

Chapter 3

Entity-Relationship Data Modeling: Process and Examples



DATABASE PROCESSING

Fundamentals, Design,
and Implementation, 9/e

A Data Modeling Process

- Steps in the data modeling process
 - Plan project
 - Determine requirements
 - Specify entities
 - Specify relationships
 - Determine identifiers
 - Specify attributes
 - Specify domains
 - Validate model

An abstract graphic on the left side of the slide, featuring a vertical orange bar with red squares, a blue and white curved shape, and a green and yellow circular pattern.

Planning the Project

- Obtaining project authorization and budget
- Building the project team
- Planning the team's activities
- Establishing tools, techniques, and standards for consistent results
- Defining the project's scope



Determining System Requirements

- Sources for data modeling requirements
 - User interviews and user activity observations
 - Existing forms and reports
 - New forms and reports
 - Existing manual files
 - Existing computer files/databases
 - Formally defined interfaces (XML)
 - Domain expertise
- The result of the requirements determination will be a repository of notes, diagram, forms reports, files, etc., that can be used to develop the data model



Specifying Entities

- An entity is something that the users want to track; something the users want to keep data about
- Entities
 - can be physical things or logical concepts
 - are identifiable; you can tell one from another
 - are things described by nouns, not characteristics described by adjectives

Specifying Relationships

- Includes:
 - Identity of the parent and child entities
 - Relationship type
 - Minimum and maximum cardinalities
 - Name of the relationships
- Two techniques:
 - Examine whether a relationship exists between every combination of two entities
 - Locate relationships from requirement documents
- A combination of the two approaches may be used

Determining Identifiers

- **Identifier** is an attribute or group of attributes that uniquely identifies an entity instance
- If there is difficulty specifying an identifier, maybe:
 - it should be part of a different entity
 - it is a subtype or category of a common entity
 - it needs one or more identifying relationships

Specifying Attributes and Domains

- Find attributes on forms, reports, existing files, etc., and add them to entities
- Determine whether the attribute has already defined a domain
 - If so, the attribute is based upon that domain
 - If not, a new domain is defined
- Review the domains and make adjustments as necessary
- **Domain property inheritance**: when the domain properties change, all the attribute properties change as well
- Domains may be used to enforce data standards promoting compatible data types and systems
- Once all attributes have been specified the model should be reviewed for missing entities

Validating Model

- Data model is a model of humans' models, not a model of reality
- A data model is wrong if it does not accurately reflect the ways the users think about their world
- Data models are validated through a series of reviews
 - Normally, a team review is followed by user reviews
- E-R model as well as prototypes of forms and reports may be used to communicate to users features of the data model

Creating Data Models From Forms and Reports

- Example:
Single
entities

Figure 3.6 Single Entity

(a) Report Showing Need for Single Entity and
(b) Entity for the Report in (a)

EQUIPMENT TAG:

EquipmentNumber: 100 Description: Desk
AcquisitionDate: 2/27/2002 PurchaseCost: \$350.00

EQUIPMENT TAG:

EquipmentNumber: 200 Description: Lamp
AcquisitionDate: 3/1/2002 PurchaseCost: \$39.95

(a)

EQUIPMENT

EquipmentNumber

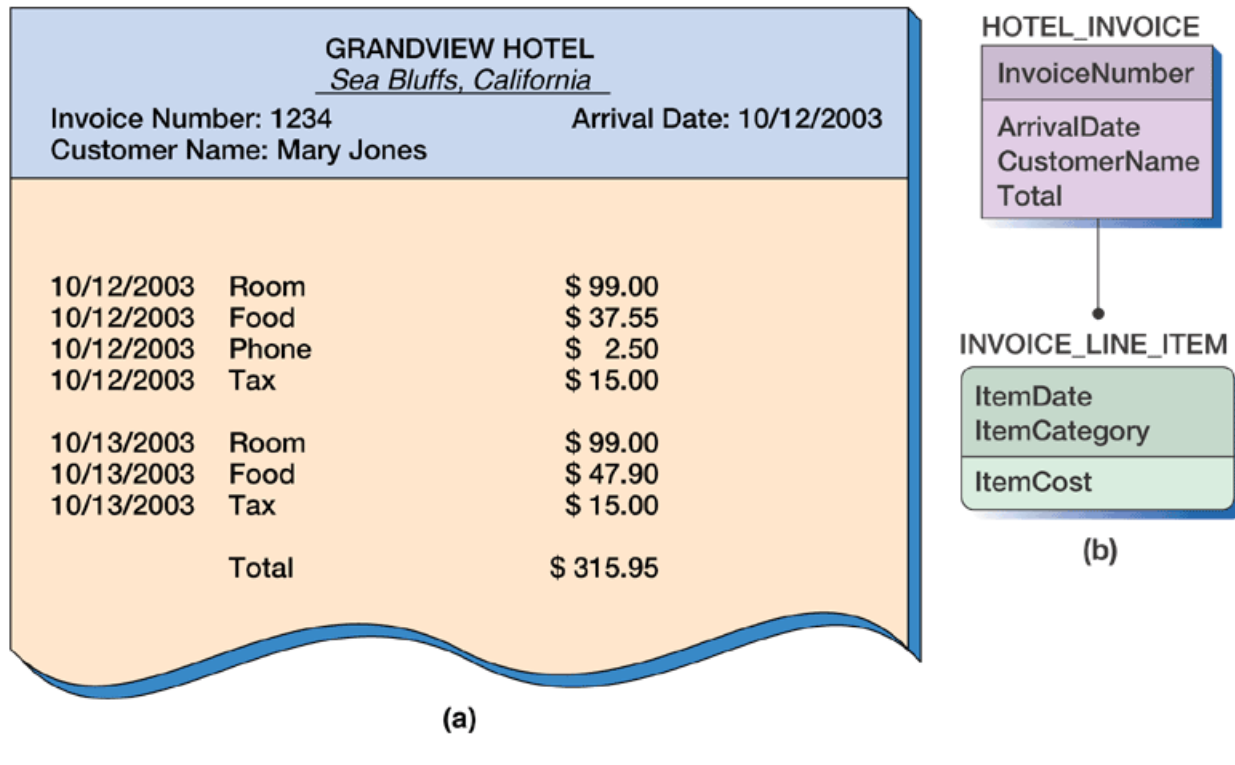
Description
AcquisitionDate
PurchaseCost

