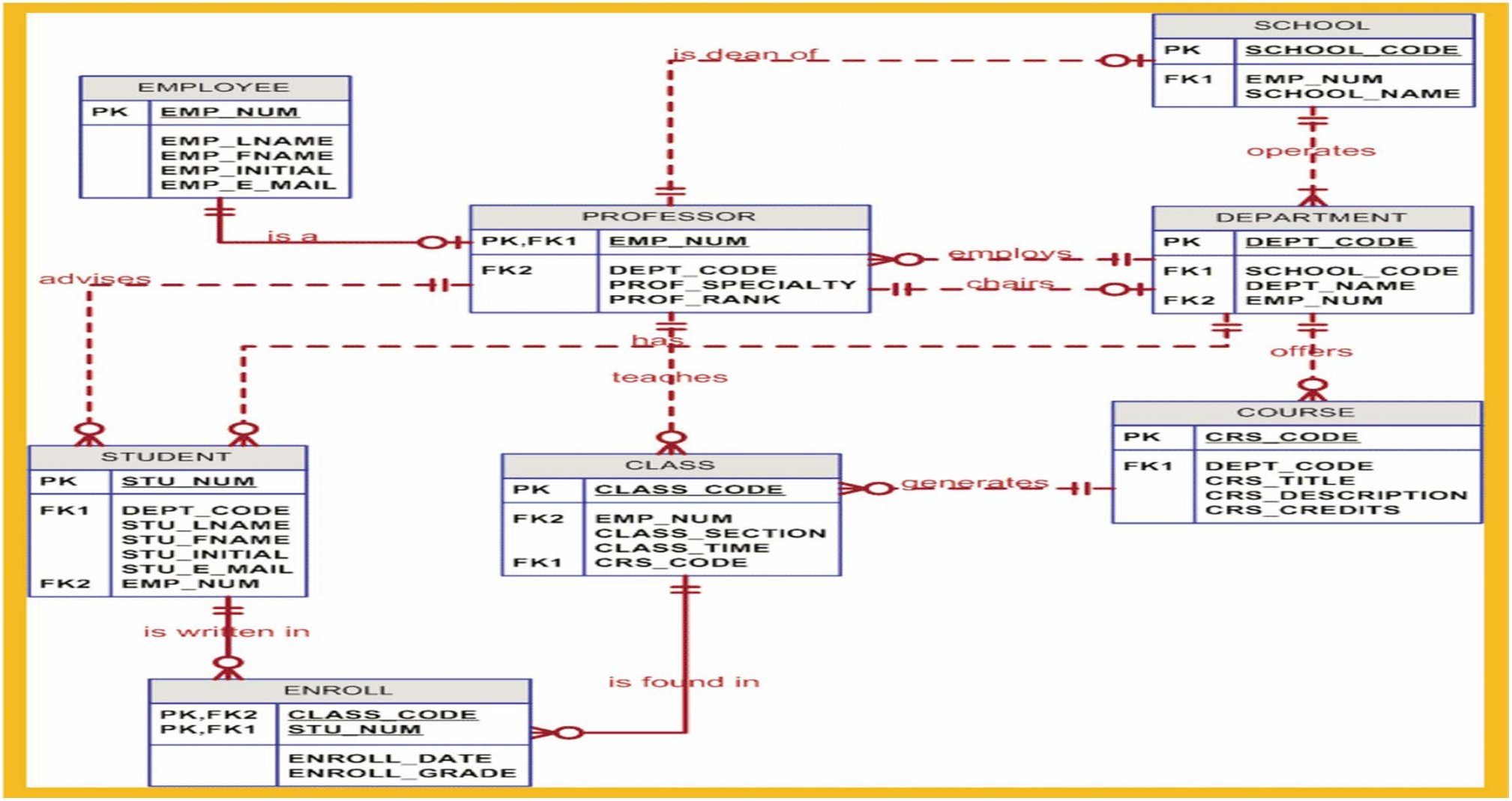
Entity Relationship Modeling

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Entity-Relationship Diagram (ERD)



