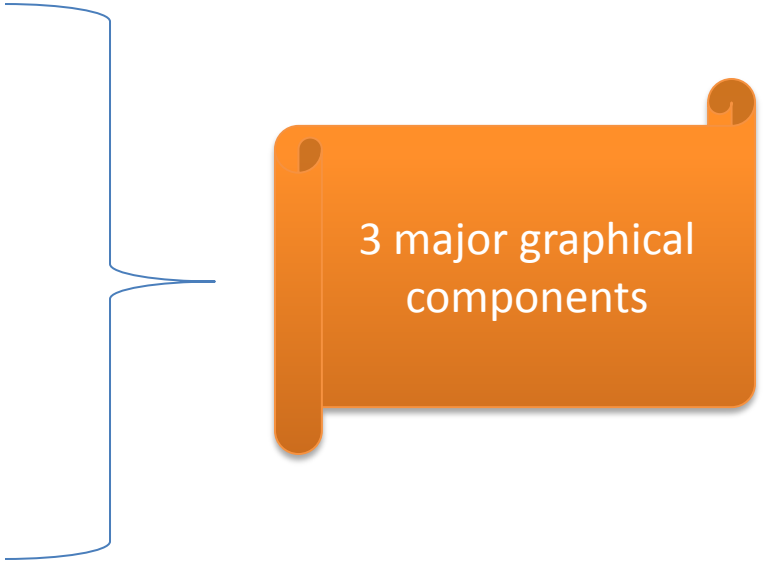
ERM and ERD

- Entity-Relationship Data Model (ERM): is a detailed, logical representation of the data for an organization or for a business area.
  - Expressed in terms of:
    - Entities
    - Attributes
    - Relationships
- Entity-Relationship Diagram (ERD): is a graphical representation of a Entity-Relationship Model.

We are going to use these terms interchangeably

E-R Model consist of:

1. Entities
2. Attributes
   a. Identifiers (Keys)
   b. Non – key attributes
3. Relationships



ERD

- The purpose of an ERD is to capture the richest possible understanding of the meaning of data necessary for an information system or organization.

- ERDs are made from Entities, Attributes, and Relations.

1. Entities

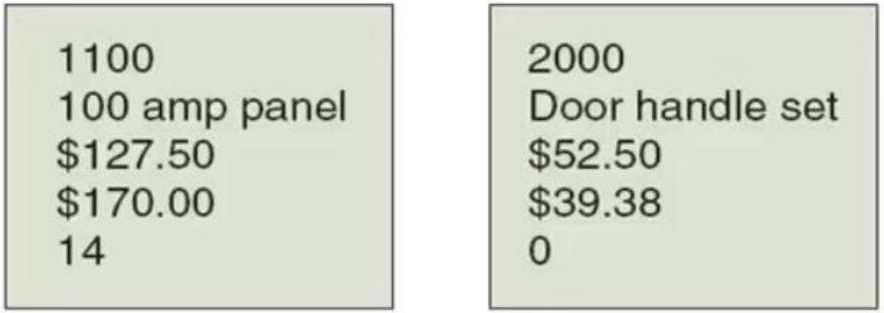
- Entity is a Real-world object distinguishable from other objects.
- Has its own identity that distinguishes it from other entities
- An entity is described using a set of attributes.
- Entity Set: A collection of entities of the same kind. E.g., all employees.
  - All entities in an entity set have the same set of attributes.
  - Each entity set has a key

Entity Class vs Entity Instance

- An Entity Class is a description of the structure and format of the occurrences of the entity
  - Similar to a recipe or architectural blueprints
- An entity instance is a specific occurrence of an entity class.

Entity Class vs Entity Instance

Entity Class



Two Entity Instances

2. Attributes:

- Entities have attributes that together describe the entity
  - Examples: For an Entity Student:
    - Student_Name
    - Student_Reg_Number
    - Student_Branch
    - Student_Join_Date
- Each attribute has a data type and other properties

Attributes

2.a Identifiers (Keys)

- Entity instances have identifiers (keys)
  - Keys are a type of attribute
- A key will identify a specific instance in the entity class
  - Examples:
    - Student_Reg_Number
    - Student_id
    - Student_emai_id
    - Student_aadhar_card_number

Types of Keys:

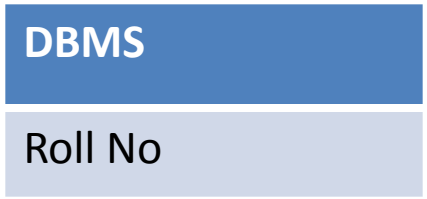
- Uniqueness
  - Keys may be UNIQUE or NON-UNIQUE
  - If the key is unique, the data value for the key must be unique among all the instances of the entity
- Composite
  - A composite key consists of two or more attributes
    - Eg: Flight Number and Flight Date
    - Eg: Subject Exam and Exam Date

