

Agenda & Objectives

- Agenda

- Overview where data modeling fits within SDLC
- Define data modeling components
- Write business rules
- Practice modeling various relationships

- Objective

- Given an existing entity relationship diagram (ERD), you will be able to create the corresponding business rules.
- Given an existing entity relationship diagram, you will be able to describe the business process.

- Resource

- BusRules_InterpretingERD.pptx

Creating Business Rules; Interpreting ERDs

Data Modeling

Outline

1. Overview of data modeling
 1. Deliverables of data modeling
 2. Questions to ask when gathering information
 3. Where data modeling maps to process modeling
2. Elements of ERD
3. Cardinality, participation
4. Degree of relationships
5. Identifying or non-identifying PK?

Overview of Data Modeling

- A model that captures the overall structure of organizational data, independent of DBMS and without implementation details
- Deliverable
 - Entity Relationship Diagram

Gathering Information

Questions for Data Modeling

1. What are subjects/objects of the business?
 - * Entities
2. What unique characteristic distinguishes each object from other objects of the same type?
 - * Primary key
3. What characteristics describe each object?
 - * Attributes
4. How do you use this data?
 - * Reports (via queries)
 - * Security controls (e.g., login requirements)

Questions (cont'd...)

5. How many instances of one entity participate with another entity?
 - * Cardinality
6. Is participation between entities required or optional?
 - * Participation
7. What events occur that imply associations between various objects?
 - * Relationships
8. Is each activity or event always handled the same way or are there special circumstances?
 - * Integrity rules and triggers

Outline

1. Overview of data modeling
2. Elements of ERD
 1. Entity
 2. Attribute
 3. Identifier/Primary Key
 4. Relationships and Business Rules
 5. ERD Notations: Chen and Crow's Foot
3. Cardinality, participation
4. Degree of relationships
5. Identifying or non-identifying PK?

Entity

- A person, place, object, event or concept in user environment about which the organization wishes to maintain data
 - E.g., employee, student, warehouse, car, sale, booking, account, course
- Note the difference
 - Entity
 - Entity instance

Attribute

- A property or characteristic of an entity of interest to the organization
 - Many CASE tools do not include attributes on the ERD to avoid cluttering the diagram, but define them in the repository
 - E.g., STUDENT (Stud_Id, Stud_name, Address, Phone)
 - E.g., AUTOMOBILE (Vehicle_Id, Color, Horsepower, Year)
- Candidate Key
 - An attribute (or combination of attributes) that uniquely identifies each entity instance
- Identifier/Primary Key
 - A candidate key that has been selected to index the entity

Relationship

- An association between entity instances in one or more entities
- Defined by business rules

Business Rules

- Business Rules *rule*
- How things work here
- Start with a single instance of each entity
- Always stated in pairs—define relationship from perspective of each related entity
- Become the verbs in the relationships
- Determine cardinality and participation
- The basis for stored procedures and triggers

Examples: Business Rules


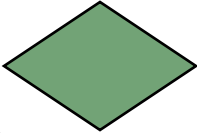
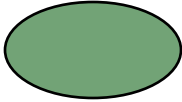
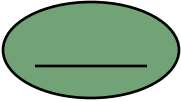
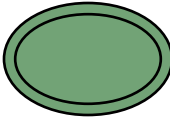
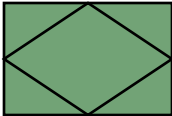
- Each customer can place many orders.
- Each order is placed by one and only one customer.
- A department employs one or more employees.
- An employee is assigned to one department.
- A customer may purchase multiple products.
- A product may be purchased by multiple customers.
- A student may enroll for many classes.
- A class may have many students enrolled in it.

Identify the entities, cardinality and participation indicated in the above business rules.

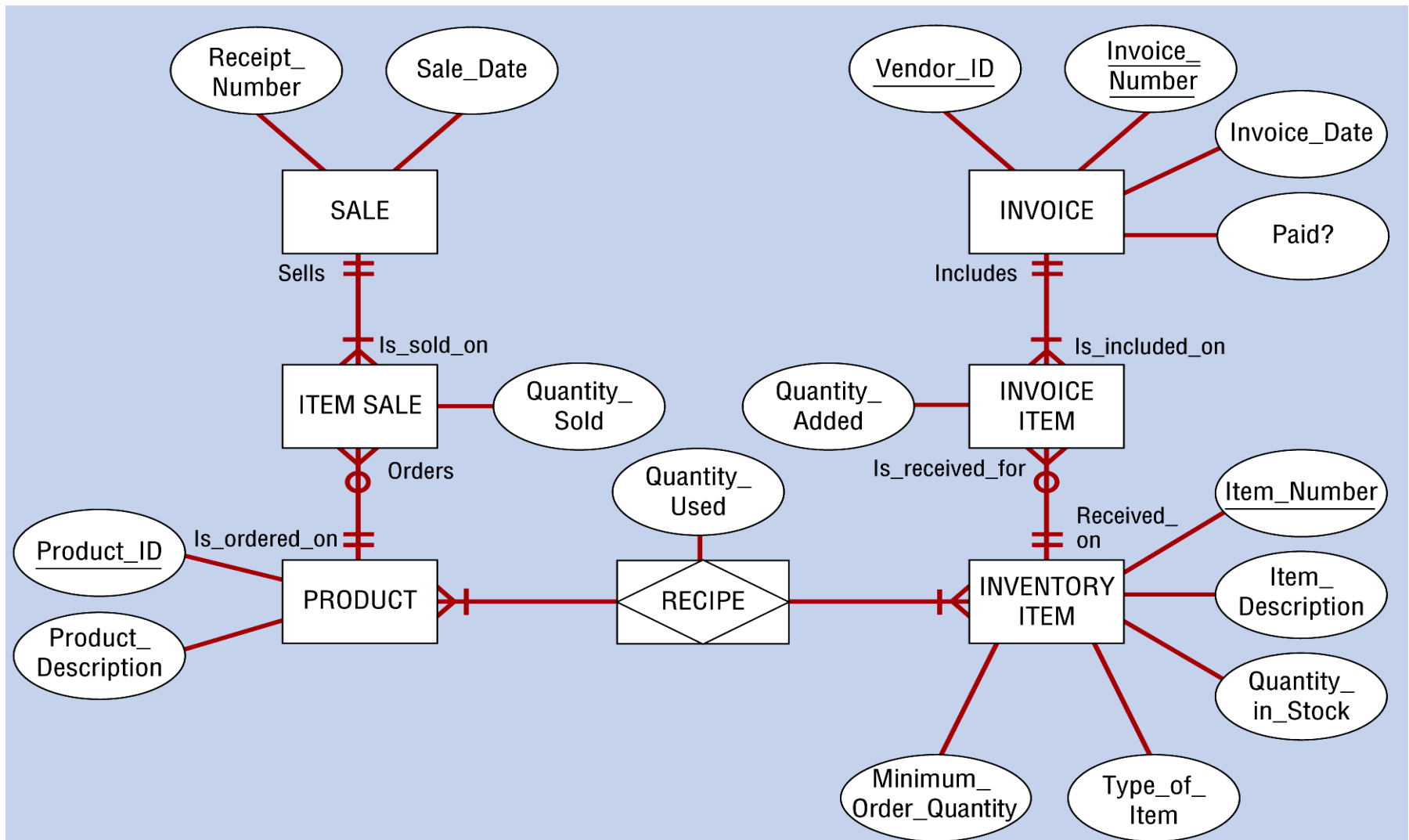
ERD Notations

- Entity-relationship data model
 - Expressed as entity-relationship diagrams (ERD)
- Different notations
 - Chen P, 1976, The entity-relationship model-toward a unified view of data, *ACM Transactions on Database Systems*, Vol 1 (March) pp. 9-36
 - Teorey, Yang & Fry, 1986, *Computing Survey*, 18 (2)
 - Storey, 1991, *Data and Knowledge Engineering*, 7 p47
- We use the “Crow’s foot” notation

