David M. Kroenke and David J. Auer

**Database Processing:**

Fundamentals, Design, and Implementation

## Chapter Five:

# Data Modeling with the Entity-Relationship Model



## Chapter Objectives

- the purpose of the data modeling process
- entity-relationship (E-R) diagrams
- entities, attributes, and relationships
- create entity identifiers
- minimum and maximum cardinalities
- To understand variations of the E-R model
- To understand and be able to use strong entity patterns

## The Data Model

- Data model : blueprint of database design.
- Generalized and Abstract
- Easier to change
- Conceptual database problem



## E-R Model

- Entity-Relationship model

**Entity class**
**(定義欄位)**

CUSTOMER Entity

| CUSTOMER |
|---|
| CustomerNumber |
| CustomerName |
| Street |
| City |
| State |
| Zip |
| ContactName |
| Email |

**屬性及特徵**
**Attributes**

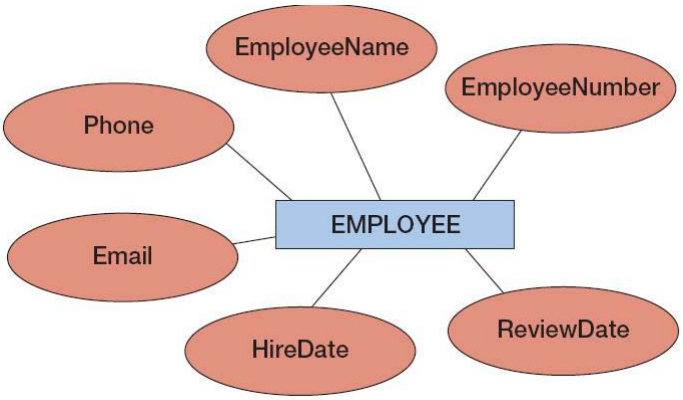
**Entity instance**
**(實際資料)**

Two CUSTOMER Instances

| | |
|---|---|
| 1234 | 99890 |
| Ajax Manufacturing | Jones Brothers |
| 123 Elm Street | 434 10th Street |
| Memphis | Boston |
| TN | MA |
| 32455 | 01234 |
| P_Schwartz | Fritz Billingsley |
| P_S@Ajax.com | Fritz@JB.com |

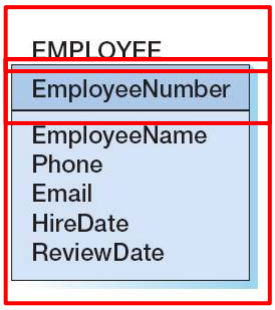
**相同的屬性**
**不同的值**

# EMPLOYEE: Attributes in Ellipses






# EMPLOYEE: Attributes in Entity Rectangle

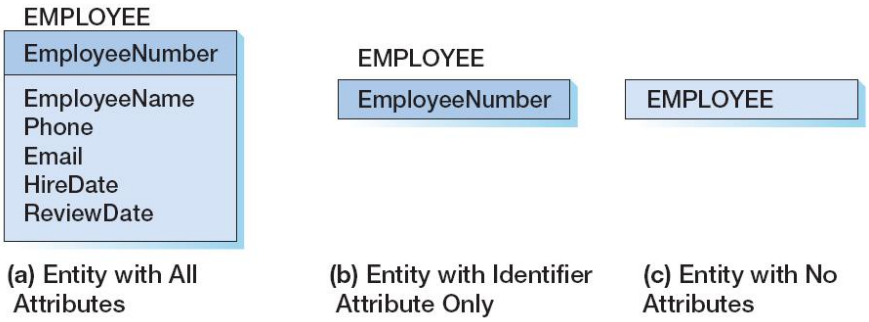



**Entity Name**

**Identifier**

**Attributes**

# Entity Attribute Display in Data Models




(a) Entity with All Attributes

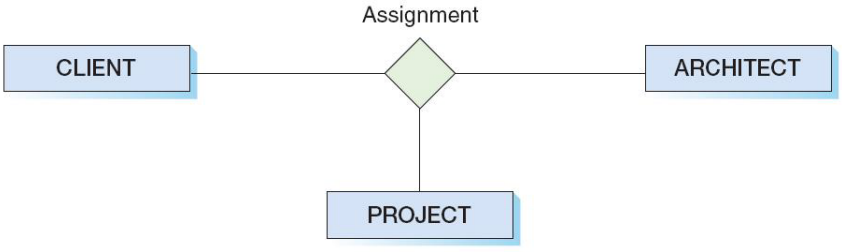
(b) Entity with Identifier Attribute Only

