

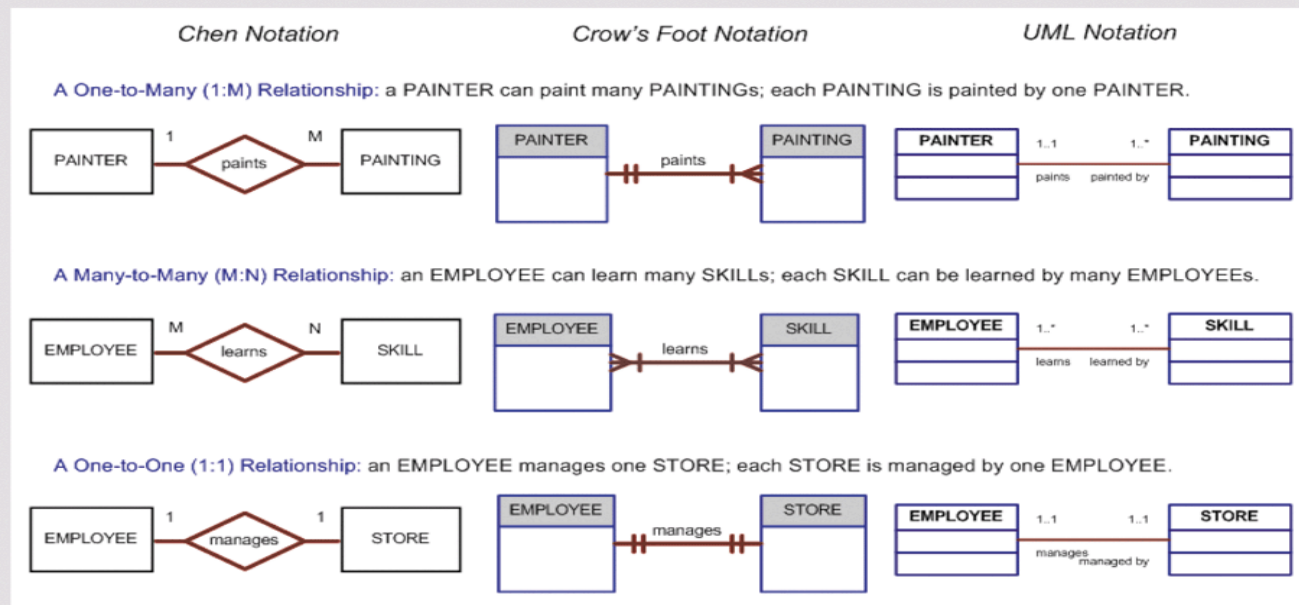
CPSC 5021: Database Systems

Entity Relationship Model

Lin Li

Notations

FIGURE 2.3 The ER model notations

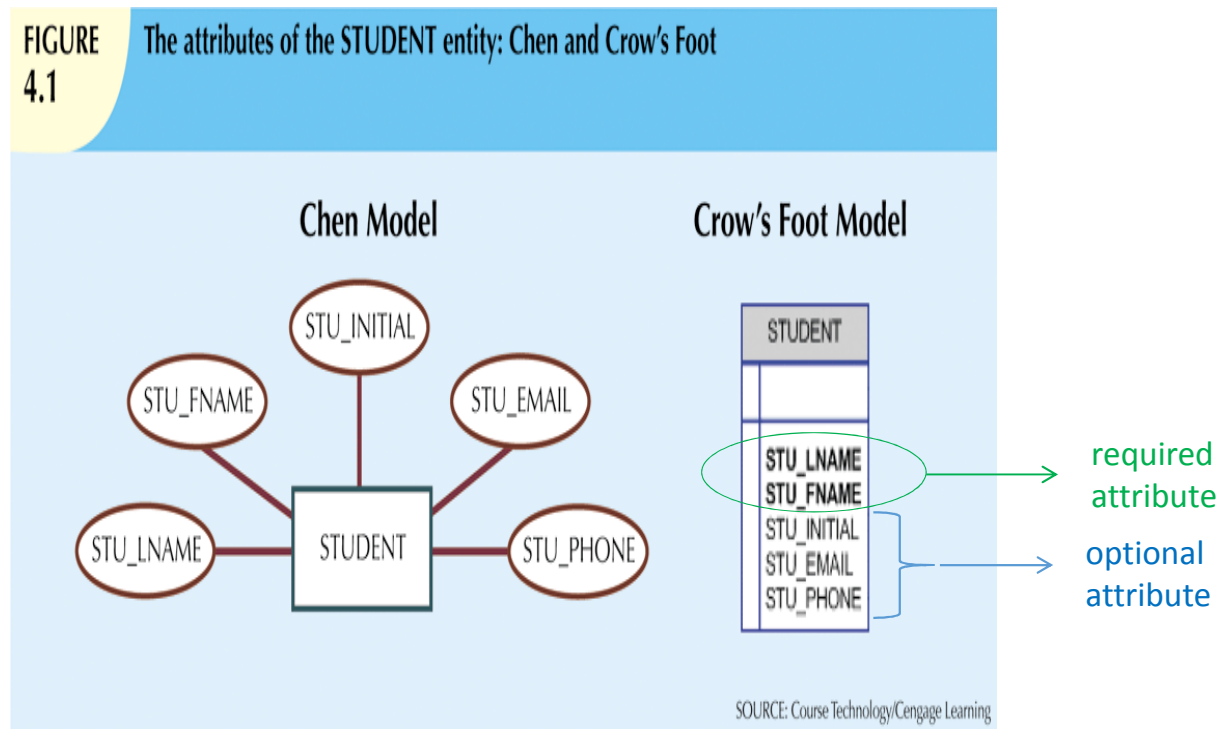


SOURCE: Course Technology/Cengage Learning

Entities

FIGURE
4.1

The attributes of the STUDENT entity: Chen and Crow's Foot



Attributes

- **Single-value attribute**: can have only a single value
- **Multivalued attributes**: can have many values.



