Database Principles: Fundamentals of Design, Implementation, and Management

Tenth Edition

Data Modeling with Entity Relationship Diagrams

Objectives

- In this chapter, students will learn:
  - The main characteristics of entity relationship components
  - How relationships between entities are defined, refined, and incorporated into the database design process
  - How ERD components affect database design and implementation
  - That real-world database design often requires the reconciliation of conflicting goals

The Entity Relationship Model (ERM)

- ER model forms the basis of an ER diagram
- ERD represents conceptual database as viewed by end user
- ERDs depict database's main components:
  - Entities
  - Attributes
  - Relationships

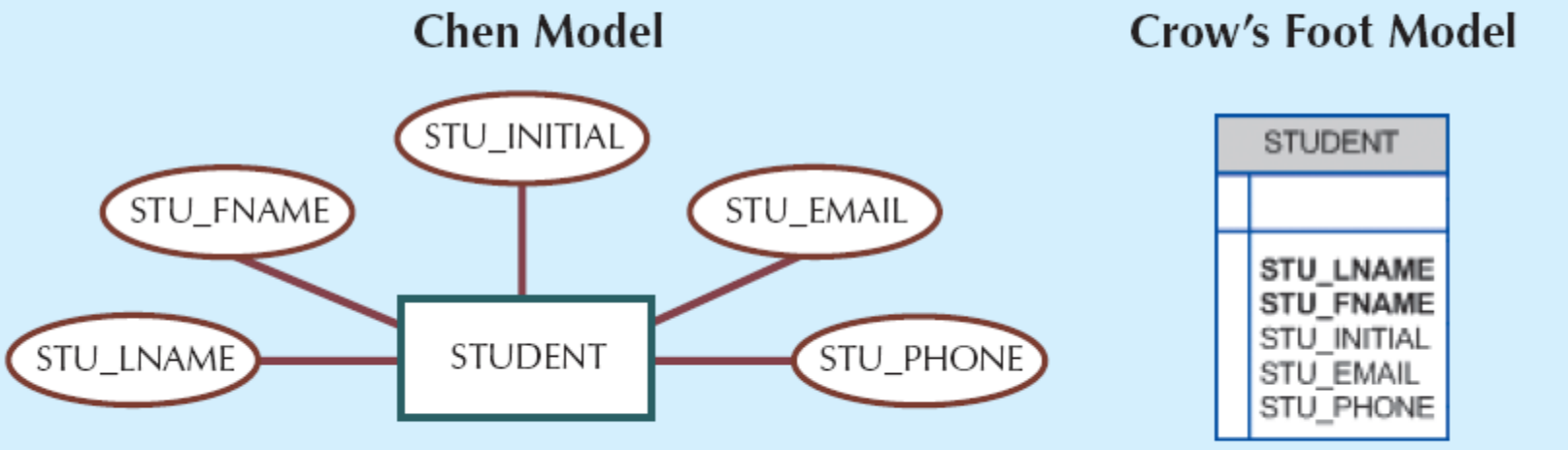
Entities

- Refers to entity set and not to single entity occurrence
- Corresponds to table and not to row in relational environment
- In Chen and Crow's Foot models, entity is represented by rectangle with entity's name
- The entity name, a noun, is written in capital letters

Attributes

- Characteristics of entities
- Chen notation: attributes represented by ovals connected to entity rectangle with a line
  - Each oval contains the name of attribute it represents
- Crow's Foot notation: attributes written in attribute box below entity rectangle

FIGURE 7.1 The attributes of the STUDENT entity: Chen and Crow's Foot



SOURCE: Course Technology/Cengage Learning

Attributes (cont'd.)

- Required attribute: must have a value
- Optional attribute: may be left empty
- Domain: set of possible values for an attribute
  - Attributes may share a domain
- Identifiers: one or more attributes that uniquely identify each entity instance
- Composite identifier: primary key composed of more than one attribute

FIGURE 7.2 The CLASS table (entity) components and contents

Database name: Ch07_TinyCollege

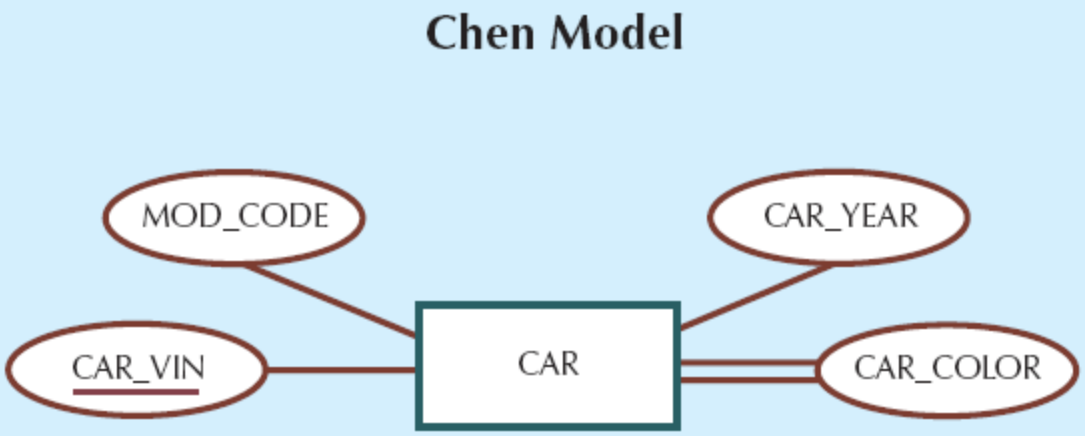
CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	PROF_NUM
10012	ACCT-211	1	MWF 8:00-8:50 a.m.	BUS311	105
10013	ACCT-211	2	MWF 9:00-9:50 a.m.	BUS200	105
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10015	ACCT-212	1	MWF 10:00-10:50 a.m.	BUS311	301
10016	ACCT-212	2	Th 6:00-8:40 p.m.	BUS252	301
10017	CIS-220	1	MWF 9:00-9:50 a.m.	KLR209	228
10018	CIS-220	2	MWF 9:00-9:50 a.m.	KLR211	114
10019	CIS-220	3	MWF 10:00-10:50 a.m.	KLR209	228
10020	CIS-420	1	W 6:00-8:40 p.m.	KLR209	162
10021	QM-261	1	MWF 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	MWF 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

Attributes (cont'd.)

