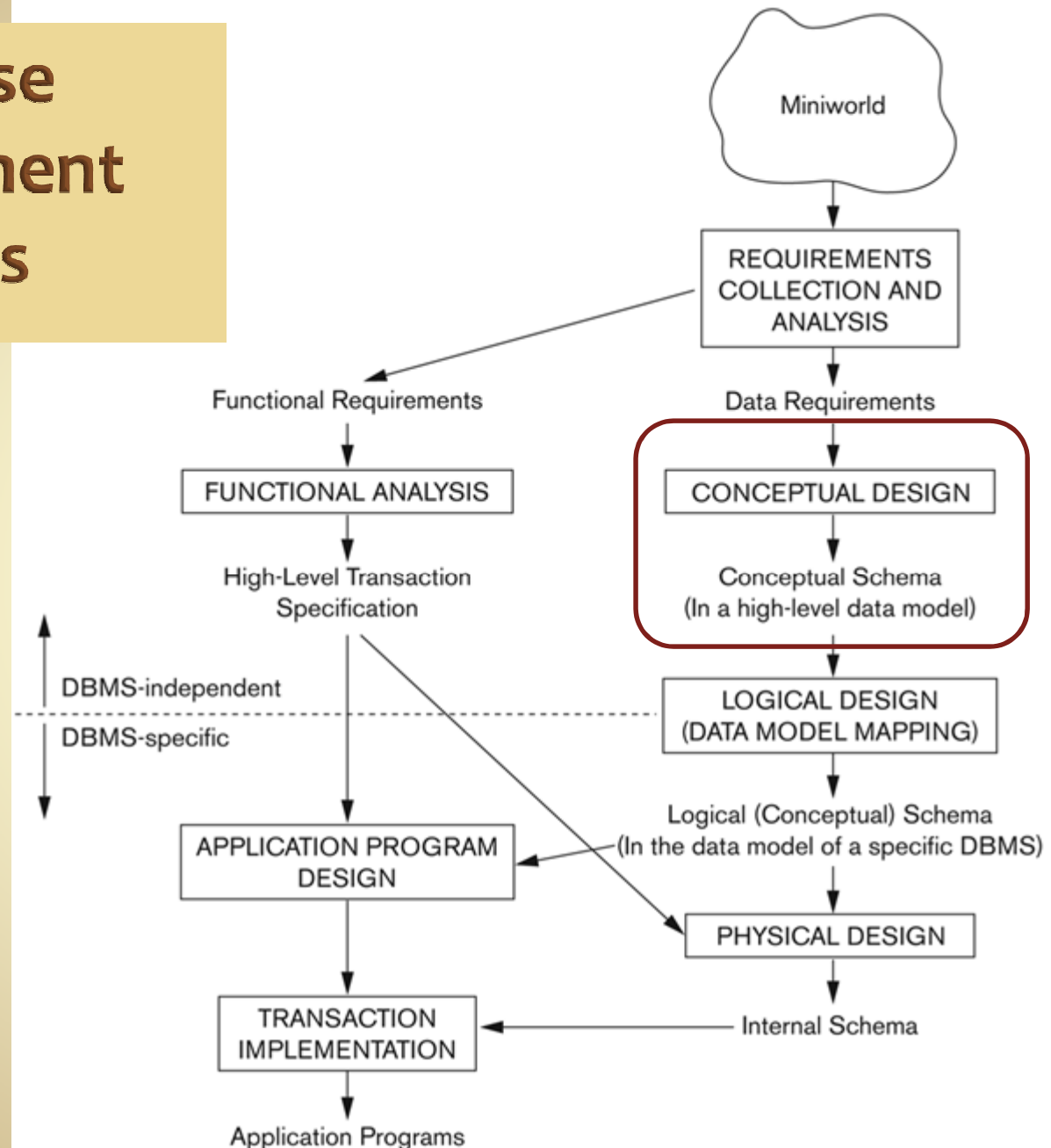


COMP163

Database Management Systems
University of the Pacific – Spring 2012

Lecture 3 – Chapter 7
Entity-Relationship Modeling

Database Development Process



Common Data Models

UML/OO	ER	Relational
class	entity type	relation/table
object	entity	tuple/row
attribute	attribute	attribute/column
association	relationship	foreign key
	key attribute	primary key
inheritance	inheritance	foreign key

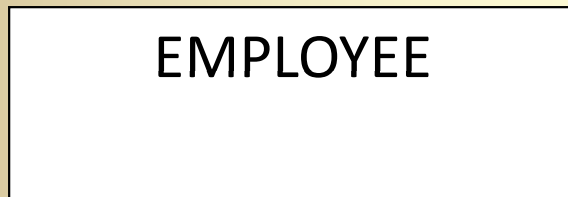
- We have standard techniques for translating between data models.

Common Data Models

- UML and ER have graphical notations
 - very good for conceptual design
 - very expressive: capture more application semantics
- Relational model is an implementation model
 - not good for conceptual design
 - not very expressive: many concepts map to same notation

Entity Types

- Entity types → boxes
Weak entity type → double box



Entity



Weak Entity

Entity Types

- Entity types are similar to classes, they describe potential objects (entities) that will appear in the database.
- Weak entity types describe dependent entities, entities that depend on other entities for identity.



EMPLOYEE

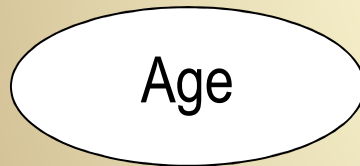
Entity

DEPENDENT

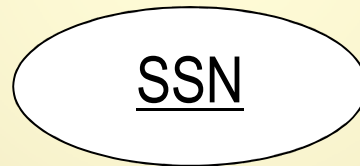
Weak Entity

Attributes and Keys

- Attributes → ovals
- Key attributes → underlined name
- Partial key attributes → dotted underlined name



Attribute



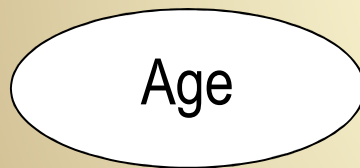
Key Attribute



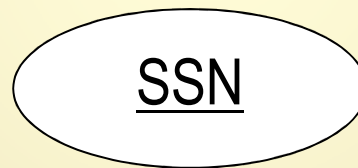
Partial Key
Attribute

Attributes and Keys

- Key attributes must be unique for each entity
- Keys are used to identify particular entities
- Partial keys are only partially unique
 - used for weak entity types