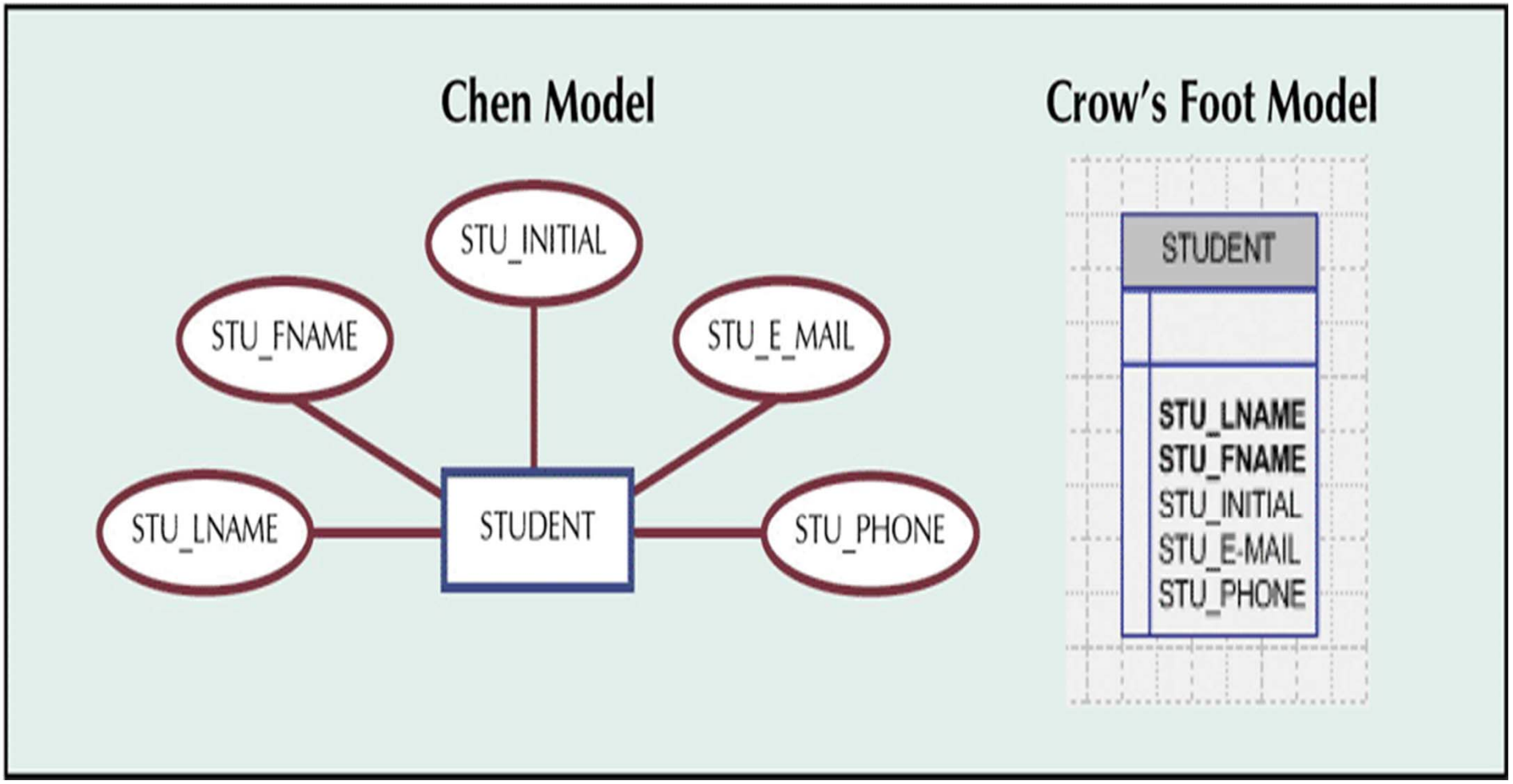
From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Components

- Entities: correspond to tables in the relational database
- Attributes: define the characteristics of entities
  - Attributes have a domain: a set of possible values
- Relationships: association between entities
  - Connectivity and cardinality: defines the characteristics of the relationships

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Example: STUDENT Entity



From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Attributes

- Composite attribute (e.g.: address)

  Further subdivided to yield additional attributes: street, city, state, zip code

- Simple attribute (e.g.: sex)

  Cannot be subdivided

- Single-valued attribute (e.g.: SSN)

  Have only a single value, No need for being simple attribute (serial number)

- Multi-valued attributes

  Have many values, car colors → interior, exterior, roof, etc.

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Derived Attributes

- Attribute whose value may be calculated (derived) from other attributes
- Need not be physically stored within the database
- Can be derived by using an algorithm

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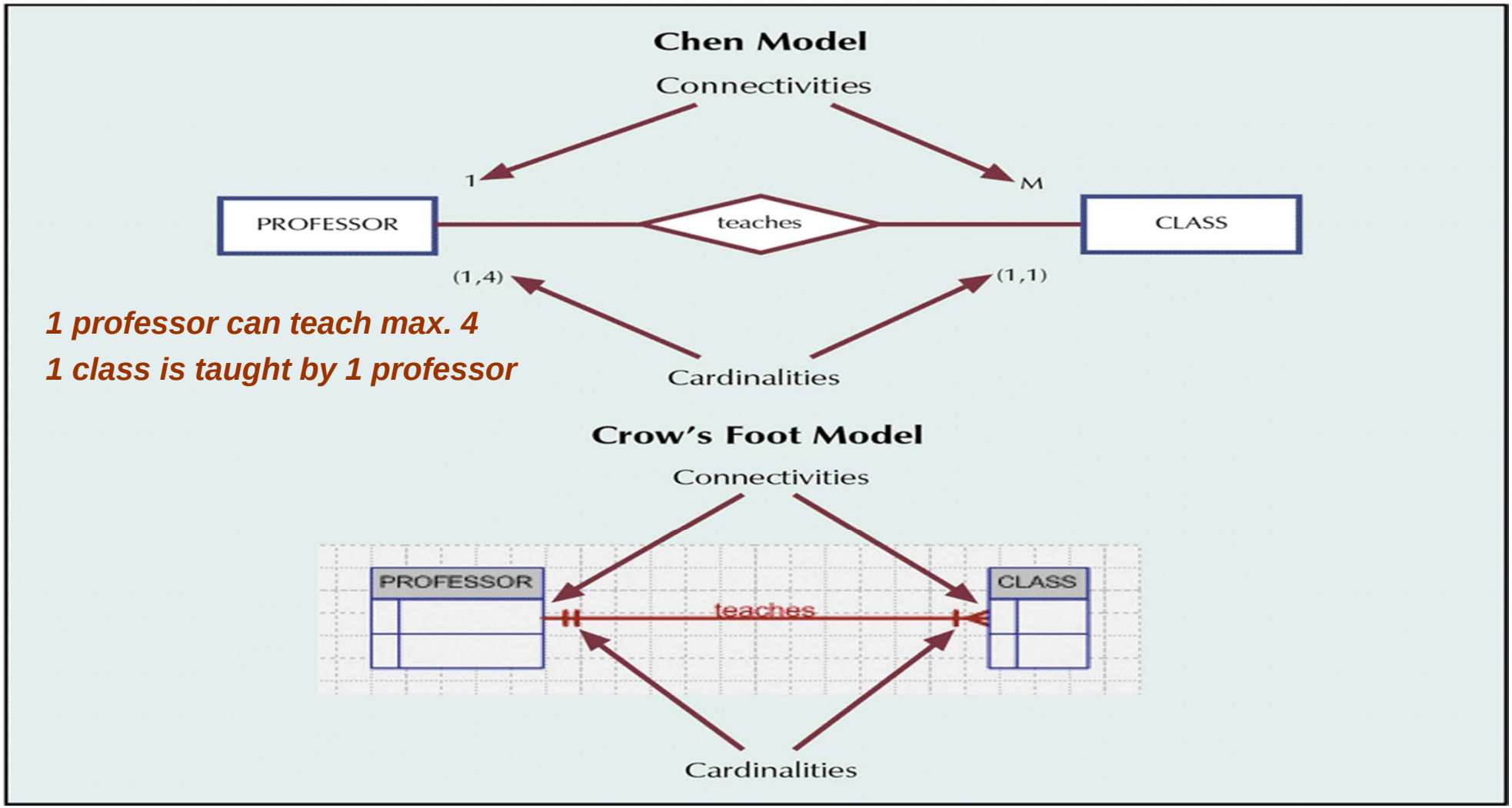
Connectivity and Cardinality

