

Previously...

## The Relational Data Model

Relation or Entity Set - A table of related entity occurrences

Tuple or row - the set of attributes for a single occurrence

Primary Key - uniquely identifies each tuple. No Nulls.

Foreign Key - links a table to the PK of another table

Relational Algebra

Select, Project, Join

Intersect, Union, Difference

Product, Divide

Relationships

1:1, 1:M, M:N

Represented in an Entity Relationship Diagram (ERD)

1:M is used frequently in good design

# Inner Join

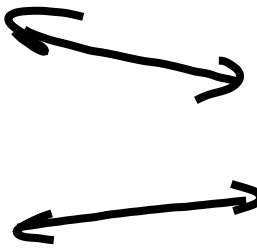
on s.sid = g.sid

S *pk*

sid	name	age
1	Joe	11
2	Sally	22
3	Jim	28

G *FK* *pk*

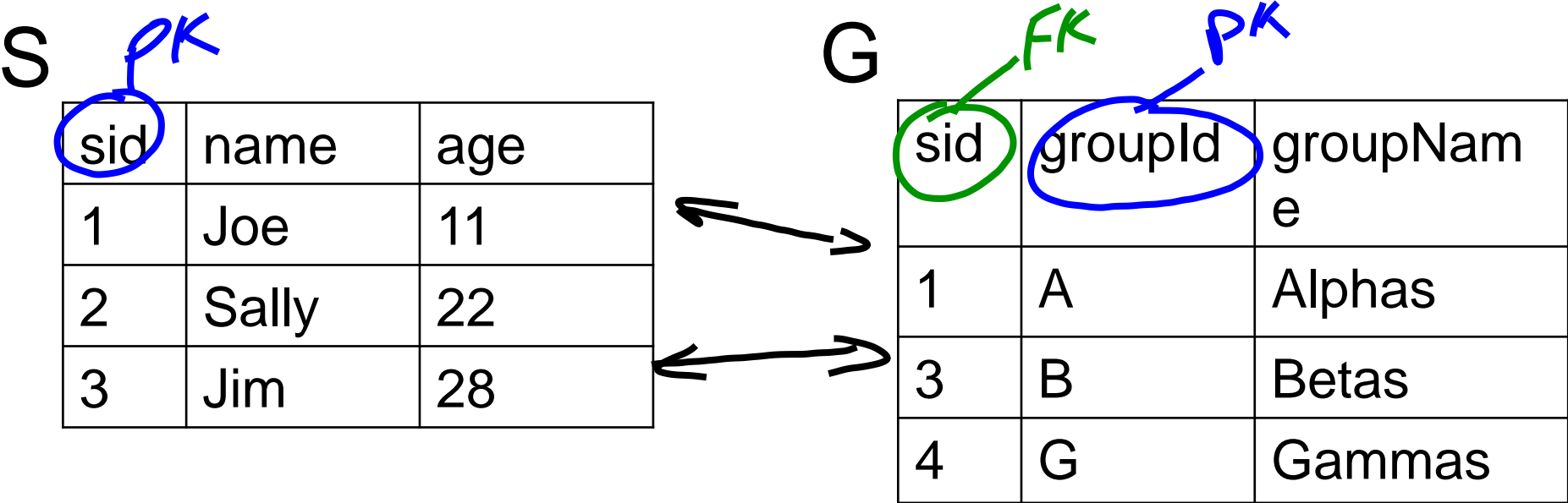
sid	groupId	groupName
1	A	Alphas
3	B	Betas
	G	Gammas



s.sid	s.name	s.age	g.sid	g.groupId	g.groupName
1	Joe	11	1	A	Alphas
3	Jim	28	3	B	Betas

# Left Outer Join

on s.sid = g.sid



s.sid	s.name	s.age	g.sid	g.groupId	g.groupName
1	Joe	11	1	A	Alphas
2	Sally	22			
3	Jim	28	3	B	Betas

# Left Outer Join on s.sid = c.sid

S

sid	name
1	Joe
2	Sally
3	Jim

C

cid	sid	grade
1163	1	B+
1158	1	B
1156	1	C
1163	2	A



s.sid	s.name	c.cid	c.sid	c.grade
1	Joe	1163	1	B+
1	Joe	1158	1	B
1	Joe	1156	1	C
2	Sally	1163	2	A
3	Jim			

# Right Outer Join

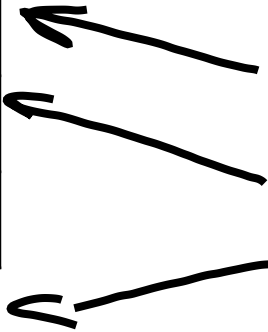
on s.sid = g.sid

S

sid	name	age
1	Joe	11
2	Sally	22
3	Jim	28

G

sid	groupId	groupName
1	A	Alphas
2	B	Betas
	G	Gammas



s.sid	s.name	s.age	g.sid	g.groupId	g.groupName
1	Joe	11	1	A	Alphas
2	Sally	22	2	B	Betas
				G	GAMMAS

And now...