- Composite attribute can be subdivided
- Simple attribute cannot be subdivided
- Single-value attribute can have only a single value
- Multivalued attributes can have many values

FIGURE 7.3 A multivalued attribute in an entity



Crow's Foot Model

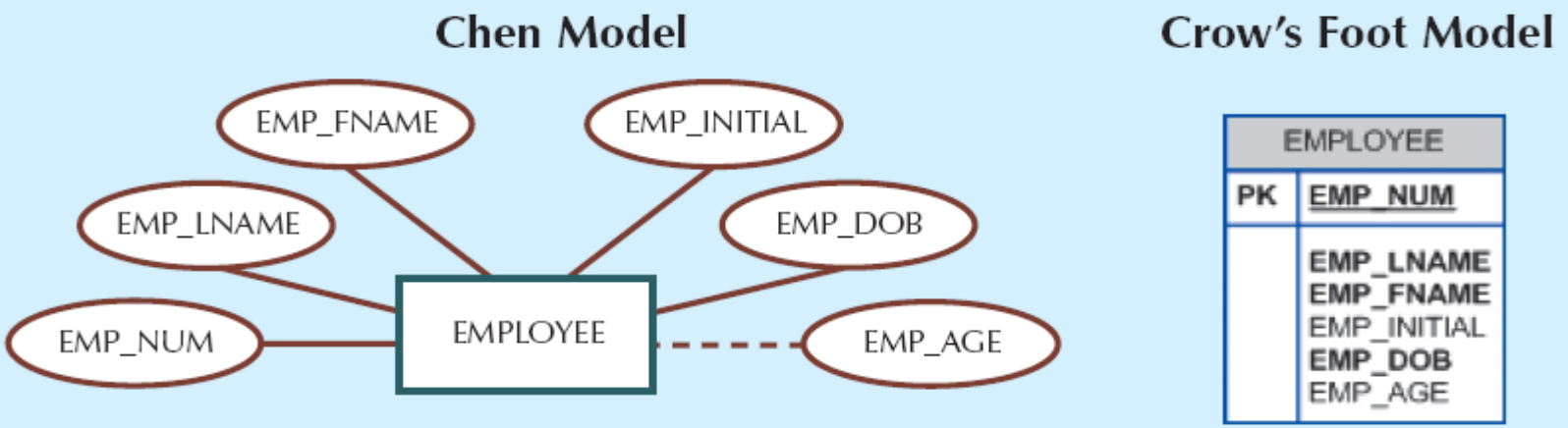
CAR	
PK	CAR_VIN
	MOD_CODE CAR_YEAR CAR_COLOR

SOURCE: Course Technology/Cengage Learning

Attributes (cont'd.)

- M:N relationships and multivalued attributes should not be implemented
  - Create several new attributes for each of the original multivalued attributes' components
  - Create new entity composed of original multivalued attributes' components
- Derived attribute: value may be calculated from other attributes
  - Need not be physically stored within database

FIGURE 7.6 Depiction of a derived attribute



SOURCE: Course Technology/Cengage Learning

TABLE 7.2 Advantages and Disadvantages of Storing Derived Attributes

	DERIVED ATTRIBUTE	
	STORED	NOT STORED
Advantage	Saves CPU processing cycles Saves data access time Data value is readily available Can be used to keep track of historical data	Saves storage space Computation always yields current value
Disadvantage	Requires constant maintenance to ensure derived value is current, especially if any values used in the calculation change	Uses CPU processing cycles Increases data access time Adds coding complexity to queries

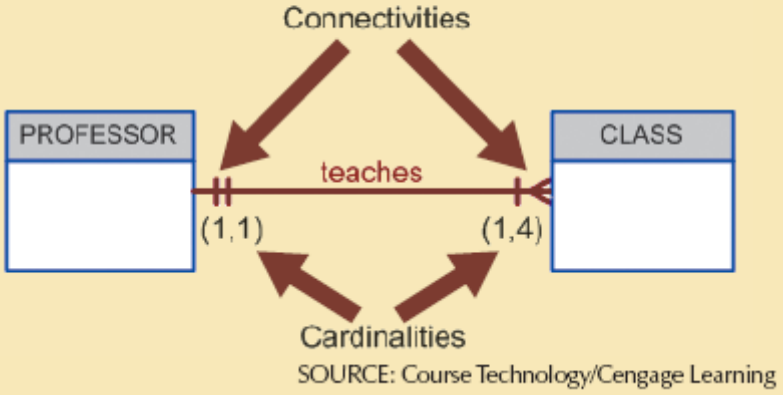
Relationships

- Association between entities
- Participants are entities that participate in a relationship
- Relationships between entities always operate in both directions
- Relationship can be classified as 1:M
- Relationship classification is difficult to establish if only one side of the relationship is known

Connectivity and Cardinality

- Connectivity
  - Describes the relationship classification
- Cardinality
  - Expresses minimum and maximum number of entity occurrences associated with one occurrence of related entity
- Established by very concise statements known as business rules

FIGURE 7.7 Connectivity and cardinality in an ERD



SOURCE: Course Technology/Cengage Learning

Connectivity

- 1:M relationship
  - Relational modeling ideal
  - Should be the norm in any relational database design
- 1:1 relationship
  - Should be rare in any relational database design

Connectivity (cont'd.)

- M:N relationships
  - Cannot be implemented as such in the relational model
  - M:N relationships can be changed into 1:M relationships

The 1:M Relationship

- Relational database norm
- Found in any database environment

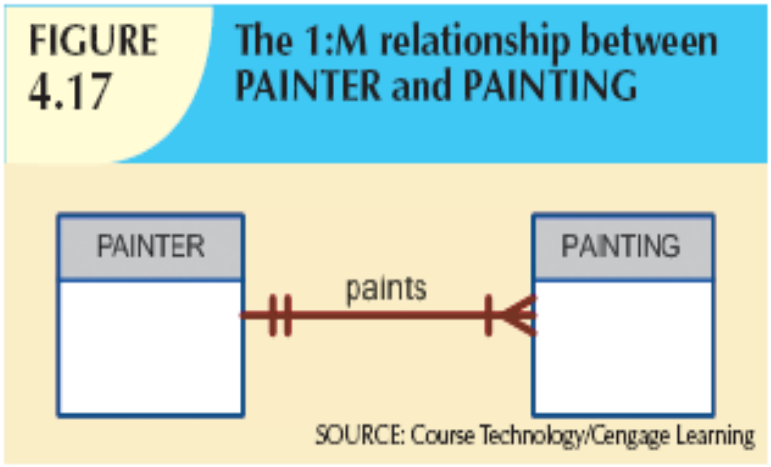


FIGURE 4.18 The implemented 1:M relationship between PAINTER and PAINTING

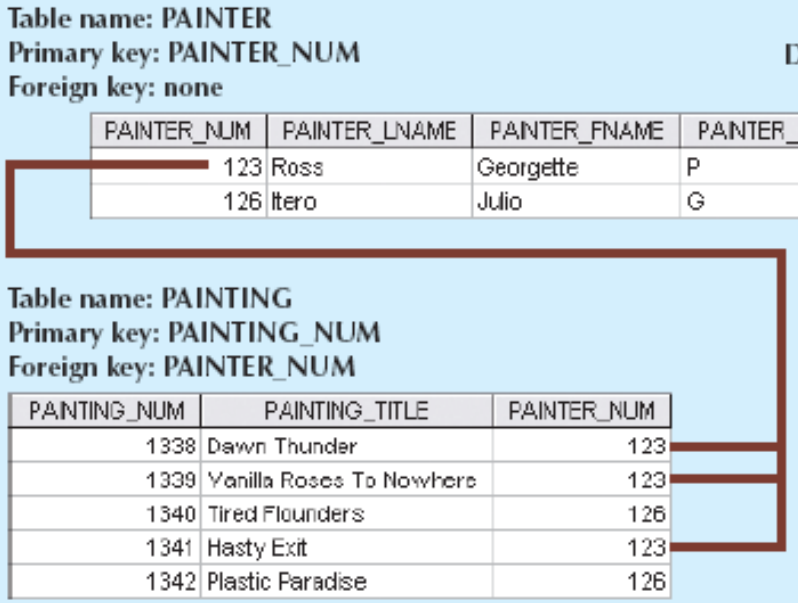


Table name: PAINTER
Primary key: PAINTER_NUM
Foreign key: none

Database name: Ch04_Museum

PAINTER_NUM	PAINTER_LNAME	PAINTER_FNAME	PAINTER_INITIAL
123	Ross	Georgette	P
126	Itero	Julio	G