Attribute



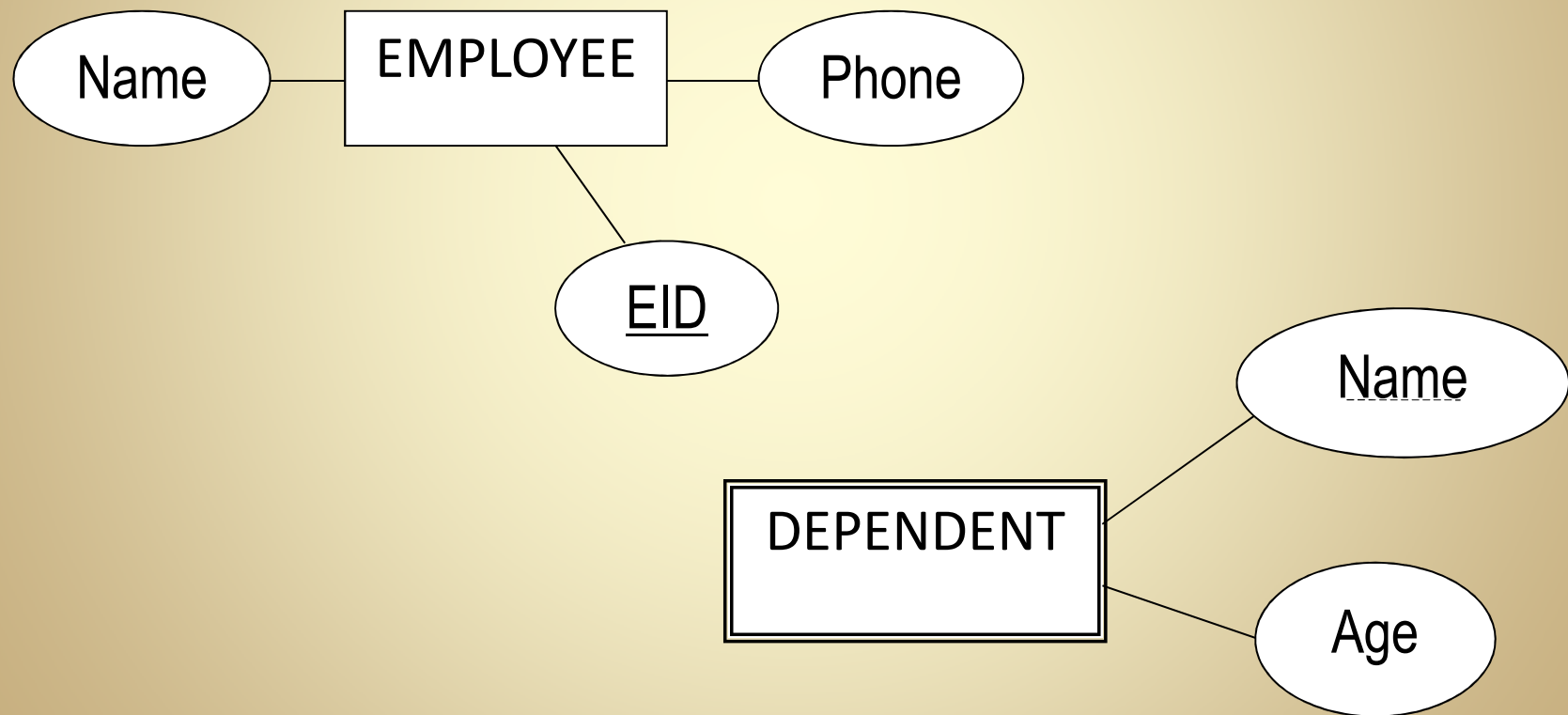
Key Attribute



Partial Key
Attribute

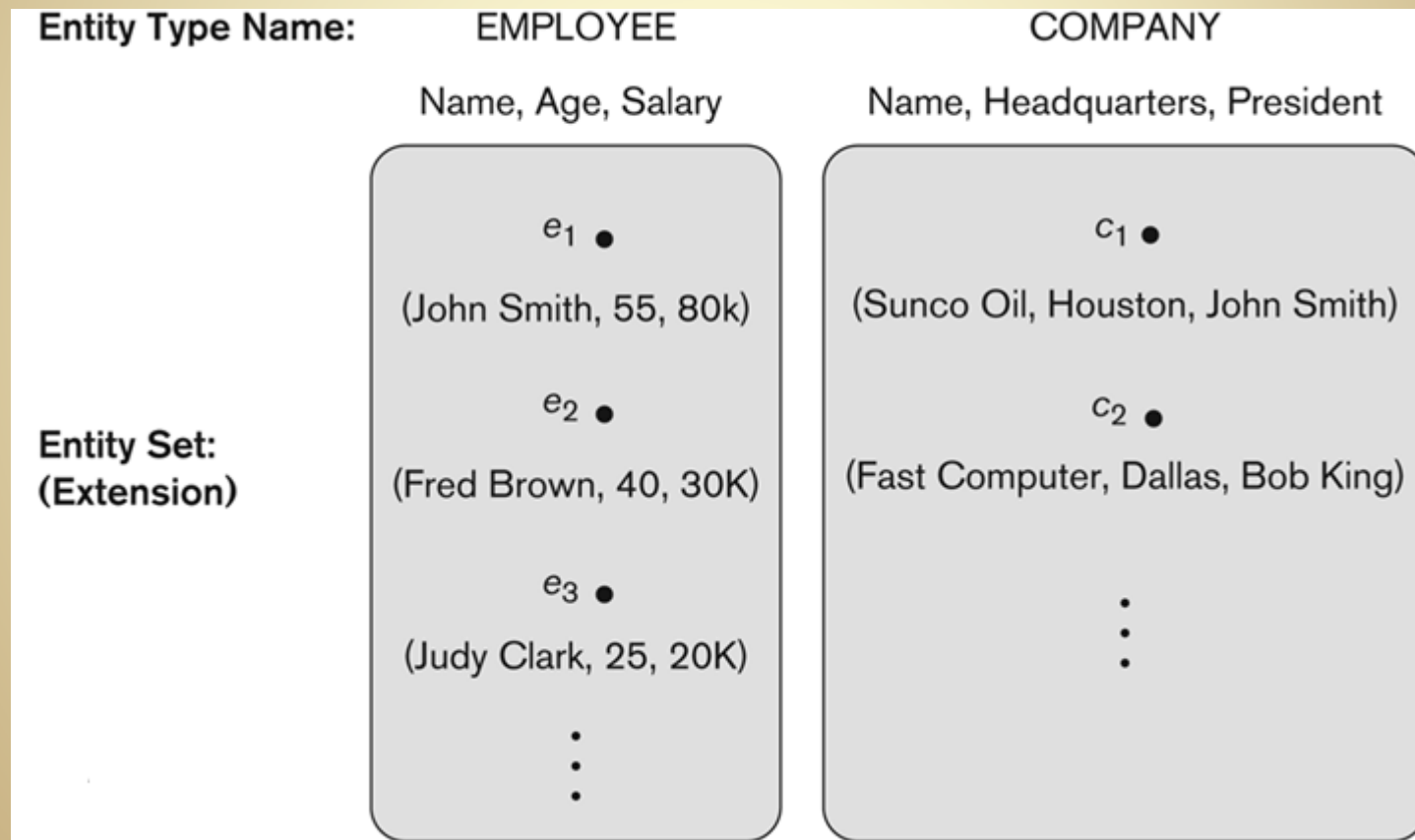
Entity Types and Attributes

- Attributes are connected to entity types by lines



Entity Types and Entities

- Entities are instances of an entity type.



Entity Types and Keys

- All regular entity types must have a key attribute or set of key attributes
- Weak entity types must have partial keys
- Weak entities get part of their key (and part of their identity) from some related entity.