- Connectivity
  - Used to describe the relationship classification (1:1, 1:M, M:N)
- Cardinality
  - Expresses the specific number of entity occurrences (min and max) associated with one occurrence of the related entity (provide boundary conditions like 1:3, define the storage requirements/limitations)
- Established by *business rules*

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Connectivity and Cardinality in an ERD



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RELATIONSHIP Strength

- Existence dependence ***Weak entity***
  - Entity's existence depends on the existence of one or more other entities (EMPLOYEE claims DEPENDENT)

DEPENDENT entity cannot exist without EMPLOYEE entity

- Existence independence ***Strong entity, In-house parts VS vendors***
  "PART is supplied by VENDOR"
  - Entity can exist apart from one or more related entities

Strong relationships: contain/inherit parent entity's PK as composite PK

*COURSE(**CRS_CODE**, DEPT_CODE, CRS_DISCRIPTION, CRS_CREDIT)*
*CLASS(**CRS_CODE**, **CLASS_SECTION**, CLASS_TIME, ROOM_CODE, …)*

*CLASS(**CLASS_CODE**, CRS_CODE, CLASS_SECTION, …) → weak relationships (PK and FK link)*

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Relationship Degree

- Indicates number of associated entities or participants
  - Unary relationship
    - Association is maintained within a single entity
  - Binary relationship
    - Two entities are associated
  - Ternary relationship
    - Three entities are associated

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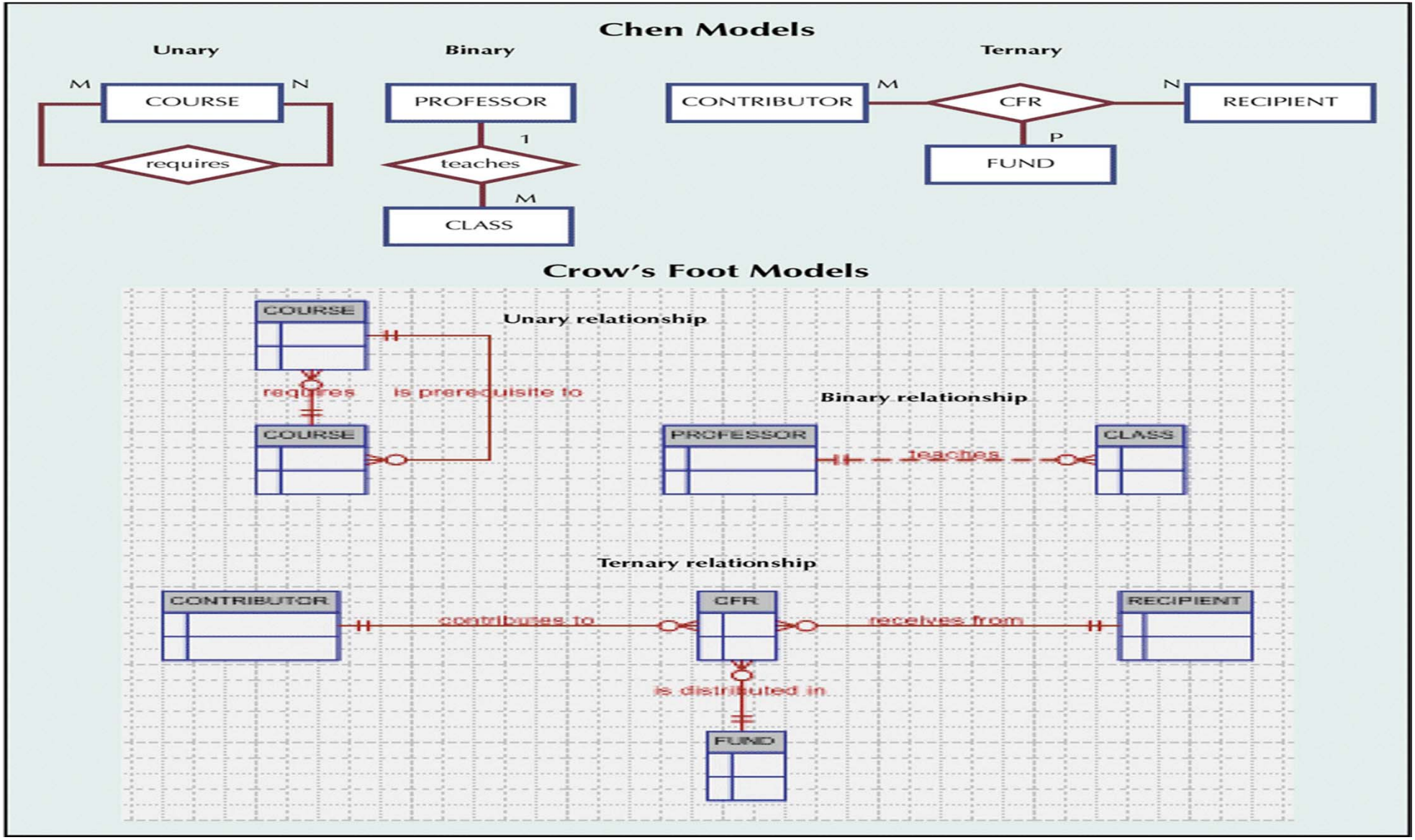
Relationship Degree (2)