Table name: PAINTING
Primary key: PAINTING_NUM
Foreign key: PAINTER_NUM

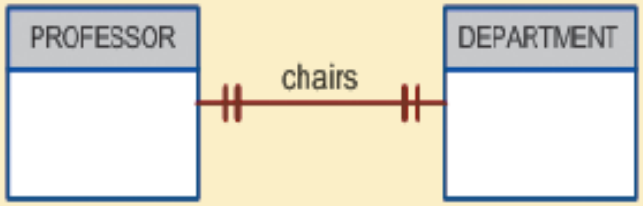
PAINTING_NUM	PAINTING_TITLE	PAINTER_NUM
1338	Dawn Thunder	123
1339	Vanilla Roses To Nowhere	123
1340	Tired Flounders	126
1341	Hasty Exit	123
1342	Plastic Paradise	126

SOURCE: Course Technology/Cengage Learning

The 1:1 Relationship

- One entity related to only one other entity, and vice versa
- Sometimes means that entity components were not defined properly
- Could indicate that two entities actually belong in the same table
- Certain conditions absolutely require their use

FIGURE 4.21 The 1:1 relationship between PROFESSOR and DEPARTMENT

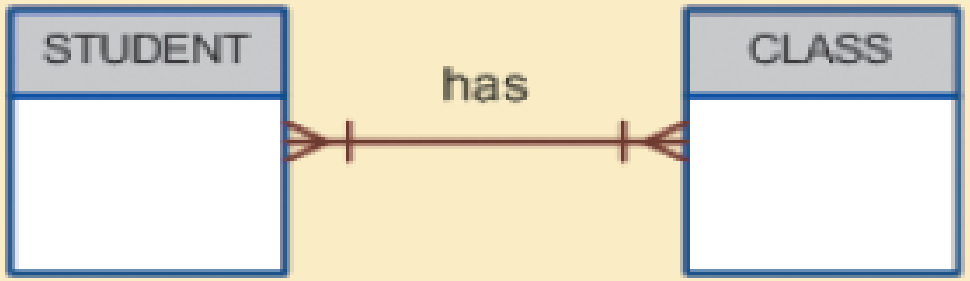


SOURCE: Course Technology/Cengage Learning

The M:N Relationship

- Implemented by breaking it up to produce a set of 1:M relationships
- Avoid problems inherent to M:N relationship by creating a composite entity
  - Includes as foreign keys the primary keys of tables to be linked

FIGURE 4.23 The ERM's M:N relationship between STUDENT and CLASS



SOURCE: Course Technology/Cengage Learning

FIGURE 4.25 Converting the M:N relationship into two 1:M relationships

Table name: STUDENT
Primary key: STU_NUM
Foreign key: none

Database name: Ch04_CollegeTry2

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Table name: ENROLL
Primary key: CLASS_CODE + STU_NUM
Foreign key: CLASS_CODE, STU_NUM

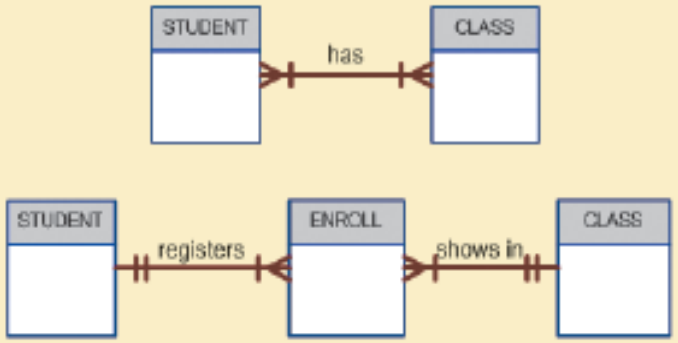
CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

Table name: CLASS
Primary key: CLASS_CODE
Foreign key: CRS_CODE

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

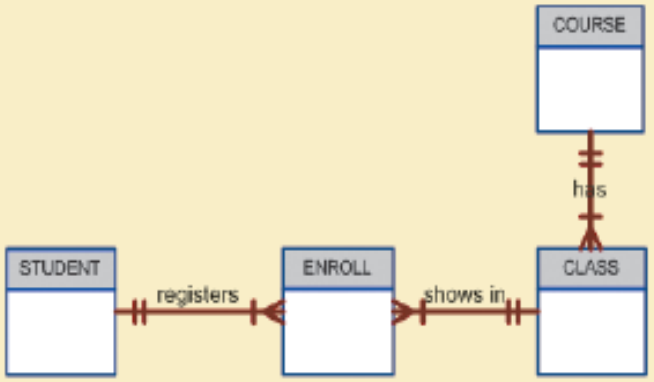
SOURCE: Course Technology/Cengage Learning

