

David M. Kroenke and David J. Auer

## Database Processing:

Fundamentals, Design, and Implementation



### Chapter Five: Data Modeling with the Entity-Relationship Model

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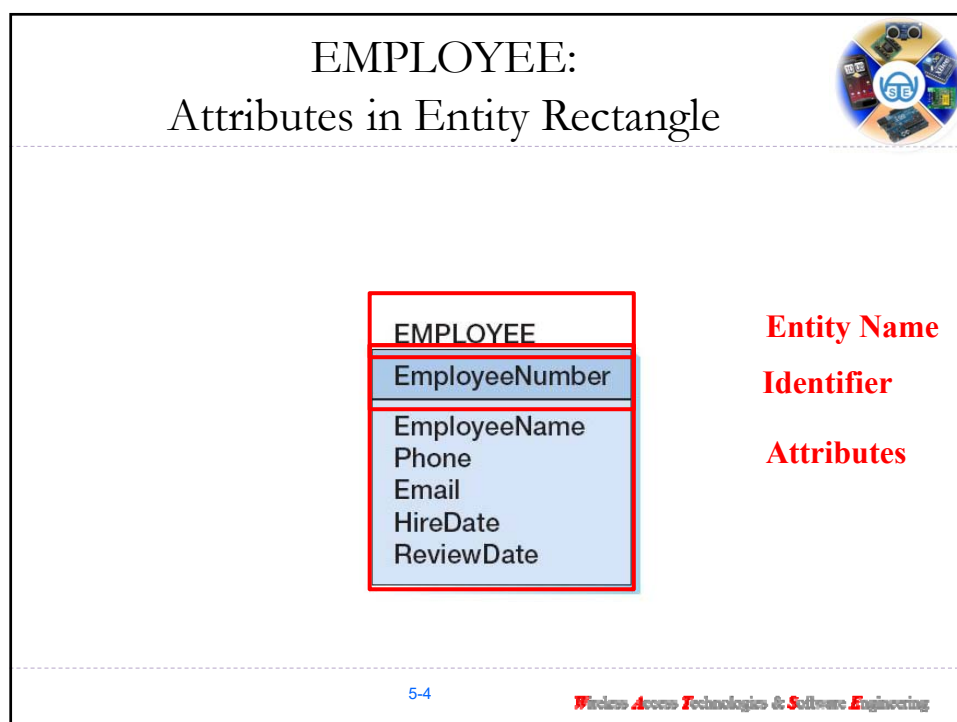
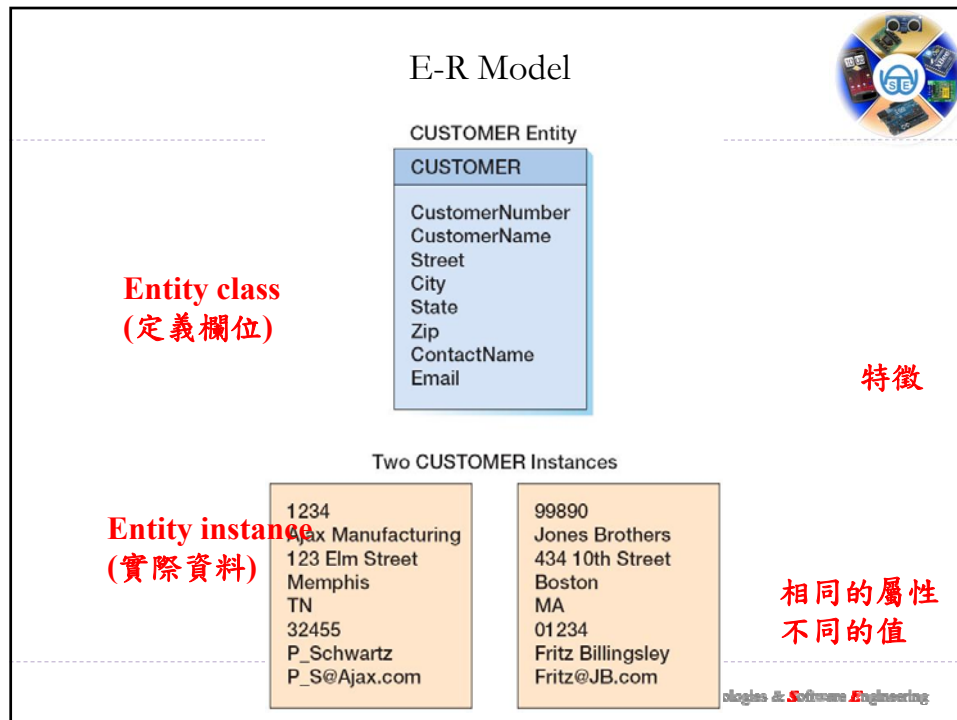
## Chapter Objectives



- use strong entities
- use ID-dependent and other weak entities
- use the ID-dependent association pattern
- use supertype/subtype entities
- use the ID-dependent multivalued attribute pattern
- use recursive patterns

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## Data Modeling Notation: IE Crow's Foot I