O: Optional (when the 'parent' does not require a 'child' to be present) "Professor teaches 0 to 3"

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Relationship Degree (2)

TABLE 4.3 Crow's Foot Symbols

CROW'S FOOT SYMBOL	CARDINALITY	COMMENT
	(0,N)	Zero or many. Many side is optional.
	(1,N)	One or many. Many side is mandatory.
	(1,1)	One and only one. 1 side is mandatory.
	(0,1)	Zero or one. 1 side is optional.

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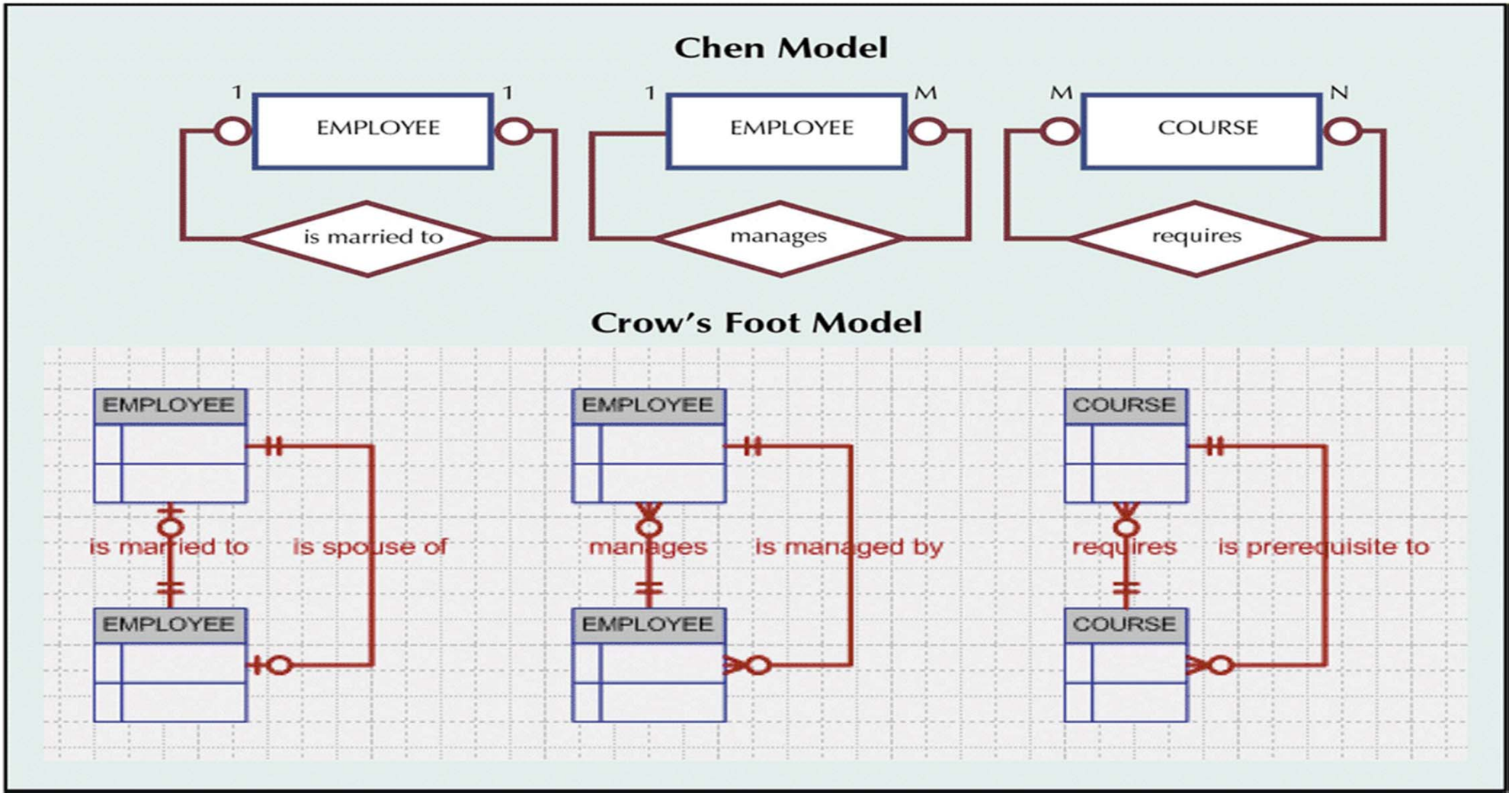
Recursive Relationships



From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Various Implementations of a 1:1 Recursive Relationship

Table name: EMPLOYEE_V1 — **Database name: Ch04_PartCo**

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_SPOUSE
345	Ramirez	James	347
346	Jones	Anne	349
347	Ramirez	Louise	345
348	Delaney	Robert	
349	Shapiro	Anton	346

First implementation

If divorces, two records must be updated! → Possible inconsistent data

Table name: EMPLOYEE

EMP_NUM	EMP_LNAME	EMP_FNAME
345	Ramirez	James
346	Jones	Anne
347	Ramirez	Louise
348	Delaney	Robert
349	Shapiro	Anton