FIGURE 4.26 Changing the M:N relationship to two 1:M relationships



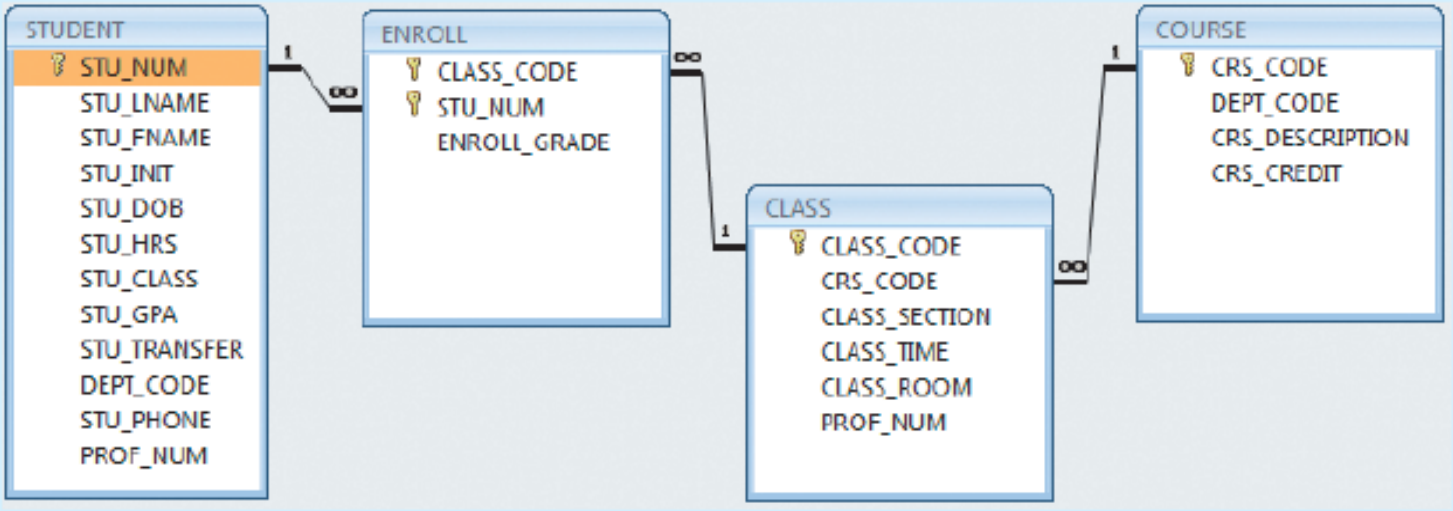
SOURCE: Course Technology/Cengage Learning

FIGURE 4.27 The expanded entity relationship model



SOURCE: Course Technology/Cengage Learning

FIGURE 4.28 The relational diagram for the Ch04_TinyCollege database



SOURCE: Course Technology/Cengage Learning

Existence Dependence

- Existence dependence
  - Entity exists in database only when it is associated with another related entity occurrence
- Existence independence
  - Entity can exist apart from one or more related entities
  - Sometimes such an entity is referred to as a strong or regular entity

Relationship Strength

- Weak (non-identifying) relationships
  - Exists if PK of related entity does not contain PK component of parent entity
- Strong (identifying) relationships
  - Exists when PK of related entity contains PK component of parent entity

FIGURE 7.8 A weak (non-identifying) relationship between COURSE and CLASS

Table name: COURSE **Database name: Ch07_TinyCollege**

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

Table name: CLASS

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	PROF_NUM
10012	ACCT-211	1	MWF 8:00-8:50 a.m.	BUS311	105
10013	ACCT-211	2	MWF 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	MWF 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	MWF 9:00-9:50 a.m.	KLR209	228
10018	CIS-220	2	MWF 9:00-9:50 a.m.	KLR211	114
10019	CIS-220	3	MWF 10:00-10:50 a.m.	KLR209	228
10020	CIS-420	1	W 6:00-8:40 p.m.	KLR209	162
10021	QM-261	1	MWF 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	MWF 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

FIGURE 7.9 A strong (identifying) relationship between COURSE and CLASS

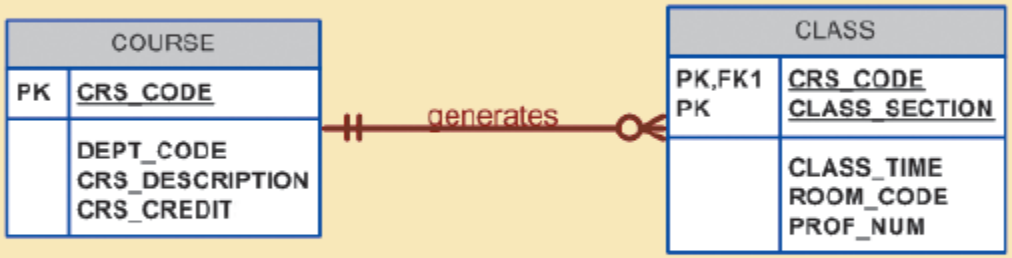


Table name: COURSE **Database name: Ch07_TinyCollege_Alt**

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

Table name: CLASS

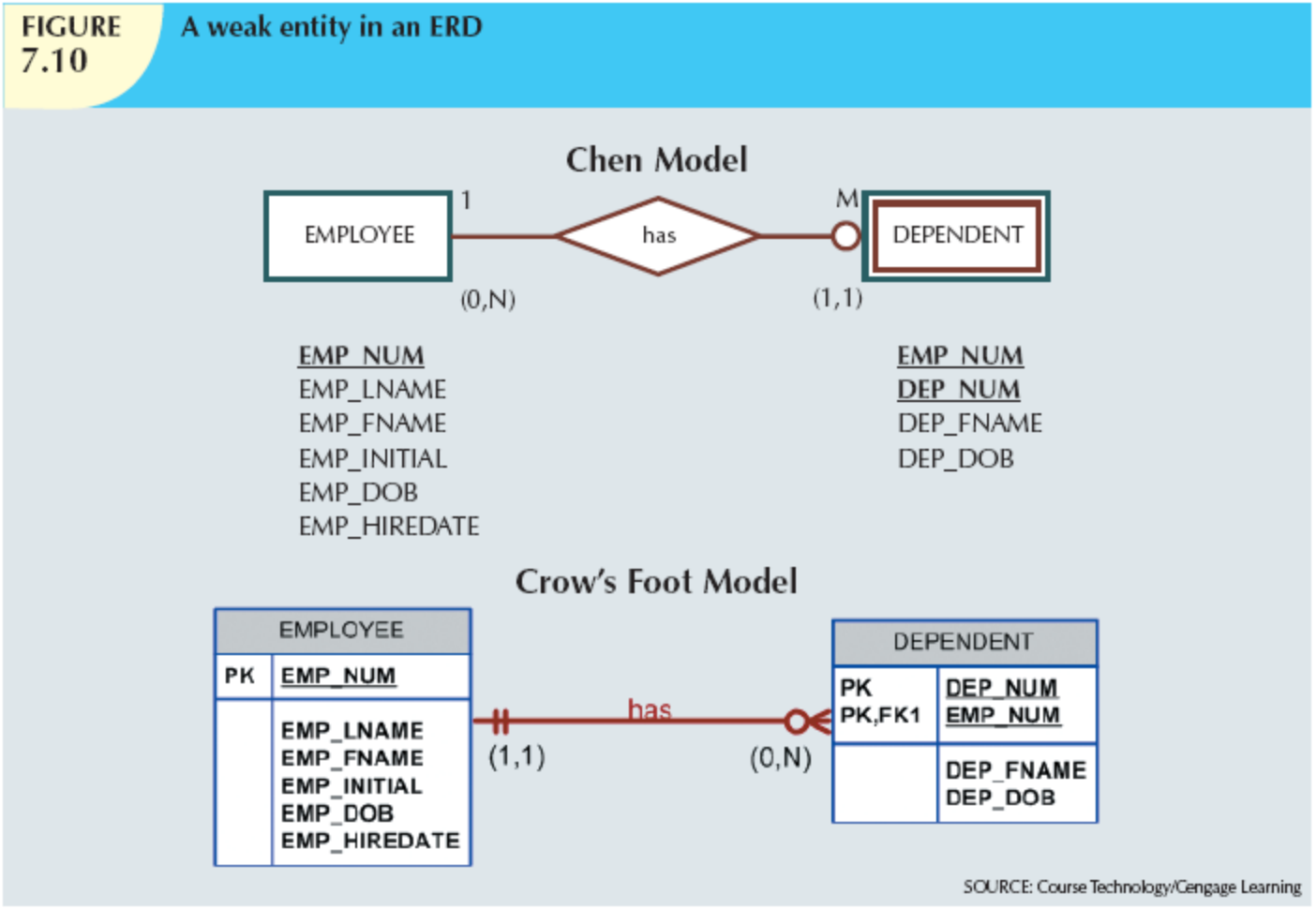
CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	PROF_NUM
ACCT-211	1	MWF 8:00-8:50 a.m.	BUS311	105
ACCT-211	2	MWF 9:00-9:50 a.m.	BUS200	105
ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
ACCT-212	1	MWF 10:00-10:50 a.m.	BUS311	301
ACCT-212	2	Th 6:00-8:40 p.m.	BUS252	301
CIS-220	1	MWF 9:00-9:50 a.m.	KLR209	228
CIS-220	2	MWF 9:00-9:50 a.m.	KLR211	114
CIS-220	3	MWF 10:00-10:50 a.m.	KLR209	228
CIS-420	1	W 6:00-8:40 p.m.	KLR209	162
MATH-243	1	Th 6:00-8:40 p.m.	DRE155	325
QM-261	1	MWF 8:00-8:50 a.m.	KLR200	114
QM-261	2	TTh 1:00-2:15 p.m.	KLR200	114
QM-362	1	MWF 11:00-11:50 a.m.	KLR200	162
QM-362	2	TTh 2:30-3:45 p.m.	KLR200	162