Symbol	Meaning
	One—Mandatory
	Many—Mandatory
	One—Optional
	Many—Optional

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## Entities Classification



- Strong Entity
- Weak Entity : an entity whose **existence depends upon** another entity
  - Non-ID-dependent
  - ID-dependent

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## Strong Entity Patterns: 1:1 Strong Entity Relationships



(a) Club Membership Data Entry Form

**MEMBER\_LOCKER**

MemberNumber: 1000  
 MemberName: Jones  
 Phone: 123-456-7777  
 Email: Jones@somewhere.com  
 LockerNumber: 2100  
 LockerRoom: Mens

Record: 1 of 4

CLUB\_MEMBER

MemberNumber  
 MemberName  
 Phone  
 Email

(b) Club Locker Report

### CLUB\_LOCKERS

LockerRoom	LockerNumber	MemberNumber	MemberName	LockerSize
Mens	2100	1000	Jones	Med
Mens	2115	3000	Wu	Large
Womens	2200	2000	Abernathy	Large
Womens	2217	4000	Lai	Small

LOCKER

LockerNumber  
 LockerRoom  
 LockerSize

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## Strong Entity Patterns: 1:N Strong Entity Relationships



Company Departments

CompanyName: Ajax Manufacturing  
 City: Sydney

Departments

	DepartmentName	BudgetCode	MailStop
	Accounting	A-100	MS-100
	Production	P-100	MS-400
	Information Systems	IS-200	MS-417
	Sales	S-1400	MS-500

Record: 1 of 4

Record: 1 of 5

COMPANY

CompanyName  
 City

DEPARTMENT

DepartmentName  
 BudgetCode  
 MailStop

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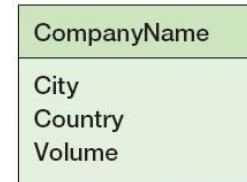
Wireless Access 1

## N:M Strong Entity Relationships

(a) SUPPLIERS Form

PartNumber	PartName	SalesPrice	ReOrderQuantity	QuantityOnHand
1000	Cedar Shakes	\$22.00	100	200
2000	Garage Heater	\$1,750.00	3	4
3000	Utility Cabinet	\$55.00	7	3

COMPANY



(b) PART Report

**PART**

Number	PartName	SalesPrice	ROQ	QOH	CompanyName	City	Country
1000	Cedar Shakes	\$22.00	100	200	British Systems	Manchester	England
					ERS Systems	Vancouver	Canada
					Forest Supplies	Denver	US
2000	Garage Heater	\$1,750.00	3	4	British Systems	Manchester	England
					ERS Systems	Vancouver	Canada
					Kyoto Importers	Kyoto	Japan
					Forest Supplies	Denver	US
3000	Utility Cabinet	\$55.00	7	3	Apex Manufacturing	Sydney	Australia
					Forest Supplies	Denver	US

PART

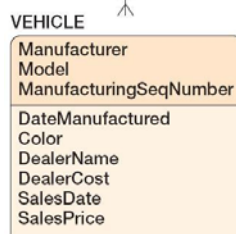
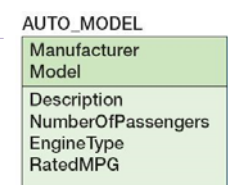


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Wireless Access

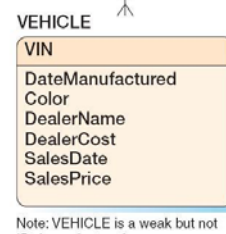
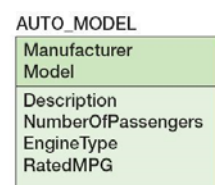
## Weak Entities

ID-dependent



(a) ID-Dependent Entity

Non-ID-dependent

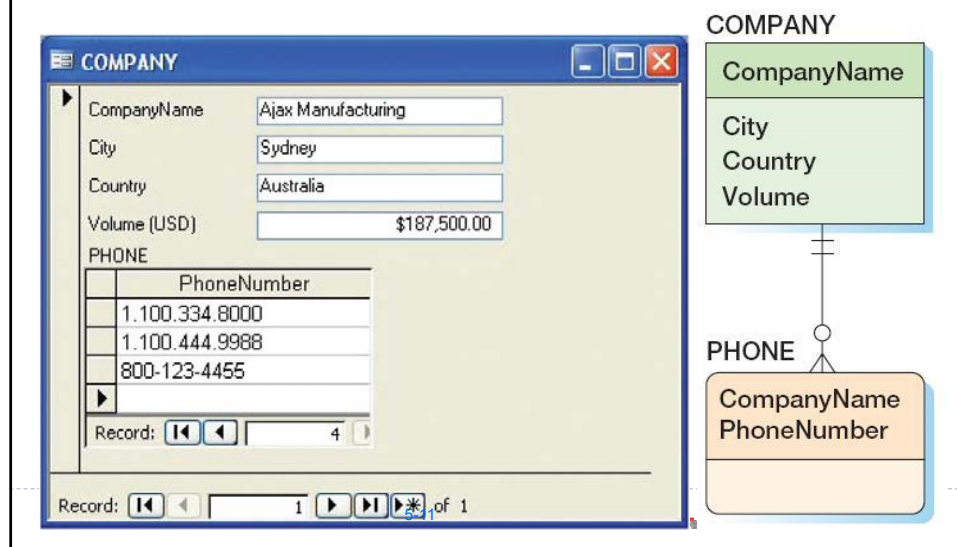


Note: VEHICLE is a weak but not ID-dependent entity.