(b)

Example: Identifying Connection Relationships

Figure 3.7 Identifying Connection Relationships

(a) Sample Invoice and (b) Identifying Connection Relationship



Example: Repeating Groups

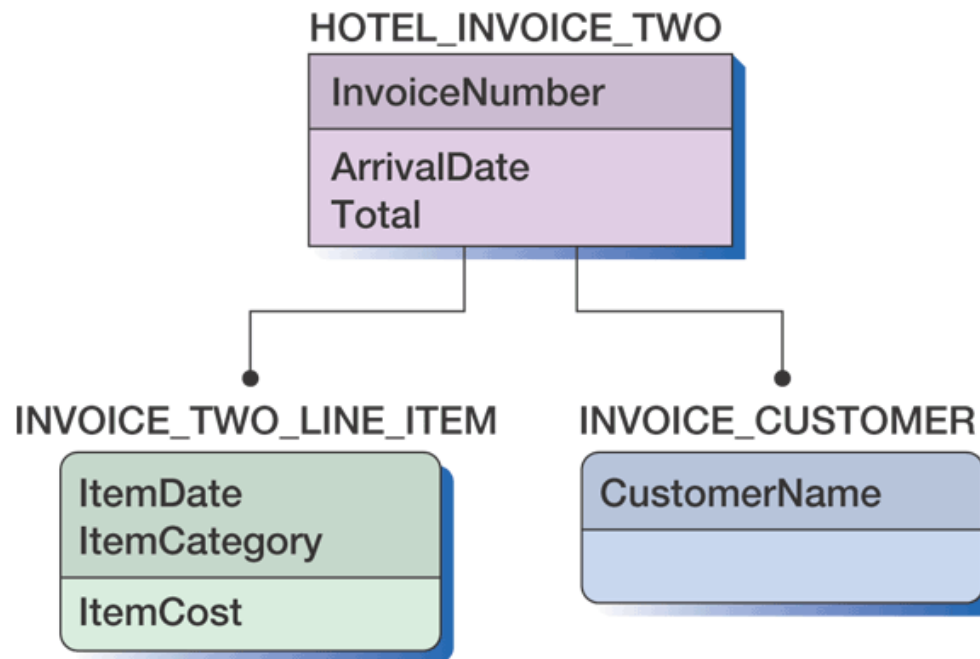
Figure 3.8a Hotel Invoice with Two Repeating Groups —
Sample Invoice

GRANDVIEW HOTEL <i>Sea Bluffs, California</i>		
Invoice Number: 1234	Arrival Date: 10/12/2003	
Customer Name: Mary Jones Fred Jones Sally Jones		
10/12/2003	Room	\$ 99.00
10/12/2003	Food	\$ 37.55
10/12/2003	Phone	\$ 2.50
10/12/2003	Tax	\$ 15.00
10/13/2003	Room	\$ 99.00
10/13/2003	Food	\$ 47.90
10/13/2003	Tax	\$ 15.00
	Total	\$ 315.95

(a)

Example: Repeating Groups

Figure 3.8b Hotel Invoice with Two Repeating Groups — Two Identifying Connection Relationships



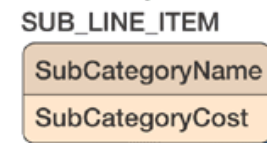
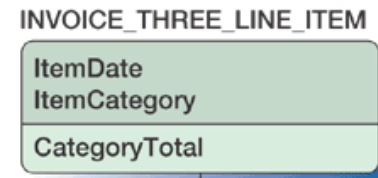
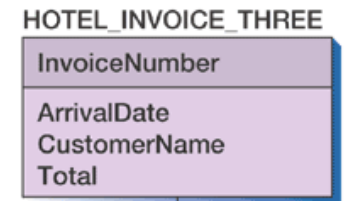
(b)

Example: Nested Groups

Figure 3.9 Hotel Invoice with Nested Groups
 (a) Sample Invoice and (b) Nested Identifying Connection Relationships