Sets and Derived Attributes

- Multivalued attributes → double lined oval
 - multivalued = set valued
 - that there may be more than one value for the attribute.
- Derived attributes → dashed line ovals
 - the attribute is computed from other data



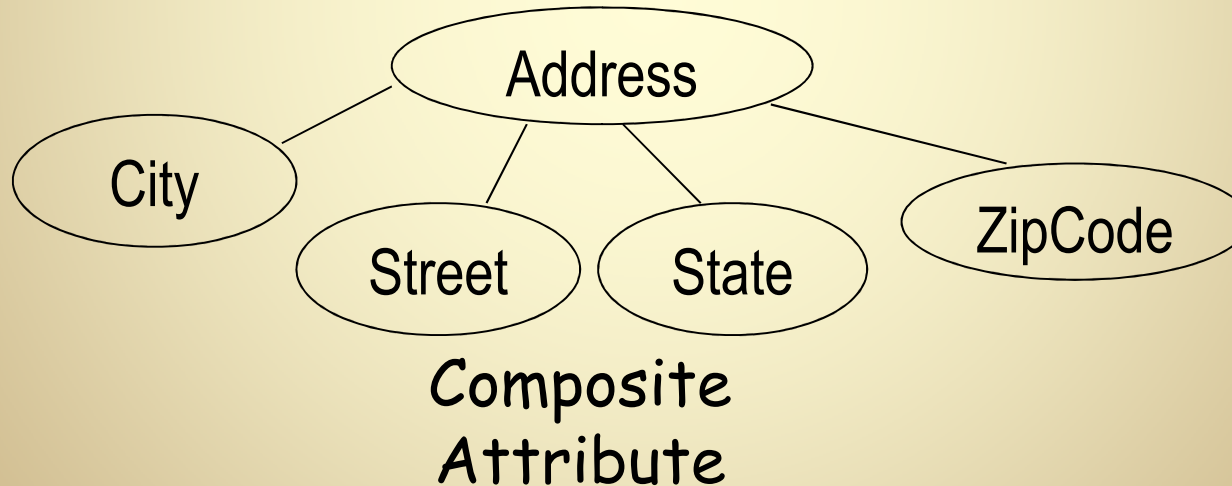
Multivalued
Attribute

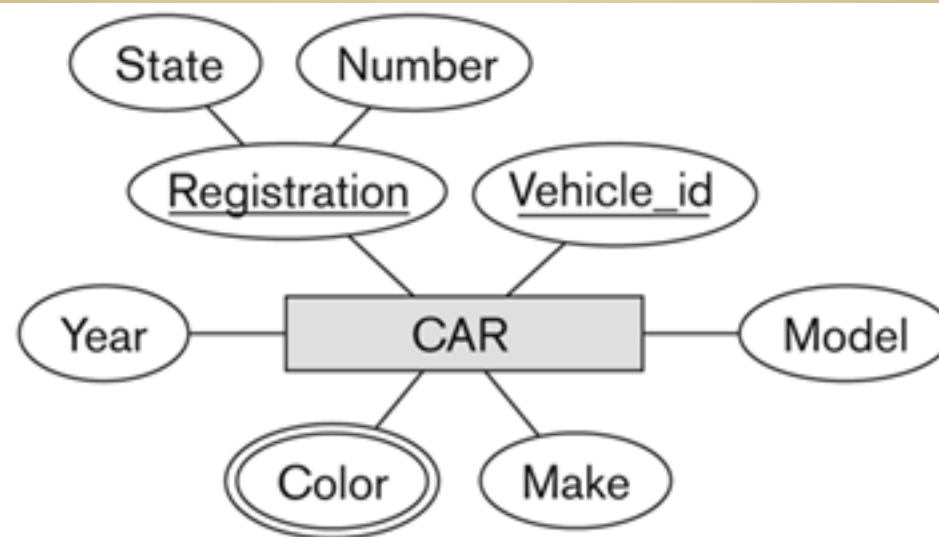


Derived
Attribute

Composite Attributes

- Composite attributes → tree
 - composed of other attributes.
 - used for a set of related attributes, when the set is not a conceptual entity
 - the composite doesn't have identity ... it doesn't have a key





CAR

Registration (Number, State), Vehicle_id, Make, Model, Year, {Color}

CAR₁

((ABC 123, TEXAS), TK629, Ford Mustang, convertible, 2004 {red, black})

CAR₂

((ABC 123, NEW YORK), WP9872, Nissan Maxima, 4-door, 2005, {blue})

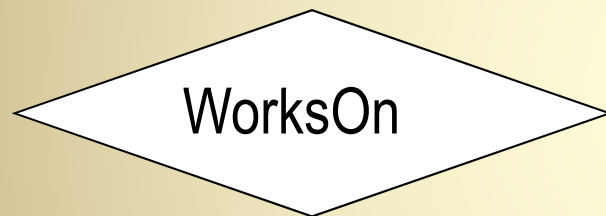
CAR₃

((VSY 720, TEXAS), TD729, Chrysler LeBaron, 4-door, 2002, {white, blue})

⋮

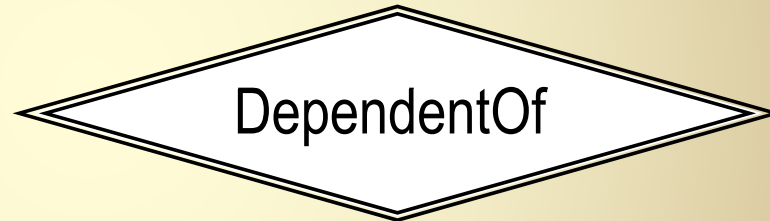
Relationships

- Relationships → diamonds
- Identifying relationship → double diamond



WorksOn

Relationship



DependentOf

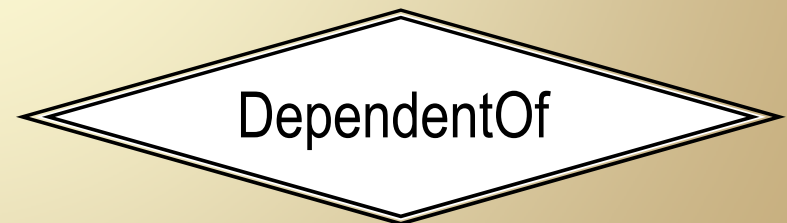
Identifying
Relationship

Relationships

- Relationships indicate a meaningful connection between two entity types
- Relationships may have attributes, but they cannot have key attributes.
- Identifying relationships connect a weak entity type to some other entity type
 - indicates where the weak entity gets a key to complete its own partial key