ERD Notation: Chen

- Entity 
- Relationships 
- Attribute 
- Identifier/PK 
- Multivalued attribute 
- Associative entity 
- Cardinality and Participation:
 - 0..1
 - 0..n *or* 0..*
 - 1..n *or* 1..*

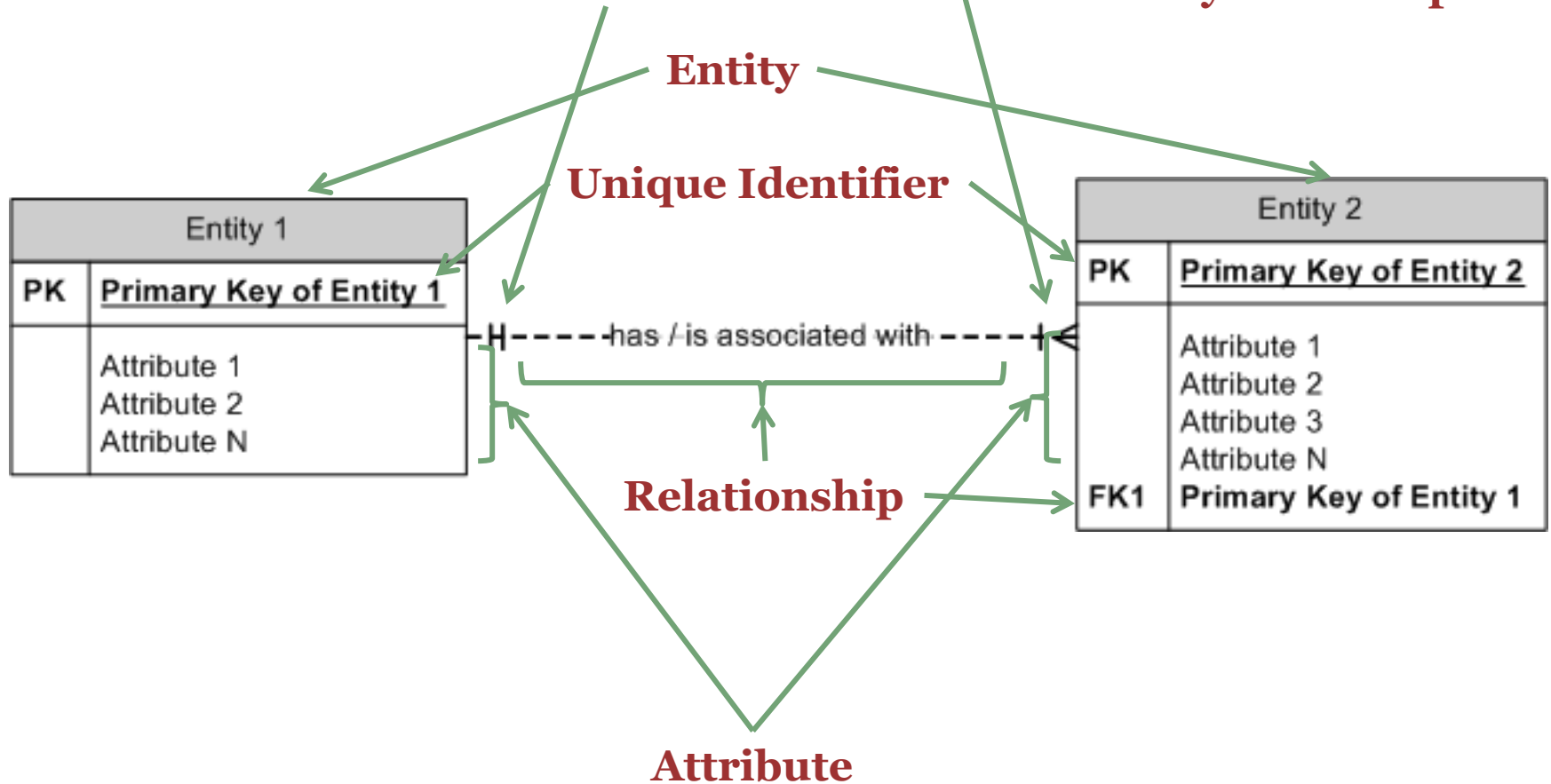
Final E-R Diagram for Hoosier Burger's Inventory Control System: Chen



ERD Notation: Crow's Foot

Cardinality & Participation

Cardinality & Participation



Outline

1. Overview of data modeling
2. Elements of ERD
3. Cardinality, participation
4. Degree of relationships
5. Identifying or non-identifying PK?

Cardinalities in Relationships

Cardinality = the number of instances of entity B that can (or must) be associated with each instance of entity A.

Cardinality: one or many | or \leq

Department	
PK	<u>Dept ID</u>
	Dept Name Dept Phone

1 - has / is assigned to - 1

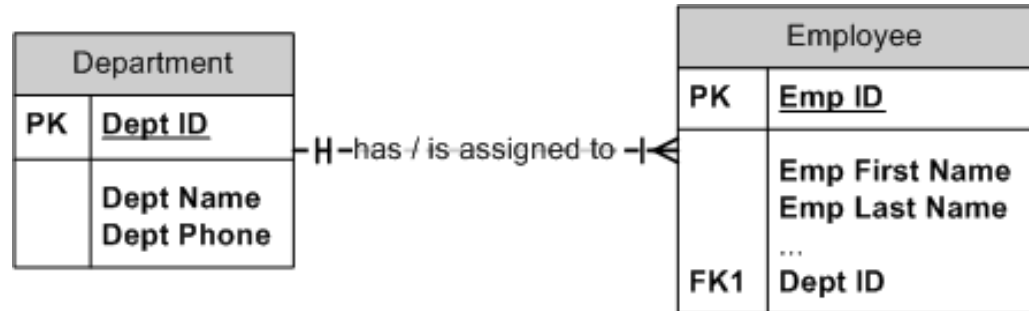
Employee	
PK	<u>Emp ID</u>
	Emp First Name Emp Last Name ...
FK1	Dept ID

Department:Employee

- A department has one or more employees.
- An employee is assigned to one department.

Cardinality is the maximum number (0, 1 or Many) of records in one file that are linked to a single record in another file and vice versa.

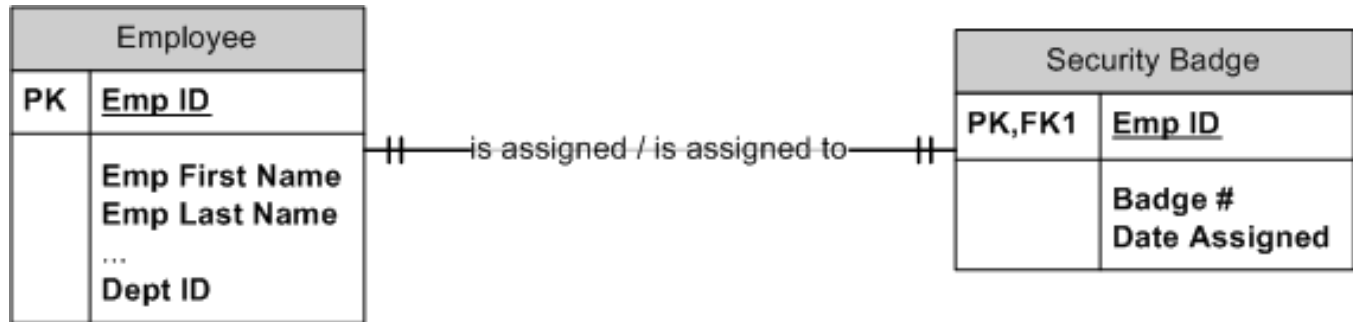
Cardinality Implemented: 1:M



DEPARTMENT		
Dept ID	Dept Name	Dept Phone
1000	Information Systems	836-1234
1001	Accounting	836-2234
1002	Finance	836-3234
1003	Marketing	836-4234

EMPLOYEE			
Emp ID	Emp First Name	Emp Last Name	Dept ID
10	Joe	Brown	1001
11	Jill	Smith	1001
12	Bob	Johnson	1000
13	Mary	Johansen	1003
14	Maxine	Brown	1000
15	Guy	Schmidt	1002
16	Bob	Black	1000