GRANDVIEW HOTEL <i>Sea Bluffs, California</i>			
Invoice Number: 1234		Arrival Date: 10/12/2003	
Customer Name: Mary Jones			
10/12/2003	Room		\$ 99.00
10/12/2003	Food		
	Breakfast	\$ 15.25	
	Dinner	\$ 22.30	
			\$ 37.55
10/12/2003	Phone		\$ 2.50
10/12/2003	Tax		\$ 15.00
10/13/2003	Room		\$ 99.00
10/13/2003	Food		
	Breakfast	\$ 15.25	
	Snack	\$ 5.50	
	Dinner	\$ 27.15	
			\$ 47.90
10/13/2003	Tax		\$ 15.00
	Total		\$ 315.95

(a)



(b)

Example: Non-Identifying Connection Relationships

- Example: 1:1

Figure 3.10a 1:1 Non-Identifying Connection Relationship — Sample Forms

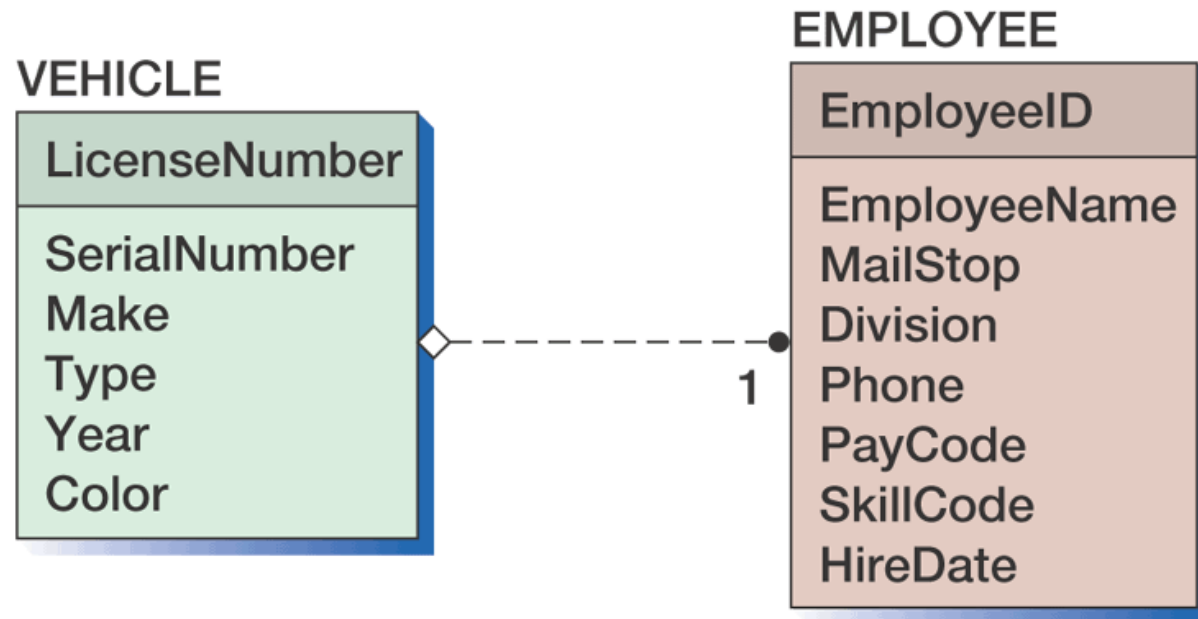
VEHICLE DATA			
License number	Serial number		
Make	Type	Year	Color
Employee assignment			

EMPLOYEE WORK DATA			
Employee name		Employee ID	
MailStop		Division	Phone
Pay code	Skill code	Hire date	Auto assigned

(a)

Example: Non-Identifying Connection Relationships

Figure 3.10b 1:1 Non-Identifying Connection Relationship —
Non-identifying Relationship



(b)