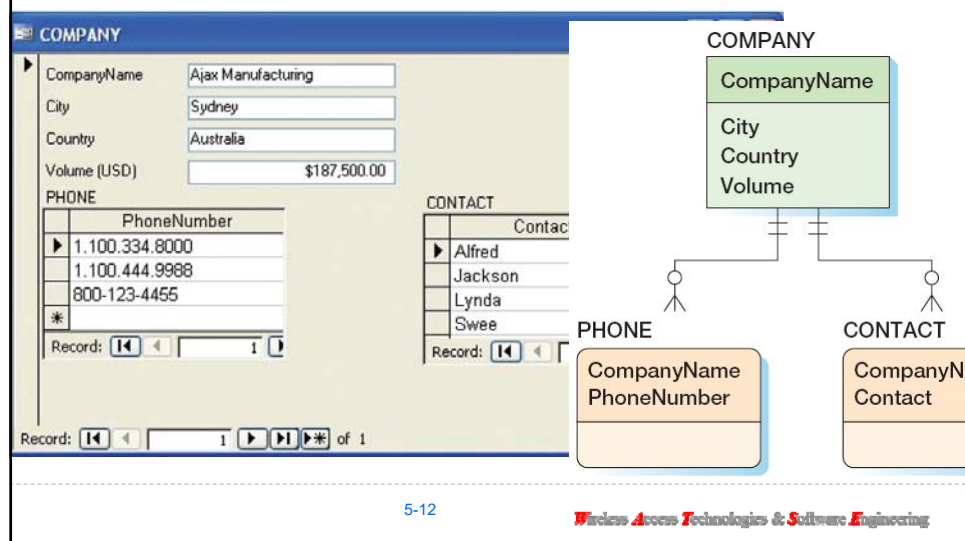
(b) Non-ID-Dependent Weak Entity

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## ID-Dependent Relationships: The Multivalued Attribute Pattern

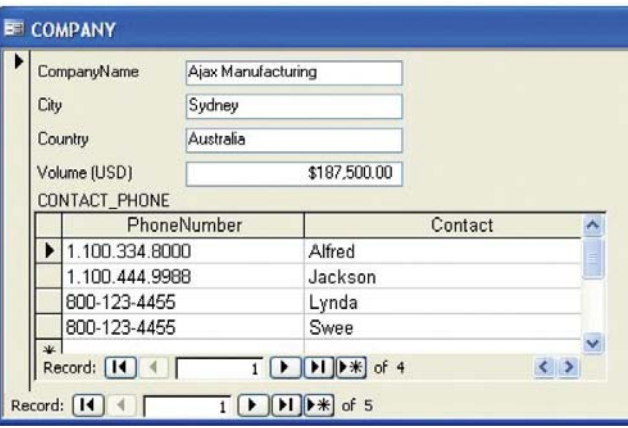


## ID-Dependent Relationships: The Multivalued Attribute Pattern



## ID-Dependent Relationships: The Multivalued Attribute Pattern





COMPANY

COMPANY	
CompanyName	Ajax Manufacturing
City	Sydney
Country	Australia
Volume (USD)	\$187,500.00

CONTACT\_PHONE

PhoneNumber	Contact
1.100.334.8000	Alfred
1.100.444.9988	Jackson
800-123-4455	Lynda
800-123-4455	Swee

COMPANY


CompanyName  
 City  
 Country  
 Volume

PHONE\_CONTACT

CompanyName  
 Contact  
 PhoneNumber

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## ID-Dependent Relationships: The Association Pattern



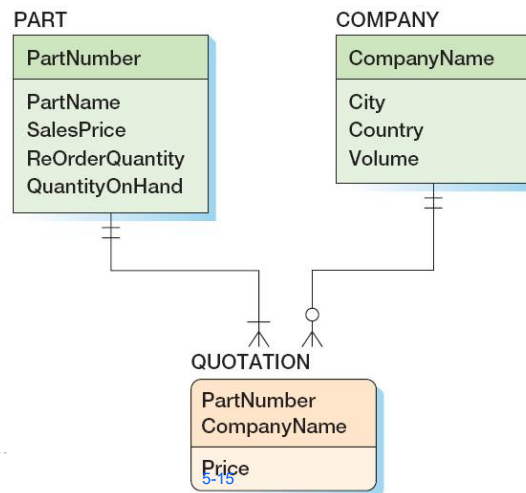
*Part Quotations*

Number	Name	SalesPrice	ROQ	QOH	Company	City	Price
1000	Cedar Shakes	\$22.00	100	200			
					Bristol Systems	Manchester	\$14.00
					ERS Systems	Vancouver	\$12.50
					Forrest Supplies	Denver	\$15.50
2000	Garage Heater	\$1,750.00	3	4			
					Bristol Systems	Manchester	\$950.00
					ERS Systems	Vancouver	\$875.00
					Kyoto Importers	Kyoto	\$1,100.00
					Forrest Supplies	Denver	\$915.00
3000	Utility Cabinet	\$55.00	7	3			
					Ajax Manufacturing	Sydney	\$37.50
					Forrest Supplies	Denver	\$42.50