Cardinality Implemented: 1:1



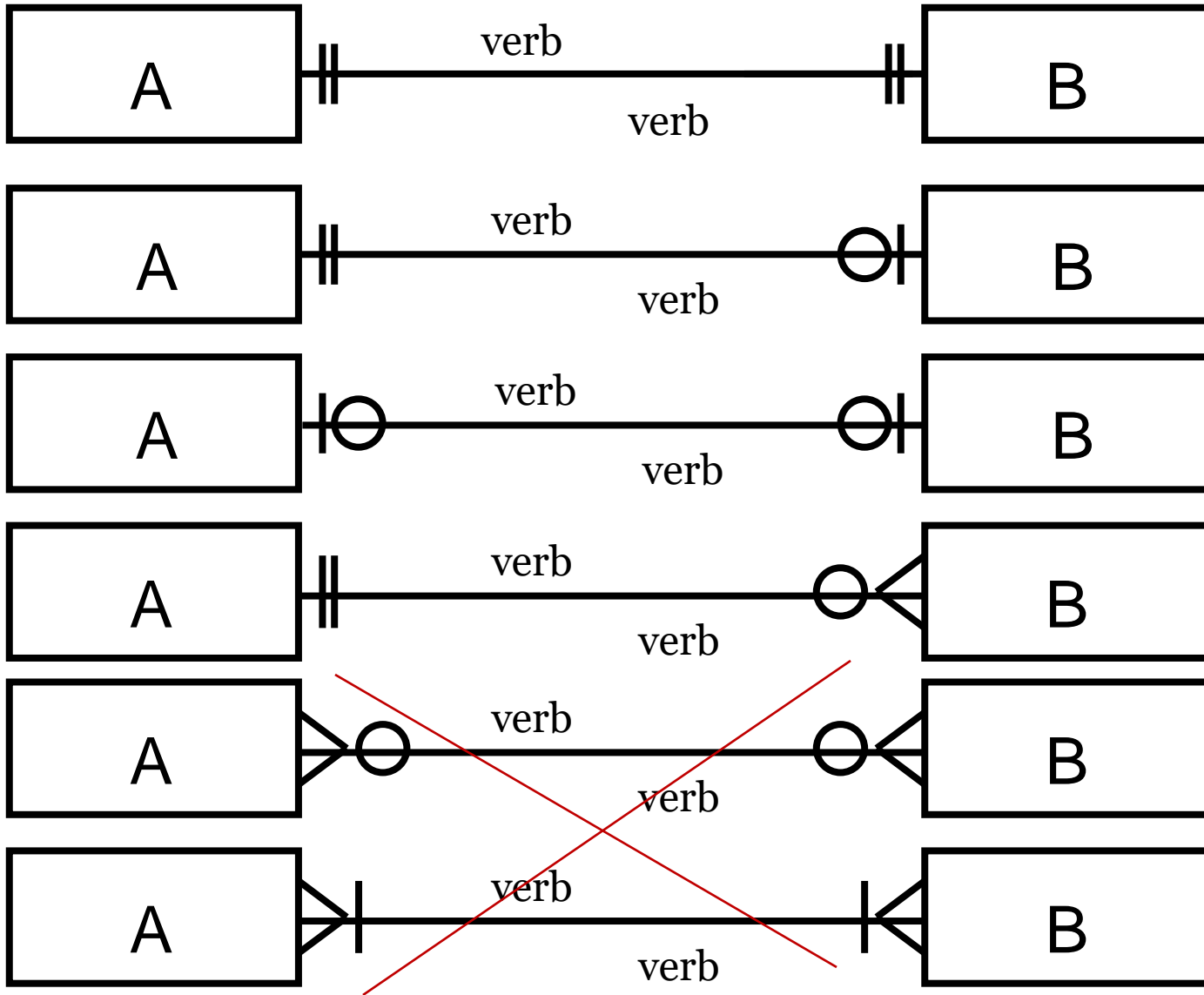
EMPLOYEE			
Emp ID	Emp First Name	Emp Last Name	Dept ID
10	Joe	Brown	1001
11	Jill	Smith	1001
12	Bob	Johnson	1000
13	Mary	Johansen	1003
14	Maxine	Brown	1000
15	Guy	Schmidt	1002
16	Bob	Black	1000

SECURITY BADGE		
Emp ID	Badge #	Date Assigned
10	A5	01/02/2004
11	A17	01/02/2004
12	B3	05/01/2005
13	C1	08/01/2007
14	A7	06/01/2004
15	D23	12/15/2007
16	B4	02/15/2008

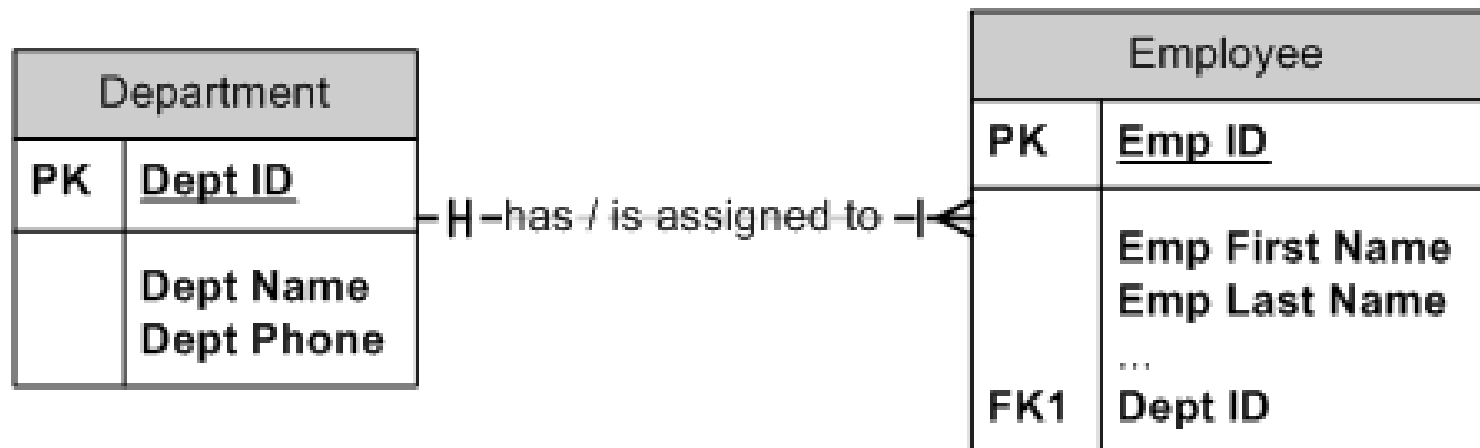
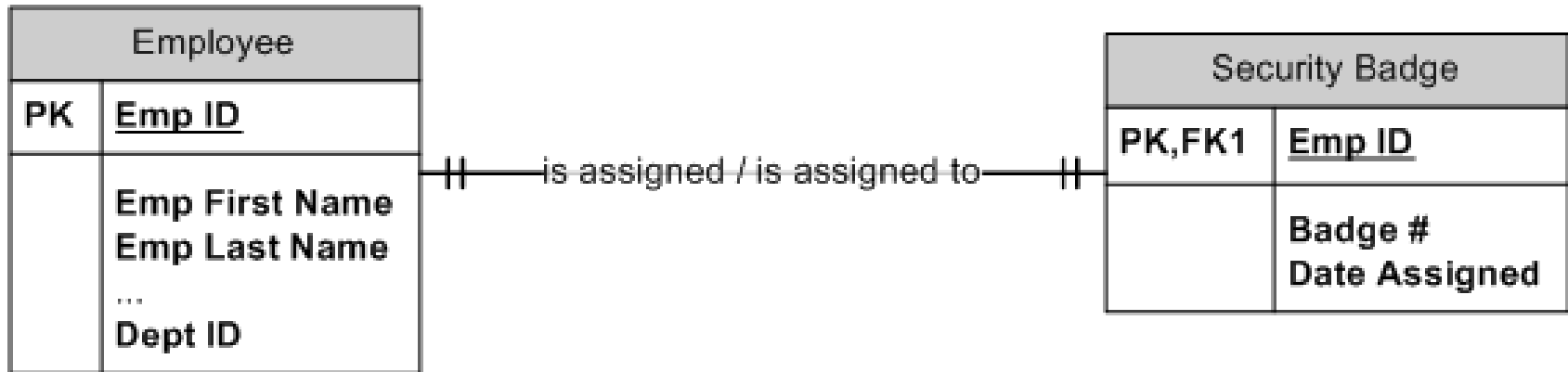
Participation in Relationships

- Participation: whether or not every instance of one entity must participate in a relationship with another entity (i.e., whether every PK from Entity 1 is a FK in Entity 2); whether or not the FK is required or can be null.
- Participation: optional or required O or |
- Optional participation
 - Minimum cardinality is zero
- Required participation
 - Minimum cardinality is one
- Participation and Minimum/Maximum Cardinality
 - If the minimum cardinality is zero, then participation is optional
 - If the minimum cardinality is one, then participation is required
 - Maximum cardinality has no effect on participation

Relationship: Crow's Foot



What are the business rules?