Table name: MARRIED_V1

EMP_NUM	EMP_SPOUSE
345	347
346	349
347	345
349	346

Second implementation

Better no "null" → still redundant

Table name: MARRIAGE

MAR_NUM	MAR_DATE
1	04-Mar-03
2	02-Feb-99

Table name: MARPART

MAR_NUM	EMP_NUM
1	345
1	347
2	346
2	349

Table name: EMPLOYEE

EMP_NUM	EMP_LNAME	EMP_FNAME
345	Ramirez	James
346	Jones	Anne
347	Ramirez	Louise
348	Delaney	Robert
349	Shapiro	Anton

The Relational Schema for the Third Implementation

Third implementation

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

Composite Entities

- Also known as *bridge entities*
- Composed of the primary keys of each of the entities to be connected
- May also contain additional attributes that play no role in the connective process

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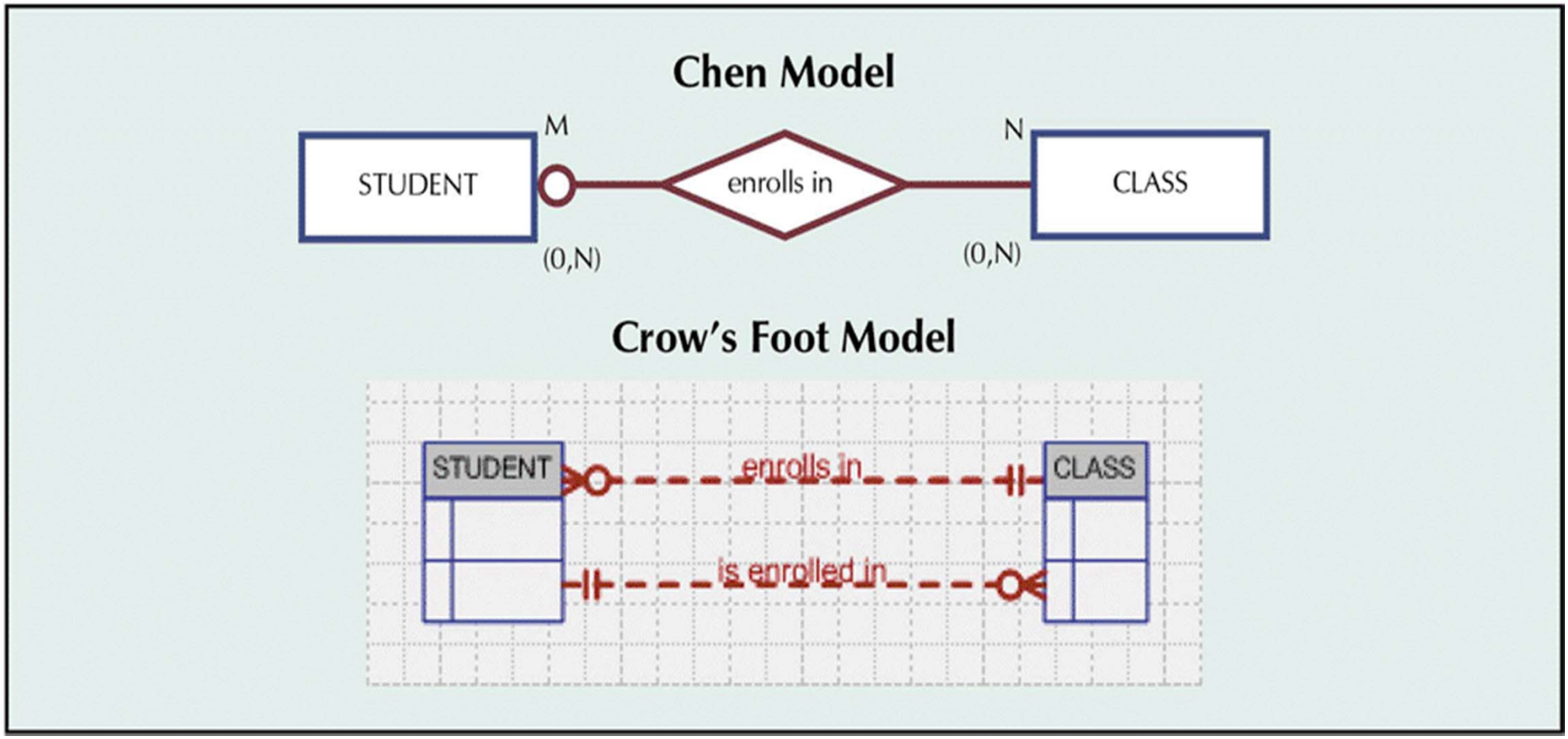
The M:N Relationship Between STUDENT and CLASS