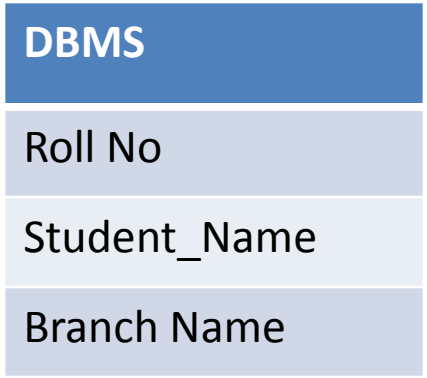
Types of Keys:

S. No.	Roll. No.	Student Name	Branch Name
1	14UCC024	POOJA	CCE
2	14UCS001	AAKARSH SINGH	CSE
3	14UCS002	ABHINANDAN MITTAL	CSE
4	14UCS003	ABHISHREYA DIXIT	CSE
5	14UCS004	ADITI	CCE
6	14UCS005	ADITI ARORA	CCE

*Random, altered data for explanation purpose only

Level of Entity Attribute Display





Entity with no attributes

Entity showing only key attributes

Entitty showing all the attributes

2.b Non – key attributes

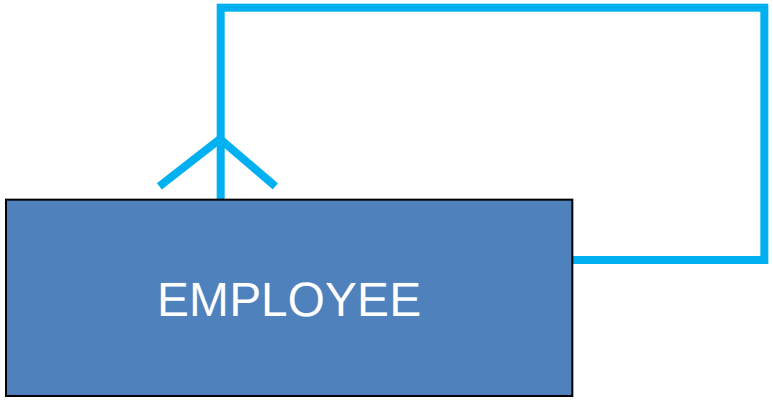
3. Relationships

- Entities can be connected to each other in relationships
- The degree of relationship defines the number of entity classes that participate in the relationship
  - Degree 1 is a unary relationship
  - Degree 2 is a binary relationship
  - Degree 3 is a ternary relationship

Conceptual Unary Relationship

One-to-one

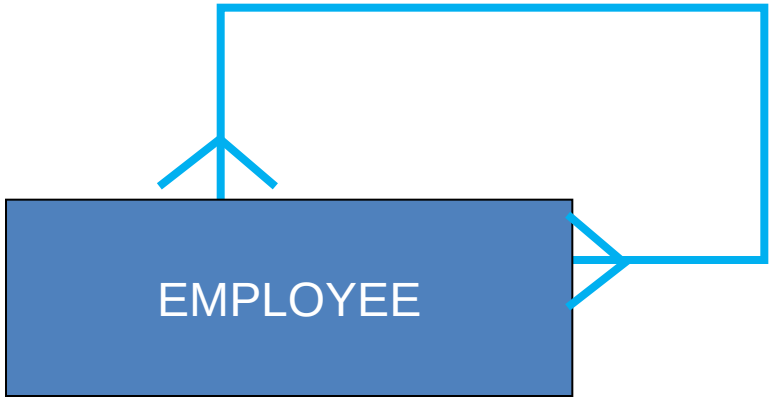
Conceptual Unary Relationship



One-to-many

Conceptual Unary Relationship

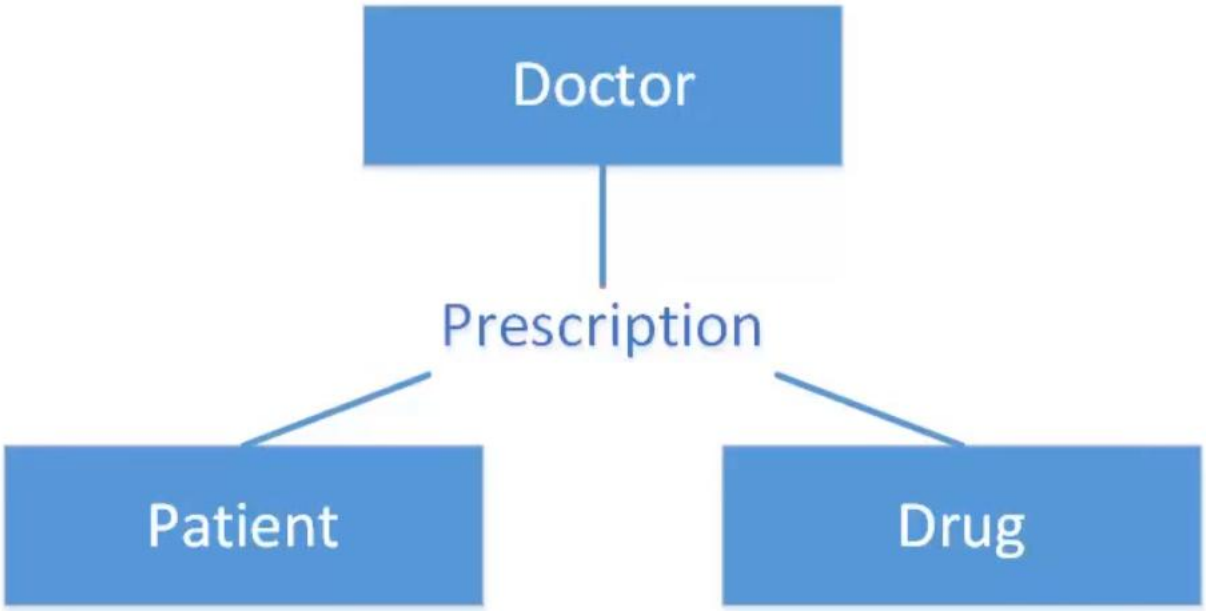
Issues ?