Outline

1. Overview of data modeling
2. Elements of ERD
3. Cardinality, participation
4. Degree of relationships
 1. Unary
 2. Binary
 3. Ternary
5. Identifying or non-identifying PK?

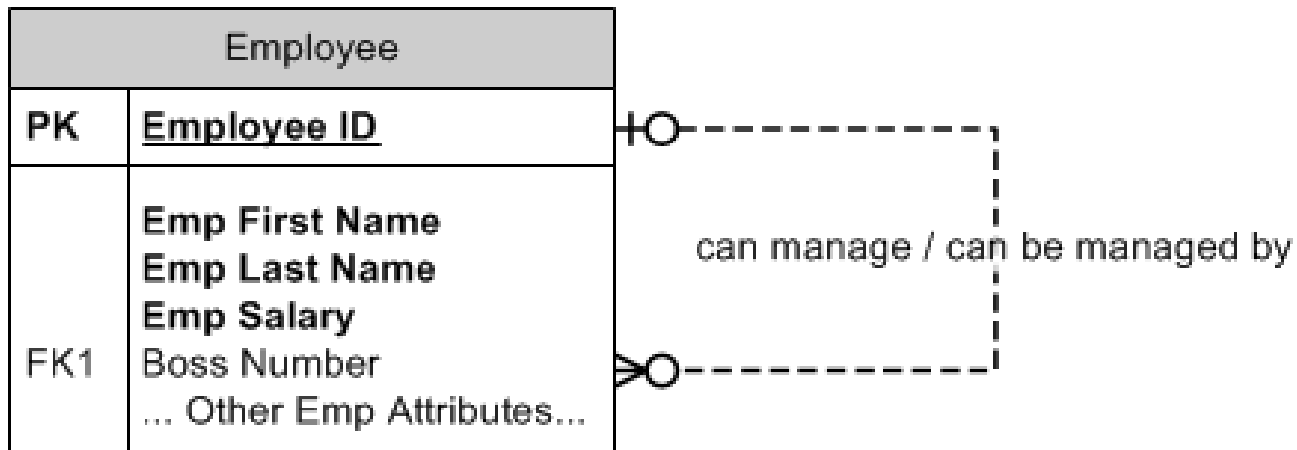
Degree of Relationships

- Degree of a relationship
 - The number of entities that participate in a relationship
- Three main types of degrees
 - Unary relationship: involves only 1 entity
 - Binary relationship (most common): involves 2 entities
 - Ternary relationship: involves 3+ entities
 - Higher is possible but rarely implemented

Relationships of Different Degrees:

Unary Relationships—1 Entity

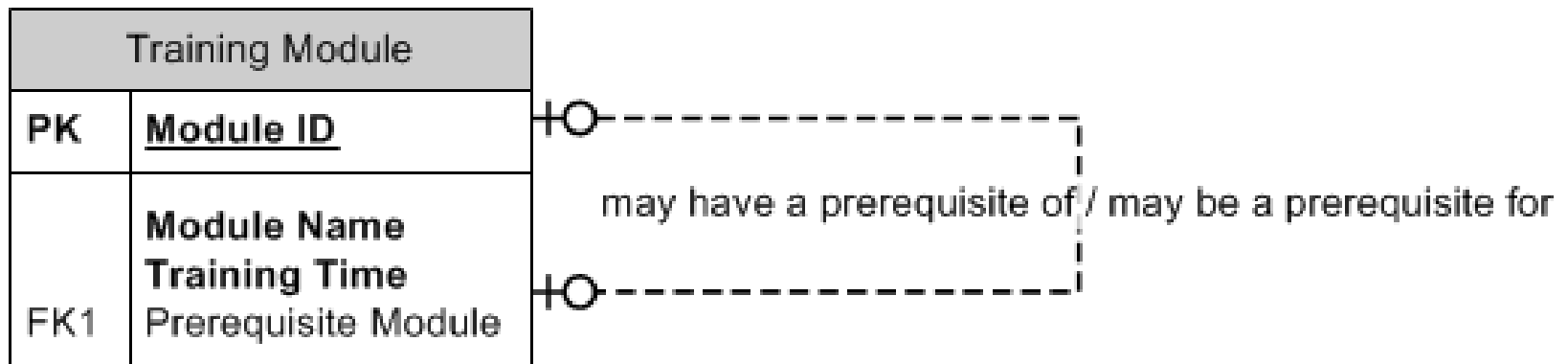
- *Employee:Manager—a 1:M Recursive Relationship*
- Notice both effects of the optional participation



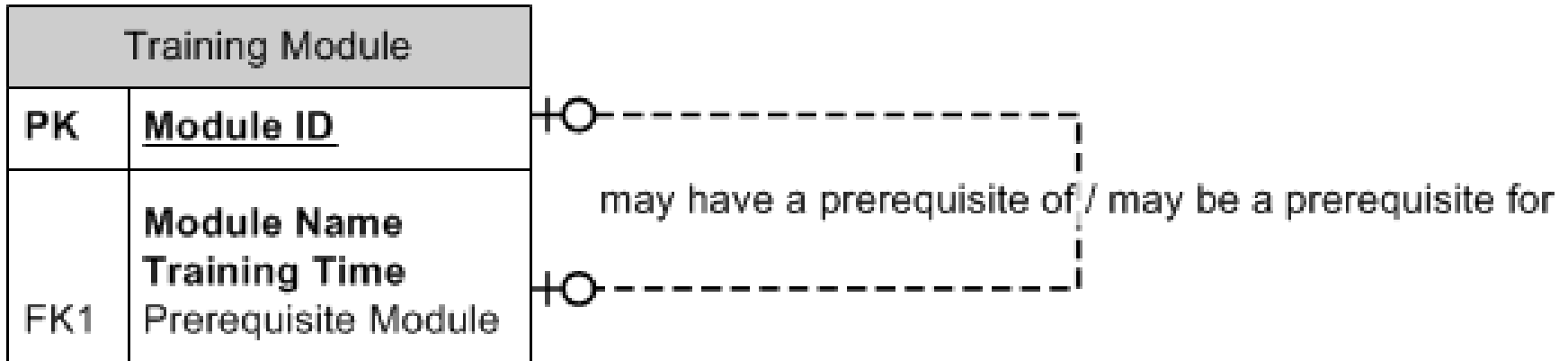
Employee_ID	First Name	Manager
1	Heather	
2	Lisa	1
3	Maxine	1
4	Gertrude	1

A Unary 1:1 Recursive Relationship

- What are the business rules?