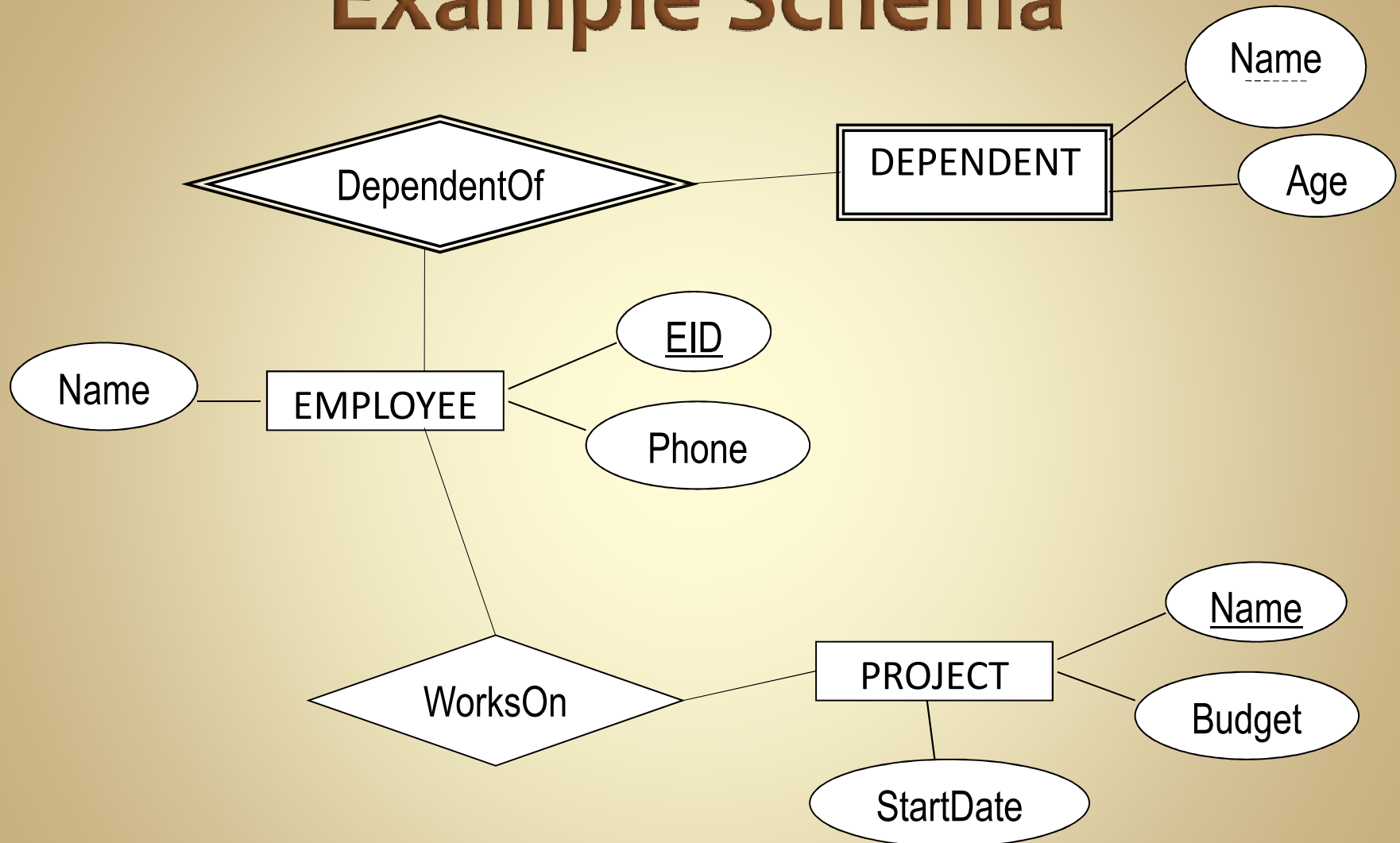


Relationship



Identifying
Relationship

Example Schema



Participation and Cardinality

- Participation and cardinality define constraints on relationships
- Participation indicates whether an entity is required to take part in a relationship
- Cardinality ratios and structural constraints place limits on the number of entities that may participate in a relationship

Participation Constraints

- Total participation → double or thick line
 - indicates required participation
- Partial participation → thin line
 - indicates optional participation



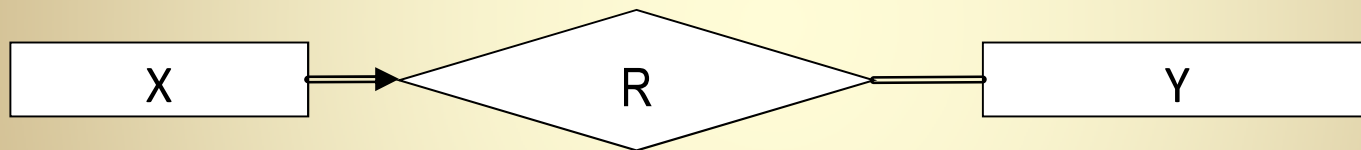
Total Participation



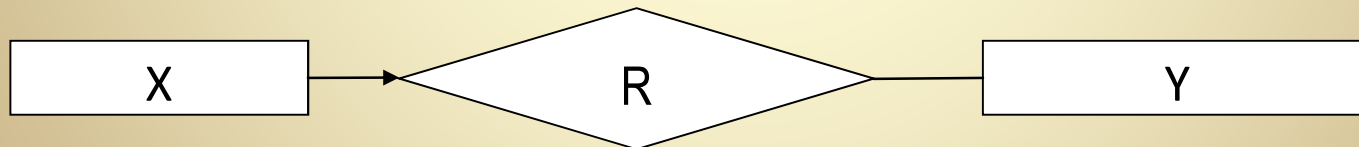
Partial Participation

Participation Constraints

- Arrowheads can be used to indicate an upper bound of 1 for participation
 - (not used in our textbook)



X must participate in exactly one R



X may participate in at most one R

Cardinality Ratios

- Cardinality ratios specify the *maximum* number of relationship instances that an entity may participate in



1:1 ratio



n:1 ratio



n:m ratio

Structural Constraints

- Structural constraints specify the *minimum* and *maximum* number of relationship instances that an entity may participate in



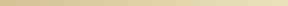


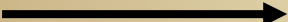
An employee must work for exactly 1 department.
A department must have at least 4 employees.



An employee may manage at most 1 department.
A department must have exactly 1 manager.

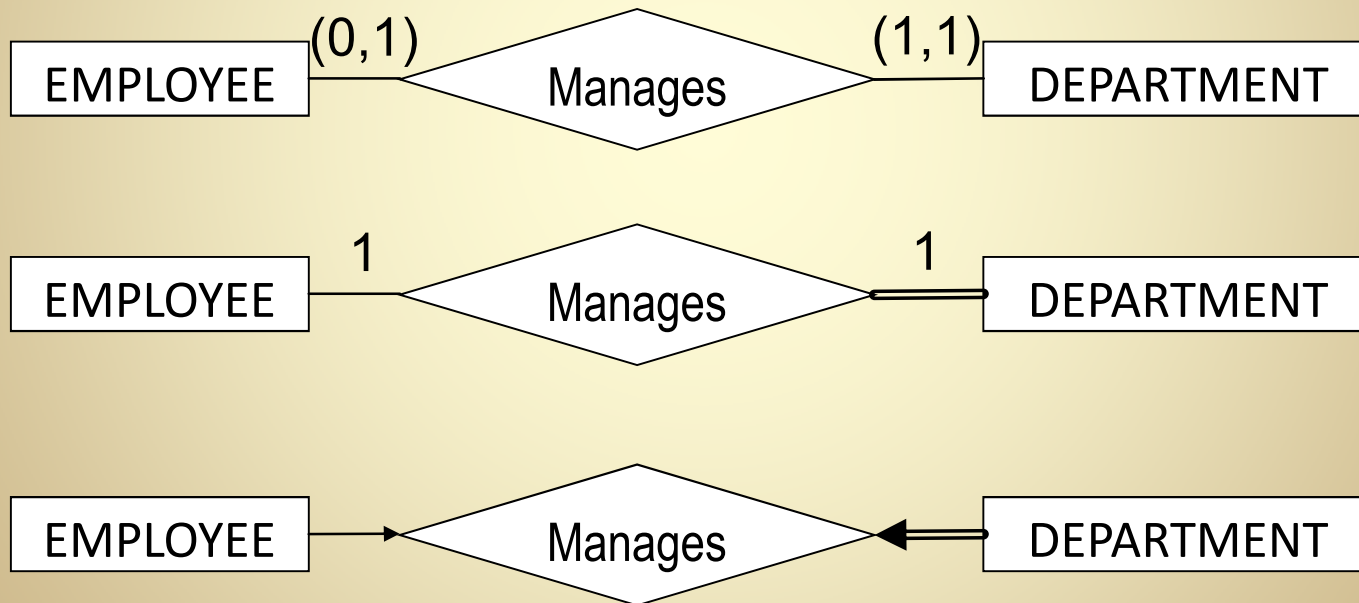
Participation and Cardinality

- There's generally numerous ways to express a relationship constraint.