(c) Entity with No Attributes



# Relationships

- **Entities can be associated with one another in relationships**



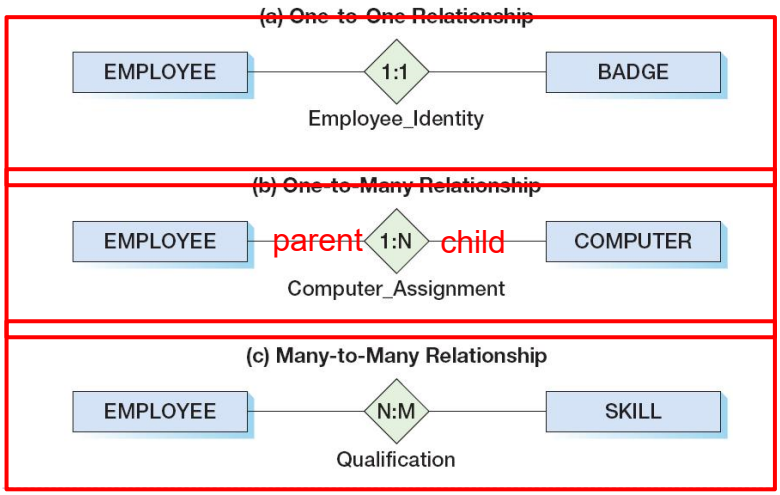

**Ternary Relationship: degree 3**

## Cardinality

- **Cardinality** : "count"
- **Maximum cardinality** : the maximum number of entity instances that *can* participate in a relationship.
- **Minimum cardinality** : the minimum number of entity instances that *must* participate in a relationship.



## The Three Types of Maximum Cardinality

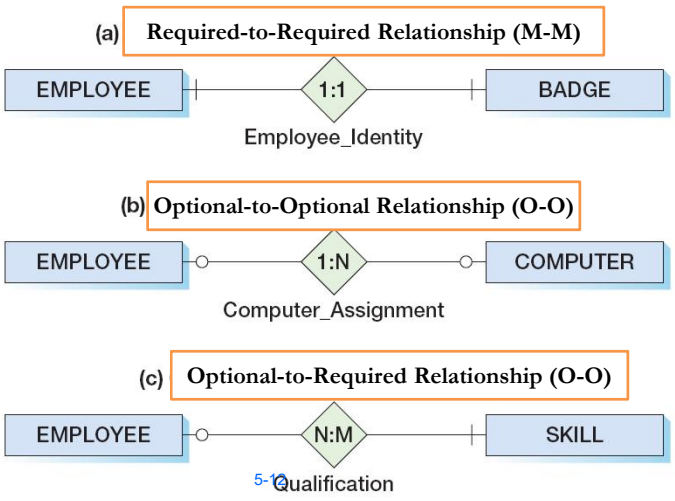


## Minimum Cardinality

- Minimum cardinality is the minimum number of entity instances that *must* participate in a relationship.
- Minimums are generally stated as either zero or one:
  - zero [0] : optional, *no* - circle
  - one [1] : required, *at least one – vertical hash mark*



## The Three Types of Minimum Cardinality



# Data Modeling Notation: IE Crow's Foot I

| Symbol | Meaning |
|---|---|
| | One—Mandatory |
| | Many—Mandatory |
| | One—Optional |
| | Many—Optional |

min max

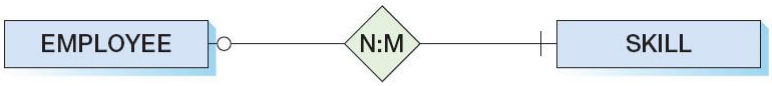
EMPLOYEE

| EmployeeNumber |
|---|
| EmployeeName<br>Phone<br>Email<br>HireDate<br>ReviewDate |





# Data Modeling Notation: IE Crow's Foot II




(a) Original E-R Model Version


(b) Crow's Foot Version

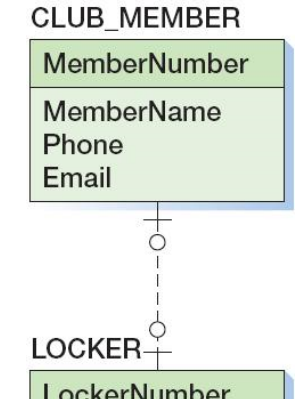
# Strong Entity Patterns: 1:1 Strong Entity Relationships

(a) Club Membership Data Entry Form


(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 |

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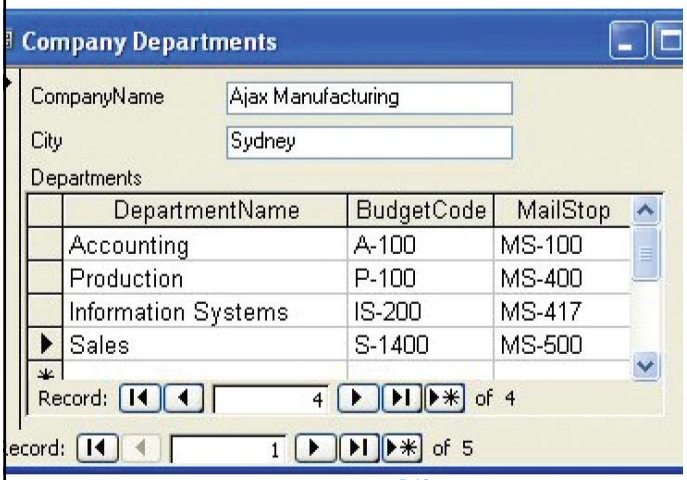
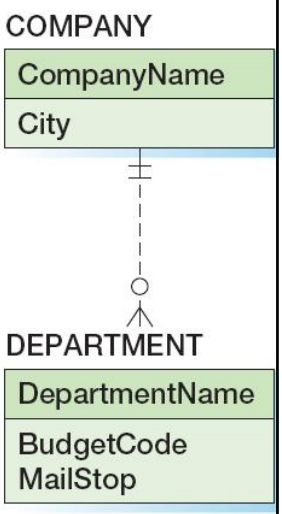
# Strong Entity Patterns: 1:N Strong Entity Relationships