Unary 1:1 Recursive Relationship



Module_ID	Module Name	Training Time	Prerequisite Module
A	Beginning Database	1	
B	Intermediate Database	1.5	A
C	Advanced Database	3	B
D	Beginning Modeling	1	
E	Intermediate Modeling	1	D
F	Advanced Modeling	3	E
G	Beginning SQL	2	
H	Intermediate SQL	5	G

Relationships of Different Degrees:

Binary Relationship—2 Entities

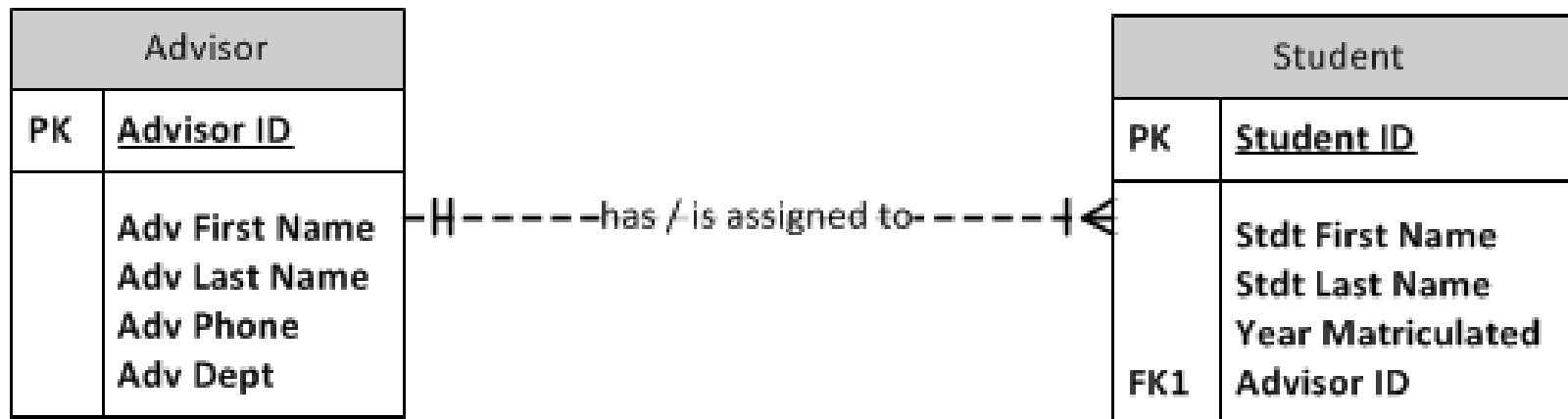
Department	
PK	<u>Dept ID</u>
	Dept Name Dept Phone

-H-has / is assigned to -|

Employee	
PK	<u>Emp ID</u>
	Emp First Name Emp Last Name ...
FK1	Dept ID

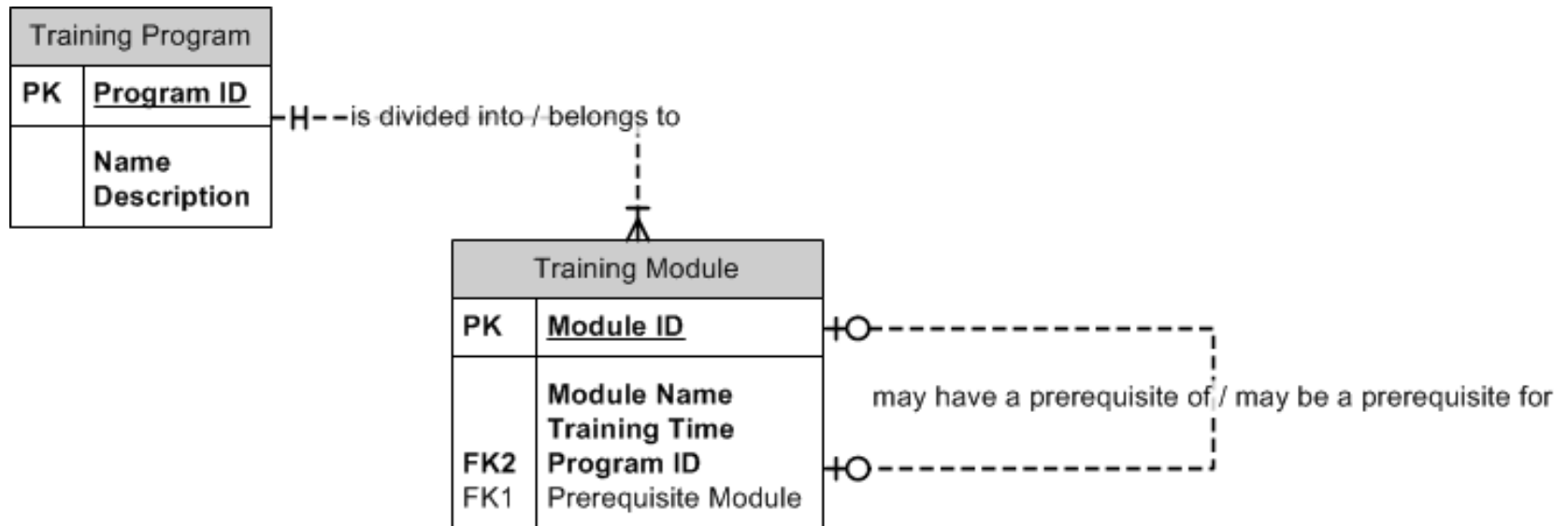
Binary 1:M Relationship

- What are the business rules?

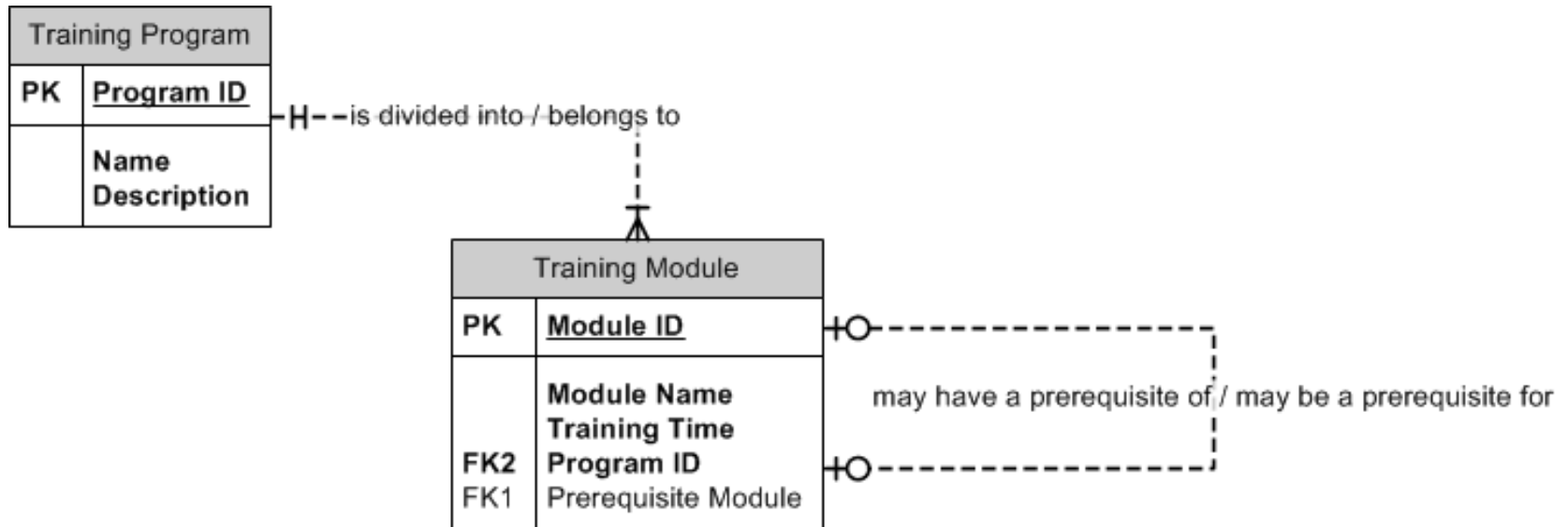


Binary 1:M Relationship

- What are the business rules?