FIGURE 4.25 THE M:N RELATIONSHIP BETWEEN STUDENT AND CLASS



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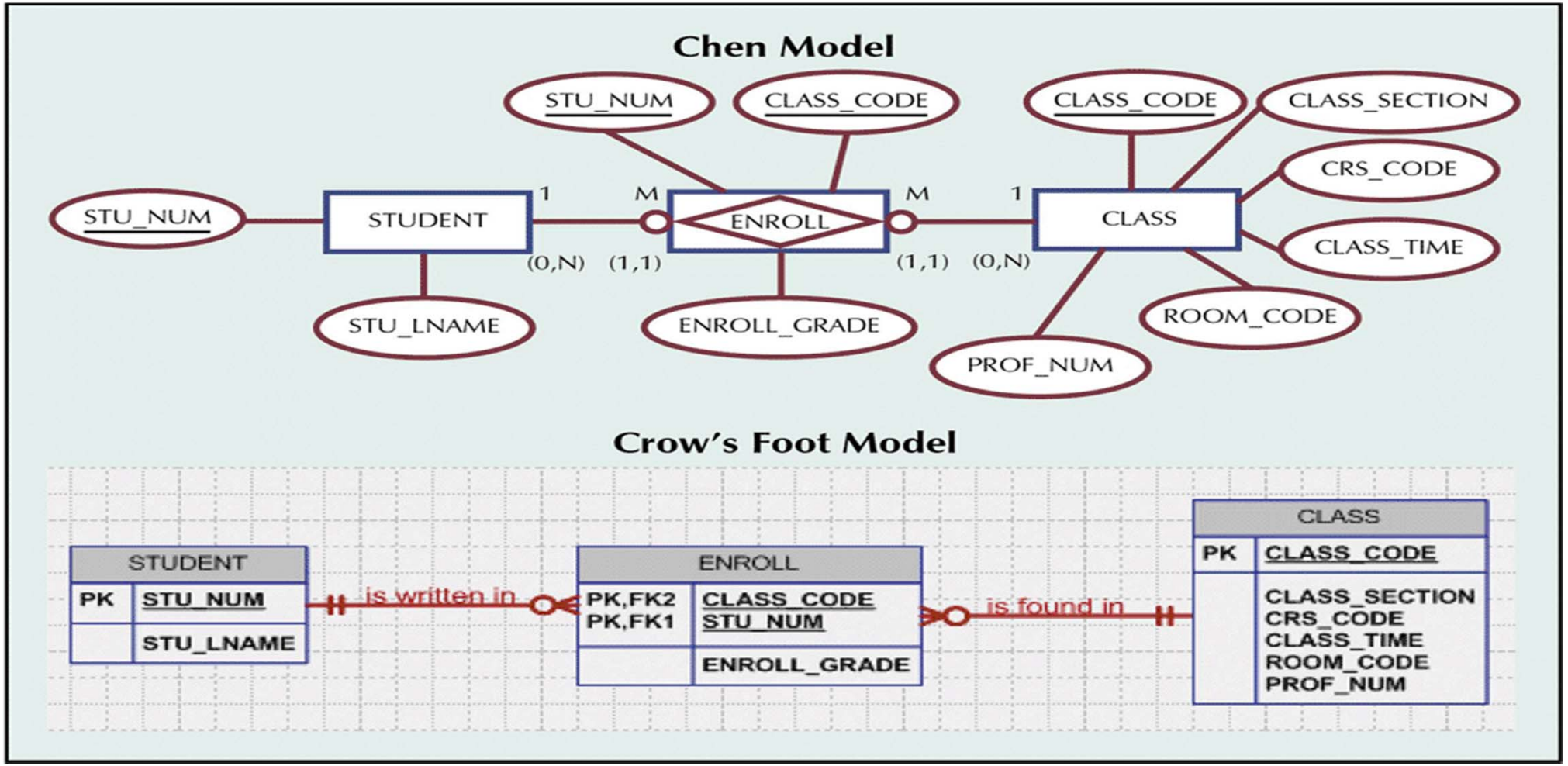
A Composite Entity in an ERD

- Converting the M:N Relationship into Two 1:M Relationships



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Converting the M:N Relationship into Two 1:M Relationships

Table name: STUDENT **Database name: Ch04_CollegeTry**

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Table name: ENROLL

CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

Table name: CLASS

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	CLASS_ROOM	PROF_NUM
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10018	CIS-220	2	MWF 9:00-9:50 a.m.	KLR211	114
10021	QM-261	1	MWF 8:00-8:50 a.m.	KLR200	114

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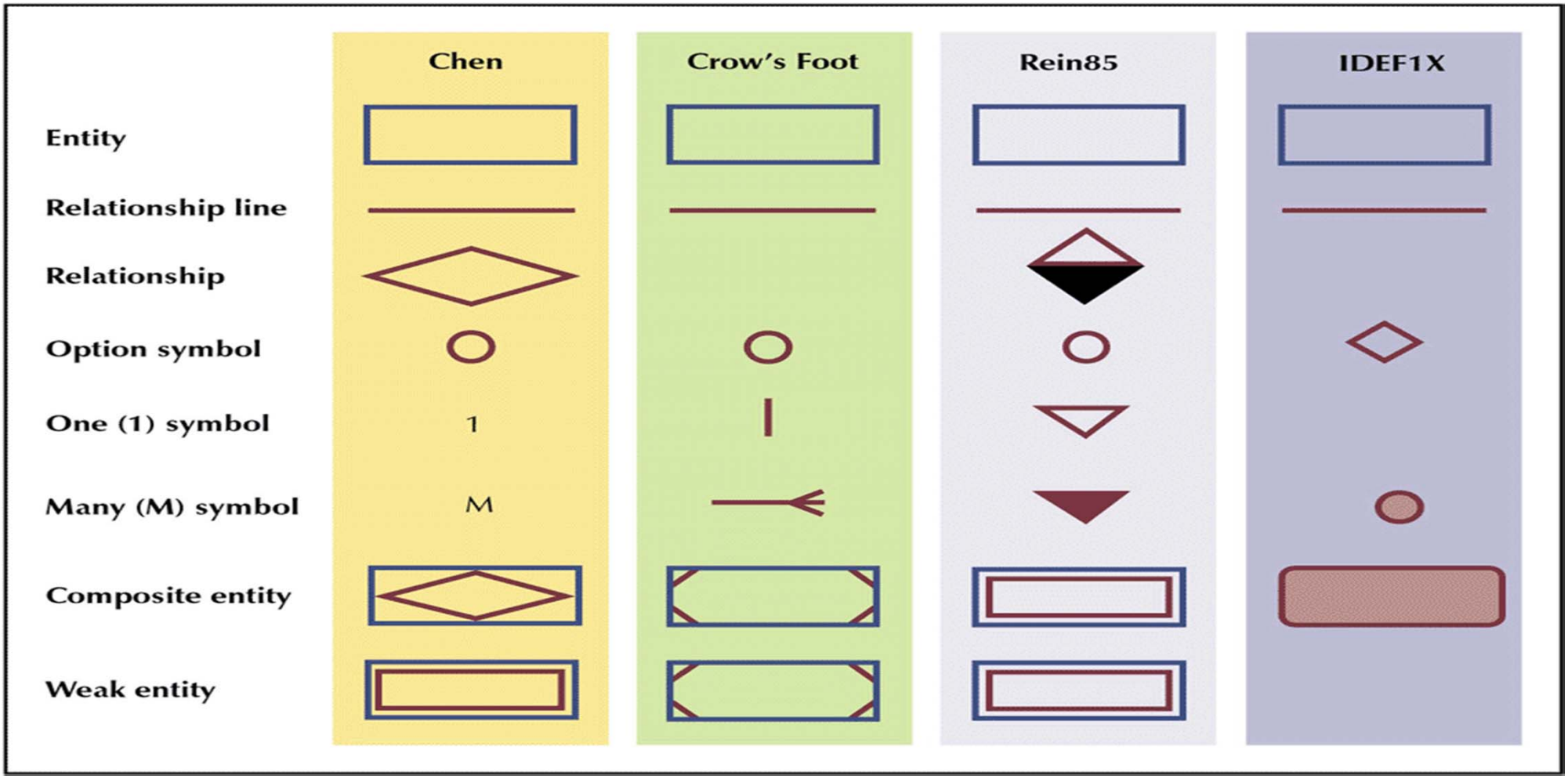
A Comparison of ER Modeling Symbols