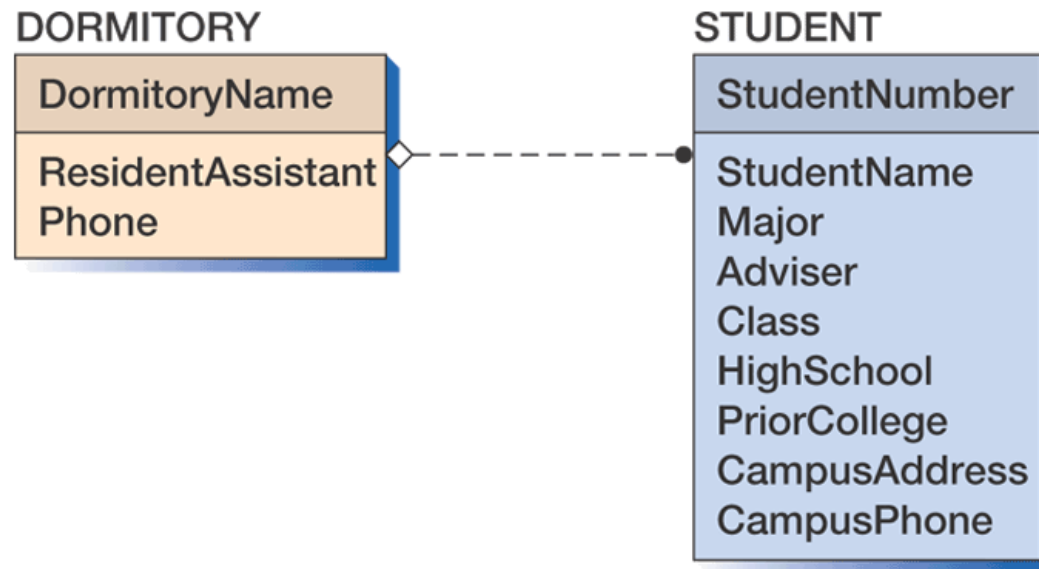
Example: 1:N

Figure 3.11a1 1:N Non-identifying Connection Relationship —
Sample Forms

DORMITORY OCCUPANCY REPORT		
<u>Dormitory</u>	<u>Resident Assistant</u>	<u>Phone</u>
Ingersoll	Sarah and Allen French	3-5567
<u>Student name</u>	<u>Student Number</u>	<u>Class</u>
Adams, Elizabeth	710	SO
Baker, Rex	104	FR
Baker, Brydie	744	JN
Charles, Stewart	319	SO
Scott, Sally	447	SO
Taylor, Lynne	810	FR

Example: 1:N

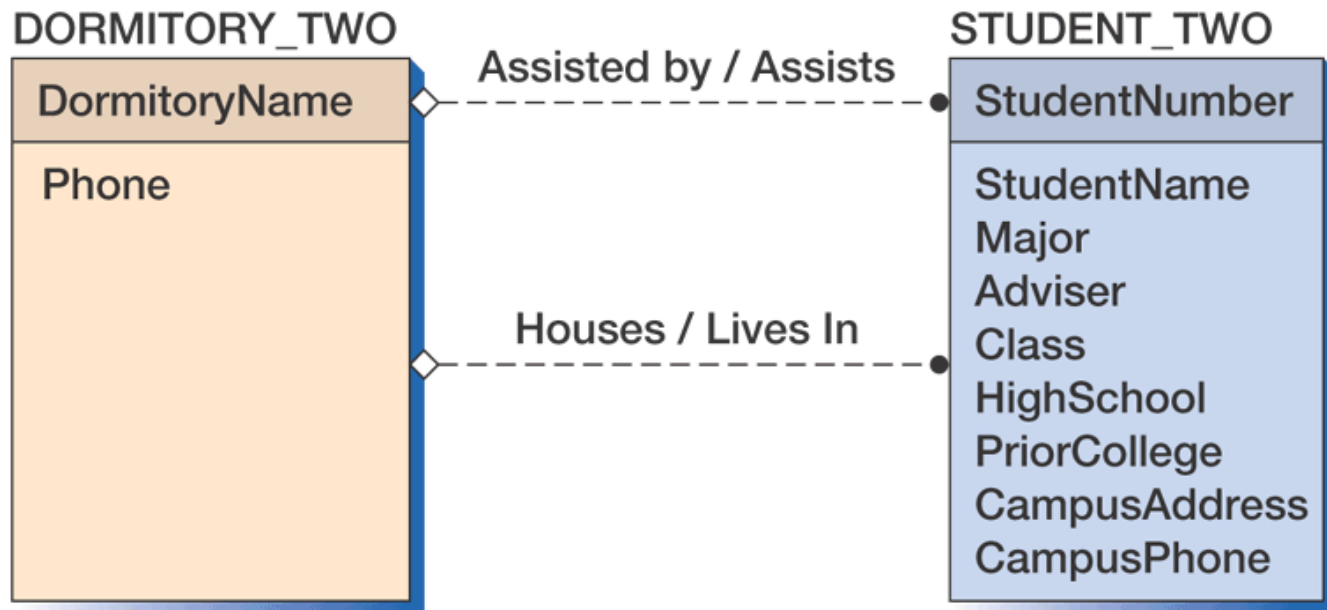
Figure 3.11b 1:N Non-identifying Connection Relationship —
Non-identifying Relationship



(b)

Example: 1:N

Figure 3.11c 1:N Non-identifying Connection Relationship —
Using Relationship for Resident Assistant

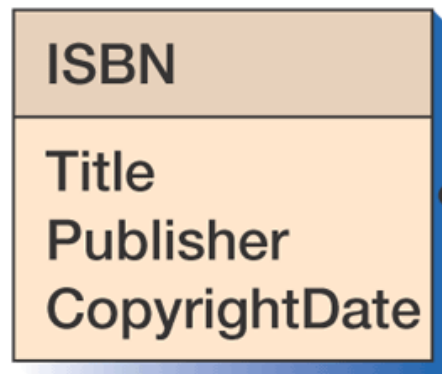


(c)

Example: N:M

Figure 3.12b N:M Relationship —
Non-Specific Relationship

BOOK



AUTHOR



(b)