Many-to-many

Conceptual Binary Relationship

Conceptual Ternary Relationship



One-to-One Binary Relationship

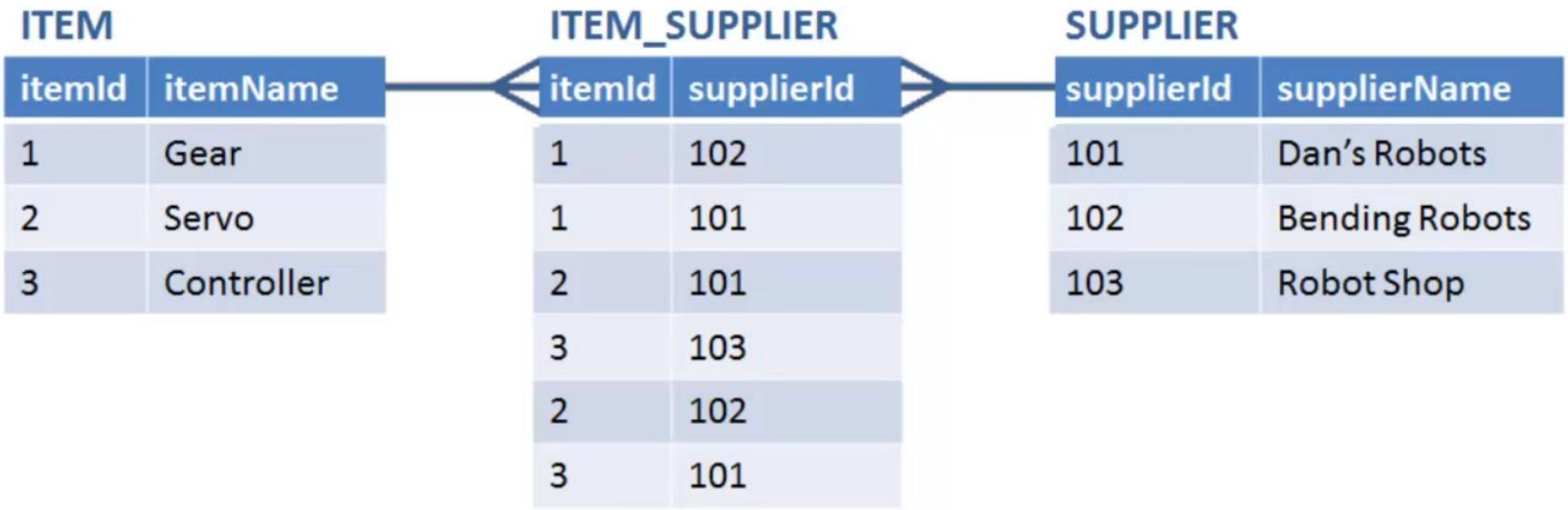
- 1:1 (one-to-one)
  - A single entity instance in one entity class is related to a single entity instance in another entity class
    - An employee may have no more than one locker
    - A locker may only be used by one employee

One-to-Many Relationship

- 1:N (one-to-many)
  - A single entity instance in one entity class is related to many entity instances in another entity class
    - An employee works in one department
    - A department can have many employees

Many-to-Many Relationship

- N:M (many-to-many)
  - Many entity instances in one entity class are related to many entity instances in another entity class
    - A supplier may supply several items
    - A particular item may be supplied by several suppliers


ITEM
itemId
itemName
1
Gear
2
Servo
3
Controller
ITEM_SUPPLIER
itemId
supplierId
1
102
1
101
2
101
3
103
2
102
3
101
SUPPLIER
supplierId
supplierName
101
Dan's Robots
102
Bending Robots
103
Robot Shop

Cardinality:

- It refers to the uniqueness of data values contained in a column.
- High cardinality means that the column contains a large percentage of totally unique values.
- Low cardinality means that the column contains a lot of “repeats” in its data range.

It is not common, but cardinality also sometimes refers to the relationships between tables. Cardinality between tables can be one-to-one, many-to-one or many-to-many.