FIGURE 4.31 A COMPARISON OF ER MODELING SYMBOLS



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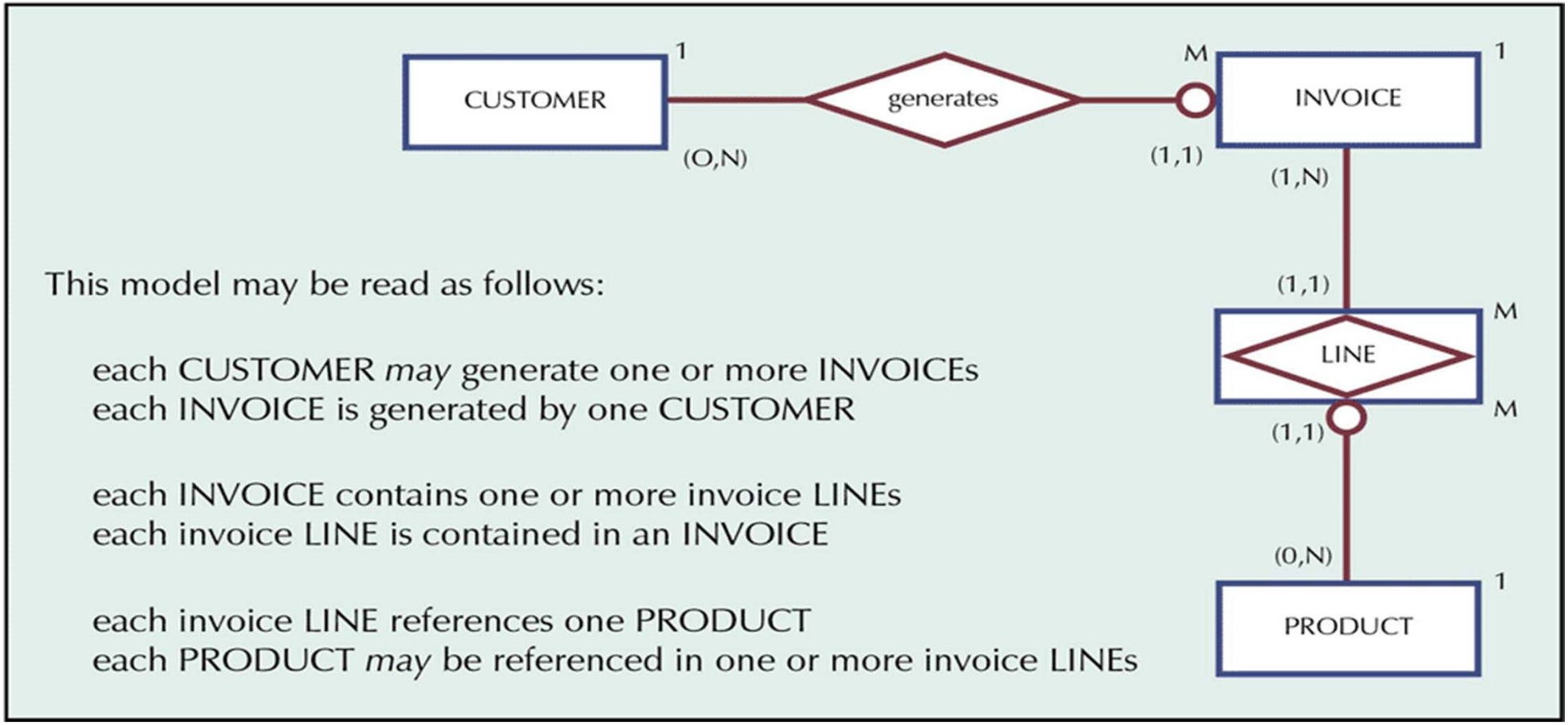
The Chen Representation of the Invoicing Problem