(1) SSN



(2) Color of this car

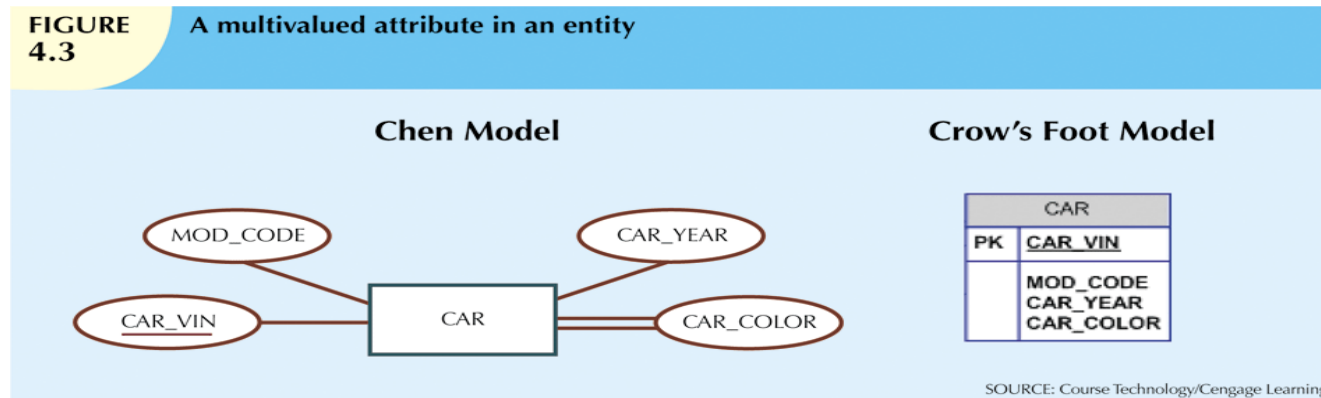
(1) → single-value

(2) → may have multiple values

Multivalued Attributes

FIGURE 4.3

A multivalued attribute in an entity



How to implement multivalued attributes in RDBMS?

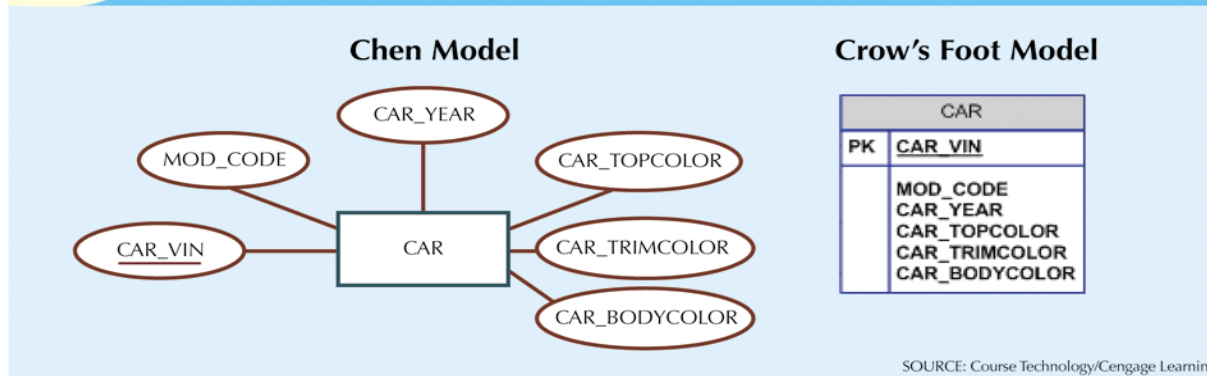
Multivalued Attributes

- Break the multivalued attribute into several new attributes

e.g. `car_color` → `car_topcolor`, `car_bodycolor`, `car_trimcolor`, etc.

FIGURE 4.4

Splitting the multivalued attribute into new attributes

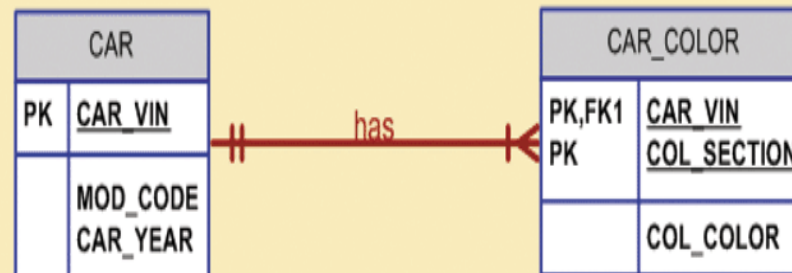


Multivalued Attributes

- Create a new entity for the multivalued attribute

FIGURE
4.5

A new entity set composed of a multivalued attribute's components



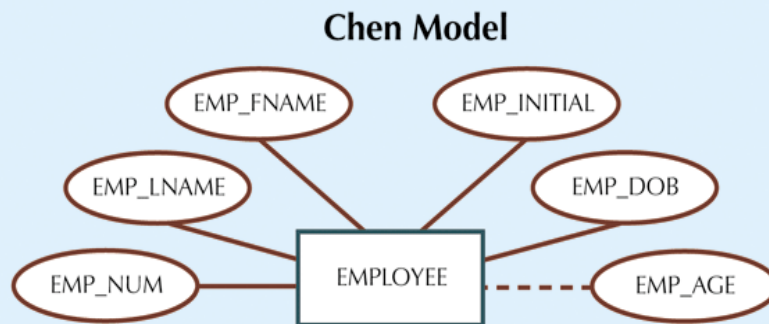
SOURCE: Course Technology/Cengage Learning