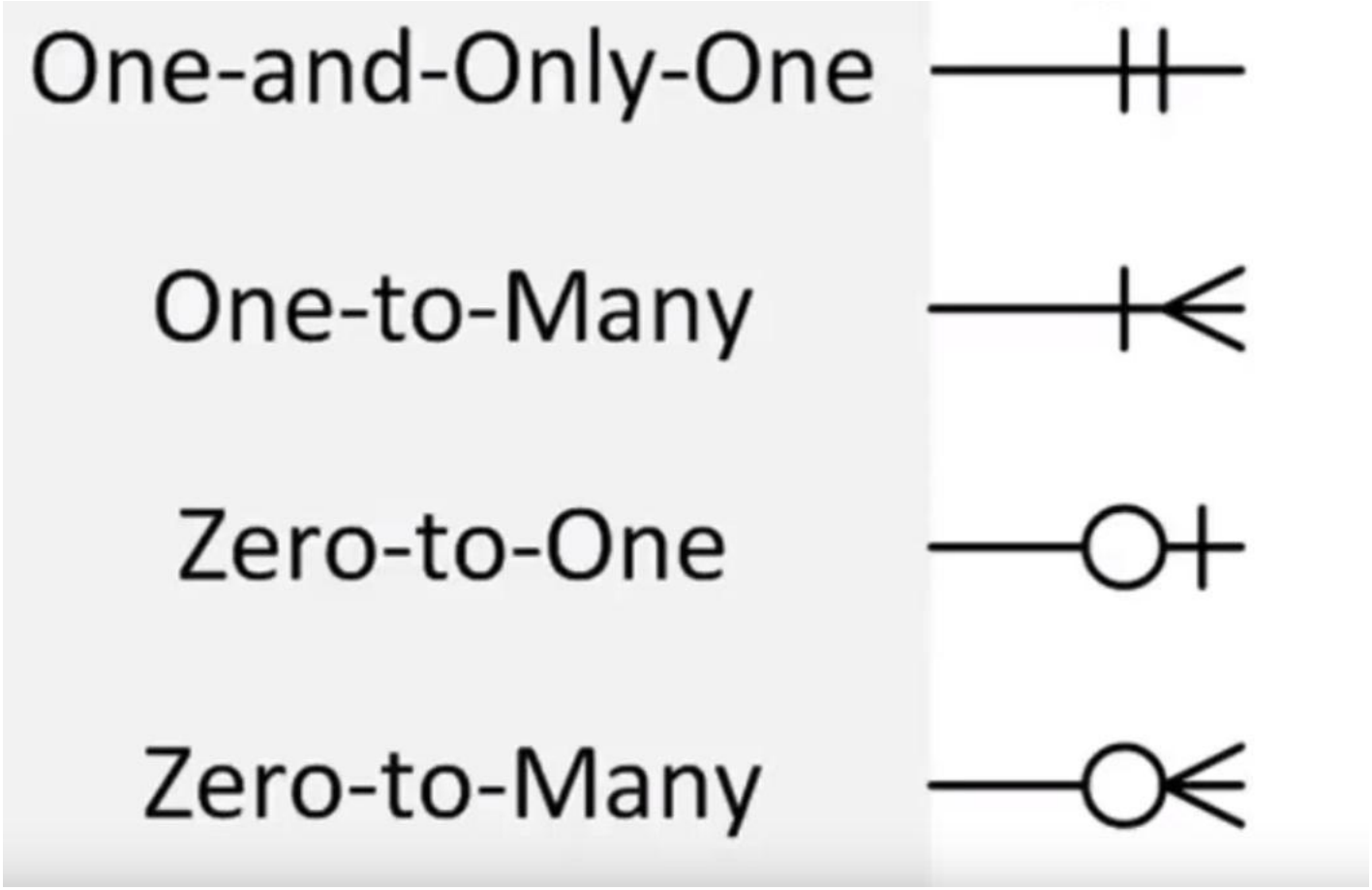
Maximum Cardinality:

- Relationships are named and classified by their cardinalities, which is a word that means count
- Each of three types of relationships shown previously has a different maximum cardinality
- Maximum cardinality is the maximum number of entity instances that can participate in a relationship instance
  - One, many or some other positive fixed number

Minimum Cardinality:

- Minimum cardinality is the minimum number of entity instances that must participate in a relationship instance
- These values typically assume a value of zero (optional) or one (mandatory)

Crow's Foot Symbols with Cardinalities:



Cardinality Example:

- Maximum cardinality is many for Order and one for Customer
- Minimum cardinality is one for both Customer and Order
  - Each customer can place one or more orders
  - Each order is associated with one and only one customer

Entity-Relationship Diagrams:

- The diagrams in previous slides are called entity-relationship diagrams
  - Entities represented by rectangles
  - Relationships represented by lines
  - Cardinality represented by Crow's Foot symbols