	<u>(0,N)</u>	optional participation in any number of relationships
	<u>(0,1)</u>	optional participation in at most one relationship
	<u>(1,N)</u>	required participation in at least one relationship
	<u>(1,1)</u>	required participation in exactly one relationship

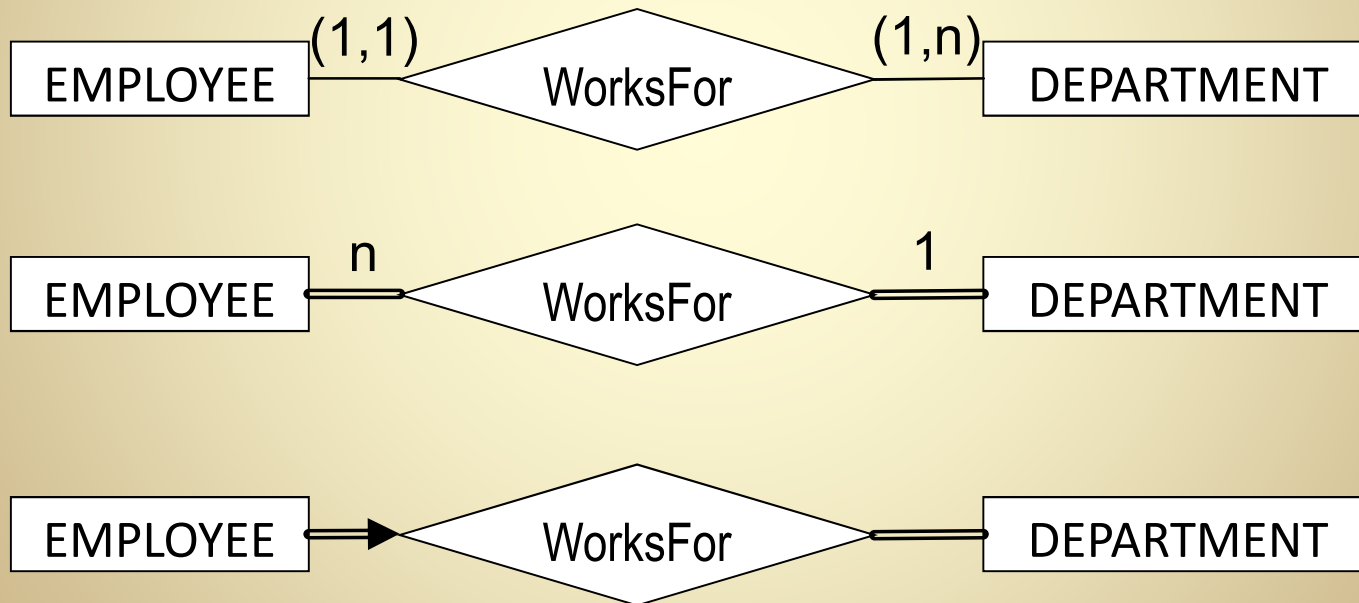
Equivalent Notations

- An employee can manage at most one department.
- A department must have exactly one manager.



Equivalent Notations

- An employee must work for exactly one department.
- A department must have at least one employee.

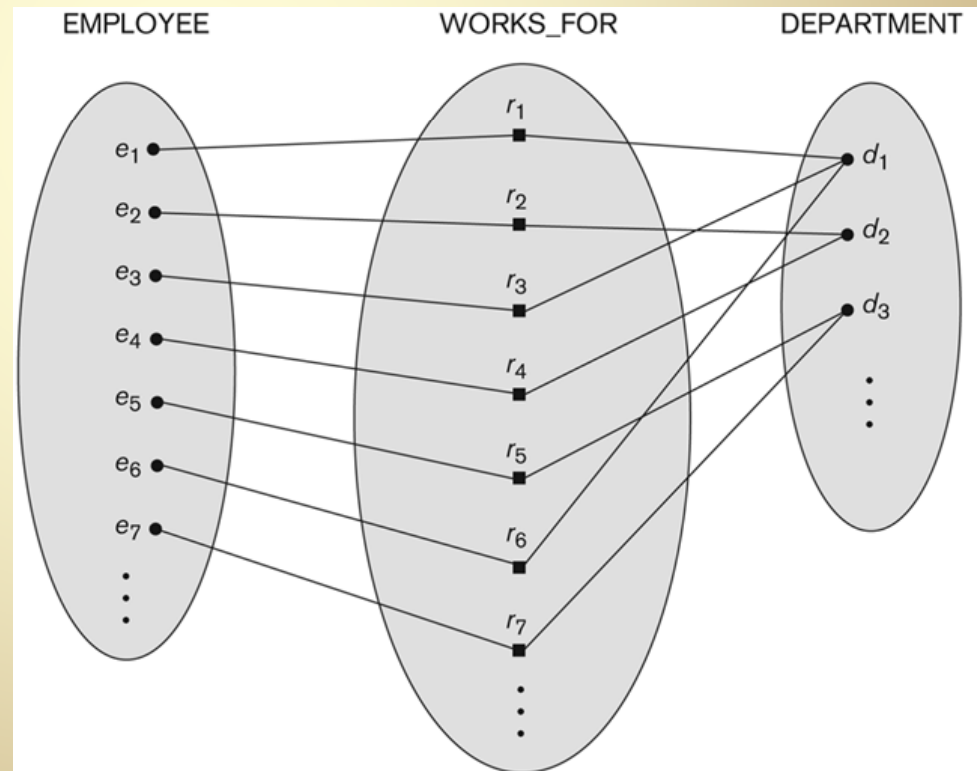


Relationship Instances



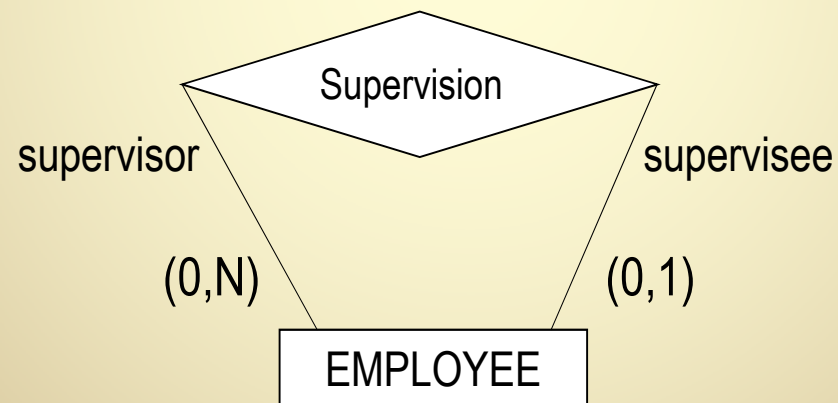
Each **EMPLOYEE** instance is connected to exactly one **WORKS_FOR** instance.

Each **DEPARTMENT** instance is connected to at least one **WORKS_FOR** instance.