Derived Attributes

- Values may be calculated from other attributes

FIGURE 4.6

Depiction of a derived attribute

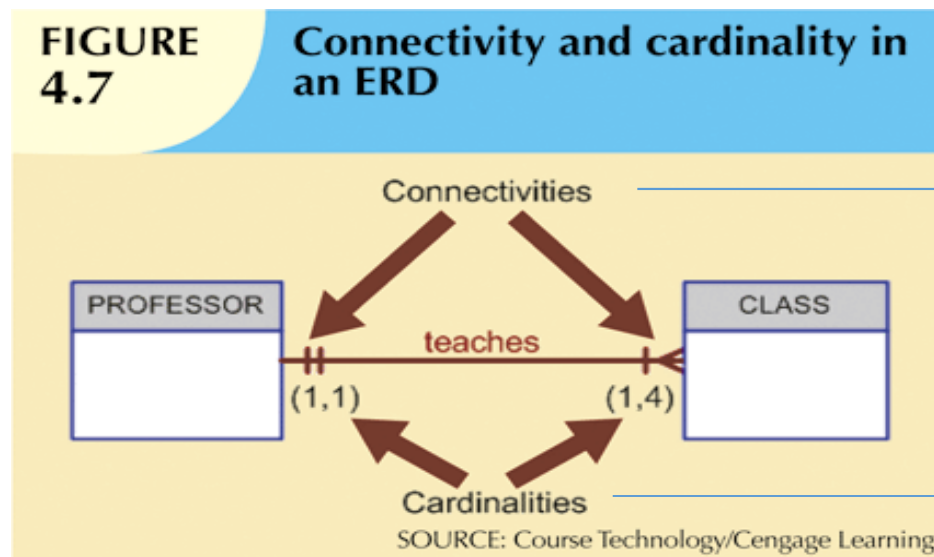


Crow's Foot Model

EMPLOYEE	
PK	<u>EMP_NUM</u>
	EMP_LNAME
	EMP_FNAME
	EMP_INITIAL
	EMP_DOB
	EMP_AGE

SOURCE: Course Technology/Cengage Learning

Relationships



describes the relationship classification

expresses minimum and maximum number of entity occurrences associated with one occurrence of related entity

Relationship Strength

- Weak (non-identifying) relationships: exists if PK of child entity does not contain PK component of parent entity.

CLASS is a **strong entity** because the existence of CLASS is apart from COURSE

Parent entity: is normally on the “one” side of the one-to-many relationship

Child entity: is mostly the entity on the “many” side of the one-to-many relationship

FIGURE 4.8

A weak (non-identifying) relationship between COURSE and CLASS



Table name: COURSE

CRS_CODE	DEPT_CODE	CRS_DESCRIPTION	CRS_CREDIT
ACCT-211	ACCT	Accounting I	3
ACCT-212	ACCT	Accounting II	3
CIS-220	CIS	Intro. to Microcomputing	3
CIS-420	CIS	Database Design and Implementation	4
MATH-243	MATH	Mathematics for Managers	3
QM-261	CIS	Intro. to Statistics	3
QM-362	CIS	Statistical Applications	4