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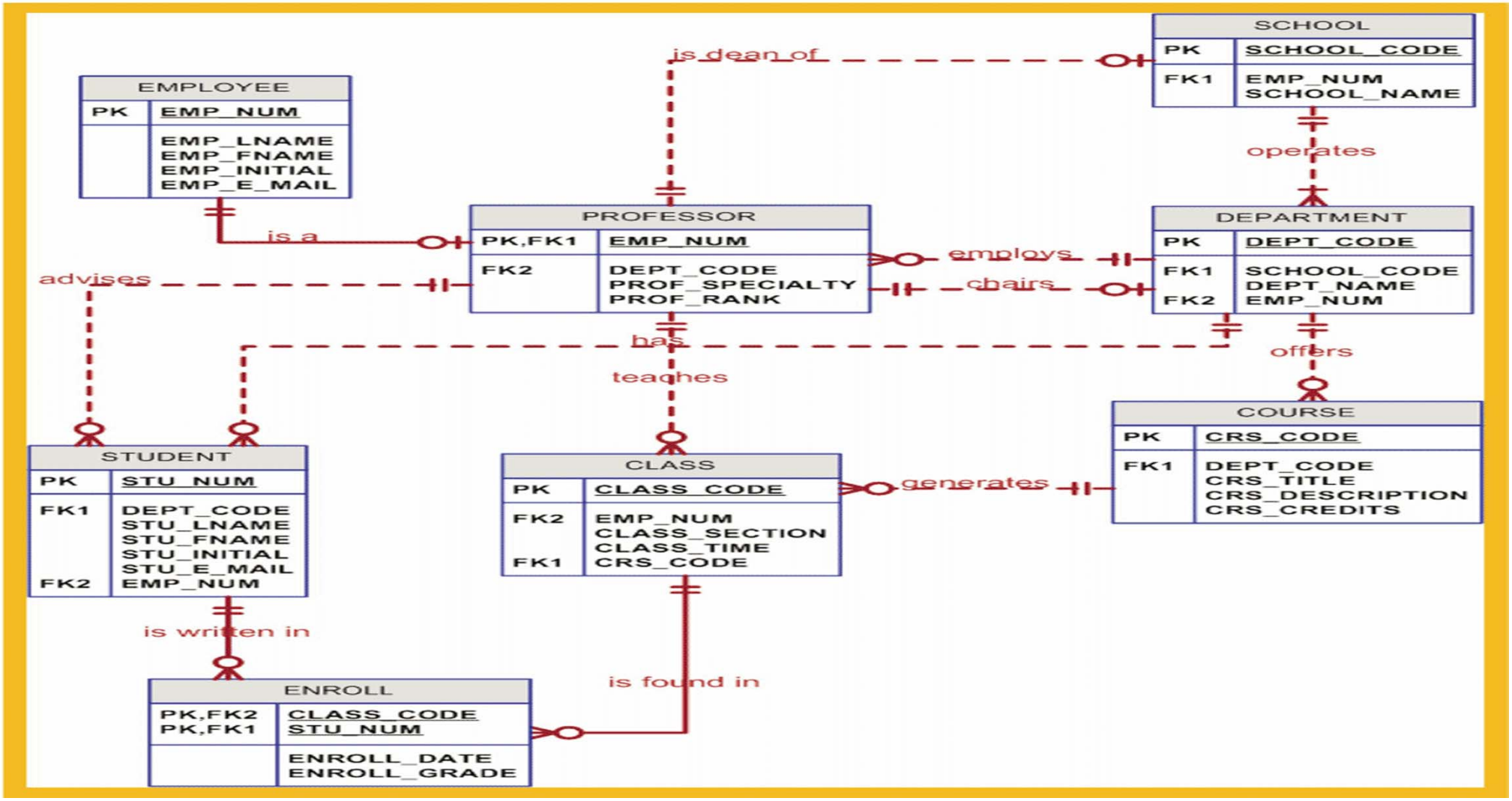
Components of the ER Model

TABLE 4.2 COMPONENTS OF THE ER MODEL

ENTITY	RELATIONSHIP	CONNECTIVITY	ENTITY
SCHOOL	operates	1:M	DEPARTMENT
DEPARTMENT	has	1:M	STUDENT
DEPARTMENT	employs	1:M	PROFESSOR
DEPARTMENT	offers	1:M	COURSE
COURSE	generates	1:M	CLASS
PROFESSOR	is an	1:1	EMPLOYEE
PROFESSOR	is dean of	1:1	SCHOOL
PROFESSOR	chairs	1:1	DEPARTMENT
PROFESSOR	teaches	1:M	CLASS
PROFESSOR	advises	1:M	STUDENT
STUDENT	enrolls in	1:M	CLASS
BUILDING	contains	1:M	ROOM
ROOM	is used for	1:M	CLASS

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

The Completed Tiny College ERD



From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

ER Diagram Exercises

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management

1. Given the following brief summary for the CM catering service, draw the fully labeled ERD. Make sure to include all appropriate entities, attributes, relationships, connectivities, and cardinalities. Each dinner is based on a single entrée, but each entrée can be served at many dinners. A guest can attend many dinners, and each dinner can be attended by many guests. Each dinner invitation can be mailed to many quests, and each guest can receive many invitations.

2. The Travis County Basketball Conference (TCBC) is an amateur basketball association. Each city in the county has one team that represents it. Each team has a maximum of 12 players and a minimum of nine players. Each team also has up to three coaches. Each team plays two games (home and visitor) against each of the other teams during the season. Scores of each game must be recorded. Given these conditions draw an ERD to represent the TCBC database. Make sure to include all appropriate entities, attributes, relationships, connectivities, and cardinalities.

From Rob and Coronel (2004), Database Systems: Design, Implementation, and Management