Example: Assignment Relationship

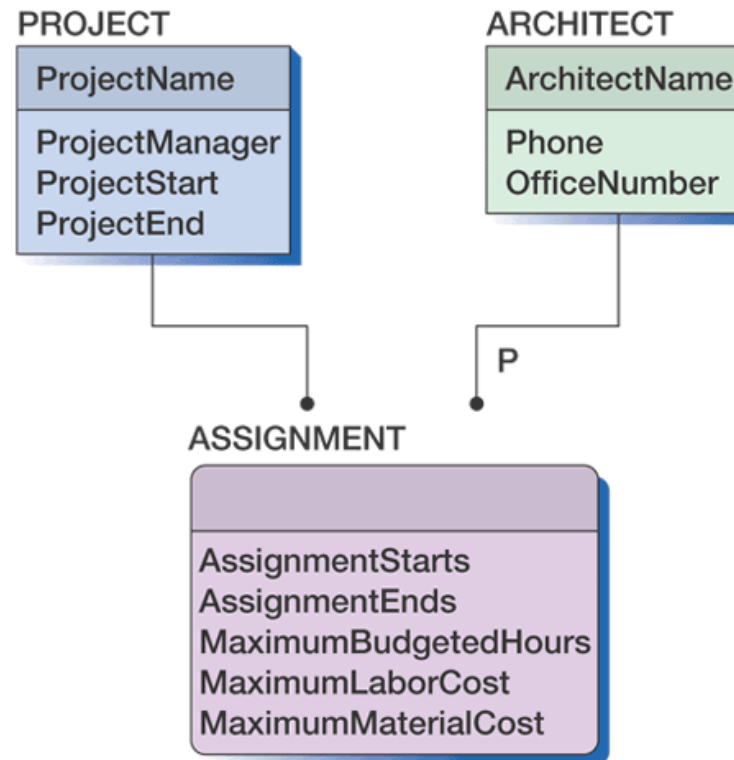
Figure 3.13a Assignment Relationship — Assignment Report

Project Assignment Report			
Project Name	Abernathy House	Architect Name	Jackson, B.
Project Manager	Smith, J	Phone	232-8878
Project Start	11/11/2003	Office Number	J-1133
Project End			
Assignment Starts		12/15/2003	
Assignment Ends		3/15/2004	
Maximum Budgeted Hours		345	
Maximum Labor Cost		\$27,500	
Maximum Material Cost		\$17,500	

(a)

Example: Assignment Relationship

Figure 3.13b Assignment Relationship —
Two Identifying Connection Relationships



(b)

Example: Category Relationship

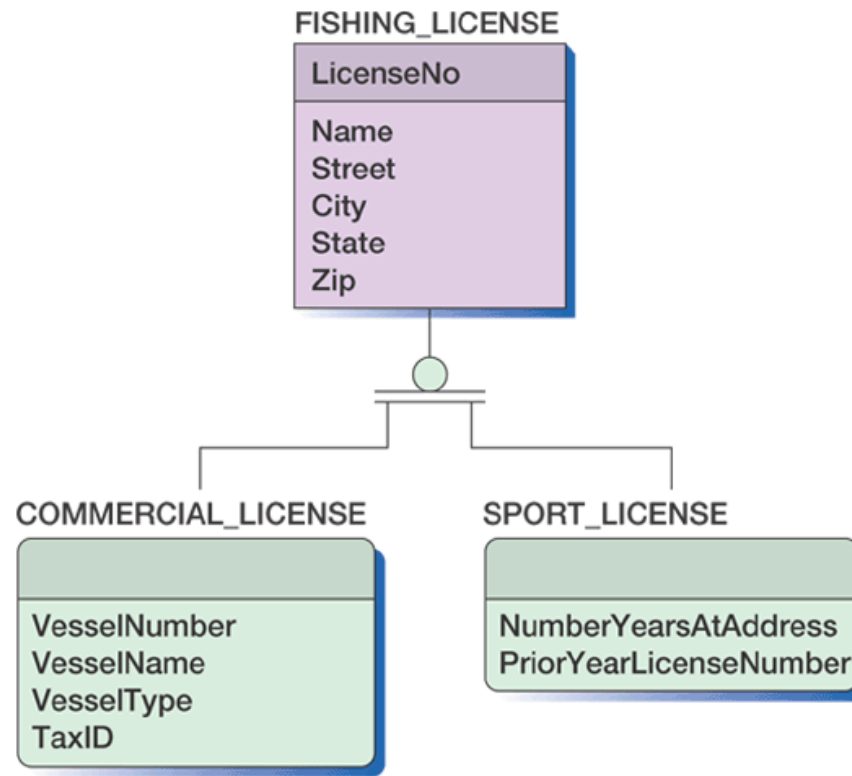
Figure 3.15a Example Category Relationship —
Form Suggesting Need for Categories (Subtypes)

Resident Fishing License 2003 Season <i>State of xxxxx</i>				License No: 03-1123432	
Name:					
Street:					
City:		State:		Zip:	
For Use by Commercial Fishers Only		For Use by Sport Fishers Only			
Vessel Number:		Number Years at this Address:			
Vessel Name:		Prior Year License Number:			
Vessel Type:					
Tax ID:					

(a)