SOURCE: Course Technology/Cengage Learning

Weak Entities

- Weak entity meets two conditions
  - Existence-dependent
  - Primary key partially or totally derived from parent entity in relationship
- Database designer determines whether an entity is weak based on business rules

FIGURE 7.10 A weak entity in an ERD



SOURCE: Course Technology/Cengage Learning

FIGURE 7.11 A weak entity in a strong relationship

Table name: EMPLOYEE **Database name: Ch07_ShortCo**

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_DOB	EMP_HREDATE
1001	Califante	Jeanine	J	12-Mar-64	25-May-97
1002	Smithson	William	K	23-Nov-70	28-May-97
1003	Washington	Herman	H	15-Aug-68	28-May-97
1004	Chen	Lydia	B	23-Mar-74	15-Oct-98
1005	Johnson	Melanie		28-Sep-66	20-Dec-98
1006	Ortega	Jorge	G	12-Jul-79	05-Jan-02
1007	O'Donnell	Peter	D	10-Jun-71	23-Jun-02
1008	Brzenski	Barbara	A	12-Feb-70	01-Nov-03

Table name: DEPENDENT

EMP_NUM	DEP_NUM	DEP_FNAME	DEP_DOB
1001	1	Annelise	05-Dec-97
1001	2	Jorge	30-Sep-02
1003	1	Suzanne	25-Jan-04
1006	1	Carlos	25-May-01
1008	1	Michael	19-Feb-95
1008	2	George	27-Jun-98
1008	3	Katherine	18-Aug-03

SOURCE: Course Technology/Cengage Learning

Relationship Participation

- Optional participation
  - One entity occurrence does not require corresponding entity occurrence in particular relationship
- Mandatory participation
  - One entity occurrence requires corresponding entity occurrence in particular relationship

TABLE 7.3 **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.

FIGURE 7.13 CLASS is optional to COURSE

SOURCE: Course Technology/Cengage Learning

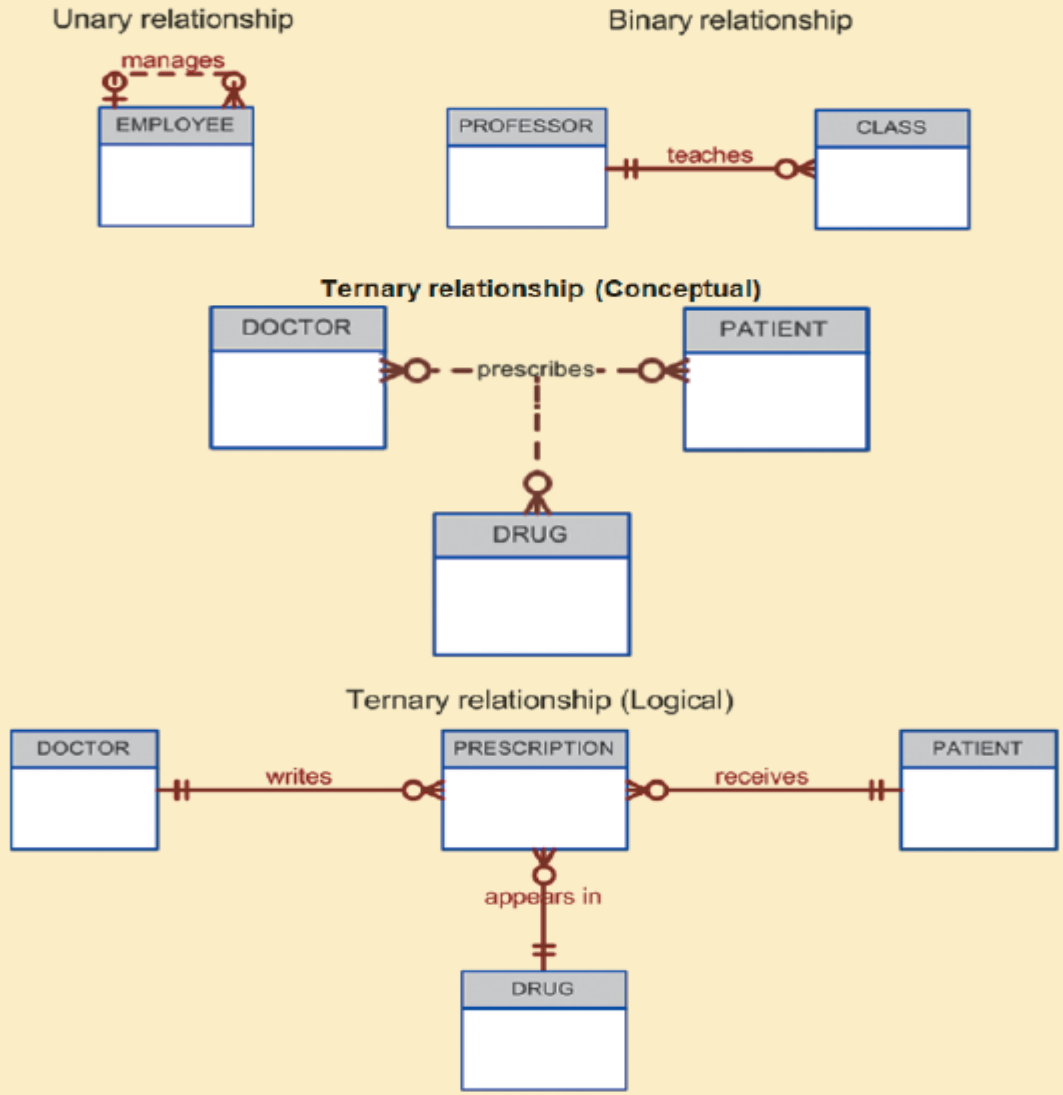
FIGURE 7.14 COURSE and CLASS in a mandatory relationship