Database name: Ch04_TinyCollege

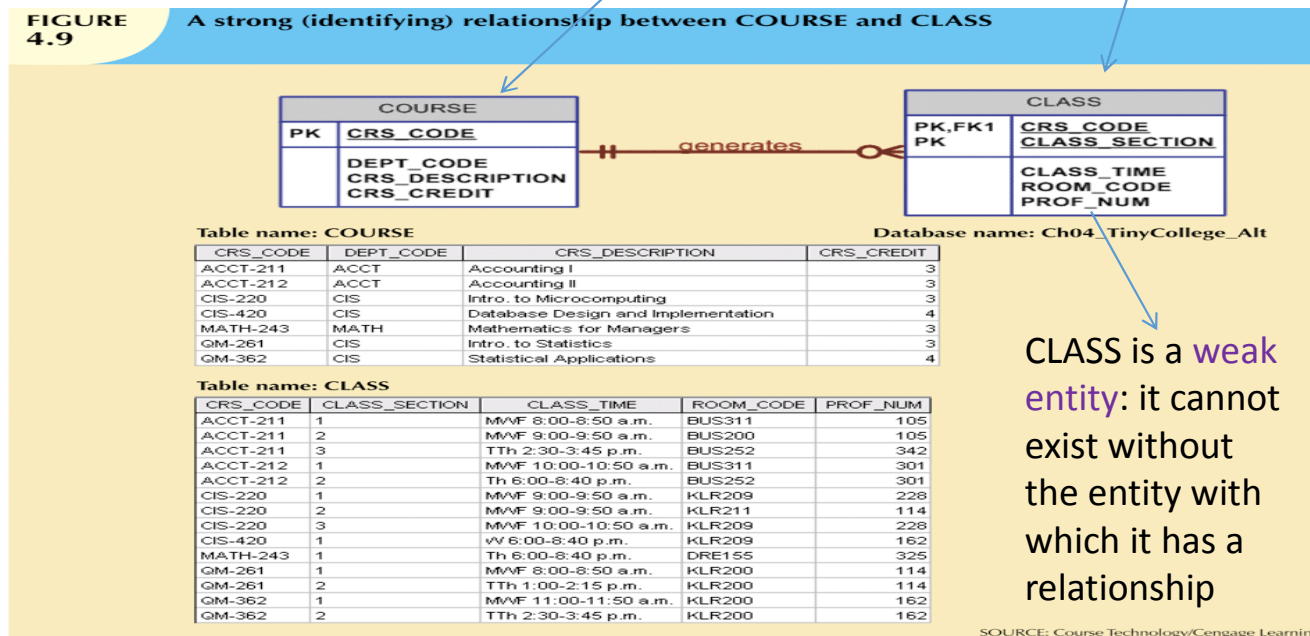
Table name: CLASS

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	PROF_NUM
10012	ACCT-211	1	MWVF 8:00-8:50 a.m.	BUS311	105
10013	ACCT-211	2	MWVF 9:00-9:50 a.m.	BUS200	105
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10015	ACCT-212	1	MWVF 10:00-10:50 a.m.	BUS311	301
10016	ACCT-212	2	Th 6:00-8:40 p.m.	BUS252	301
10017	CIS-220	1	MWVF 9:00-9:50 a.m.	KLR209	228
10018	CIS-220	2	MWVF 9:00-9:50 a.m.	KLR211	114
10019	CIS-220	3	MWVF 10:00-10:50 a.m.	KLR209	228
10020	CIS-420	1	WV 6:00-8:40 p.m.	KLR209	162
10021	QM-261	1	MWVF 8:00-8:50 a.m.	KLR200	114
10022	QM-261	2	TTh 1:00-2:15 p.m.	KLR200	114
10023	QM-362	1	MWVF 11:00-11:50 a.m.	KLR200	162
10024	QM-362	2	TTh 2:30-3:45 p.m.	KLR200	162
10025	MATH-243	1	Th 6:00-8:40 p.m.	DRE155	325

SOURCE: Course Technology/Cengage Learning

Relationship Strength

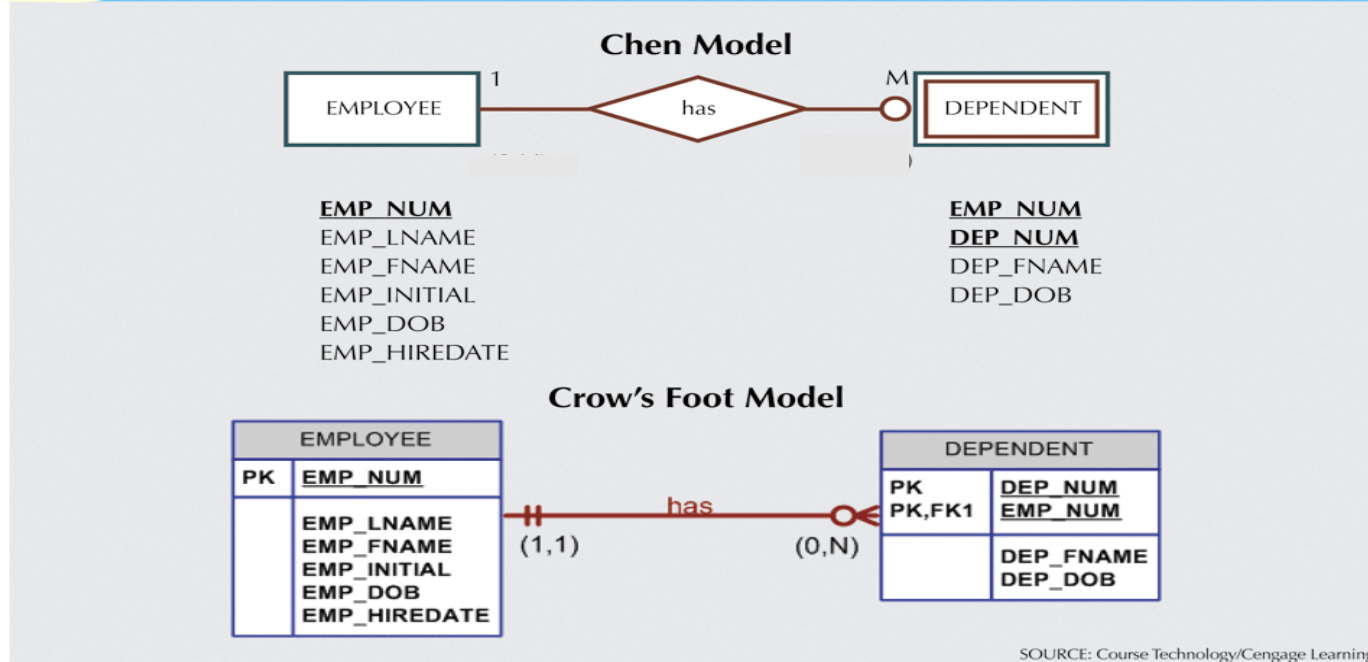
- **Strong (identifying) relationships:** exists when PK of child entity contains PK component of parent entity.



Weak Entity Example

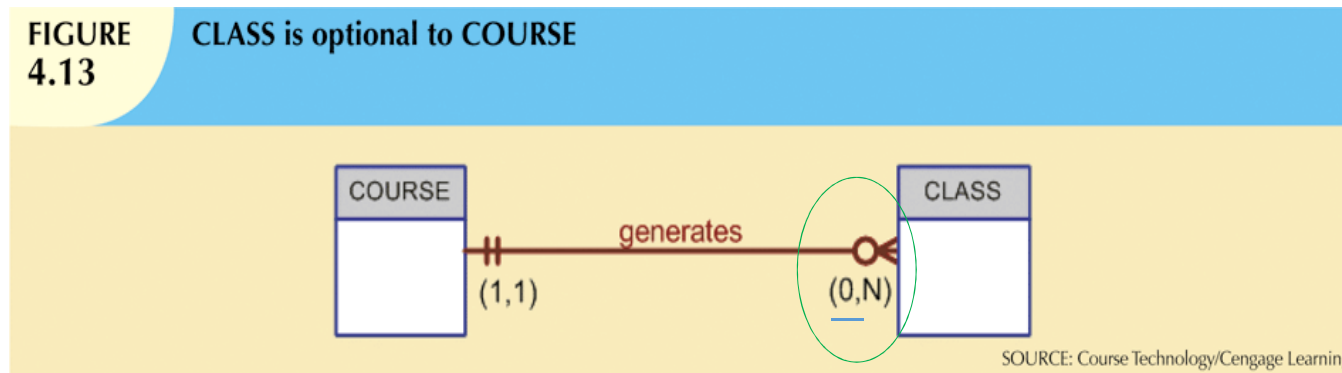
FIGURE 4.10

A weak entity in an ERD



Relationship Participation

- **Optional participation:** One entity occurrence **does not require** corresponding entity occurrence in particular relationship