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## ID-Dependent Relationships: The **Association** Pattern



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## Mixed Patterns: The Line-Item Pattern



**Carbon River Furniture Sales Order Form**

Sales Order Number: 10643 Date: 25-Sep-08

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

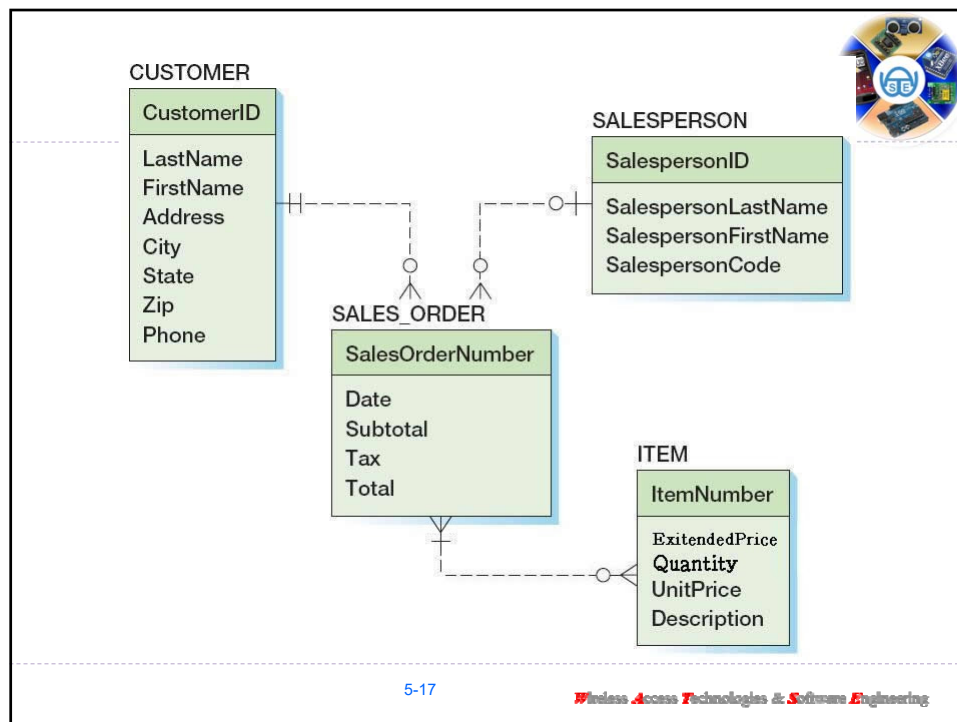
Quantity	Item Number	Description	Unit Price	Extended Price
1	78	Executive Desk	\$959.00	\$959.00
1	79	Conference Table	\$1,750.00	\$1,750.00
4	80	Side Chair	\$99.00	\$396.00

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

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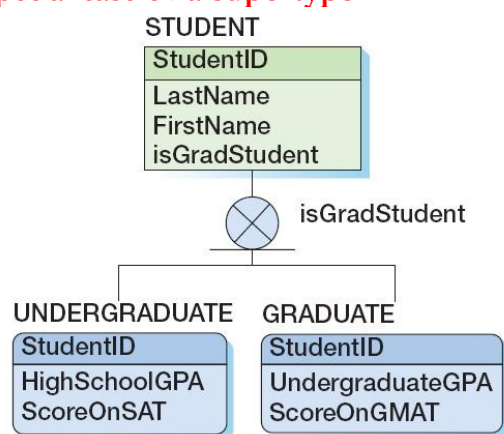


## Subtype Entities

- A **subtype entity** is a special case of a **supertype entity**:

– STUDENT :  
UNDERGRADUATE

- **Supertype**: all common attributes
- **Subtypes**: specific attributes
- The supertype may have a discriminator which indicates the subtype
- Subtypes are used to avoid redundancy



(a) Exclusive Subtypes with Discriminator

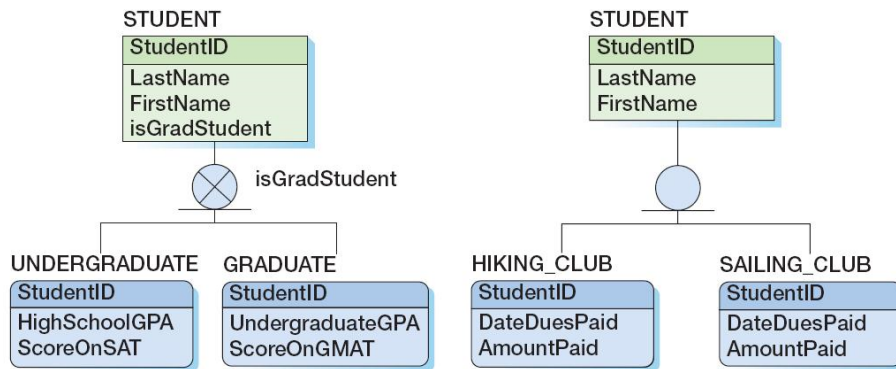
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## Subtypes: Exclusive or Inclusive



- **Exclusive:** at most one subtype
- **Inclusive:** one or more subtypes.



