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

- 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

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The Data Model

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

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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
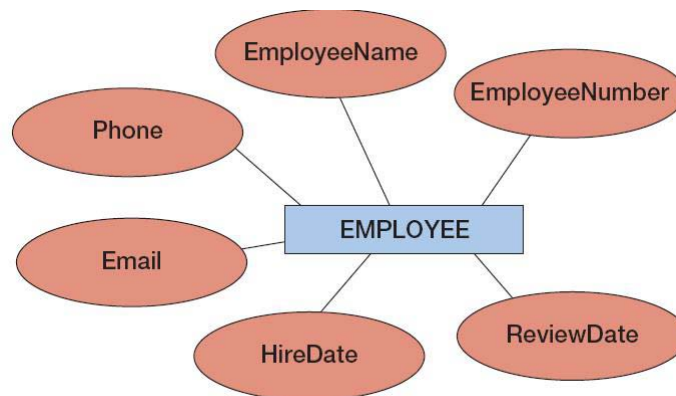
Two CUSTOMER Instances

Entity instance
(實際資料)

1234
Ajax Manufacturing
123 Elm Street
Memphis
TN
32455
P_Schwartz
P_S@Ajax.com

99890
Jones Brothers
434 10th Street
Boston
MA
01234
Fritz Billingsley
Fritz@JB.com

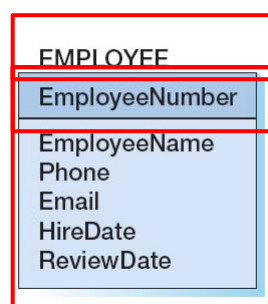相同的屬性
不同的值

2020/11/16

EMPLOYEE:
Attributes in Ellipses

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EMPLOYEE:
Attributes in Entity Rectangle

Entity Name

Identifier

Attributes

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Entity Attribute Display in Data Models

EMPLOYEE

EmployeeNumber
EmployeeName Phone Email HireDate ReviewDate

EMPLOYEE

EmployeeNumber

EMPLOYEE

(a) Entity with All Attributes

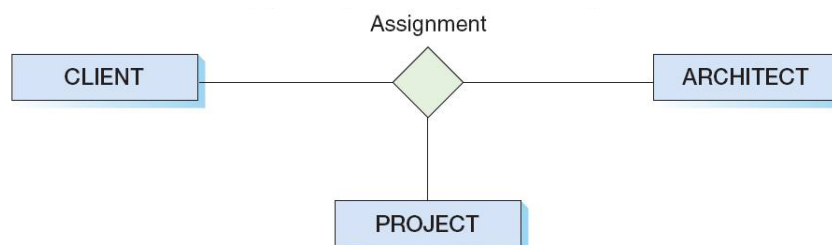(b) Entity with Identifier Attribute Only

(c) Entity with No Attributes

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Relationships

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

Assignment

CLIENT

ARCHITECT

PROJECT

Ternary Relationship: degree 3

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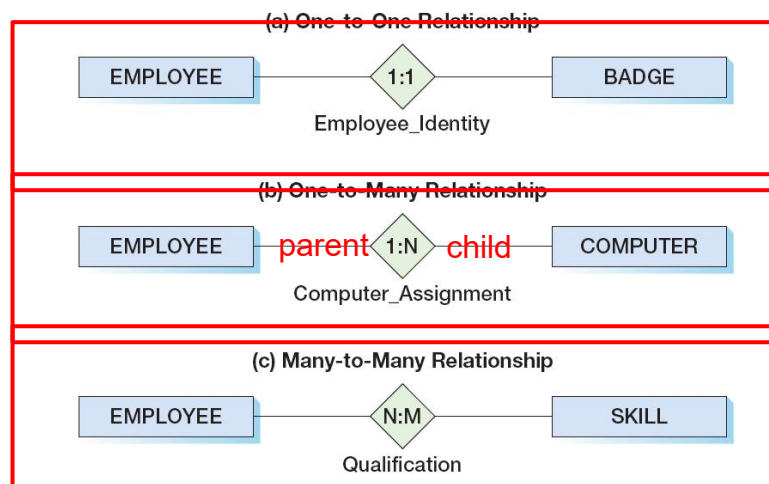*Wireless Access Technologies & Software Engineering*

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.