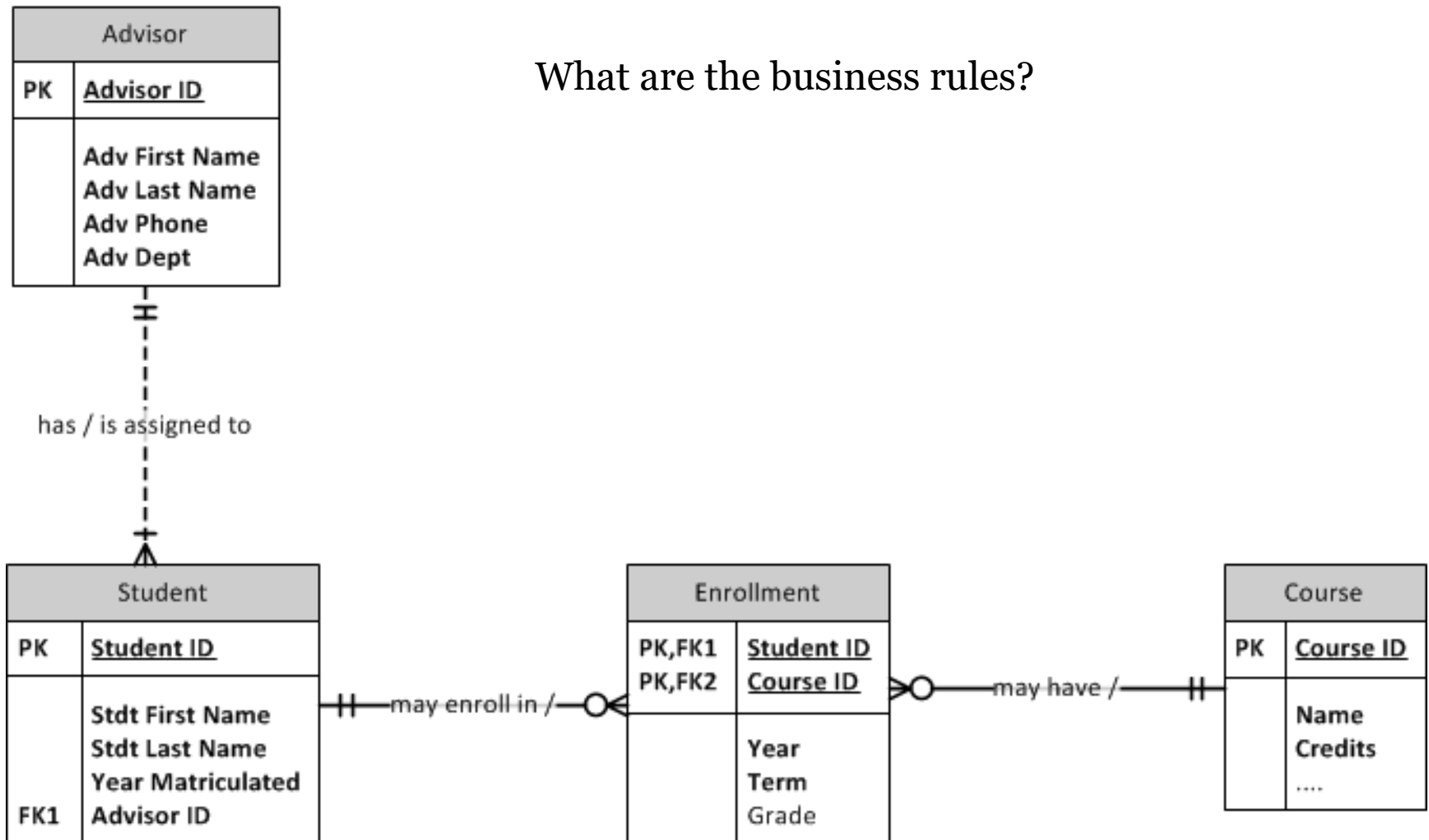
Binary 1:M Relationship



Module_ID	Module Name	Training Time	Prerequisite Module	Program ID
A	Beginning Database	1		1
B	Intermediate Database	1.5	A	1
C	Advanced Database	3	B	1
D	Beginning Modeling	1		2
E	Intermediate Modeling	1	D	2
F	Advanced Modeling	3	E	2
G	Beginning SQL	2		3
H	Intermediate SQL	5	G	3

Binary M:M Relationship

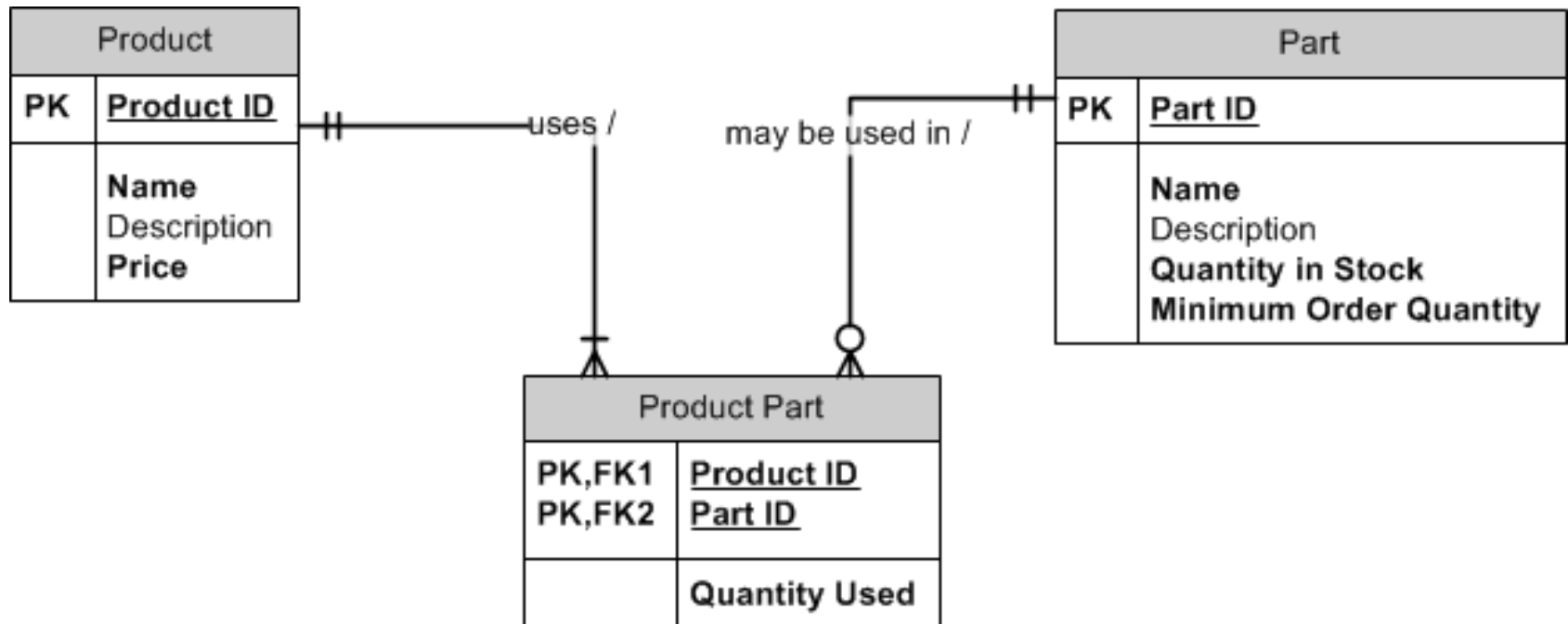
What are the business rules?