SOURCE: Course Technology/Cengage Learning

Relationship Degree

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

FIGURE 7.15 Three types of relationship degree



SOURCE: Course Technology/Cengage Learning

FIGURE 7.16 The implementation of a ternary relationship

Database name: Ch07_Clinic

Table name: DRUG

DRUG_CODE	DRUG_NAME	DRUG_PRICE
AF15	Afgapan-15	25.00
AF25	Afgapan-25	35.00
DRO	Droxlene Chloride	111.89
DRZ	Druzocholer Cryptolene	18.99
KO15	Kollsiber Oxyhexalene	65.75
OLE	Oleander-Drizapan	123.95
TRYP	Tryptolec 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.	Diante	Jorge	D	21-Aug-1974	615	890-4567
108	Mr.	Wiesenbach	Paul	R	14-Feb-1966	615	897-4358
109	Mr.	Smith	George	K	18-Jun-1961	901	504-3339
110	Mrs.	Genkazi	Leighla	W	19-May-1970	901	569-0093
111	Mr.	Washington	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.	Serenda	Hermine	R	25-Jul-1972	615	324-5505
116	Mr.	Smith	George	A	08-Nov-1985	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
33889	LaGrande	George		Pediatrics
34409	Washington	Dennis	F	Orthopaedics
36221	McPherson	Katya	H	Dermatology
36712	Dreifag	Herman	G	Psychiatry
38995	Minh	Tran		Neurology
40004	Chin	Ming	D	Orthopaedics
40026	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

SOURCE: Course Technology/Cengage Learning

Recursive Relationships

- Relationship can exist between occurrences of the same entity set
  - Naturally found within unary relationship

FIGURE 7.19 Another unary relationship: "PART contains PART"

Table name: PART_V1 Database name: CH07_PartCo

PART_CODE	PART_DESCRIPTION	PART_IN_STOCK	PART_UNITS_NEEDED	PART_OF_PART
AA21-6	2.5 cm. washer, 1.0 mm. rim	432	4	C-130
AB-121	Cotter pin, copper	1034	2	C-130
C-130	Rotor assembly	36		
E129	2.5 cm. steel shank	128	1	C-130
X10	10.25 cm. rotor blade	345	4	C-130
X34AW	2.5 cm. hex nut	879	2	C-130

SOURCE: Course Technology/Cengage Learning

FIGURE 7.20 Implementation of the M:N recursive relationship "PART contains PART"

Table name: COMPONENT

Database name: Ch07_PartCo

COMP_CODE	PART_CODE	COMP_PARTS_NEEDED
C-130	AA21-6	4
C-130	AB-121	2
C-130	E129	1
C-131A2	E129	1
C-130	X10	4
C-131A2	X10	1
C-130	X34AW	2
C-131A2	X34AW	2

Table name: PART

PART_CODE	PART_DESCRIPTION	PART_IN_STOCK
AA21-6	2.5 cm. washer, 1.0 mm. rim	432
AB-121	Cotter pin, copper	1034
C-130	Rotor assembly	36
E129	2.5 cm. steel shank	128
X10	10.25 cm. rotor blade	345
X34AW	2.5 cm. hex nut	879

SOURCE: Course Technology/Cengage Learning

FIGURE 7.22 Implementation of the 1:M recursive relationship "EMPLOYEE manages EMPLOYEE"

Database name: Ch07_PartCo

Table name: EMPLOYEE_V2

EMP_CODE	EMP_LNAME	EMP_MANAGER
101	Waddell	102
102	Orinccna	
103	Jones	102
104	Rebalioh	102
105	Robertson	102
106	Deltona	102

SOURCE: Course Technology/Cengage Learning

Associative (Composite) Entities

- Also known as bridge entities
- Used to implement M:N relationships
- Composed of primary keys of each of the entities to be connected
- May also contain additional attributes that play no role in connective process

FIGURE 7.23 Converting the M:N relationship into two 1:M relationships

Table name: STUDENT — **Database name: Ch07_CollegeTry**

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Table name: ENROLL

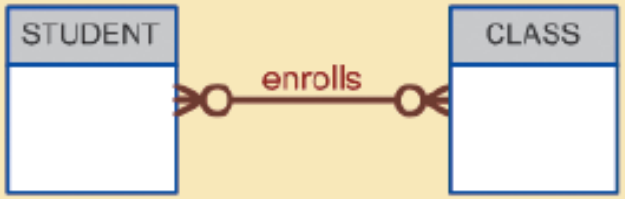
CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

Table name: CLASS

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	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

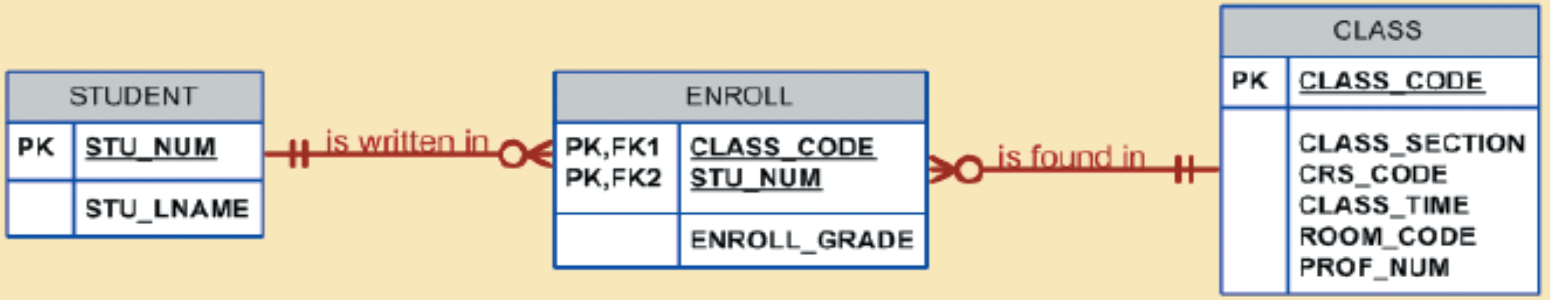
SOURCE: Course Technology/Cengage Learning