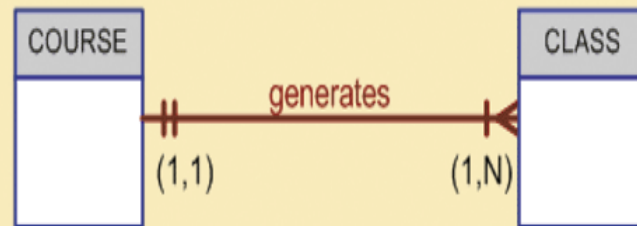


Relationship Participation

- **Mandatory participation:** One entity occurrence **requires** corresponding entity occurrence in particular relationship

FIGURE
4.14

COURSE and CLASS in a mandatory relationship







SOURCE: Course Technology/Cengage Learning

Relationship Participation

TABLE
4.3

Crow's Foot Symbols

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

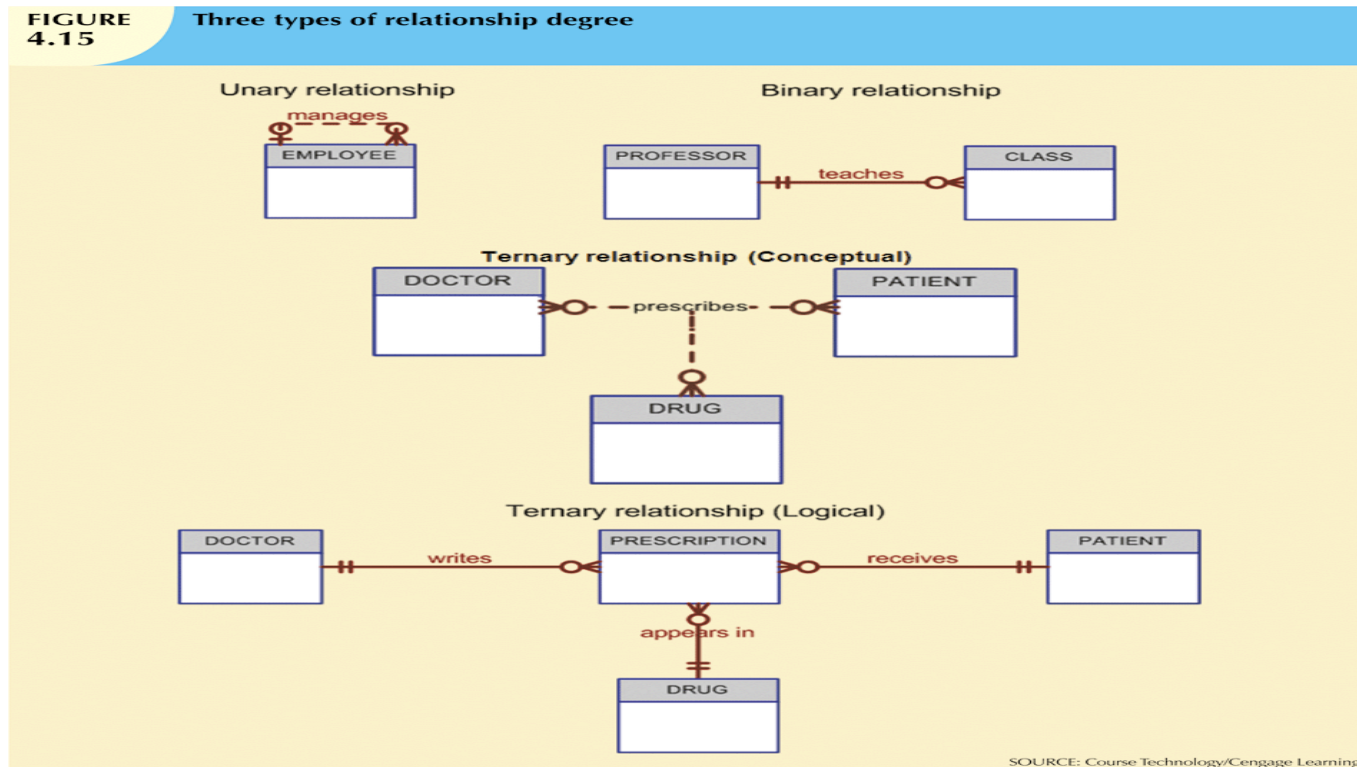
Relationship Degree

- **Unary relationship:** Association is maintained with single entity.
- **Binary relationship:** Two entities are associated.
- **Ternary relationship:** Three entities are associated.

Relationship Degree

FIGURE 4.15

Three types of relationship degree



Ternary Relationship

FIGURE 4.16

The implementation of a ternary relationship

Database name: Ch04_Clinic

Table name: DRUG

DRUG_CODE	DRUG_NAME	DRUG_PRICE
AF15	Afgapan-15	25.00
AF25	Afgapan-25	35.00
DRO	Droalene Chloride	111.89
DRZ	Druzocholar Cryptolene	18.99
KO15	Koliabar Oxyhexalene	65.75
OLE	Oleander-Drizapan	123.95
TRYP	Tryptolac Heptadimetric	79.45