# Entity Relationship Modelling

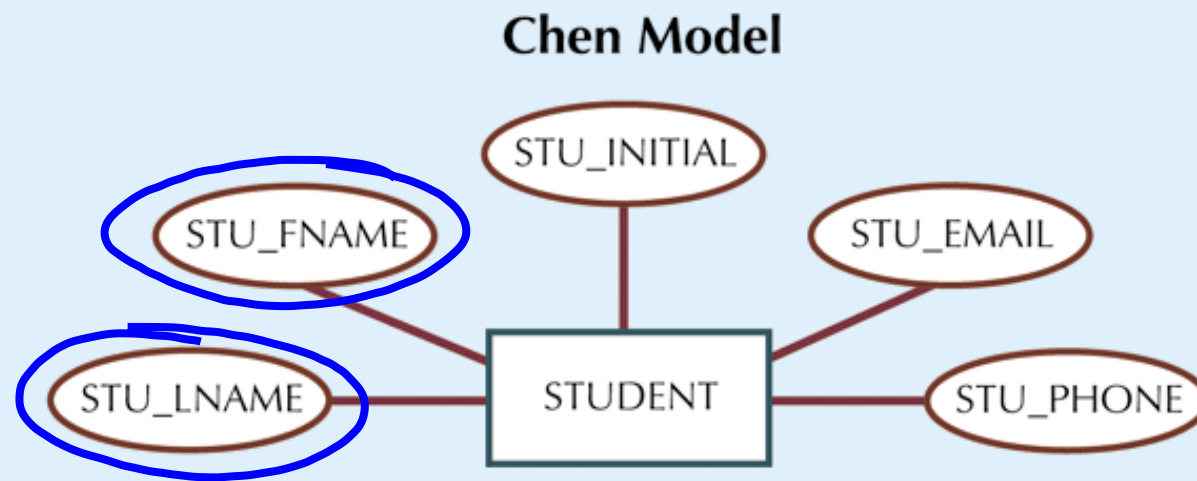
## Objectives

- Understand and create Entity Relationship Diagrams
- Correctly use cardinality and connectivity
- Create composite entities to remove M:N relationships

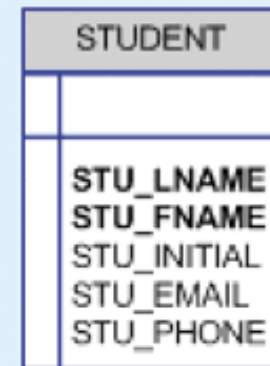
# Some Tools

**FIGURE 4.1**

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



**Crow's Foot Model**



SOURCE: Course Technology/Cengage Learning



# Attributes

Required vs. optional

Domain

The set of possible values for an attribute

Domains may be shared

Identifiers (Primary Keys)

TABLE [ key attribute1, attribute\_2, ..., attribute\_k ]

May be composite

May be simple or composite

age, sex, marital status

address, phone number

Single valued vs. Multi-valued

serial numbers

phones, full address (street, city, province, etc.)

— simple  
— composite

STUDENT [ sid, address, (phone) ]

key

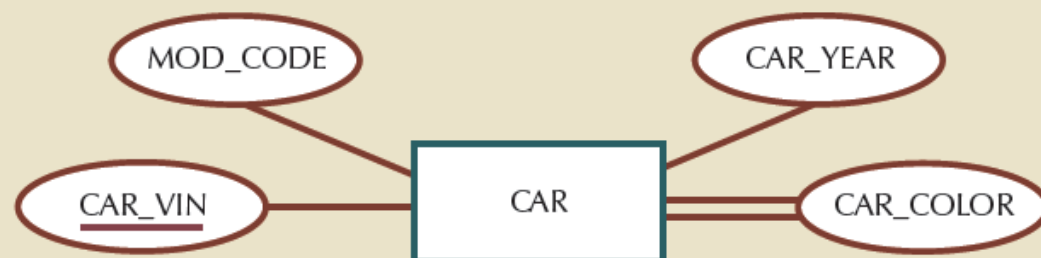
↑  
Composite

← Composite  
multi-valued

s0075425, 3000 College Dr. S, (403-320-3202, 403-555-1211)

FIGURE 4.3 A MULTIVALUED ATTRIBUTE IN AN ENTITY

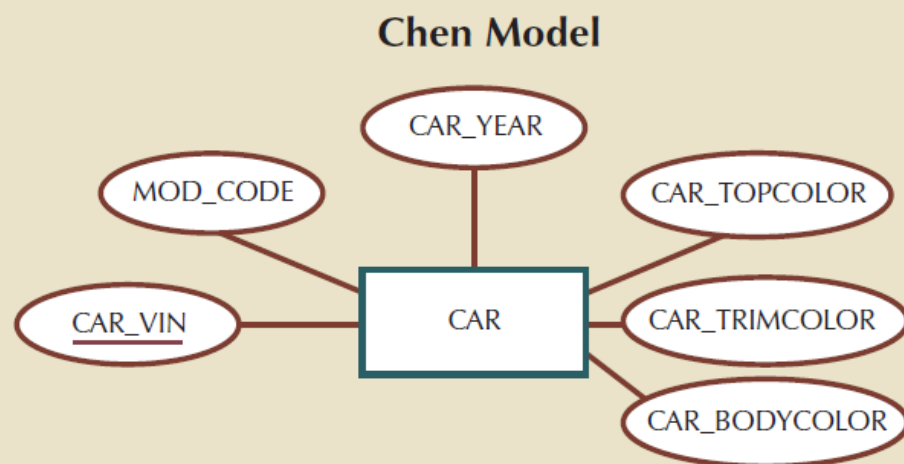
**Chen Model**



**Crow's Foot Model**

CAR	
PK	<u>CAR_VIN</u>
	MOD_CODE CAR_YEAR CAR_COLOR

FIGURE 4.4 SPLITTING THE MULTIVALUED ATTRIBUTE INTO NEW ATTRIBUTES



**Crow's Foot Model**

CAR	
PK	<u>CAR_VIN</u>
	MOD_CODE CAR_YEAR CAR_TOPCOLOR CAR_TRIMCOLOR CAR_BODYCOLOR

# Derived Attributes

Attributes calculated from other attributes

Examples?