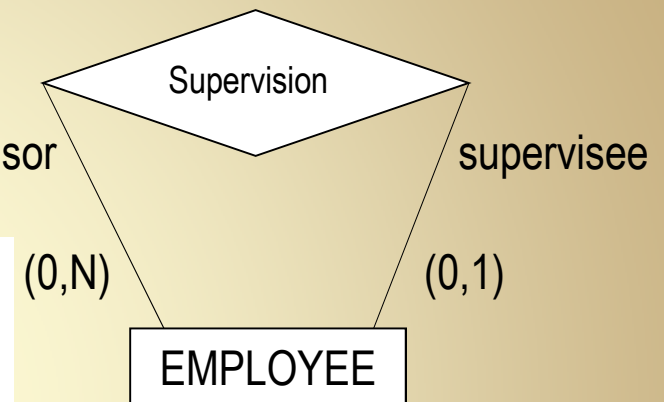
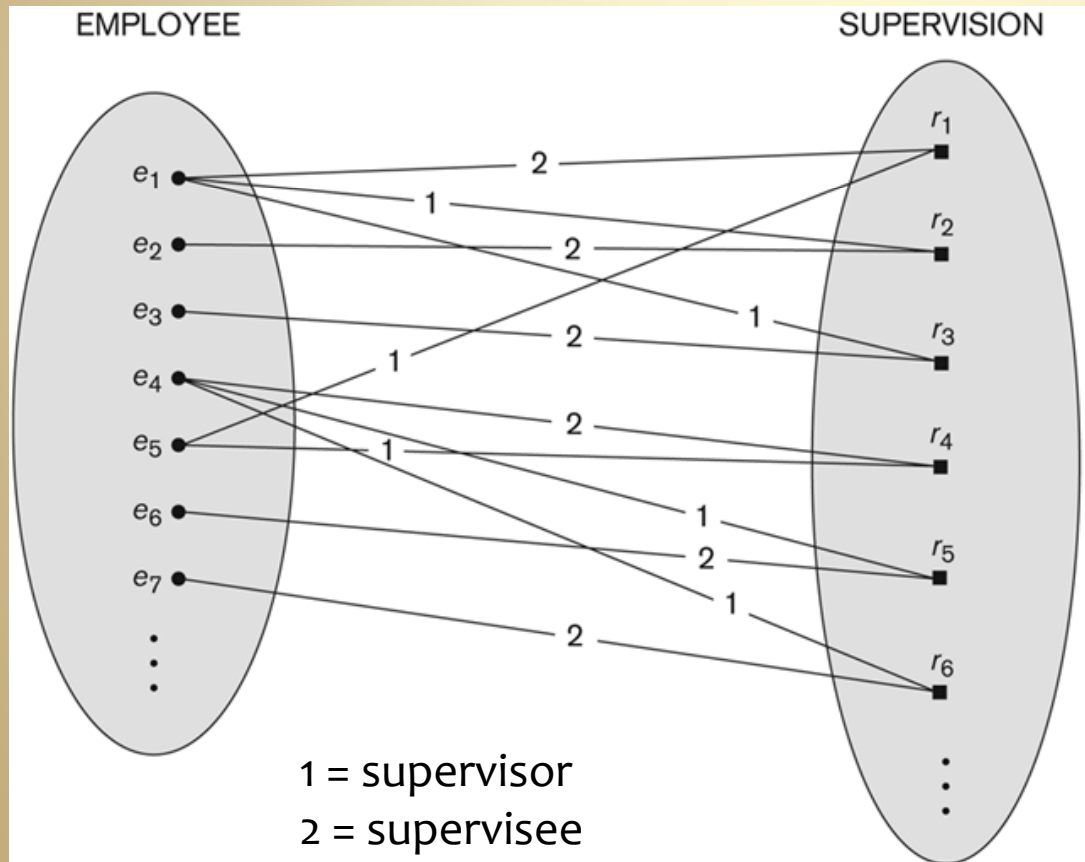


Relational Roles

- It is sometimes convenient to name an entity's role in a relationship.
 - particularly useful in recursive relationships
 - removes ambiguity in direction of relationship