Table name: PATIENT

PAT_NUM	PAT_TITLE	PAT_LNAME	PAT_FNAME	PAT_INITIAL	PAT_DOB	PAT_AREACODE	PAT_PHONE
100	Mr.	Kolmycz	George	D	15-Jun-1942	615	324-5456
101	Ms.	Lewis	Rhonda	G	19-Mar-2005	615	324-4472
102	Mr.	Vandam	Rhett		14-Nov-1958	901	675-8993
103	Ms.	Jones	Anne	M	16-Oct-1974	615	898-3456
104	Mr.	Lange	John	P	08-Nov-1971	901	504-4430
105	Mr.	Williams	Robert	D	14-Mar-1975	615	890-3220
106	Mrs.	Smith	Jeanine	K	12-Feb-2003	615	324-7883
107	Mr.	Diarie	Jorge	D	21-Aug-1974	615	890-4567
108	Mr.	vWesenbach	Paul	R	14-Feb-1966	615	897-4358
109	Mr.	Smith	George	K	18-Jun-1961	901	504-3339
110	Mrs.	Genkazi	Leighla	vV	19-May-1970	901	569-0093
111	Mr.	vWashington	Rupert	E	03-Jan-1966	615	890-4925
112	Mr.	Johnson	Edward	E	14-May-1961	615	898-4387
113	Ms.	Smythe	Melanie	P	15-Sep-1970	615	324-9006
114	Ms.	Brandon	Marie	G	02-Nov-1932	901	882-0845
115	Mrs.	Saranda	Hermine	R	25-Jul-1972	615	324-5505
116	Mr.	Smith	George	A	08-Nov-1965	615	890-2984

Table name: DOCTOR

DOC_ID	DOC_LNAME	DOC_FNAME	DOC_INITIAL	DOC_SPECIALTY
29827	Sanchez	Julio	J	Dermatology
32445	Jorgensen	Annelise	G	Neurology
33456	Korenski	Anatoly	A	Urology
33989	LeGrande	George		Pediatrics
34409	vWashington	Dennis	F	Orthopaedics
36221	McPherson	Katye	H	Dermatology
36712	Dreifag	Herman	G	Psychiatry
38995	Minh	Tran		Neurology
40004	Chin	Ming	D	Orthopaedics
40028	Feinstein	Denise	L	Gynecology

Table name: PRESCRIPTION

DOC_ID	PAT_NUM	DRUG_CODE	PRES_DOSAGE	PRES_DATE
32445	102	DRZ	2 tablets every four hours -- 50 tablets total	12-Nov-12
32445	113	OLE	1 teaspoon with each meal -- 250 ml total	14-Nov-12
34409	101	KO15	1 tablet every six hours -- 30 tablets total	14-Nov-12
36221	109	DRO	2 tablets with every meal -- 60 tablets total	14-Nov-12
38995	107	KO15	1 tablet every six hours -- 30 tablets total	14-Nov-12

PK, FK

SOURCE: Course Technology/Cengage Learning

Unary Relationship

- Exist between occurrences of the same entity set (known as recursive relationship).

EMP_CODE	EMP_LNAME	EMP_MANAGER
101	Waddell	102
102	Orincona	
103	Jones	102
104	Reballoh	102
105	Robertson	102
106	Deltona	102

Implementation of 1:M recursive relationship
 "EMPLOYEE manages EMPLOYEE"

CRS_CODE	DEPT_CODE	CRS_DESCRIPTION	CRS_CREDIT
ACCT_211	ACCT	Accounting 1	3
ACCT_212	ACCT	Accounting 2	3
CIS_220	CIS	Intro. To Microcomputing	3
CIS_420	CIS	Database Design and Implementation	4
MATH_243	MATH	Mathematics for Managers	3
QM_261	CIS	Intro. To Statistics	3
QM_362	CIS	Statistical Applications	4

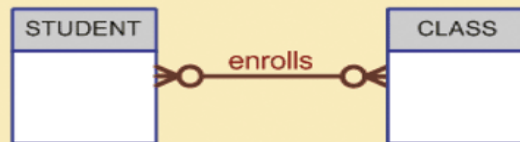
CRS_CODE	PRE_TAKE
CIS-420	CIS-220
QM-261	MATH-243
QM-362	MATH-243
QM-362	QM-261

Implementation of M:N recursive relationship
 "COURSE requires COURSE"

Binary Relationship

FIGURE 4.24

The M:N relationship between STUDENT and CLASS

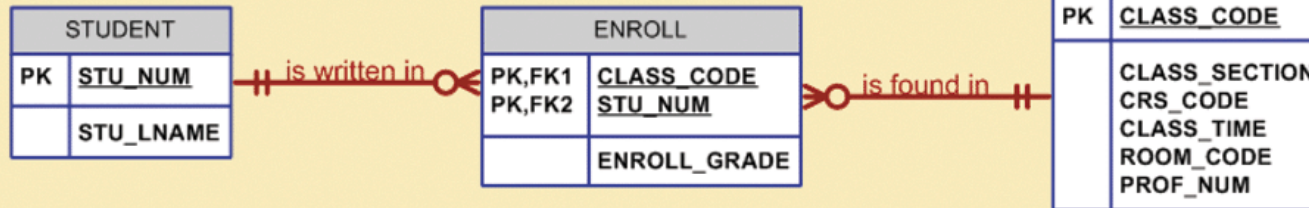


SOURCE: Course Technology/Cengage Learning

FIGURE 4.25

A composite entity in an ERD

ENROLL is a composite entity



SOURCE: Course Technology/Cengage Learning

Binary Relationship

FIGURE 4.23

Converting the M:N relationship into two 1:M relationships

Table name: STUDENT

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Database name: Ch04_CollegeTry

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	ROOM_CODE	PROF_NUM
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10018	CIS-220	2	MWTF 9:00-9:50 a.m.	KLR211	114
10021	QM-261	1	MWTF 8:00-8:50 a.m.	KLR200	114