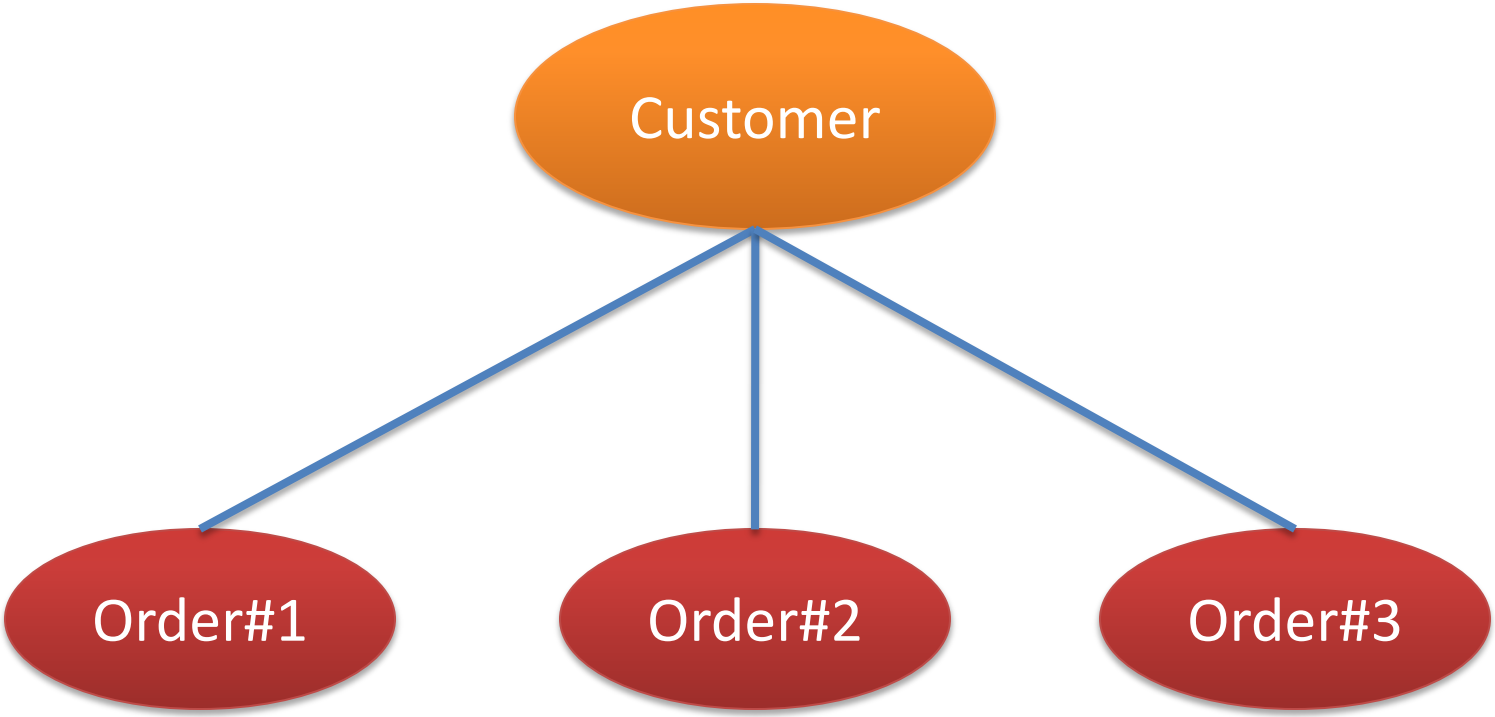
HAS-A relationships:

- The relationships in the previous slides are called HAS-A relationships.
- The term is used because each entity instance has a relationship to a second entity instance
  - An employee has a locker
  - A locker has an employee
- There are also IS-A relationships

Strong and Weak Entities

- A weak entity is an entity whose instances cannot exist in the database without the existence of an instance of another entity
- Any entity that is not a weak entity is called a strong entity
  - Instances of a strong entity can exist in the database independently