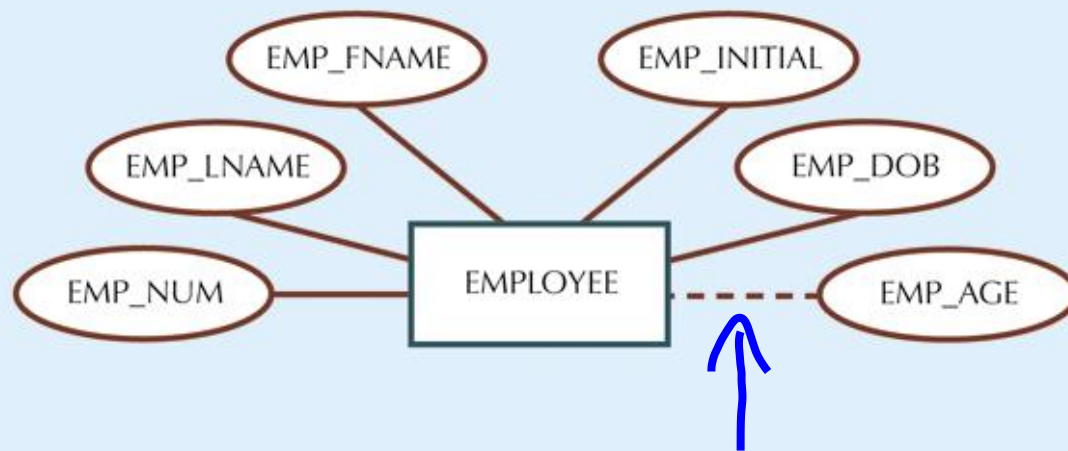
Age  $\leftarrow$  DOB

Cumulative GPA  $\leftarrow$  Avg of Set of Grades

**FIGURE  
4.6**

## Depiction of a derived attribute

### Chen Model



### Crow's Foot Model

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

*derived*

SOURCE: Course Technology/Cengage Learning

# Relationships

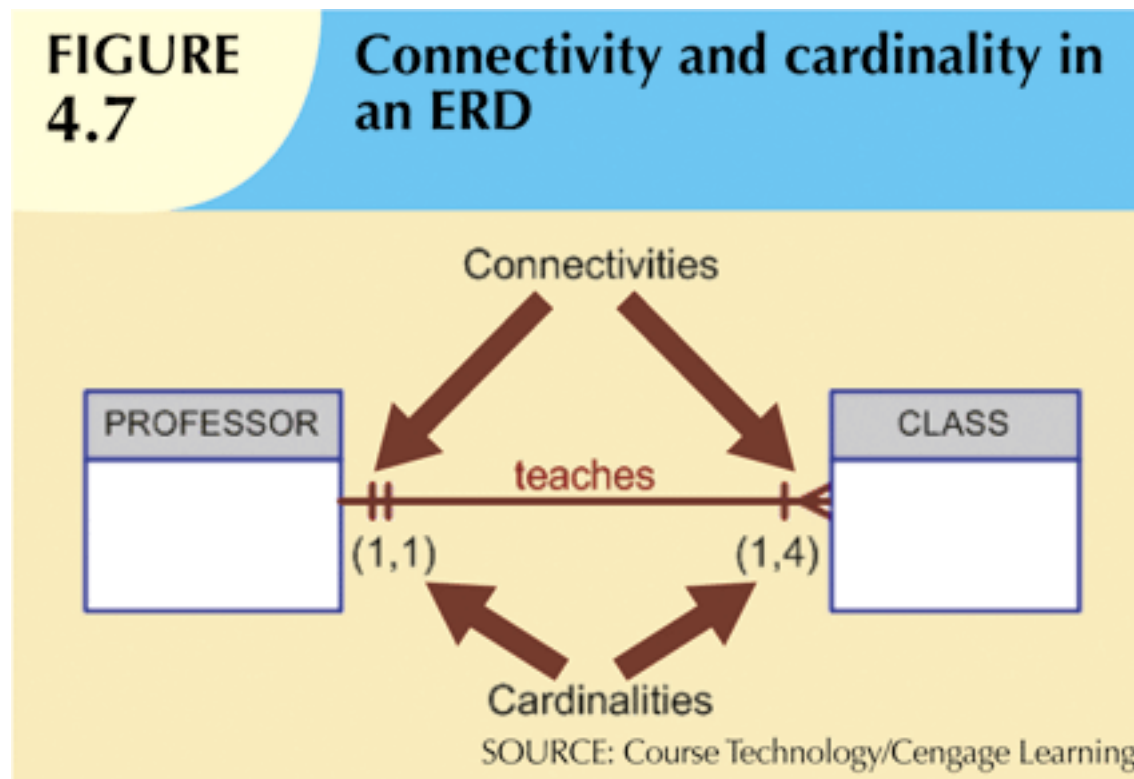
An association between entities

*Participants* are the entities in the relationship

The relationship name is a VERB

✓

**Connectivity** - the classification of the relationship between entities. (AKA **Modality**)  
**Cardinality** - the minimum and maximum number of entity occurrences associated with one occurrence of a related entity