(a) Exclusive Subtypes with Discriminator

(b) Inclusive Subtypes

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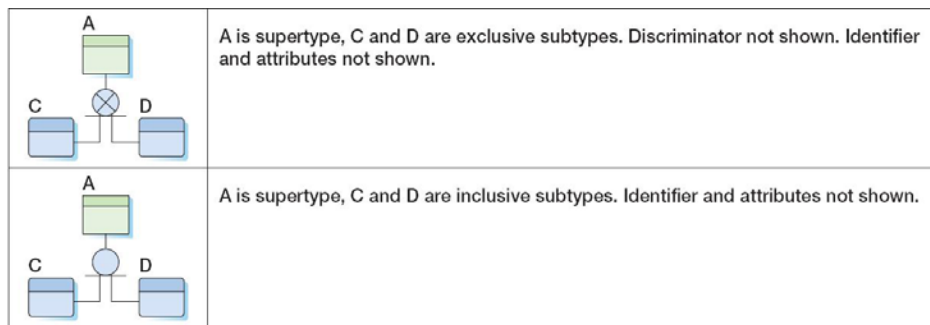
## IE Crow's Foot Symbol Summary

<b>DEPARTMENT</b> DepartmentName BudgetCode OfficeNumber	DEPARTMENT entity; DepartmentName is identifier; BudgetCode and OfficeNumber are attributes.
	1:1, nonidentifying relationship. A relates to zero or one B; B relates to exactly one A. Identifier and attributes not shown.
	1:N, nonidentifying relationship. A relates to one or many Bs; B relates to zero or one A. Identifier and attributes not shown.
	Many-to-many, identifying relationship. A relates to zero or more Bs; B relates to one or more As.
	1:N identifying relationship. A relates to zero, one, or many Bs. B relates to exactly one A. Identifier and attributes not shown. For identifying relationships, the child must always relate to exactly one parent. The parent may relate to zero, one, many, or a combination of these minimum cardinalities.

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## IE Crow's Foot Symbol Summary



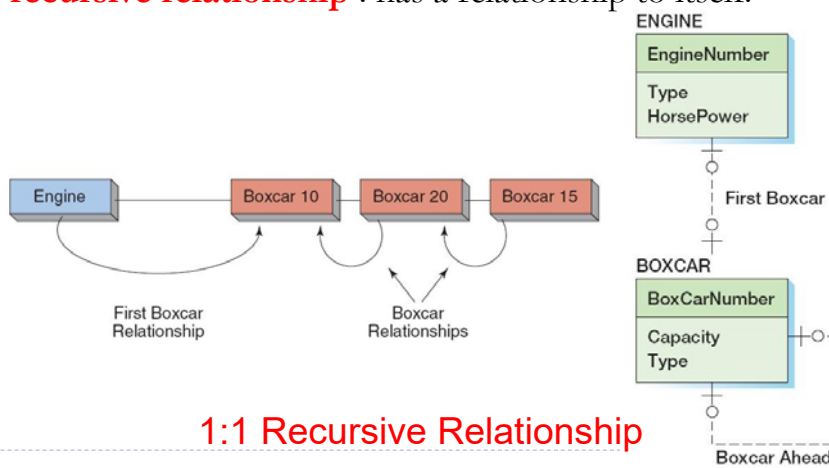
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## Recursive Relationships



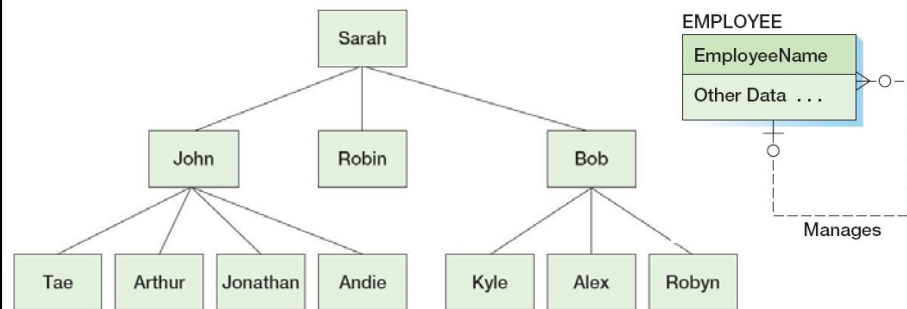
- recursive relationship** : has a relationship to itself.