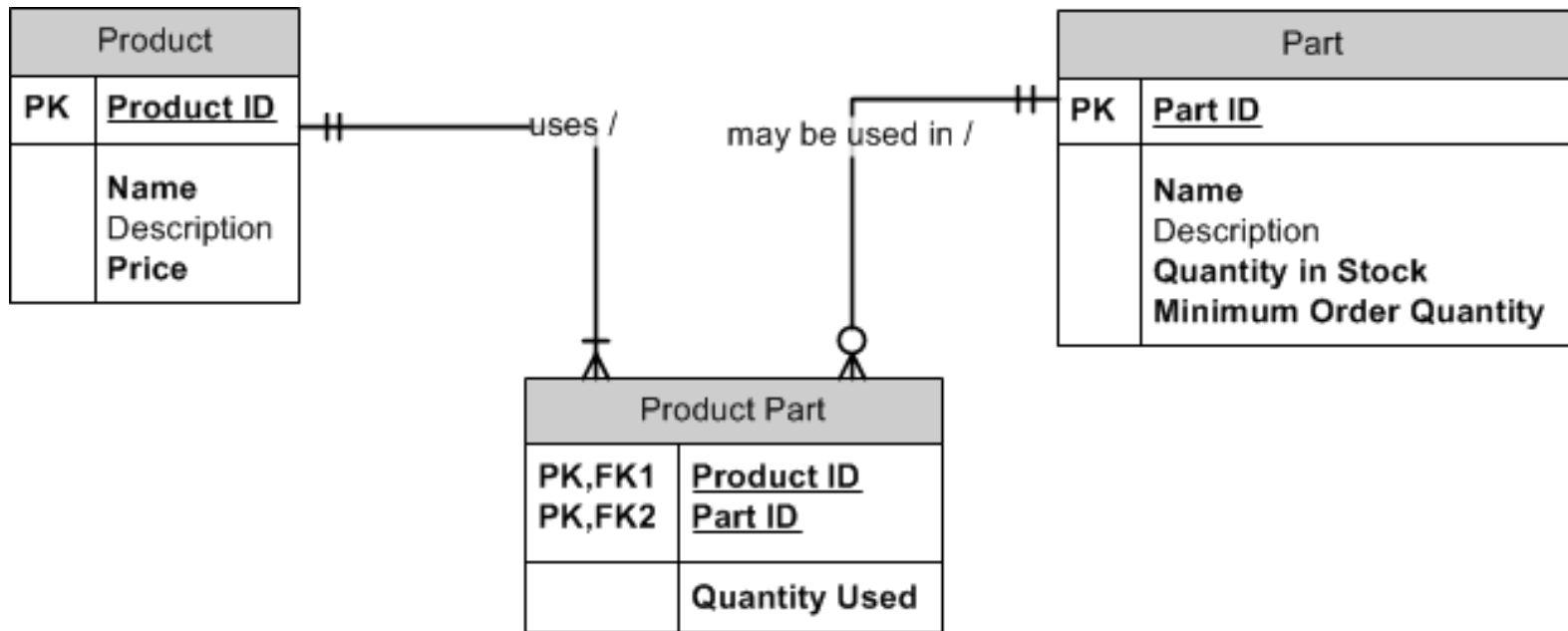
Demo: Binary M:M Relationship

Product:Part

- A part may be used in multiple products.
- A product uses multiple parts.



Binary M:M Relationship

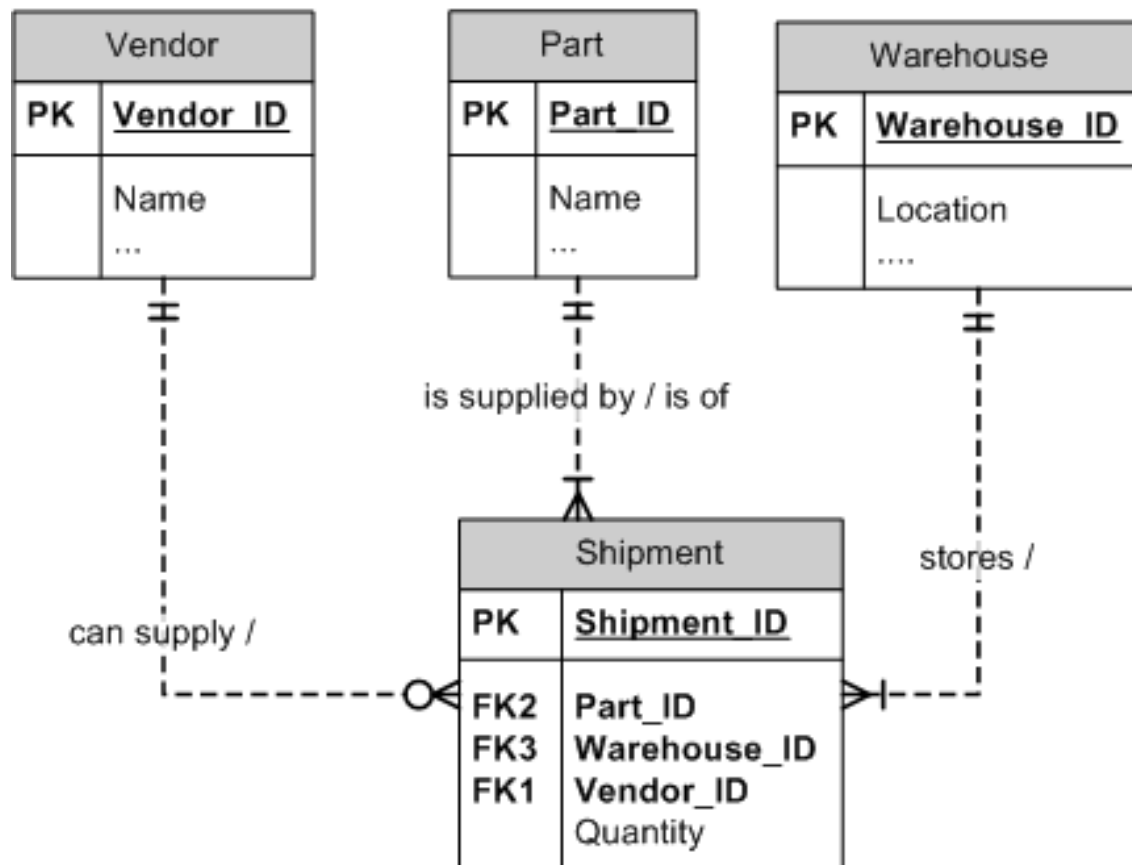


Product_ID	Part_ID	Qty Used
1551	234	2
1551	567	5
1551	369	1
1552	234	1
1552	900	1
1553	567	2
1553	678	4