Example: Category Relationship

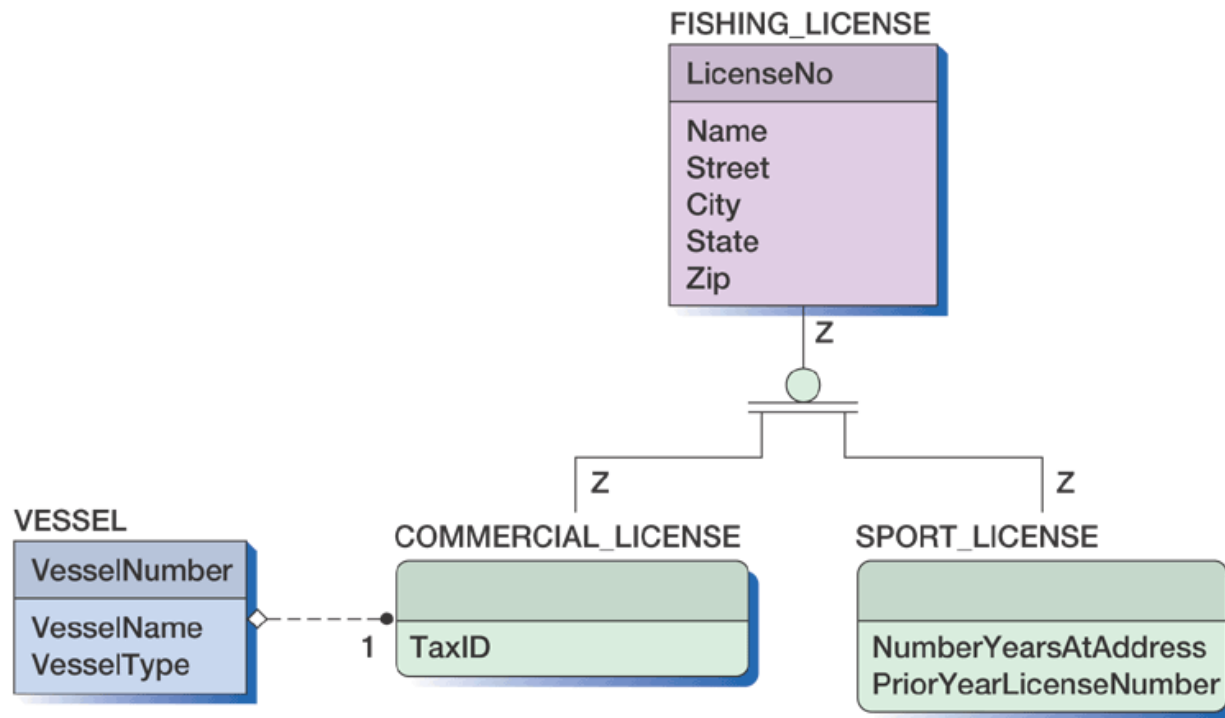
Figure 3.15b Example Category Relationship —
Category Cluster with Two Categories



(b)

Example: Category Relationship

Figure 3.15c Example Category Relationship —
One Category Has Additional Relationship



(c)

Sales-Order Model

Figure 3.16a Sales Order Example — Sample Document;

Carbon River Furniture Sales Order Form

Sales Order Number: 10643 Date: 25-Sep-01

Customer Name: Carbon River Bookshop

Address: 1145 Elm Street

City: Carbon River State: IL Zip: 02234

Phone: 232-0010

Salesperson Name: Dodsworth, Anne Salesperson Code: EZ-1

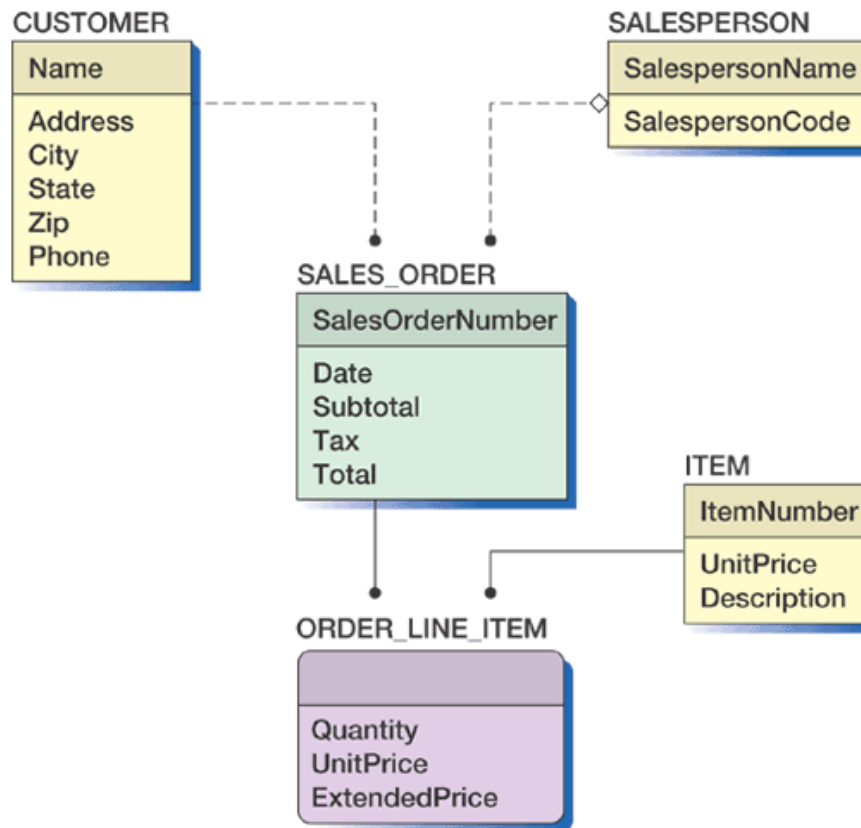
	Quantity:	Item Number	Description	Unit Price:	Extended Price:
▶	1	78	Executive Desk	\$959.00	\$959.00
	1	79	Conference Table	\$1,750.00	\$1,750.00
	4	80	Side Chair	\$99.00	\$396.00
*					