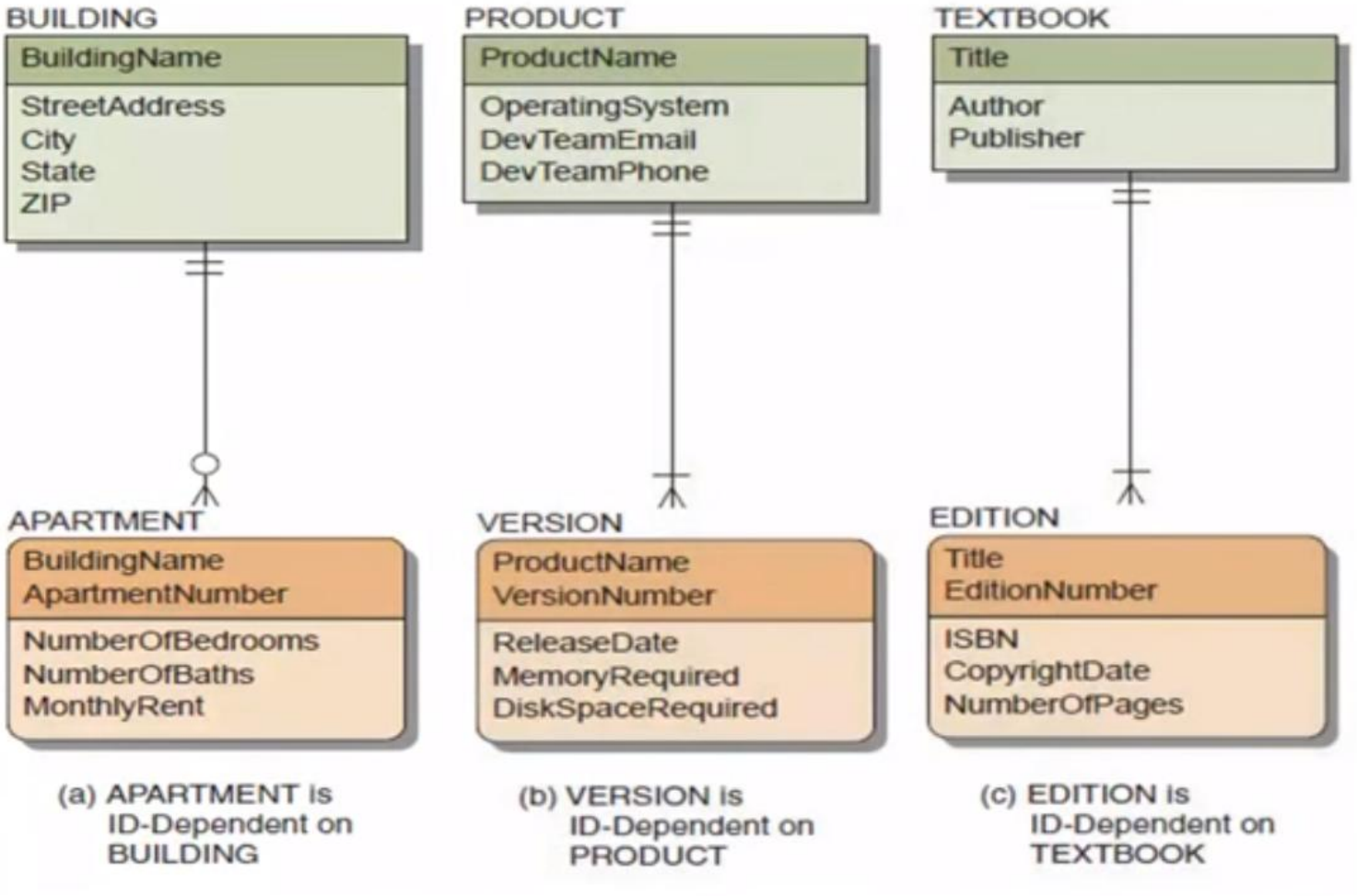
Strong and Weak Entities:



ID-Dependent Weak Entities:

- An ID-Dependent weak entity is a weak entity that cannot exist without its parent entity
- This requirement is enforced by using a composite key for the weak entity
  - The first part of the key is the key for the strong entity
  - The second part of the key is the key for the weak entity itself.

ID-Dependent Weak Entities:



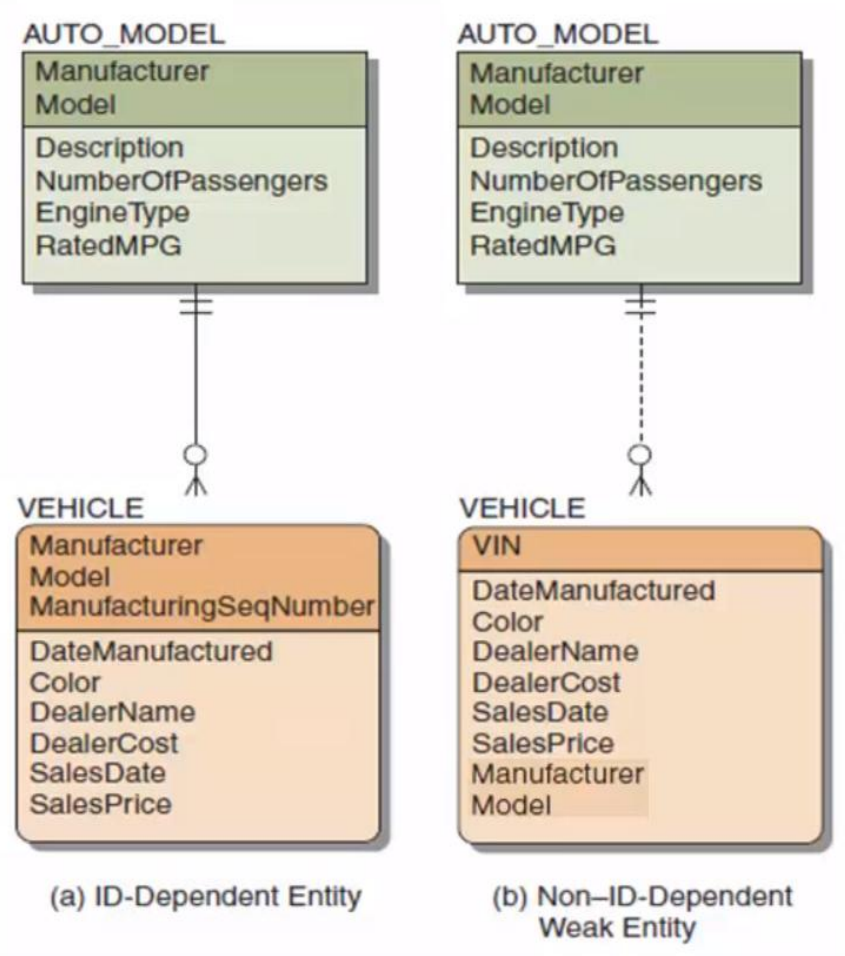
Weak Entity Relationships

- The relationship between a strong and weak entity is termed an identifying relationship if the weak entity is ID-dependent
  - Represented by a solid line
- The relationship between a strong and weak entity is termed a non-identifying relationship if the weak entity is non-ID-dependent
  - Represented by a dashed line
  - Also used between strong entities

Weak entity identifier: Non-ID-dependent

- All ID-dependent entities are weak entities, but there are other entities that are weak but not ID-dependent
- A non-ID-dependent weak entity may have a single or composite key, but the key of the parent entity will be a foreign key within the weak entity.