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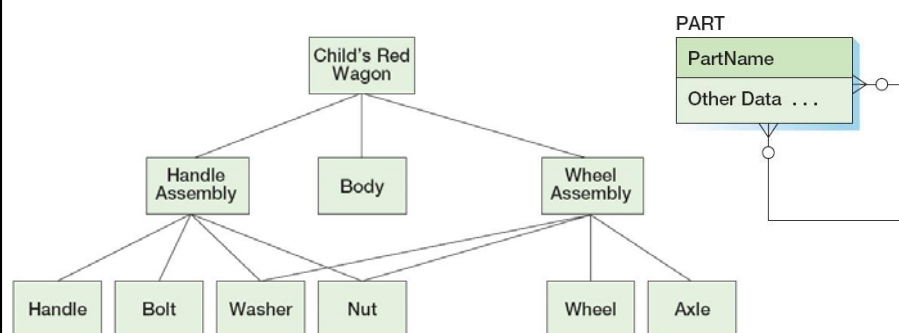
## Recursive Patterns: 1:N Recursive Relationship



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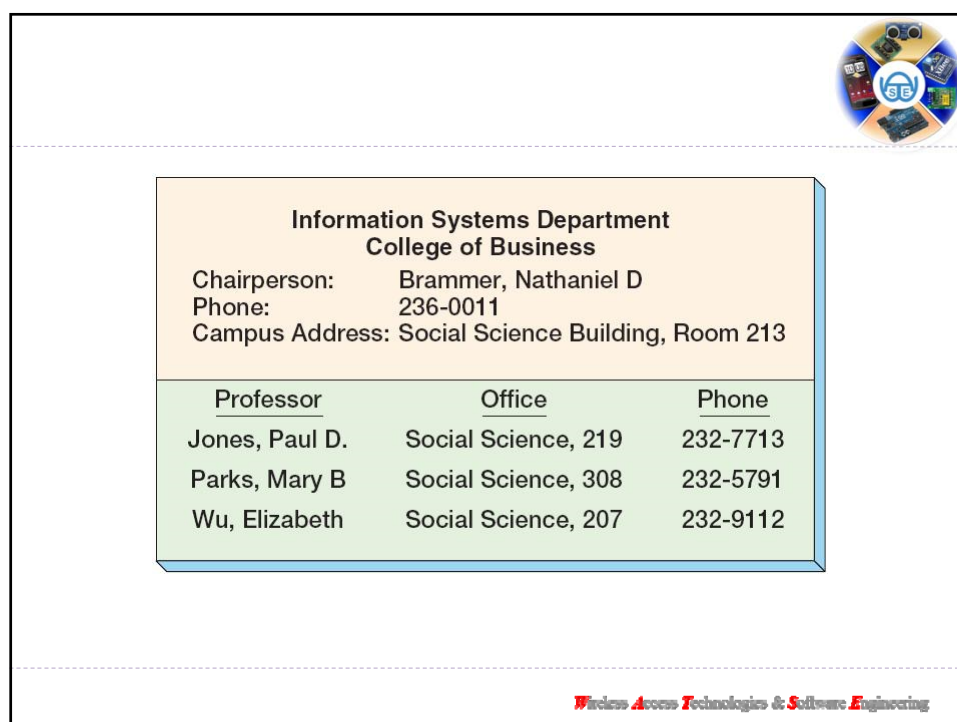
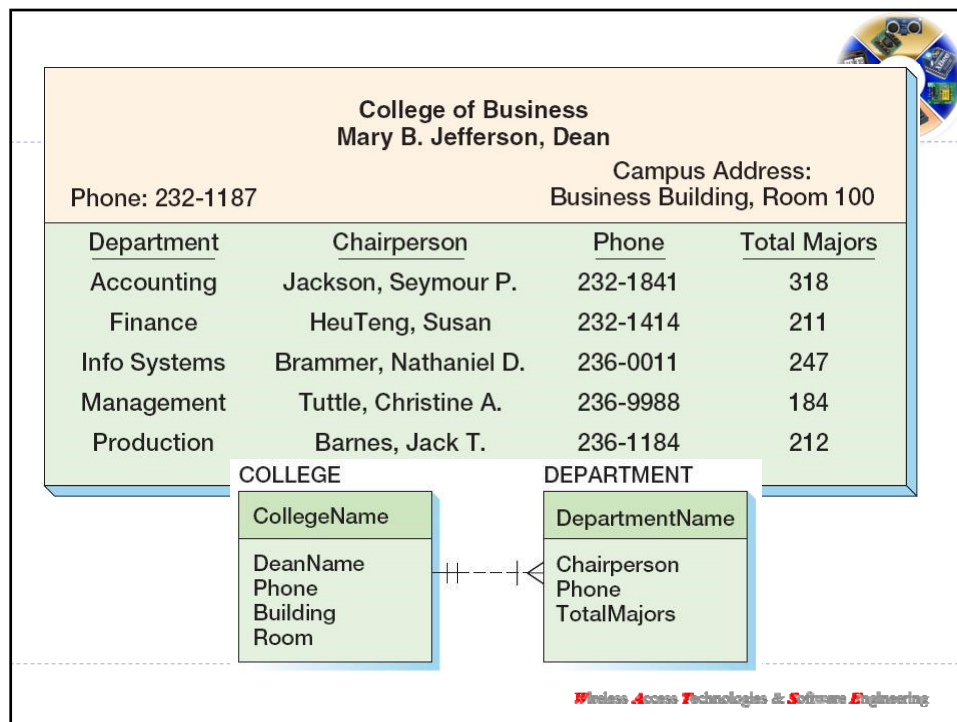
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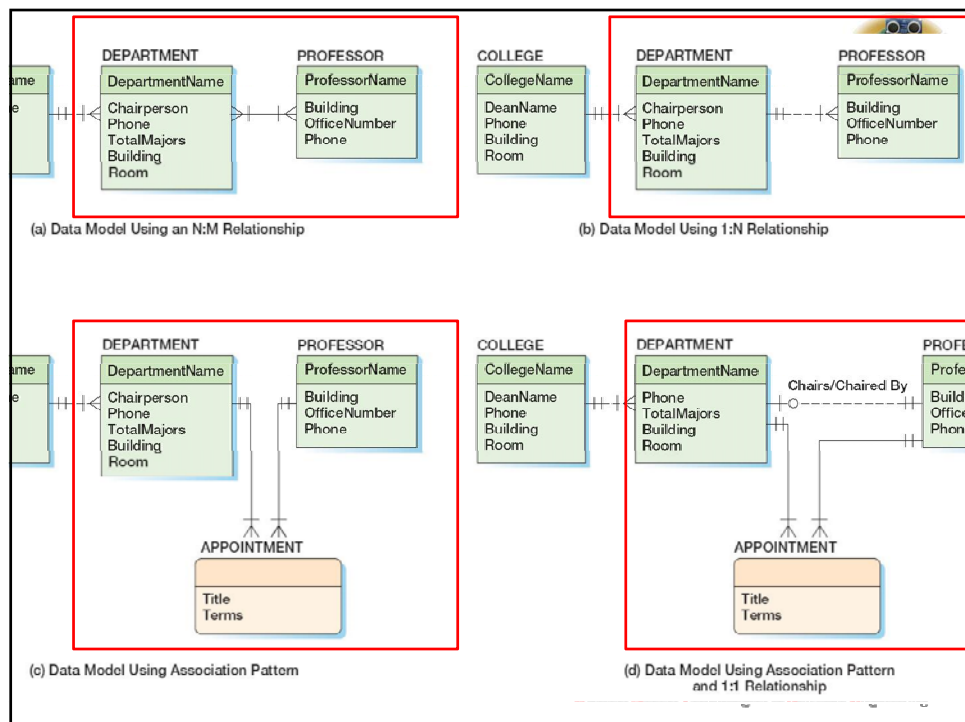