FIGURE 7.24 The M:N relationship between STUDENT and CLASS



SOURCE: Course Technology/Cengage Learning

FIGURE 7.25 A composite entity in an ERD

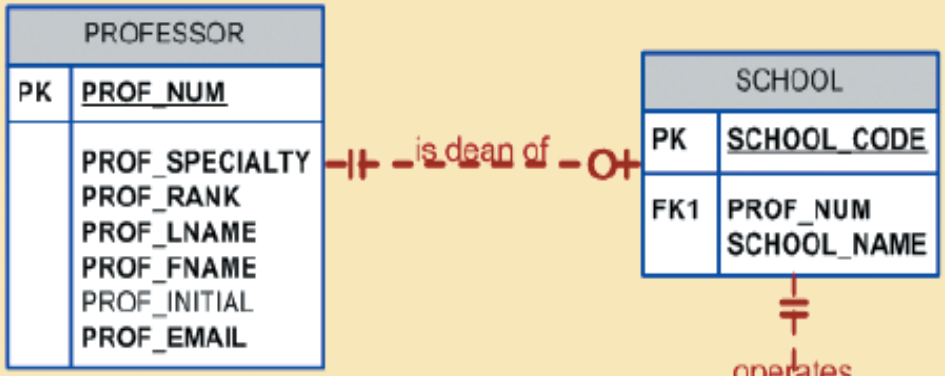


SOURCE: Course Technology/Cengage Learning

Developing an ER Diagram

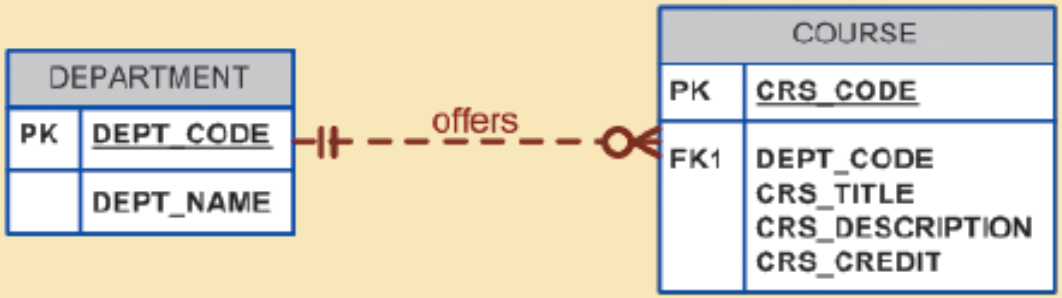
- Database design is an iterative process
  - Create detailed narrative of organization's description of operations
  - Identify business rules based on description of operations
  - Identify main entities and relationships from business rules
  - Develop initial ERD
  - Identify attributes and primary keys that adequately describe entities
  - Revise and review ERD

FIGURE 7.26 The first Tiny College ERD segment



SOURCE: Course Technology/Cengage Learning

FIGURE 7.27 The second Tiny College ERD segment

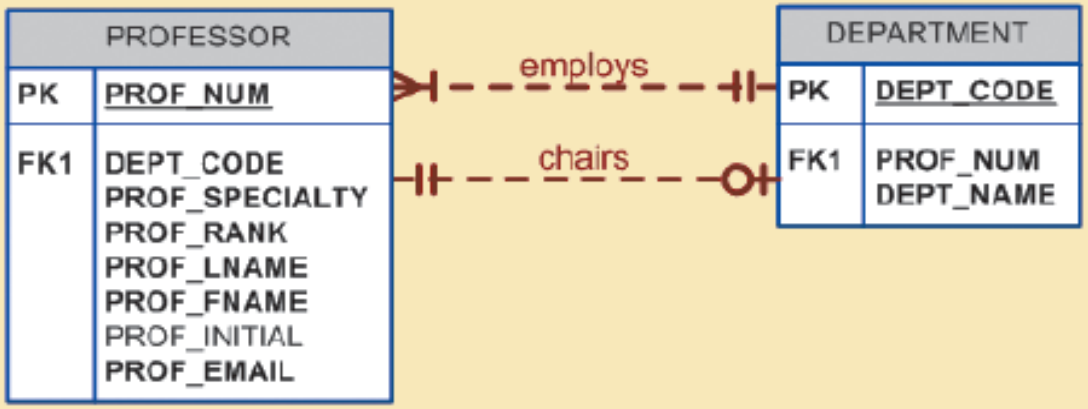


SOURCE: Course Technology/Cengage Learning

FIGURE 7.28 The third Tiny College ERD segment

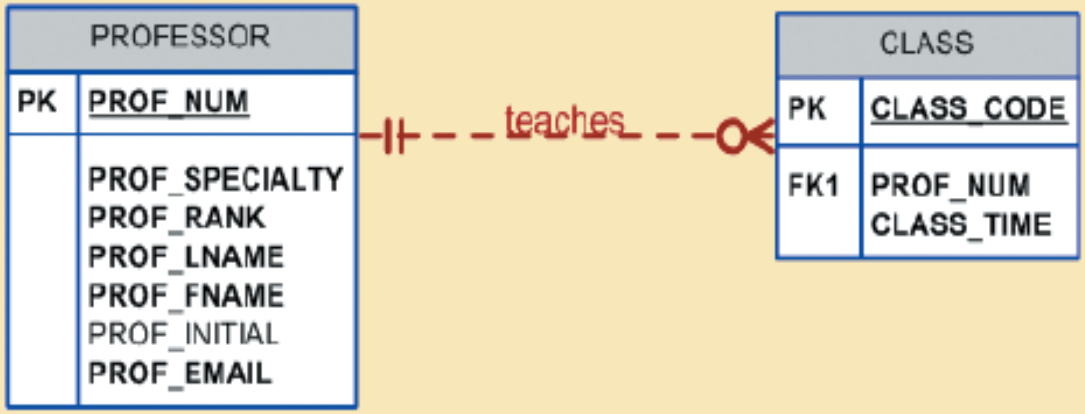
SOURCE: Course Technology/Cengage Learning

FIGURE 7.29 The fourth Tiny College ERD segment



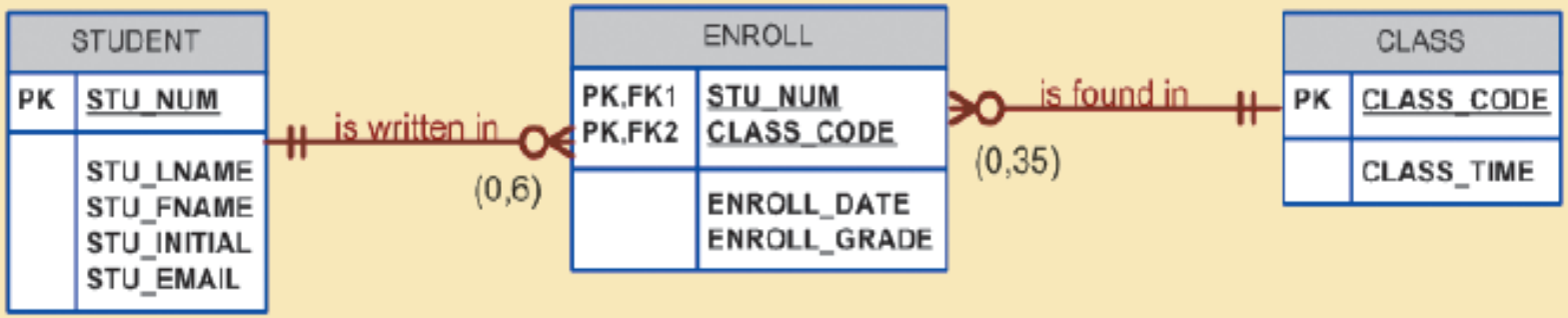
SOURCE: Course Technology/Cengage Learning