SOURCE: Course Technology/Cengage Learning

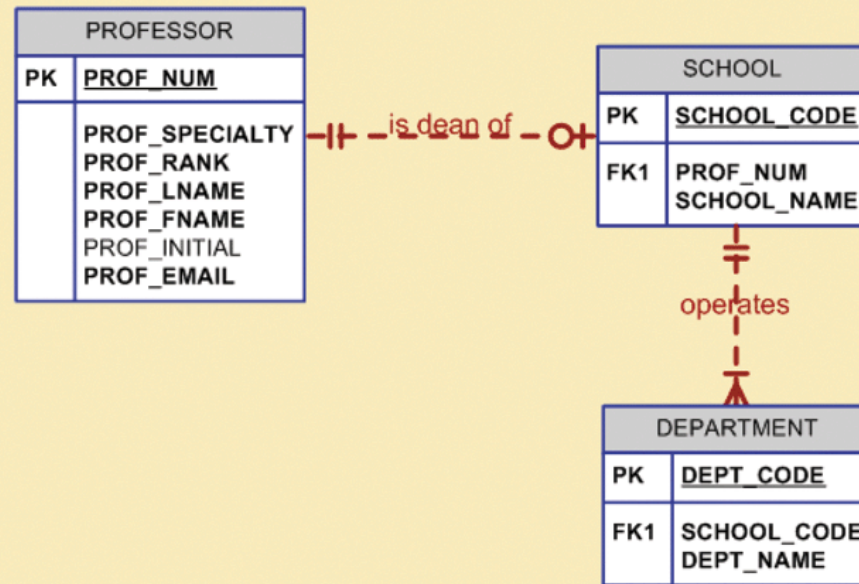
Developing an ER Diagram

- **Example:** Tiny college is divided into several schools: business, arts and sciences, education, and applied sciences. Each **school** is administered by a dean who is a **professor**. Each professor can be the dean of only one school, and a professor is not required to be the dean of any school.
- Each **school** comprises several **departments**. For example, the school of business has an accounting department, a marketing department, etc. The smallest number of departments operated by a school is one, and the largest number of departments is indeterminate (N). On the other hand, each department belongs to only a single school.

Developing an ER Diagram

FIGURE 4.26

The first Tiny College ERD segment



SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Example:** Each department may offer courses. Tiny College has some departments that are classified as “research only”, which would not offer courses.

FIGURE
4.27

The second Tiny College ERD segment



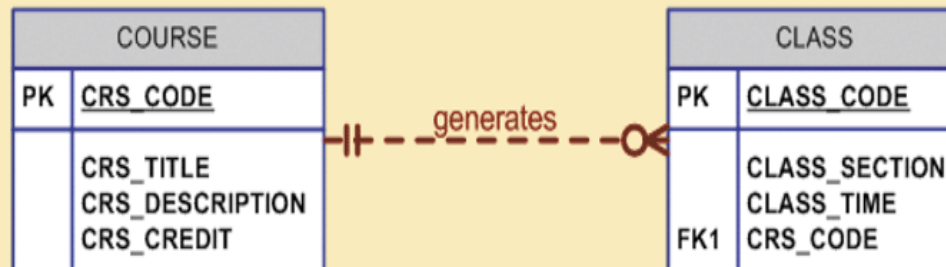
SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Example:** A department may offer **several classes** of the same **course**. But a course may exist in Tiny College's course catalog even when it is not offered as a class in a current class schedule.

FIGURE
4.28

The third Tiny College ERD segment



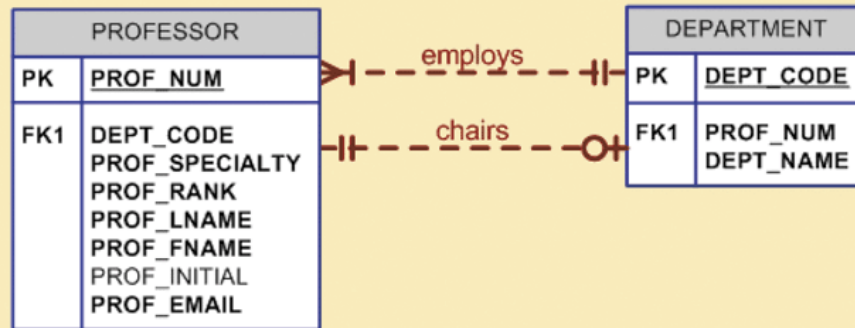
SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Example:** Each department should have one or more professors assigned to it. One and only one of those professors chairs the department, and no professor is required to accept the chair position.

FIGURE 4.29

The fourth Tiny College ERD segment



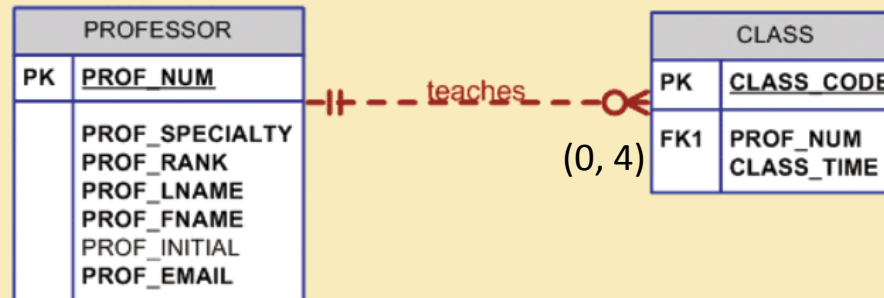
SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Exercise:** Each professor may teach up to four classes. A professor may also be on a research contract and teach no classes at all. There is no co-teaching of a class.