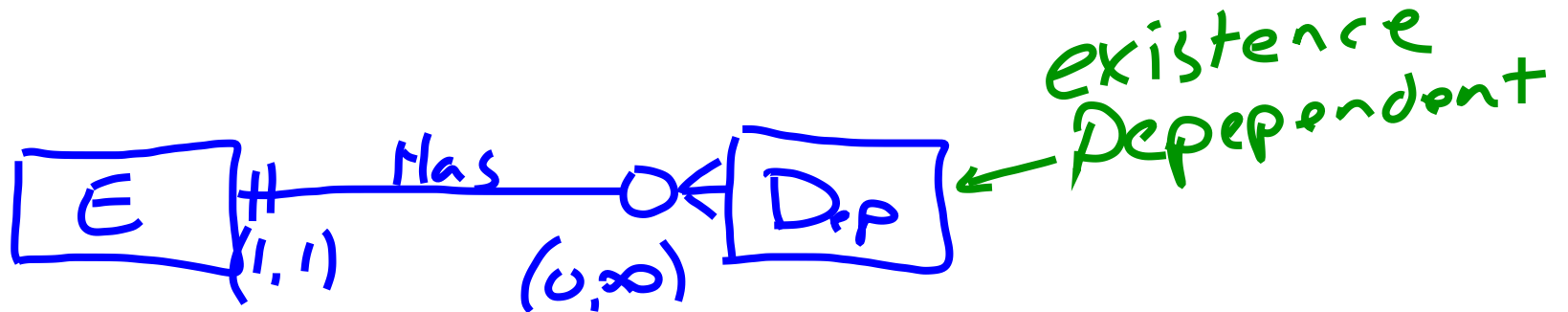


Connectivity and Cardinality are established by *business rules*



# Existence Dependence

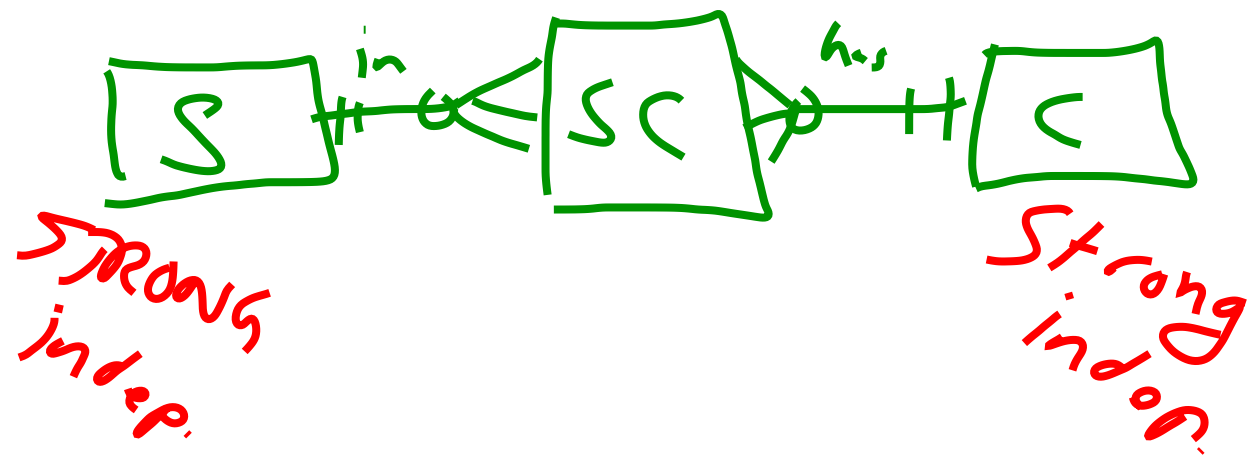
An entity is **existence-dependent** if it can only have an occurrence when related to another entity



An entity is **existence-independent** if it can have an occurrence without being related to another entity.