FIGURE 7.30 The fifth Tiny College ERD segment



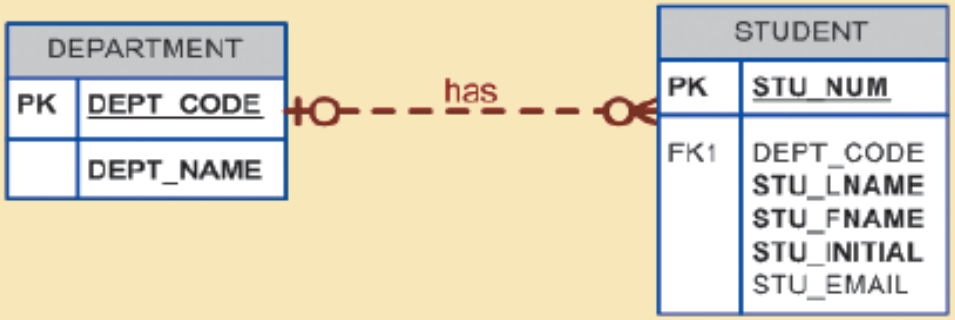
SOURCE: Course Technology/Cengage Learning

FIGURE 7.31 The sixth Tiny College ERD segment



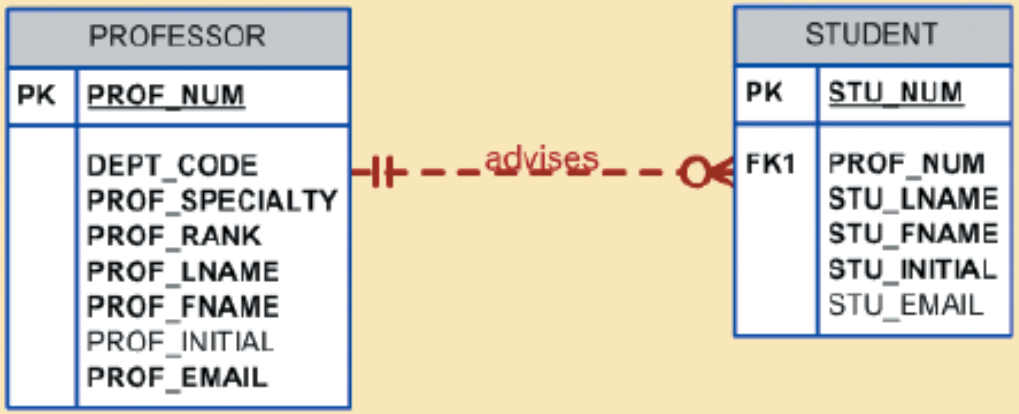
SOURCE: Course Technology/Cengage Learning

FIGURE 7.32 The seventh Tiny College ERD segment



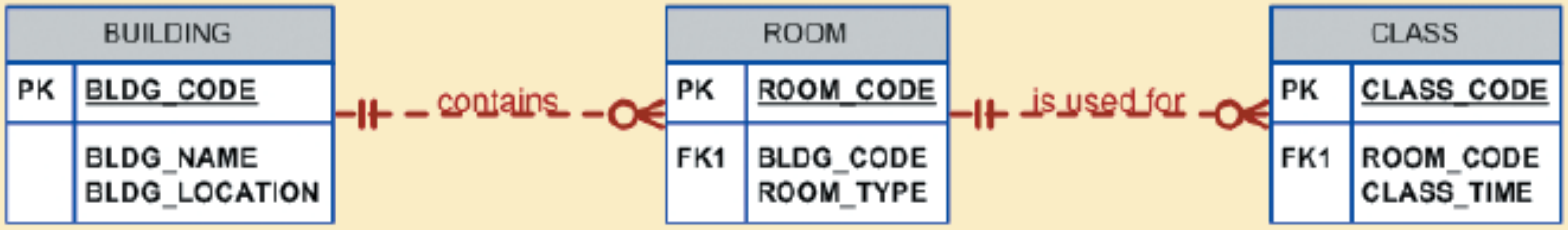
SOURCE: Course Technology/Cengage Learning

FIGURE 7.33 The eighth Tiny College ERD segment



SOURCE: Course Technology/Cengage Learning

FIGURE 7.34 The ninth Tiny College ERD segment



SOURCE: Course Technology/Cengage Learning

TABLE 7.4 **Components of the ERM**

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 dean of	1:1	SCHOOL
PROFESSOR	chairs	1:1	DEPARTMENT
PROFESSOR	teaches	1:M	CLASS
PROFESSOR	advises	1:M	STUDENT
STUDENT	enrolls in	M:N	CLASS
BUILDING	contains	1:M	ROOM
ROOM	is used for	1:M	CLASS

Note: ENROLL is the composite entity that implements the M:N relationship "STUDENT enrolls in CLASS."

Database Design Challenges: Conflicting Goals

- Database designers must make design compromises
  - Conflicting goals: design standards, processing speed, information requirements
- Important to meet logical requirements and design conventions
- Design is of little value unless it delivers all specified query and reporting requirements
- Some design and implementation problems do not yield “clean” solutions

FIGURE 7.38 Various implementations of the 1:1 recursive relationship

Table name: EMPLOYEE_V1 — **Database name: Ch07_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

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

Table name: MARRIAGE

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

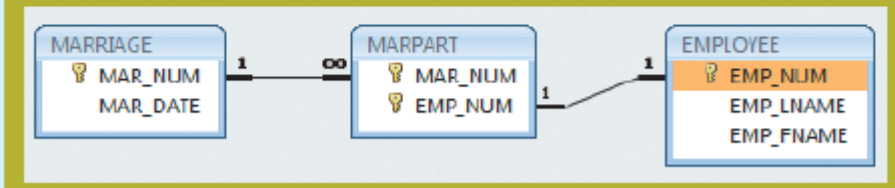
Table name: MARPART

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 diagram for the third implementation



Third implementation

SOURCE: Course Technology/Cengage Learning

Summary

- Entity relationship (ER) model
  - Uses ERD to represent conceptual database as viewed by end user
  - ERM's main components:
    - Entities
    - Relationships
    - Attributes
  - Includes connectivity and cardinality notations

Summary (cont'd.)

- Connectivities and cardinalities are based on business rules
- M:N relationship is valid at conceptual level
  - Must be mapped to a set of 1:M relationships
- ERDs may be based on many different ERMs
- UML class diagrams are used to represent the static data structures in a data model
- Database designers are often forced to make design compromises