ID-Dependent vs. Non-ID-Dependent Weak Entities



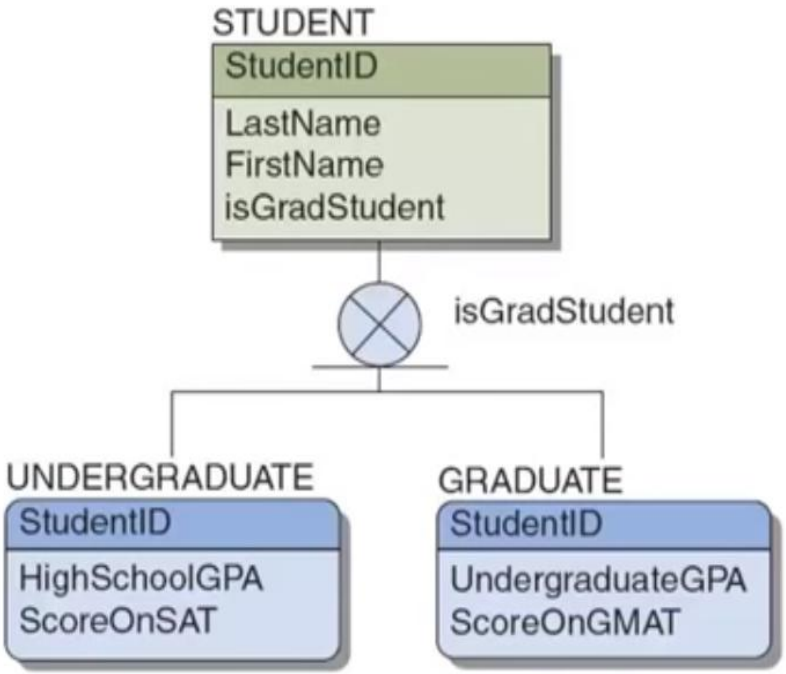
Subtype Entities

- A subtype entity is a special case of another entity (which is called its supertype)
- An attribute of the supertype may be used to indicate which of the subtypes is appropriate for a given instance-This attribute is called a Discriminator
- Subtype can be exclusive or inclusive
  - If excusive, the supertype related to at most one subtype
  - If inclusive, the supertype can relate to one or more subtypes

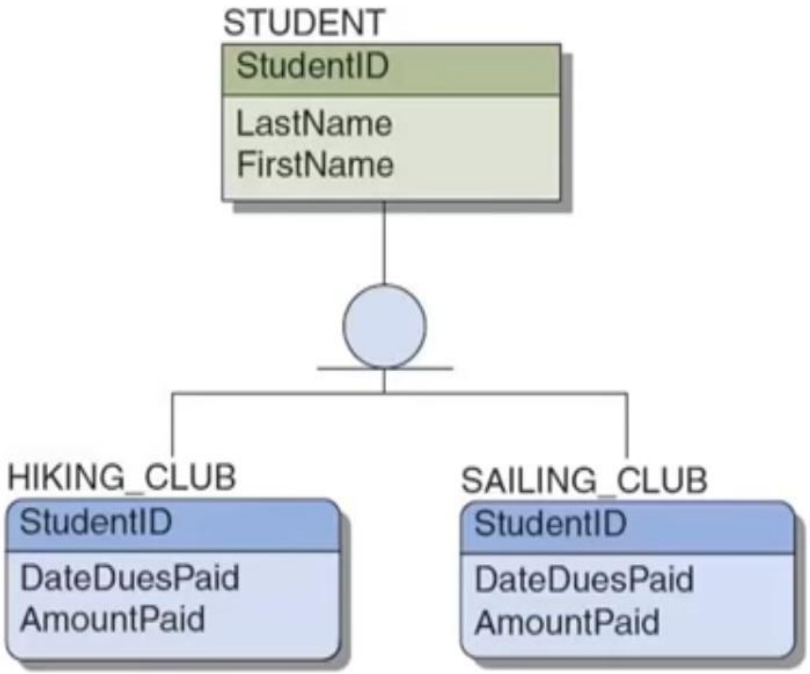
Subtype Entity Identifiers

- The identifier of a supertype and all of its subtypes is the same attribute
- The relationships that connect supertypes and subtypes can be IS-A relationsips if a subtype is the same entity as the supertype
  - An instance of the subtype inherits all of the properties of its supertype