Strong Entity

Regular Entity



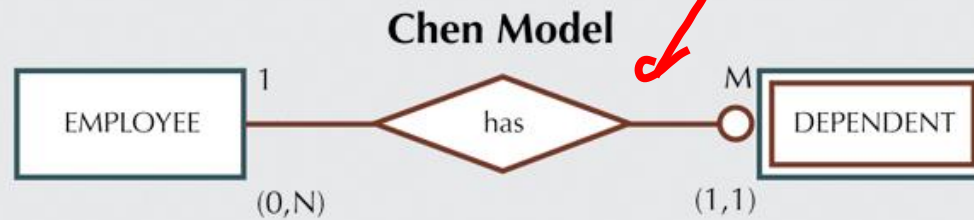
# Weak Entities

Existence-dependent

Strong dependence

FIGURE 4.10

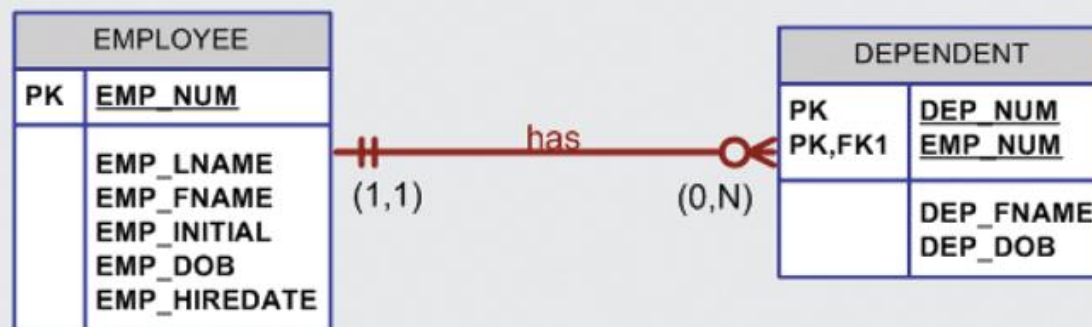
A weak entity in an ERD



EMP\_NUM  
EMP\_LNAME  
EMP\_FNAME  
EMP\_INITIAL  
EMP\_DOB  
EMP\_HIREDATE

EMP\_NUM  
DEP\_NUM  
DEP\_FNAME  
DEP\_DOB

**Crow's Foot Model**



SOURCE: Course Technology/Cengage Learning

# Relationship Strength

Weak (non-identifying) Relationship  
PK of the related entity does not contain a PK component of the parent

**FIGURE 4.8** A weak (non-identifying) relationship between COURSE and CLASS

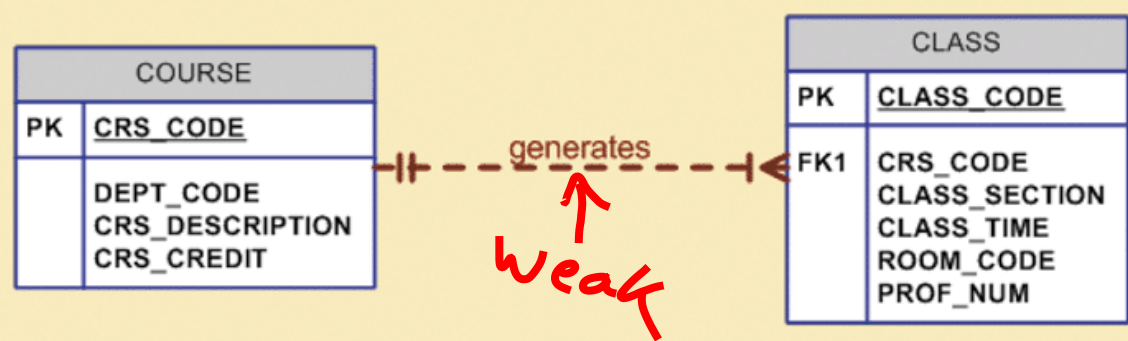


Table name: COURSE

Database name: Ch04\_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

# Relationship Strength

Strong (identifying) Relationship  
PK of the related entity contains a PK component of the parent

**FIGURE 4.9** A strong (identifying) relationship between COURSE and CLASS

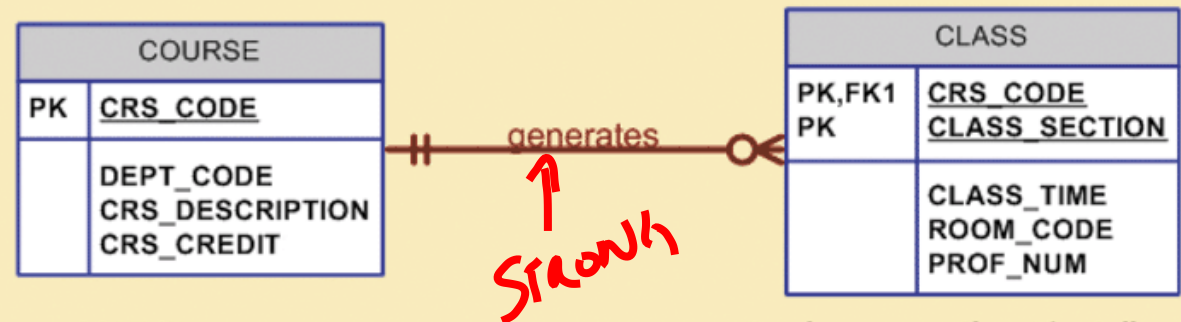


Table name: COURSE

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\_Alt

Table name: CLASS

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

# Relationship Participation

Optional Participation - minimum cardinality is 0

**FIGURE 4.12**

An optional CLASS entity in the relationship “PROFESSOR teaches CLASS”