FIGURE 4.30

The fifth Tiny College ERD segment

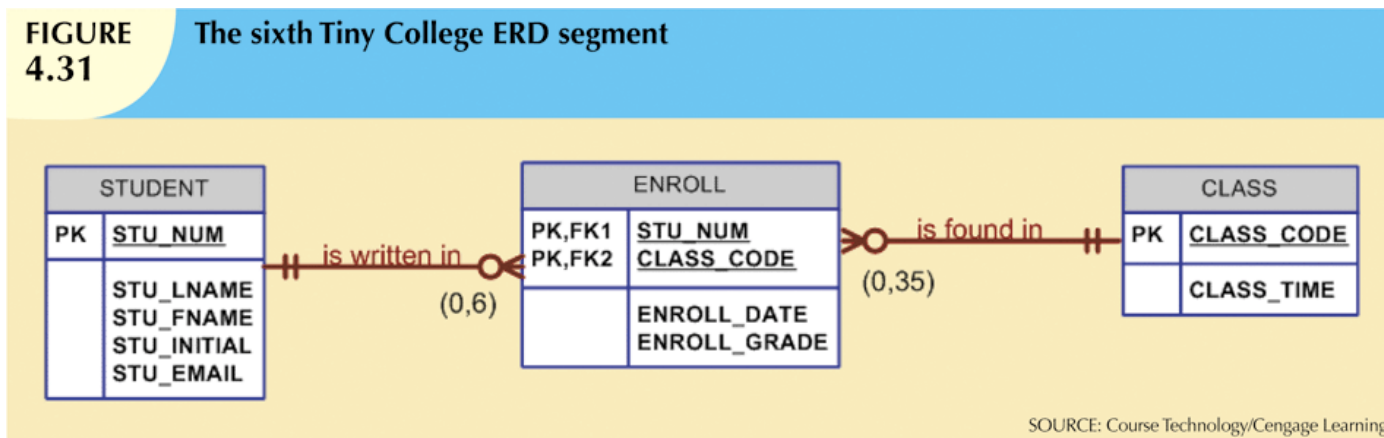


SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Exercise:** A student may enroll in up to six classes, and each class may have up to 35 students.

FIGURE 4.31 The sixth Tiny College ERD segment

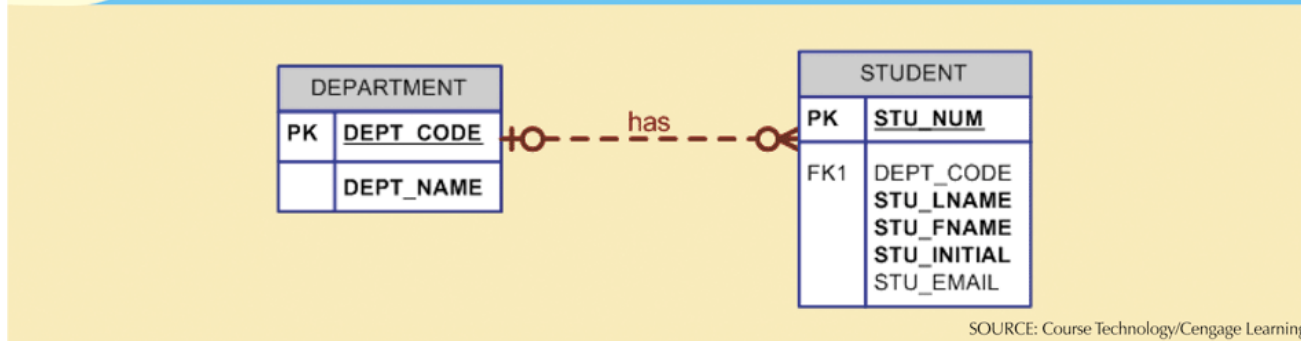


Developing an ER Diagram

- **Exercise:** Each department has several students whose major is offered by that department. However, each student has only a single major. In the Tiny College, it is possible – at least for a while – for a student not to declare a major.

FIGURE 4.32

The seventh Tiny College ERD segment

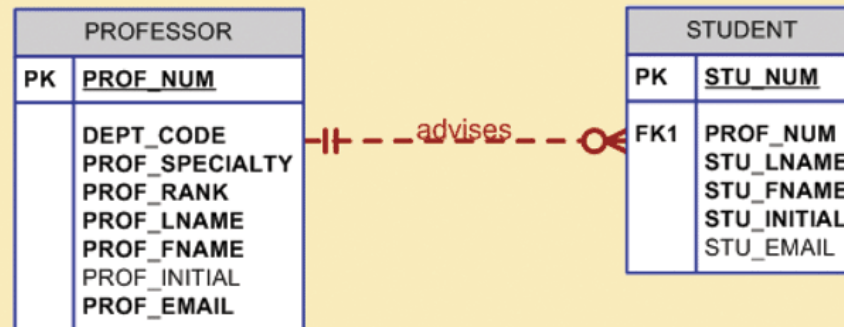


Developing an ER Diagram

- **Exercise:** Each **student** has an **advisor** in his or her department; each advisor counsels **several** students. An advisor is also a professor, but not all professors advise students.

FIGURE
4.33

The eighth Tiny College ERD segment



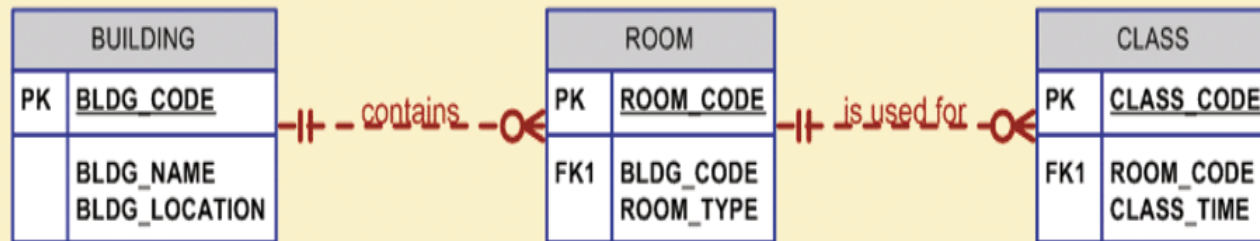
SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

- **Exercise:** A **class** is taught in a **classroom**, each room is located in a single **building**. A building may contain many rooms.

FIGURE 4.34

The ninth Tiny College ERD segment



SOURCE: Course Technology/Cengage Learning

The completed Tiny College ERD