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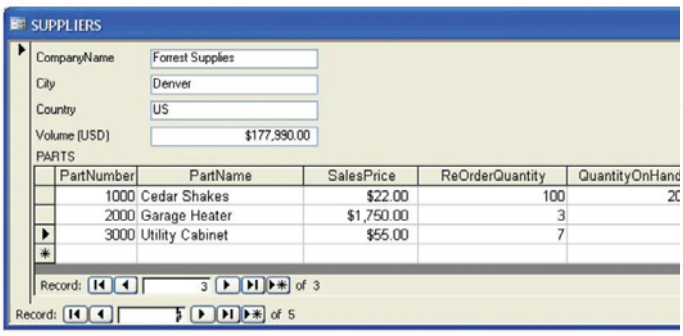
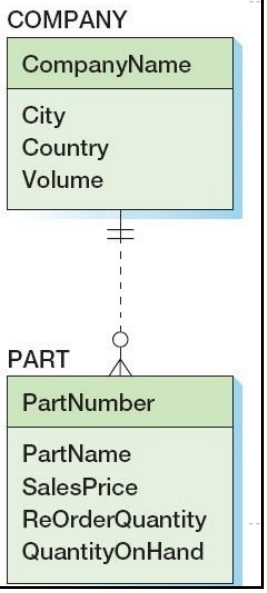
(a) SUPPLIERS Form

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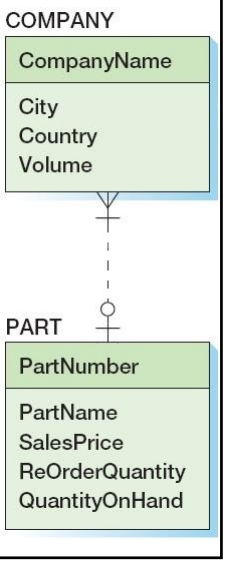
(b) PART Report

PART

| Number | PartName | SalesPrice | ROQ | QOH | CompanyName | City | Country |
|---|---|---|---|---|---|---|---|
| 1000 | Cedar Shakes | $22.00 | 100 | 200 | | | |
| | | | | | Bristol Systems | Machester | England |
| | | | | | ERS Systems | Vancouver | Canada |
| | | | | | Forrest Supplies | Denver | US |
| 2000 | Garage Heater | $1,750.00 | 3 | 4 | | | |
| | | | | | Bristol Systems | Machester | England |
| | | | | | ERS Systems | Vancouver | Canada |
| | | | | | Kyoto Importers | Kyoto | Japan |
| | | | | | Forrest Supplies | Denver | US |
| 3000 | Utility Cabinet | $55.00 | 7 | 3 | | | |
| | | | | | Ajax Manufacturing | Sydney | Australia |
| | | | | | Forrest Supplies | Denver | US |

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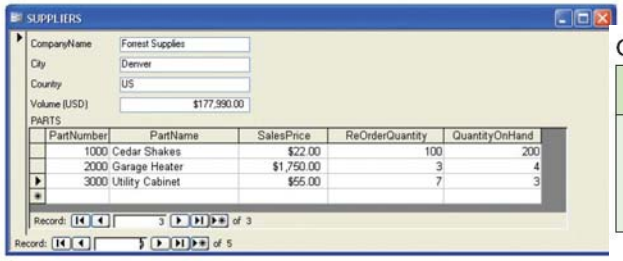
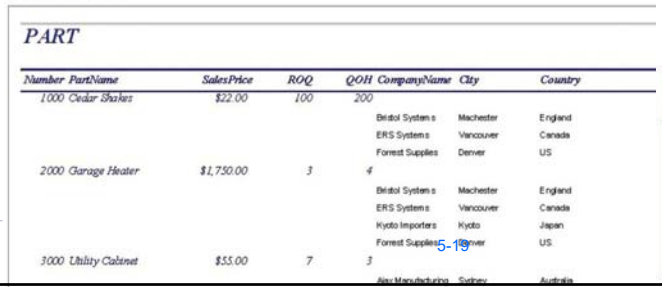
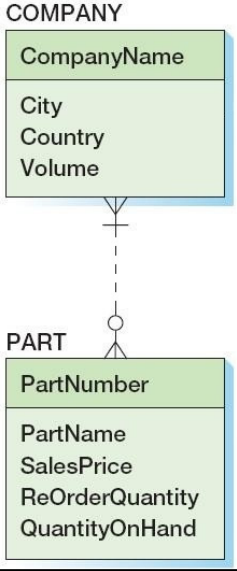
# 2 x 1:N ➔ N:M Relationships

(a) SUPPLIERS Form




(b) PART Report

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# Review

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