SOURCE: Course Technology/Cengage Learning

Mandatory Participation - minimum cardinality is 1

**FIGURE 4.14**

COURSE and CLASS in a mandatory relationship



SOURCE: Course Technology/Cengage Learning

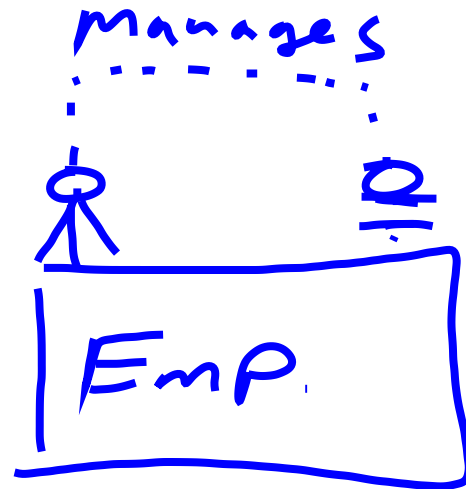
## Relationship Degree

Indicates the number of entities or participants associated with a relationship

**Unary relationship:** association is maintained within a single entity

recursive

e.g. An employee manages some employees



## Relationship Degree

Binary

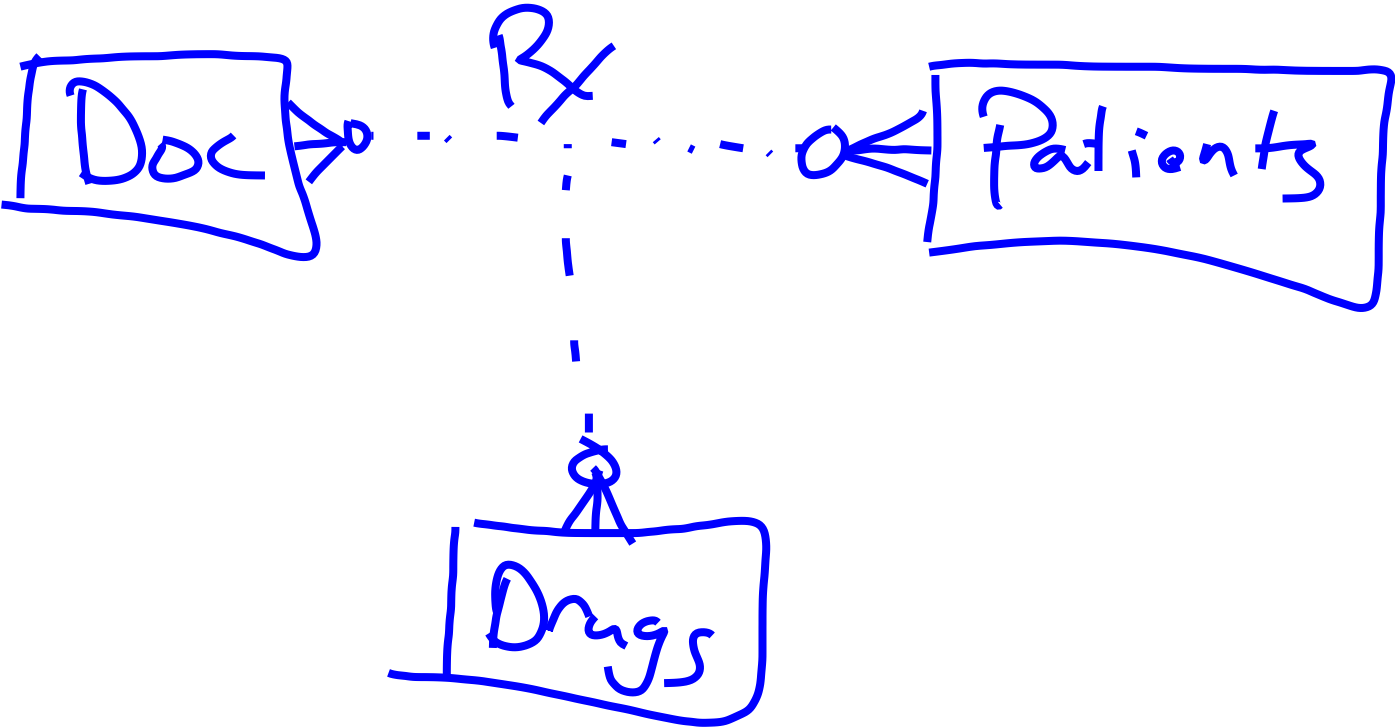
Between two entities

e.g. A professor teaches one or more classes



Relationship Degree

Ternary (or higher)  
Three (or more entities)  
Many doctors prescribe many drugs to many patients