Subtype Entity Examples



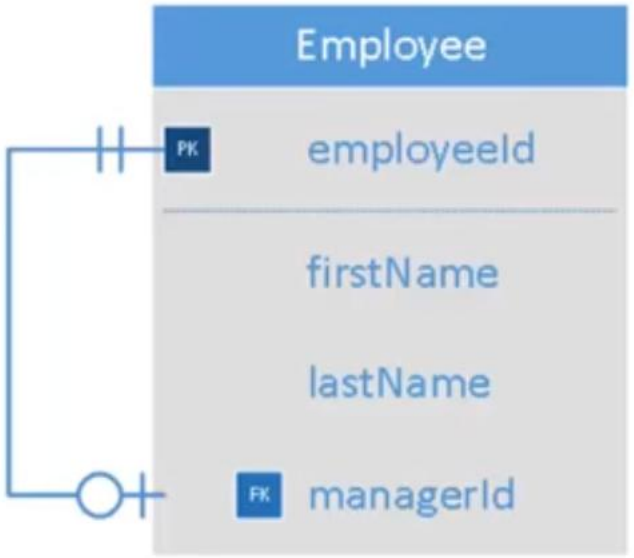
(a) Exclusive Subtypes with Discriminator



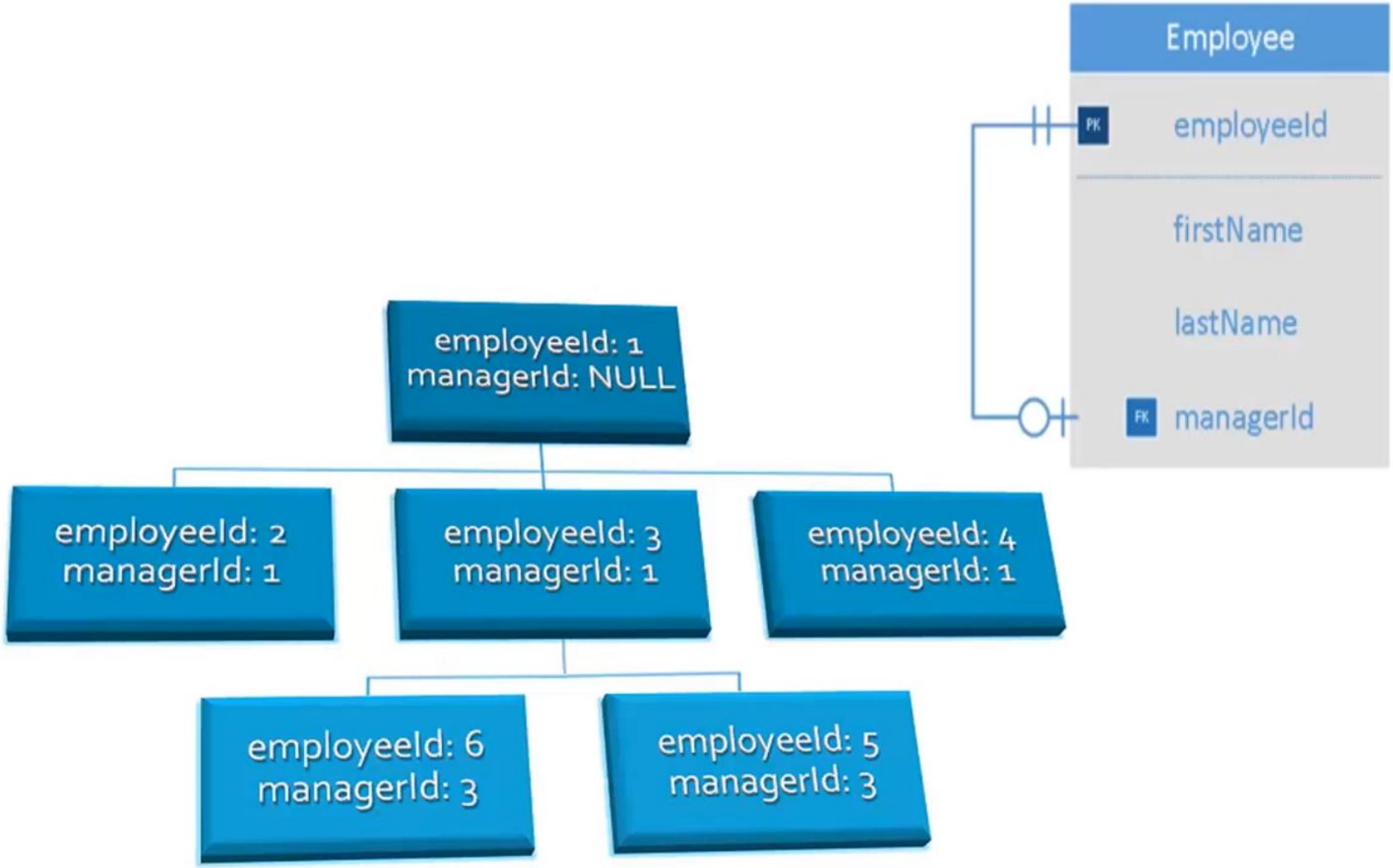
(b) Inclusive Subtypes

Recursive Relationships:

- As noted earlier, it is possible for an entity to have a (unary) relationship to itself-this is called a recursive relationship
- Recursion can be used to implement hierarchical relationships.



Recursive Relationships:



University Entity-Relationship Diagram