Ternary Relationships

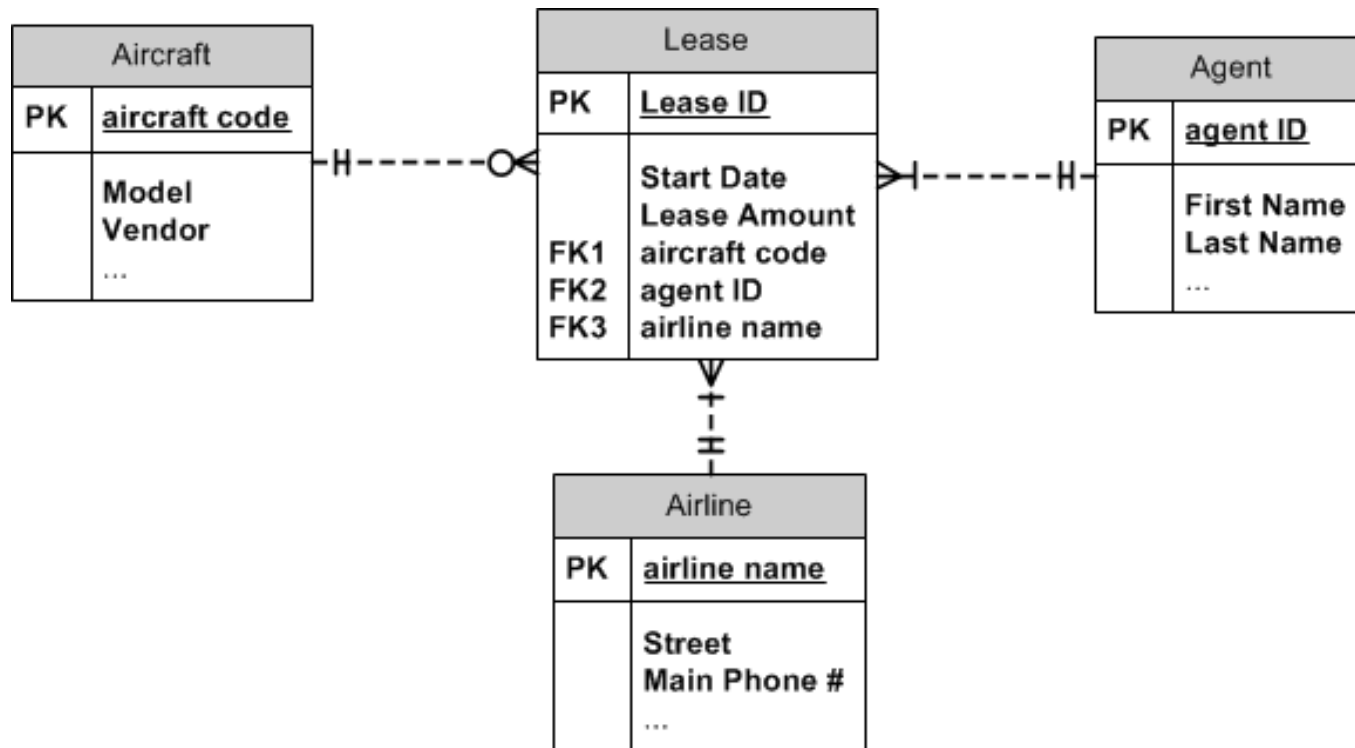
Ternary Relationships: 3 Entities

What are the business rules?



Ternary Relationships

Ternary Relationships: 3 Entities
What are the business rules?



Outline

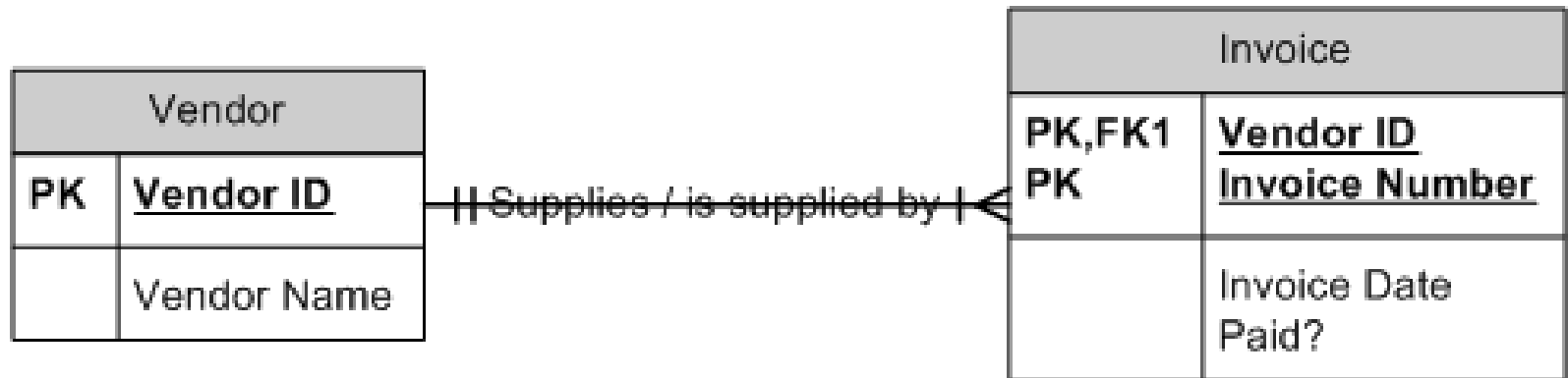
1. Overview of data modeling
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Identifying/Non-identifying PK?

- Purpose of the Primary Key is to uniquely identify each row in the table.
- Rules for creating PK:
 - Must uniquely identify each row
 - Value will not change
 - Will not have a NULL value
 - Is the least amount of fields that will satisfy the above
- Identifying relationship
 - PK of one entity includes the PK of another entity
- Non-identifying relationship
 - PK of an entity is independent of other entities

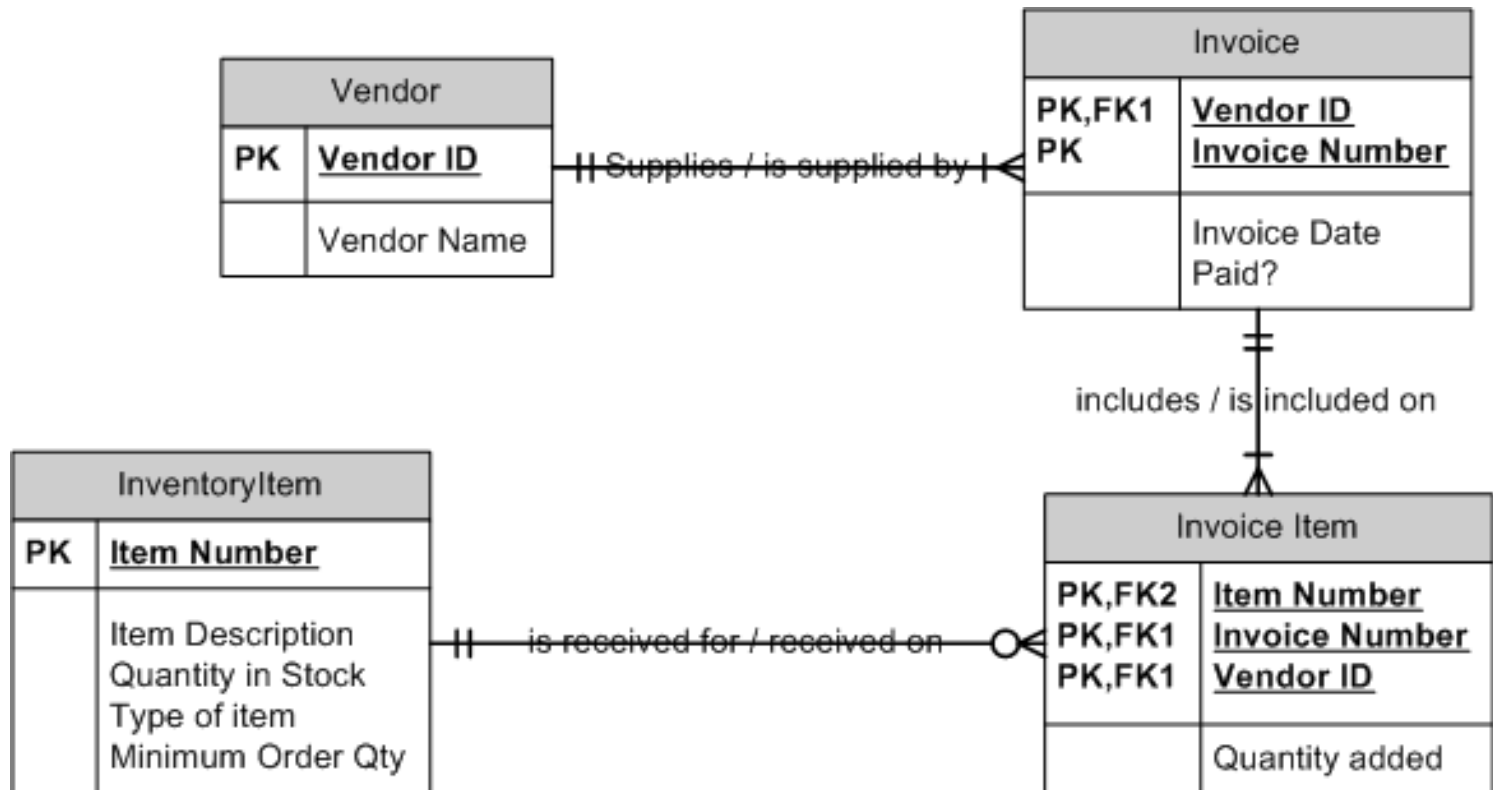
Identifying/Non-identifying PK?

- Which entity is *strong/independent/non-identifying*?
- Which entity is *weak/dependent/identifying*?



Identifying/Non-identifying PK?

- Although technically correct, what is an inherent problem in *identifying* relationships?



Review: What you Know

- How data modeling fits with process modeling
- How to define and identify each element in a data model
- How to interpret unary, binary and ternary relationships in data models
- How to avoid data modeling problems