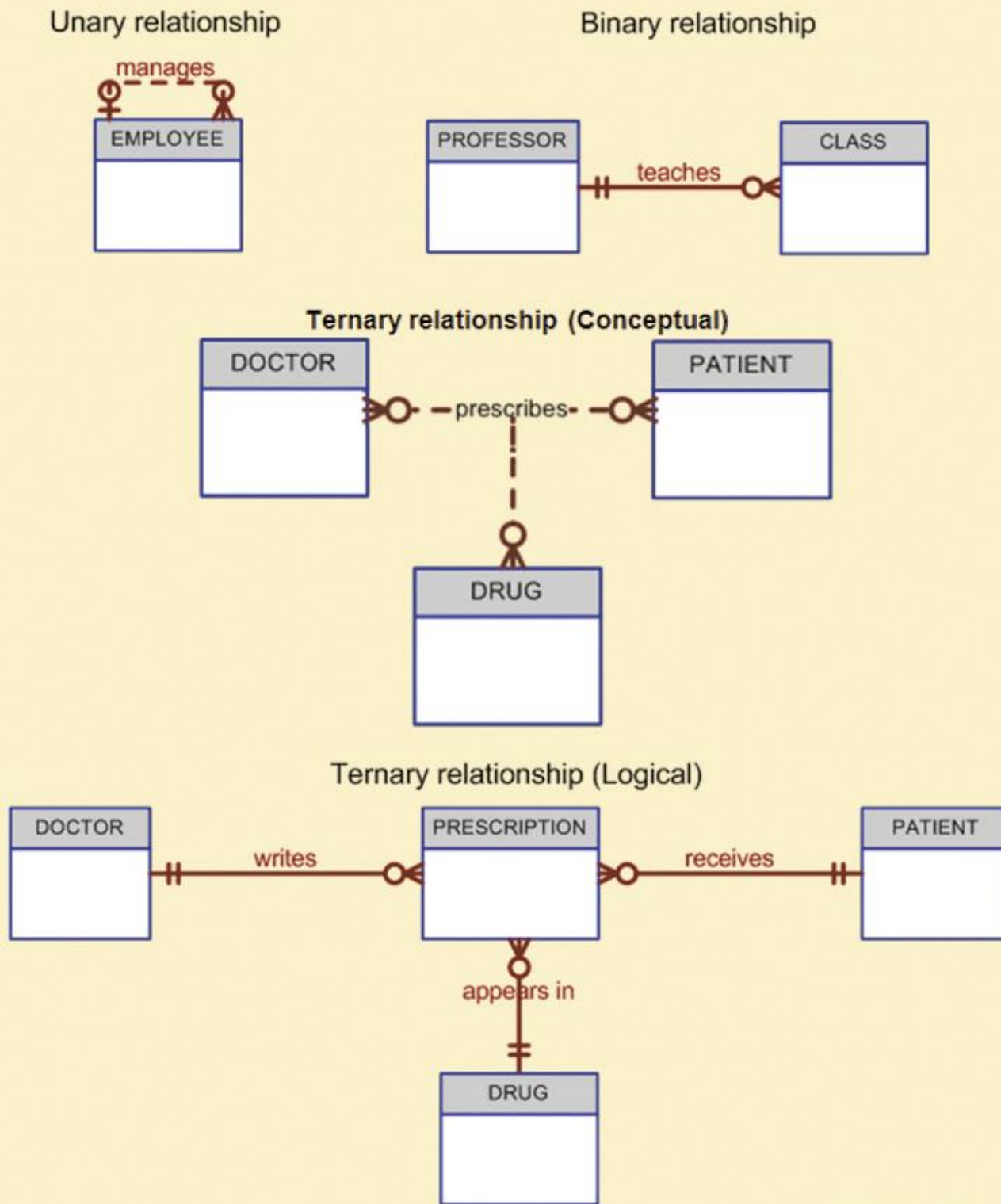




# Relationship Degree

**FIGURE 4.15**

**Three types of relationship degree**

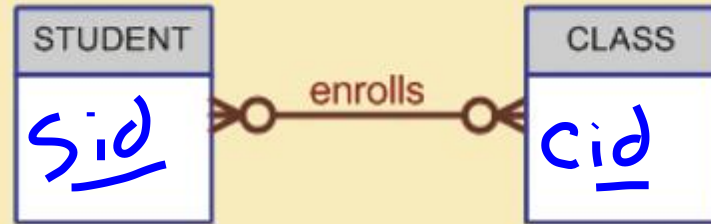


SOURCE: Course Technology/Cengage Learning

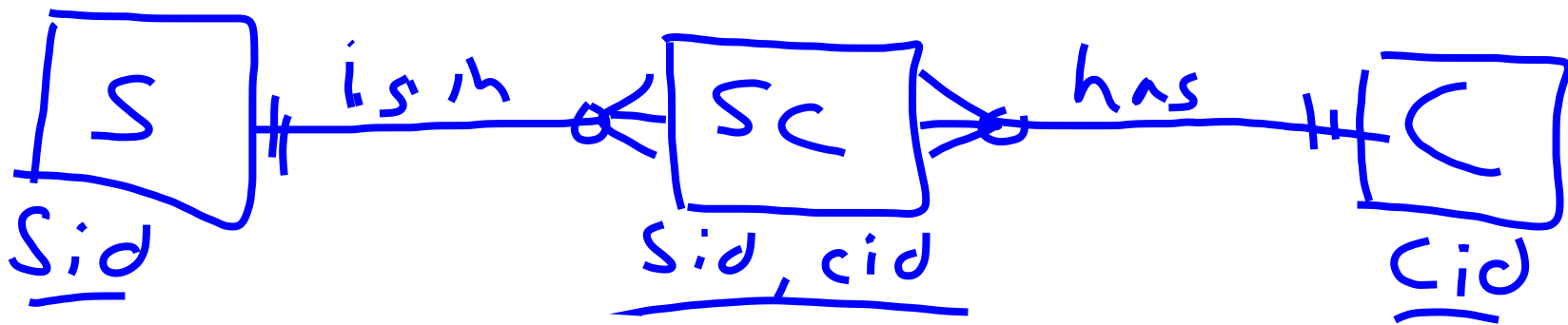
# Associative (Composite) Entities

FIGURE  
4.24

The M:N relationship between STUDENT and CLASS



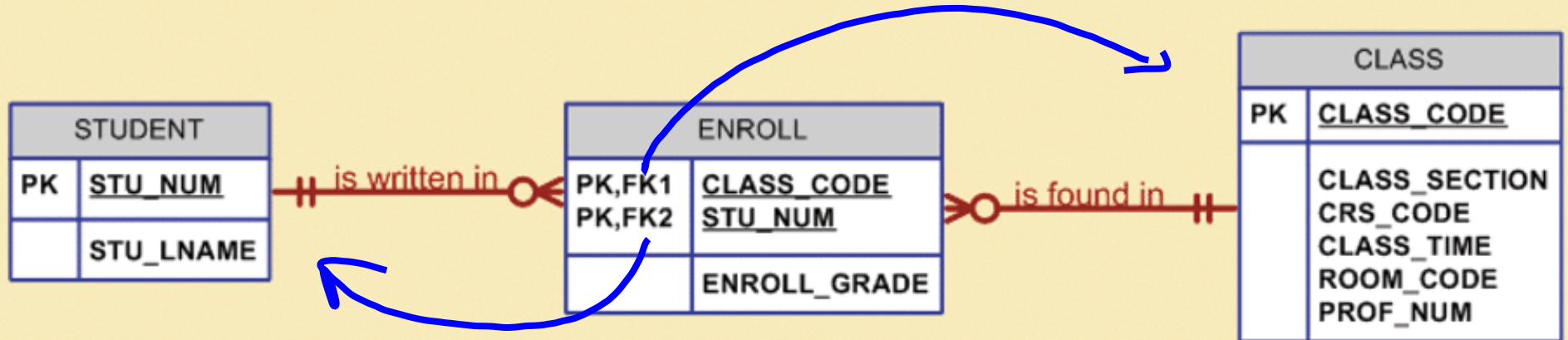
SOURCE: Course Technology/Cengage Learning