## Recursive Patterns: N:M Recursive Relationship



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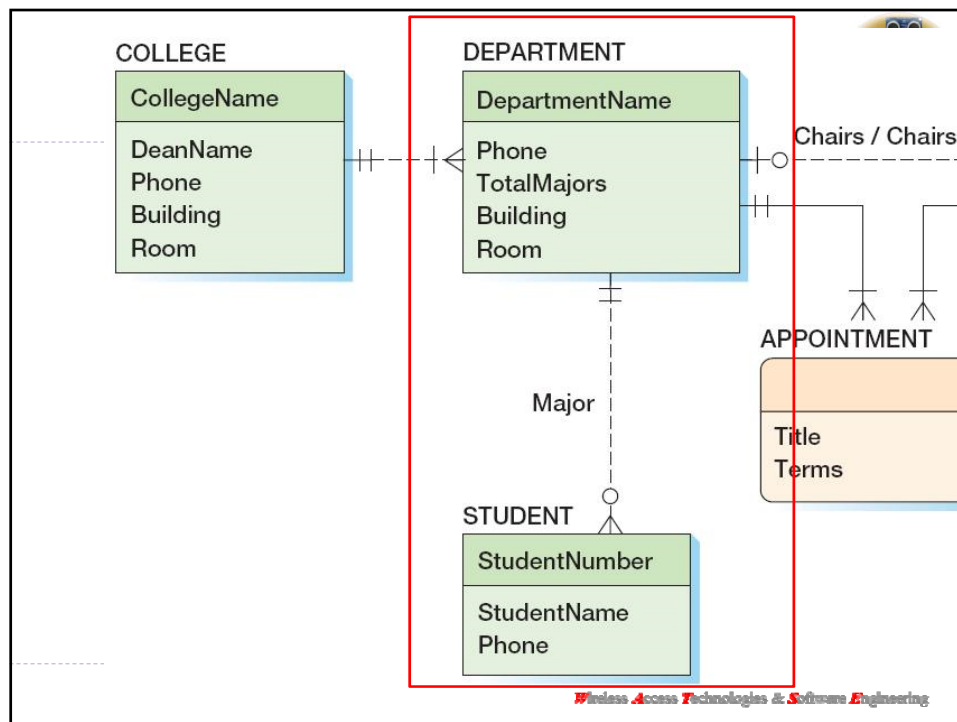
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Student Major List Information Systems Department		
Chairperson: Brammer, Nathaniel D Phone: 236-0011		
Major's Name	Student Number	Phone
Jackson, Robin R.	12345	237-8713
Lincoln, Fred J.	48127	237-8713
Madison, Janice A.	37512	237-8713

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**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, 2009. 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!