Subtotal: \$3,105.00
Tax: \$29.46
Total: \$3,134.46

(a)

Example: Sales Order

Figure 3.16b Sales Order Example —
LINE_ITEM with Two Identifying Relationships

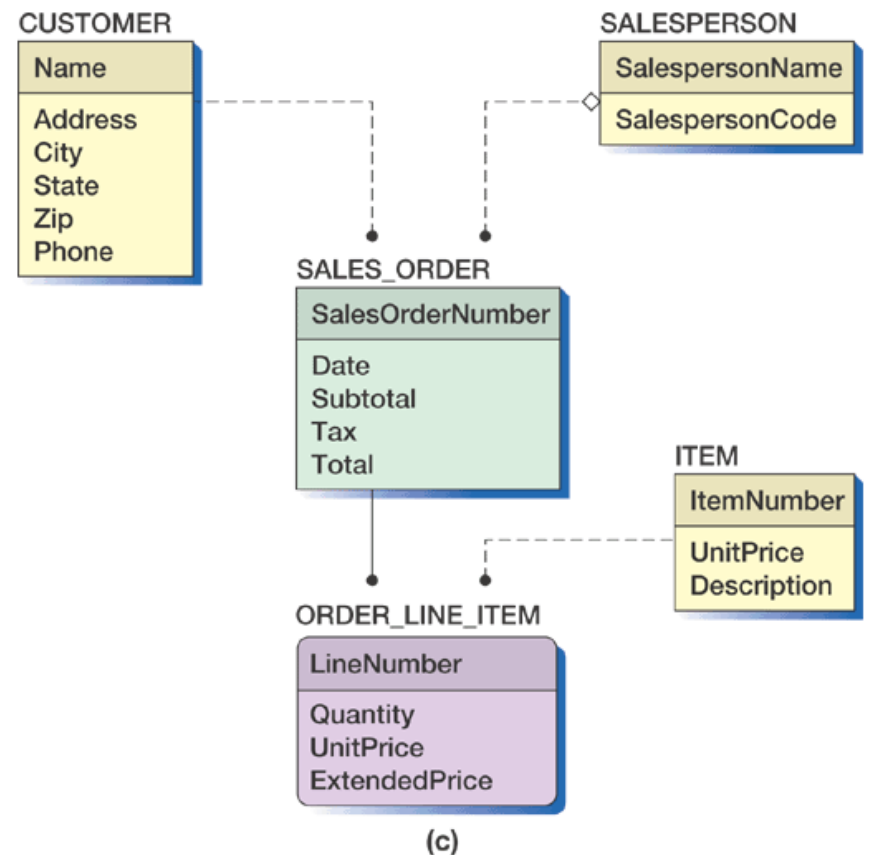


(b)

Example: Sales Order

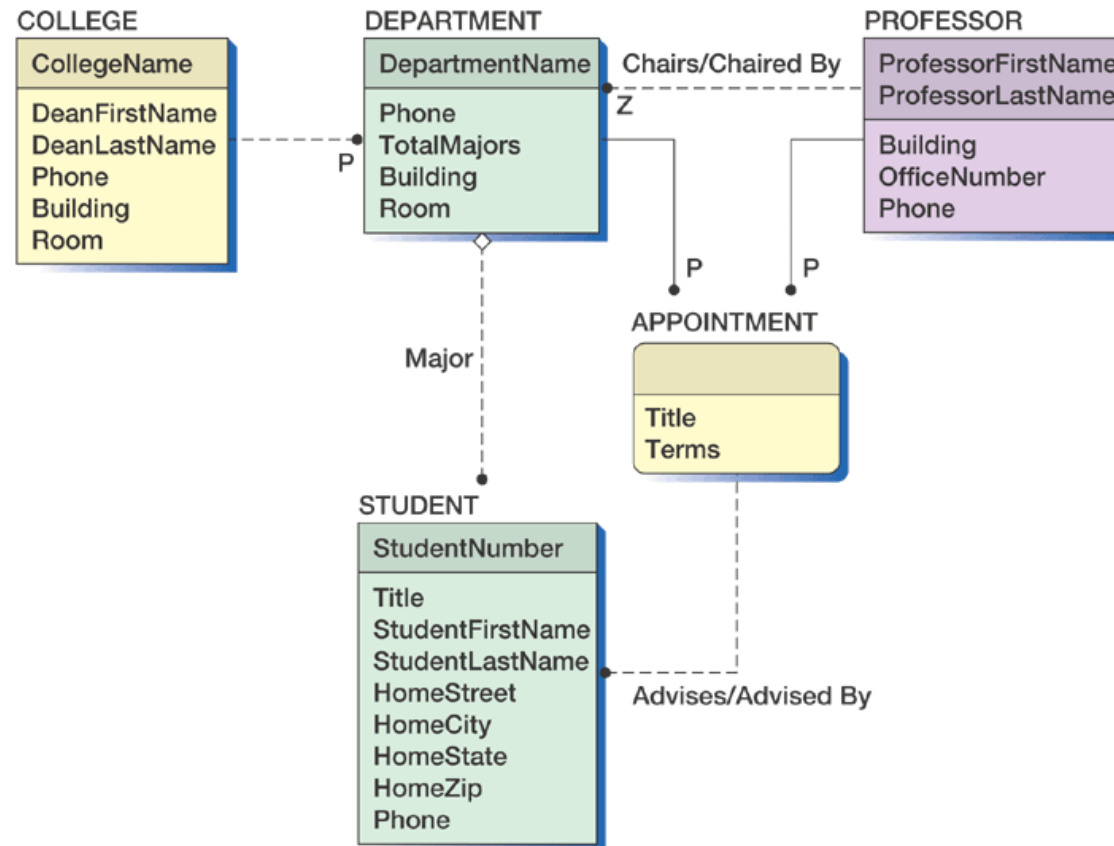
- Figure 3-16(c) shows an alternative design that allows an item to appear more than once on a given order