# Associative (Composite) Entities

FIGURE  
4.25

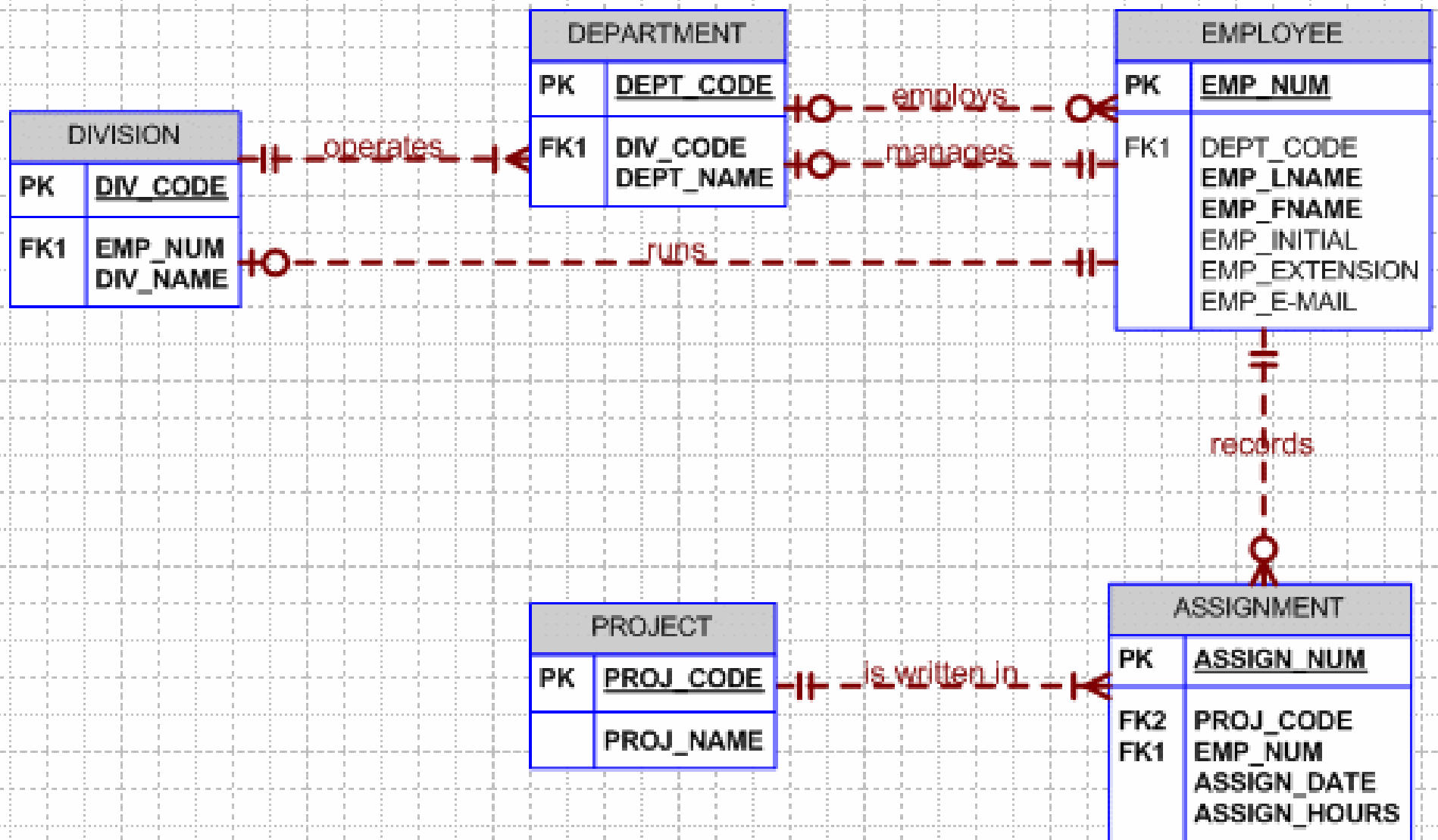
A composite entity in an ERD



SOURCE: Course Technology/Cengage Learning

## Page 154 - Problem 1 - Create the ERD

- A department employs many employees, but each employee is employed by only one department
- Some employees, known as "rovers", are not assigned to any department
- A division operates many departments, but each department is operated by only one division
- An employee may be assigned to many projects, and a project may have many employees assigned to it
- A project must have at least one employee assigned to it
- One of the employees manages each department, and each department is managed by only one employee
- One of the employees runs each division, and each division is run by only one employee



# Thursday

Access Lab #2

Quiz Chapter 3