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The Three Types of Maximum Cardinality

(a) One-to-One Relationship

EMPLOYEE — 1:1 — BADGE

Employee_Identity

(b) One-to-Many Relationship

EMPLOYEE — parent 1:N child — COMPUTER

Computer_Assignment

(c) Many-to-Many Relationship

EMPLOYEE — N:M — SKILL

Qualification

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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
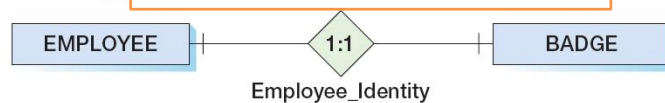 - **one [1] : required,** *at least one – vertical hash mark*

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The Three Types of Minimum Cardinality

(a) **Required-to-Required Relationship (M-M)**

| EMPLOYEE | —||— 1:1 —||— | BADGE |

Employee_Identity

(b) **Optional-to-Optional Relationship (O-O)**

| EMPLOYEE | —o— 1:N —o— | COMPUTER |

Computer_Assignment

(c) **Optional-to-Required Relationship (O-O)**

| EMPLOYEE | —o— N:M —||— | SKILL |

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are Engineering

Data Modeling Notation:
IE Crow's Foot I

Symbol	Meaning
——||—	One—Mandatory
——|<	Many—Mandatory
——O|—	One—Optional
——O<	Many—Optional

min   max

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EMPLOYEE

EmployeeNumber

EmployeeName
Phone
Email
HireDate
ReviewDate

Data Modeling Notation:
IE Crow's Foot II

EMPLOYEE ——o——◇N:M◇——||—— SKILL
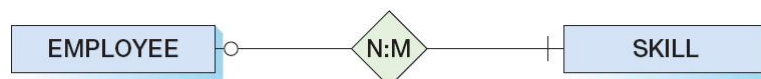
(a) Original E-R Model Version

EMPLOYEE >——o—————|< SKILL

(b) Crow's Foot Version

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Strong Entity Patterns:
1:1 Strong Entity Relationships

Strong Entity Patterns:
1:N Strong Entity Relationships

Slide 5-17

(a) SUPPLIERS Form

SUPPLIERS

CompanyName	Forrest Supplies
City	Denver
Country	US
Volume (USD)	$177,990.00

PARTS

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

Record: 3 of 3

Record: 5 of 5

COMPANY

CompanyName
City
Country
Volume

PART

PartNumber
PartName
SalesPrice
ReOrderQuantity
QuantityOnHand

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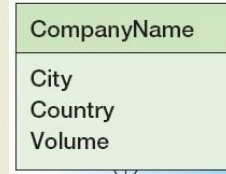
(b) PART Report

PART

Number	PartName	SalesPrice	ROQ	QOH	CompanyName	City	Country
1000	Cedar Shakes	$22.00	100	200			
					Bristol Systems	Manchester	England
					ERS Systems	Vancouver	Canada
					Forrest Supplies	Denver	US
2000	Garage Heater	$1,750.00	3	4			
					Bristol Systems	Manchester	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

COMPANY

CompanyName
City
Country
Volume

PART

PartNumber
PartName
SalesPrice
ReOrderQuantity
QuantityOnHand

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2 x 1:N ➔ N:M Relationships

(a) SUPPLIERS Form

COMPANY

- CompanyName
- City
- Country
- Volume

PART

- PartNumber
- PartName
- SalesPrice
- ReOrderQuantity
- QuantityOnHand

(b) PART Report

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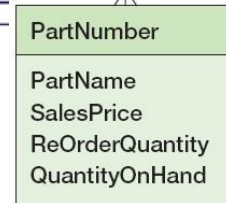
Review

- 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**

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