Figure 3.16c Sales Order Example —
LINE_ITEM with One Identifying Relationship



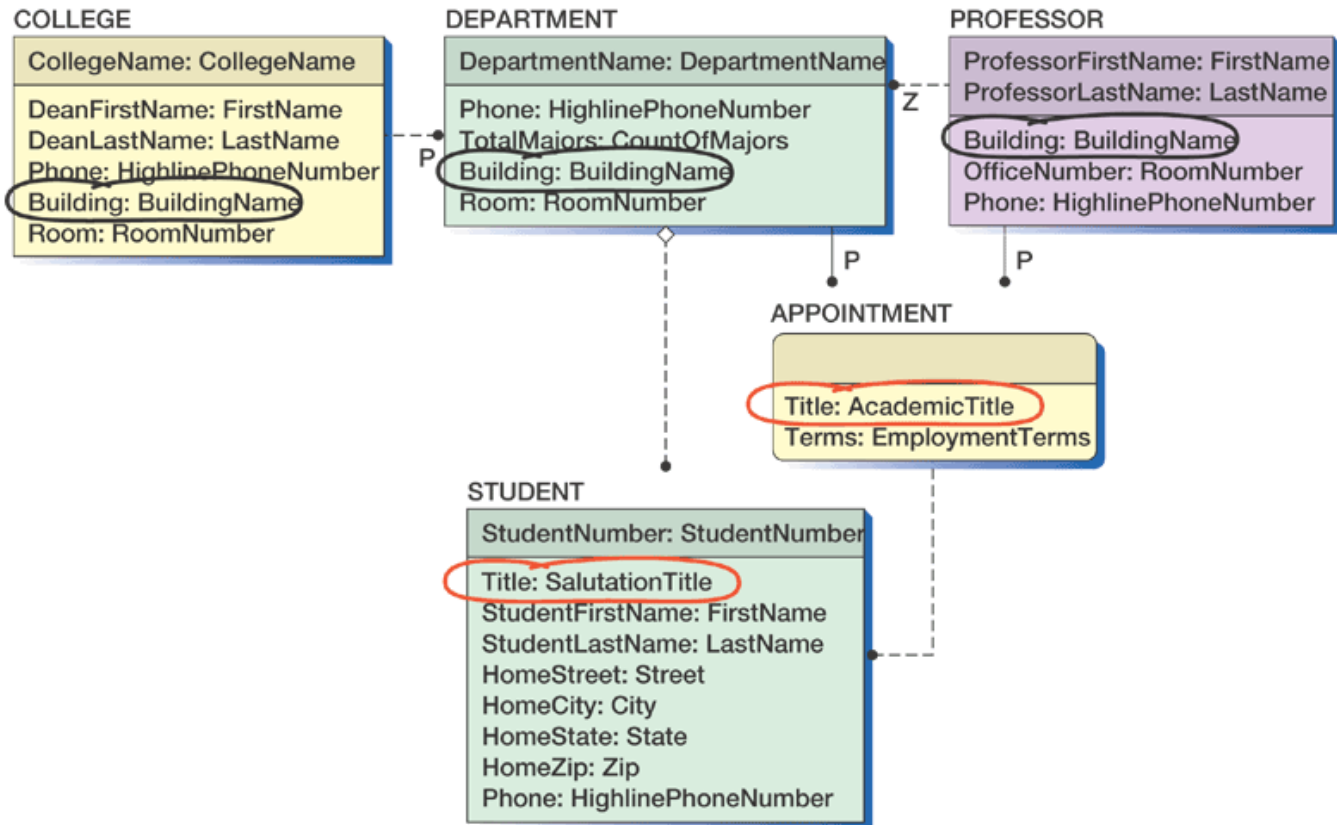
Example: University System

Figure 3.25 Final Data Model



University System With Domain Names

Figure 3.27 Model with Domain Names



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