Recursive Relationship



Notation Summary



Entity



Weak Entity



Relationship



Identifying Relationship



Total Participation of E_2 in R



Cardinality Ratio 1: N for $E_1:E_2$ in R



Structural Constraint (min, max)
on Participation of E in R



Attribute



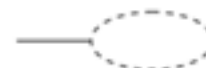
Key Attribute



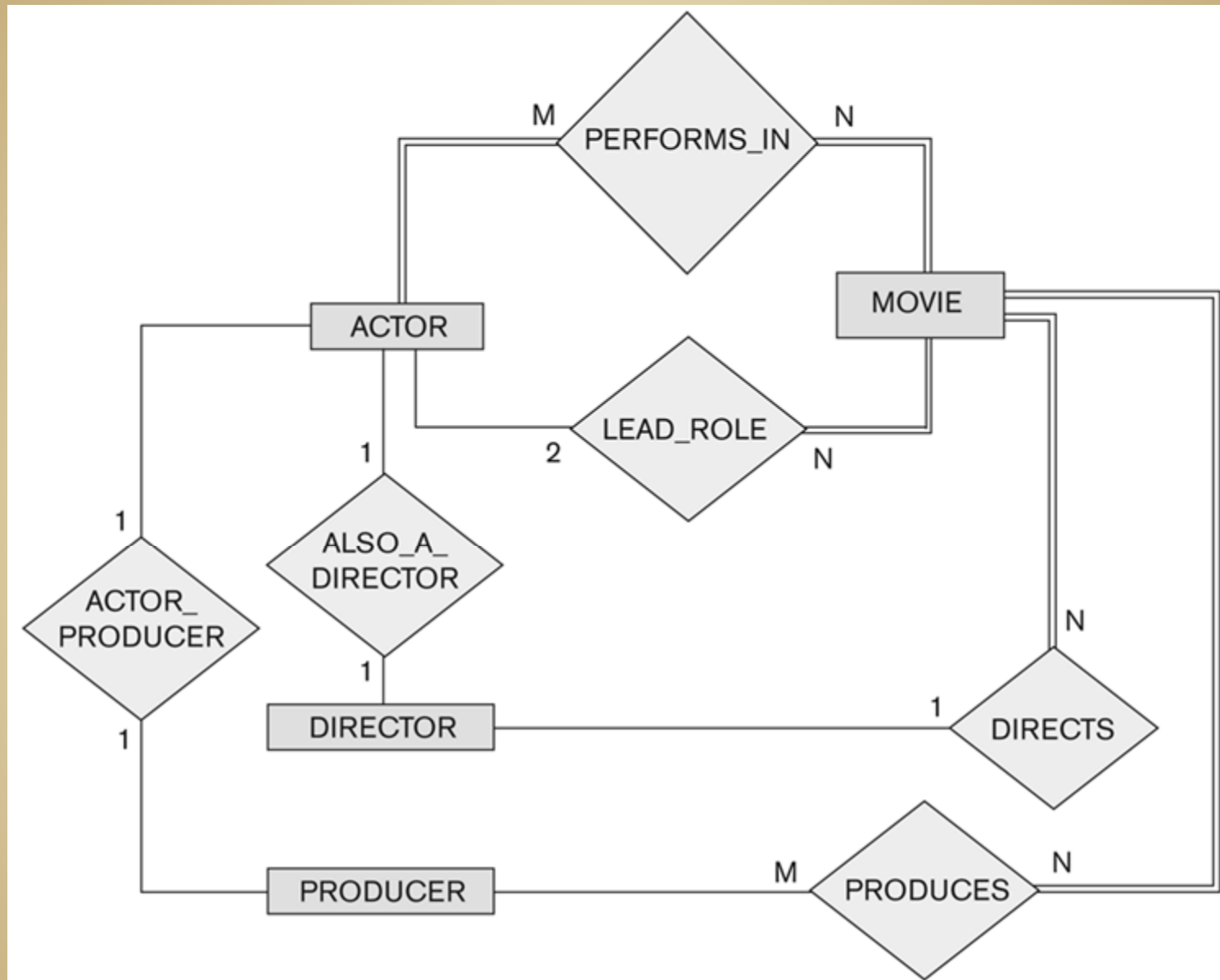
Multivalued Attribute

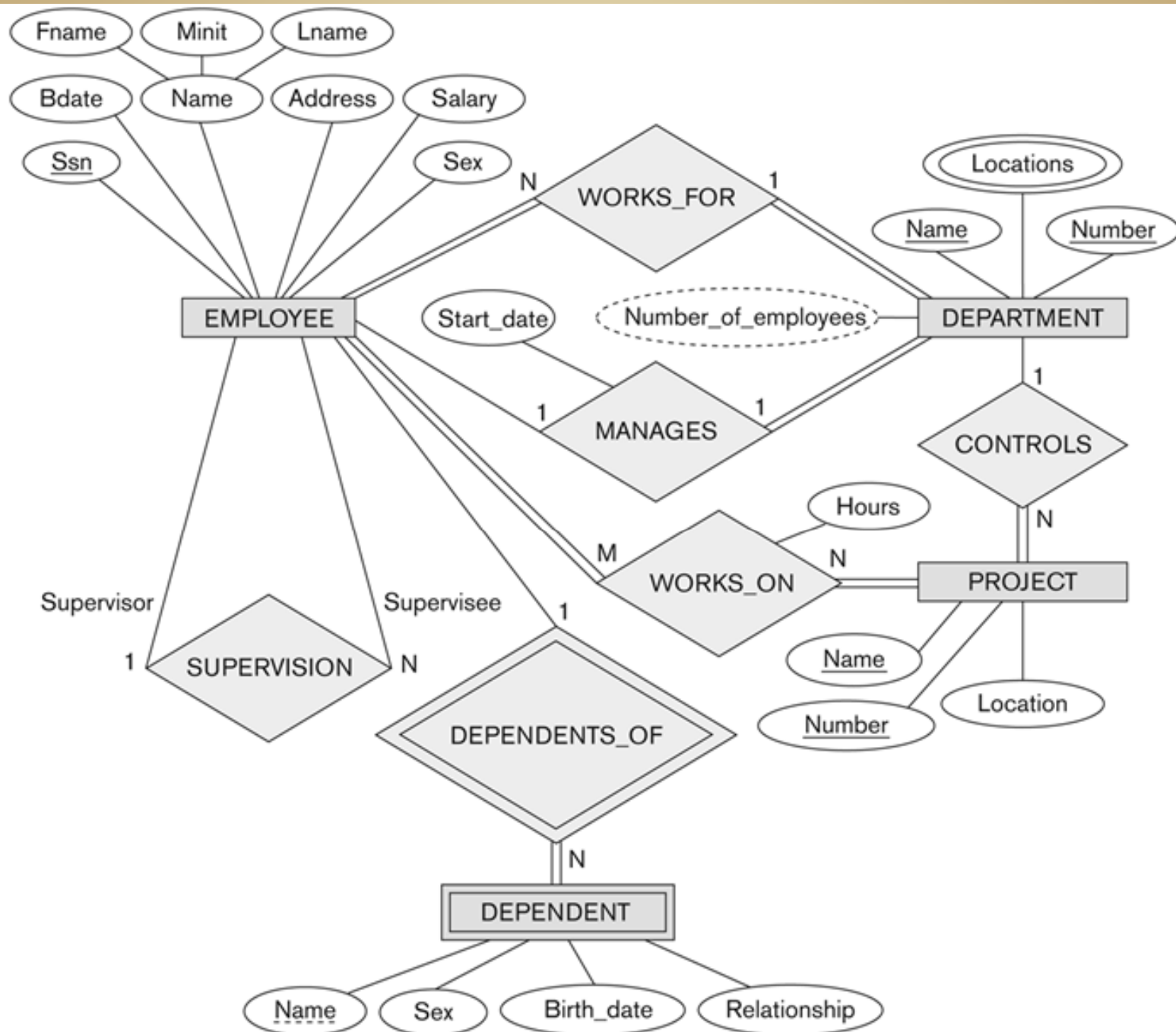


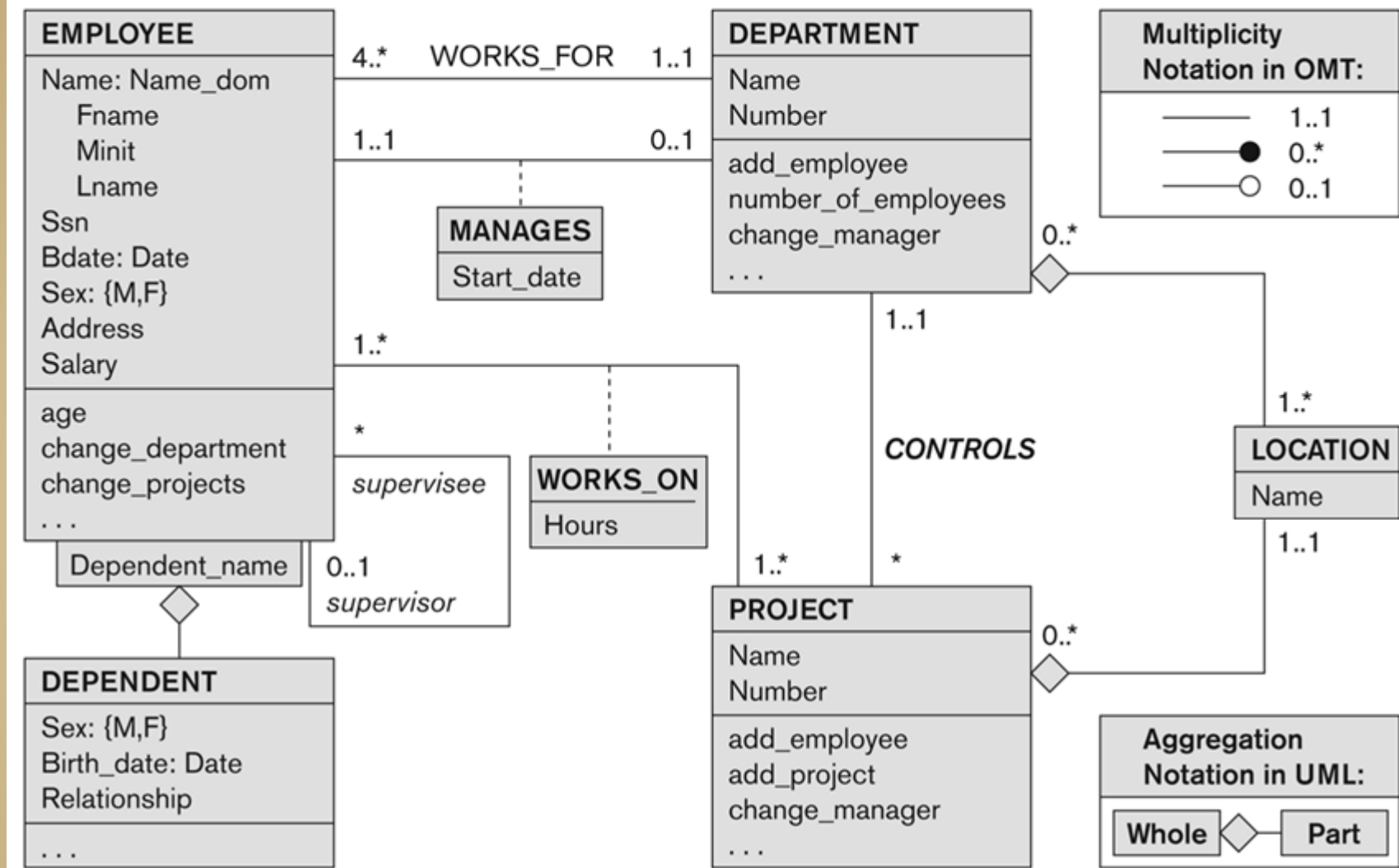
Composite Attribute



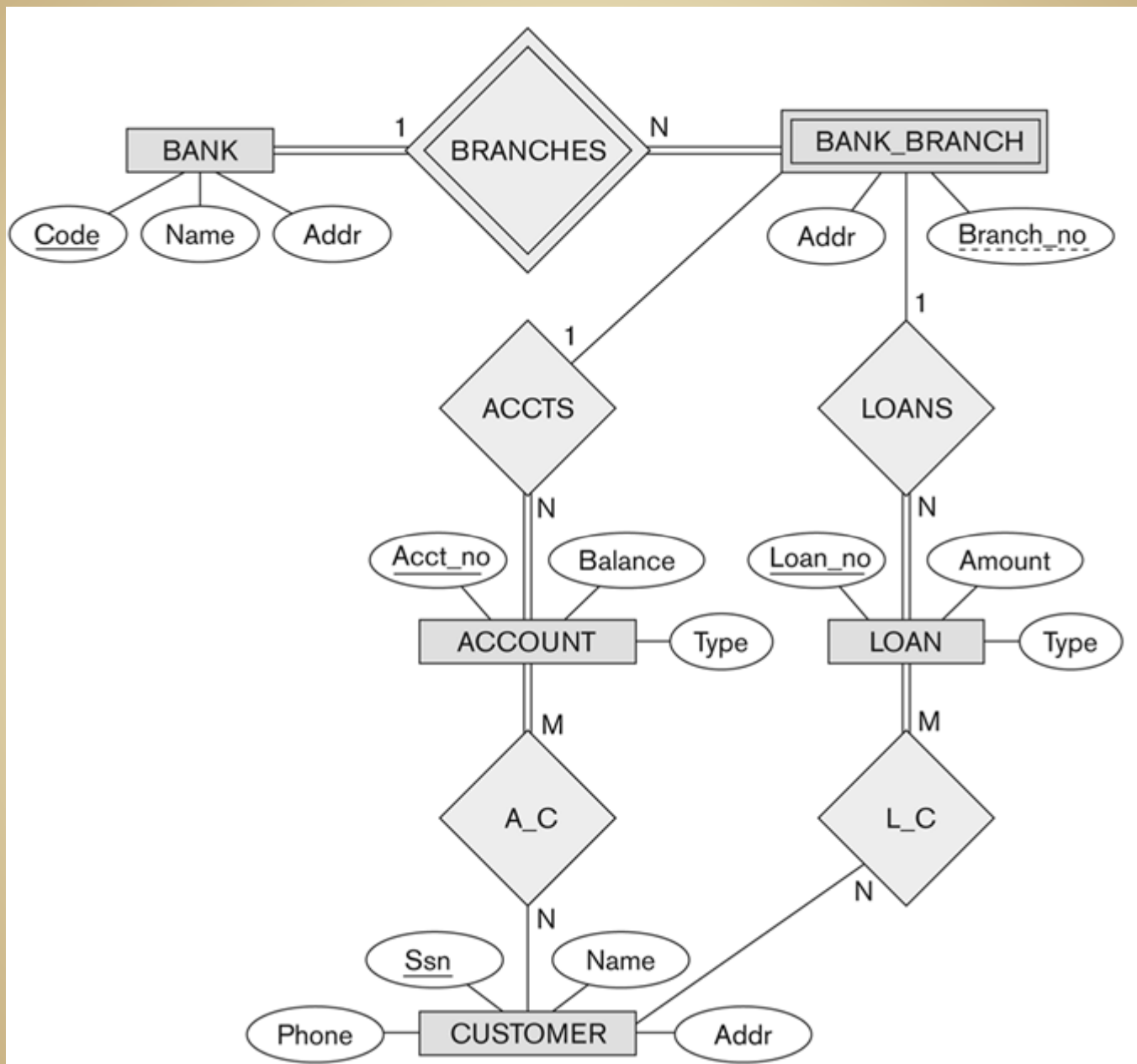
Derived Attribute

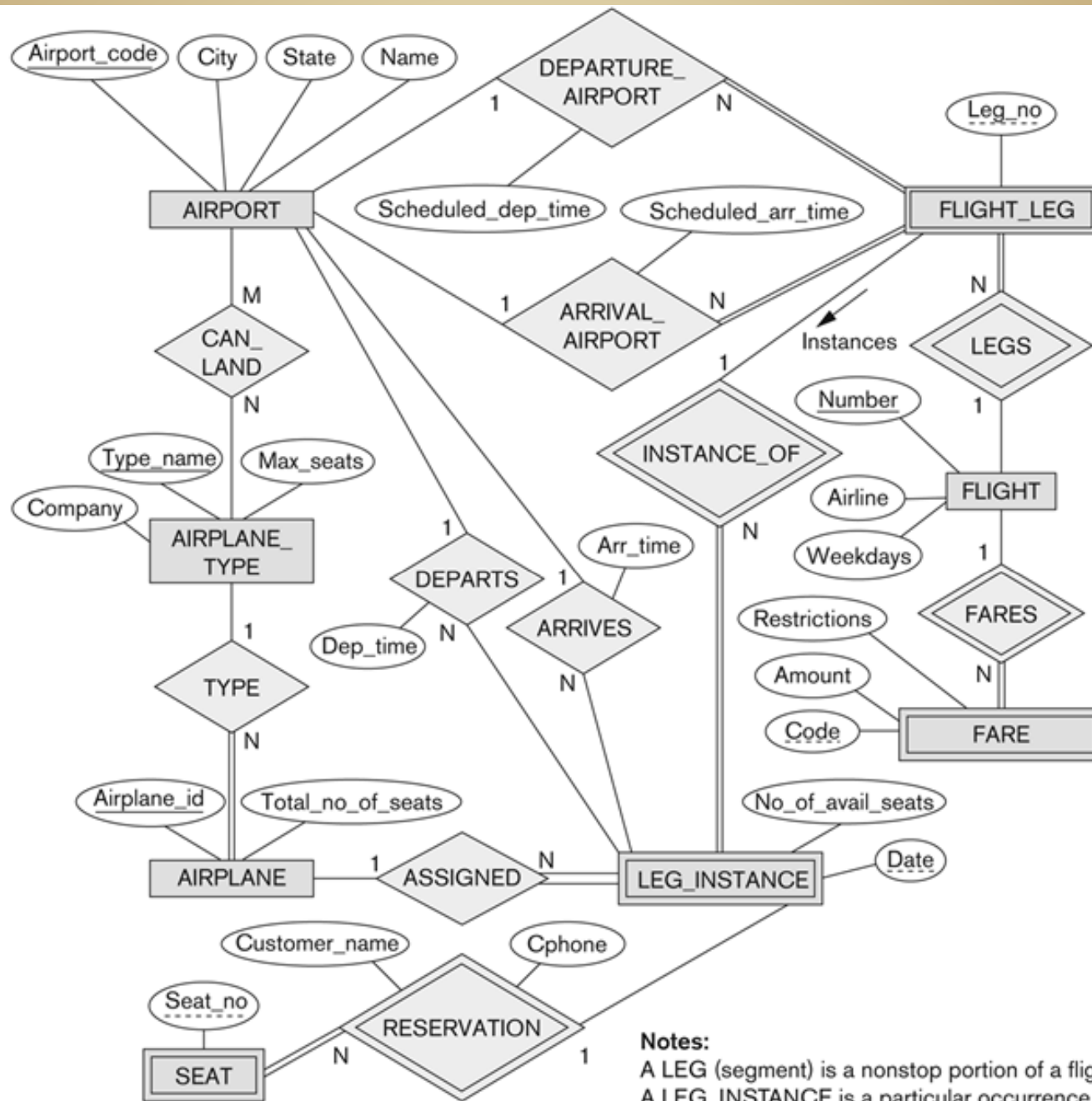






Equivalent Schema defined in UML





Design an ER schema for the following enterprise:

Consider a MAIL_ORDER database in which employees take orders for parts from customers. The data requirements are summarized as follows:

- The mail order company has employees, each identified by a unique employee number, first and last name, and ZIP code.
- Each customer of the company is identified by a unique customer number, first and last name, and ZIP code.
- Each part sold by the company is identified by a unique part number, a part name, price, and quantity in stock.
- Each order placed by a customer is taken by an employee and is given a unique order number. Each order contains specified quantities of one or more parts. Each order has a date of receipt as well as an expected ship date. The actual ship date is also recorded.