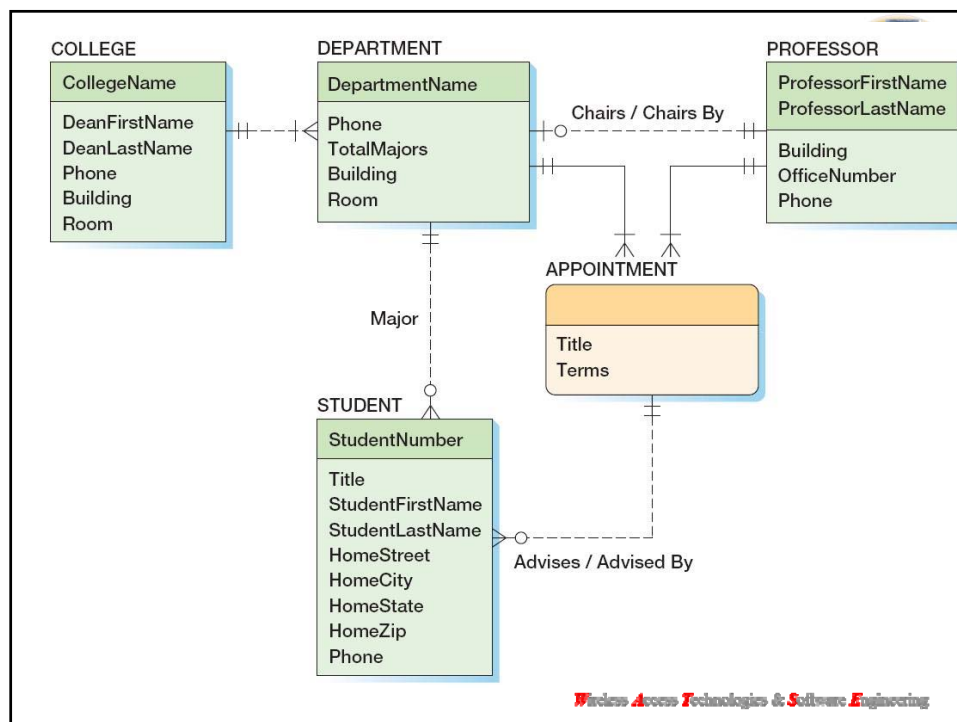
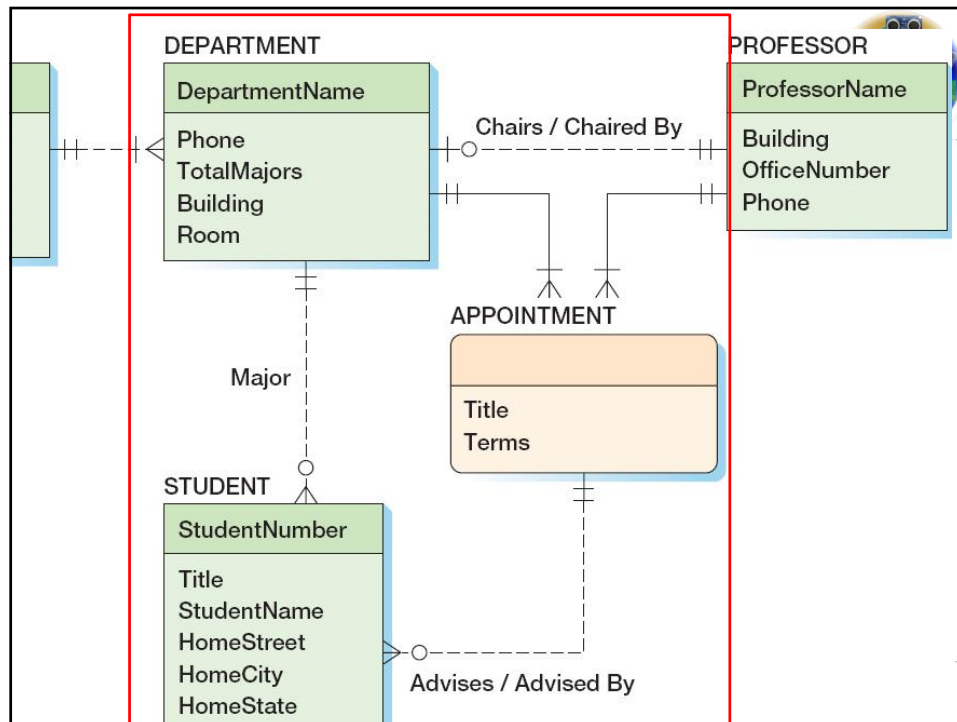
Sincerely,

Jan P. Smathers  
President

JPS/rkp

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## Chapter Review



- understand the **E-R model**
- use **strong entity** patterns
- use **ID-dependent** and other **weak** entities
- **use supertype/subtype** entities
- use the ID-dependent **association** pattern
- use the ID-dependent **multivalued** attribute pattern
- use **recursive** patterns