



Entity Relationship (E-R) Modeling

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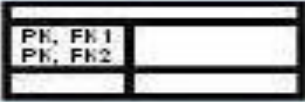
















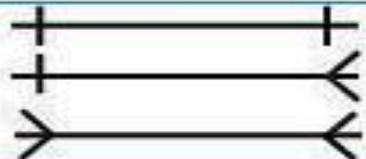
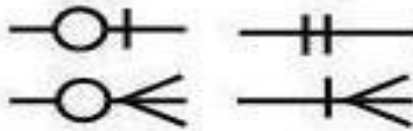
Instructional Objectives:

- ✚ How **relationships** between entities are defined and refined and how such relationships are incorporated into the database design process.
- ✚ How **ERD components** affect database design and implementation.



1) The Entity Relationship (E-R) Model

- ❖ Represent the **Conceptual View**.
- ❖ Main Components: **Entities, Attributes and Relationships**.
- ❖ Several types of **model** can be used to show the relationships between entities such as **Crow's Foot model, Chen model, Rein85 model and IDEF1X**.
- ❖ A comparison of **E-R Modeling Symbols** between **Crow's Foot** and **Chen models**:

	Crow's Foot model	Chen model
Entity		
Composite entity		
Weak entity		
Relationship line	(Strong)  (Weak) 	
Relationship		
Option symbol		
One (1) symbol		
One and only one (Mandatory)		
Many (M) symbol		
Connectivity is used to describe the relationship classification.		1:1 (one-to-one) 1:M (one-to-many) M:N (many-to-many)
Cardinality expresses the specific number of entity occurrences associated with one occurrence of the related entity.		(Min, Max) (0,1), (1,1), (0,N), (1,N), (0,4)

1.1) Entities

- ❖ Corresponds to entire table, not row.
- ❖ Represented by rectangle.
- ❖ Entity name is a noun and usually written in capital letters.
- ❖ A specific table row is called **entity instance** or **entity occurrence**.

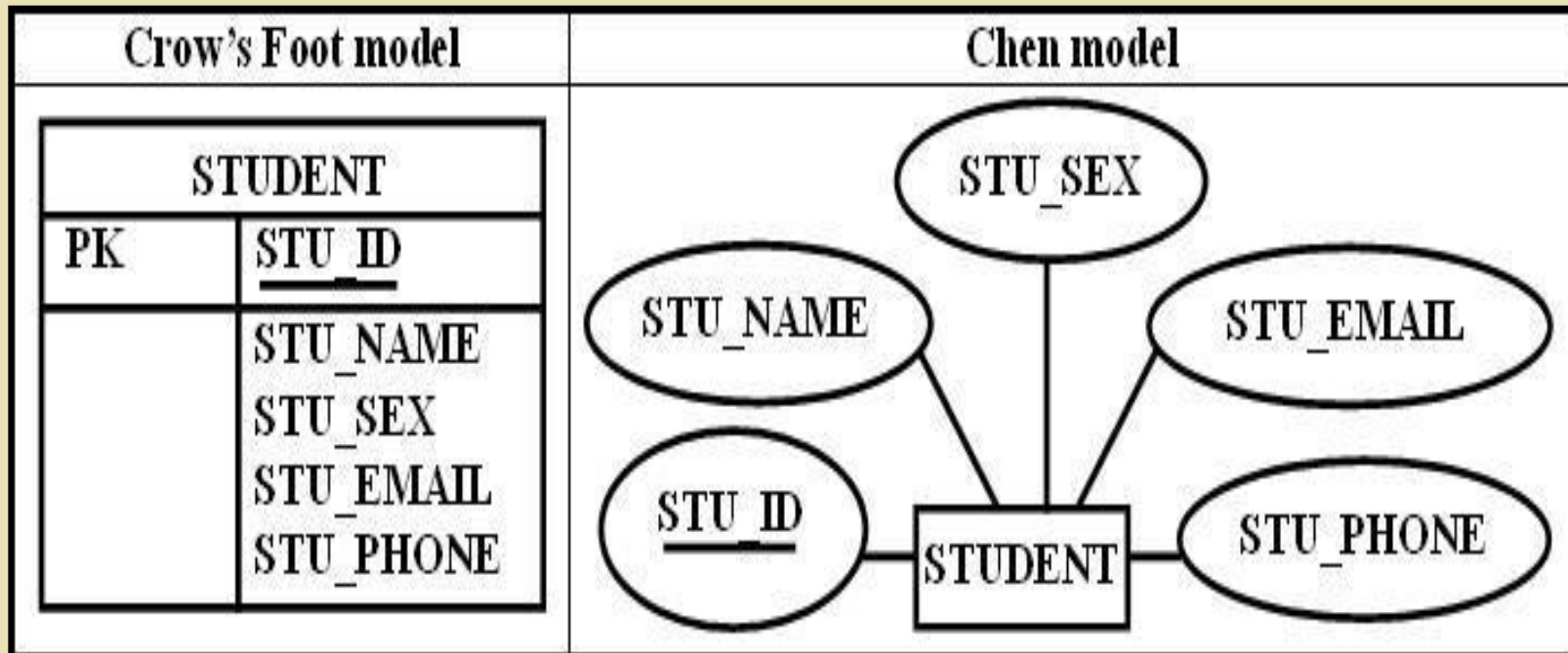
Entity Name : CUSTOMER
Entity Instance: 6

Table name: CUSTOMER

	CUS_CODE	CUS_LNAME	CUS_ZIP	AGENT_CODE
▶	132445	Walker	32145	231
	1217782	Adares	32145	125
	1312243	Rakowski	34129	167
	1321242	Rodriguez	37134	125
	1542311	Smithson	37134	
	1657399	Varloo	32145	231

1.2) Attributes

- ✚ **Characteristics** of entities, e.g., STU_NAME, STU_SEX, STU_EMAIL, STU_PHONE.
- ✚ **Domain** is set of possible values, e.g., M or F for attribute STU_SEX.
- ✚ **Primary keys** underlined.





Types Of Attributes

Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

1. Composite Attributes

- ❖ An attribute that can be further subdivided to yield additional attributes.
- ❖ E.g., attribute **ADDRESS** can be subdivided into street, area, postcode, city and state.
- ❖ E.g., **PHONE_NUMER** can be subdivided into area_code and exchange number.



Types Of Attributes

Types:

1. Composite Attributes

2. Simple Attributes


3. Single-valued Attributes

4. Multivalued Attributes

5. Derived Attributes

2. Simple Attributes / Atomic Attributes

- ❖ An attribute that cannot be subdivided.
- ❖ E.g., sex, age, marital status.
- ❖ E.g., Street, Area, Postcode, City and State.
(Components of Address)



NOTE: To facilitate detailed queries, it is usually appropriate to change composite attribute into a series of simple attributes.

Types Of Attributes

Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

3. Single-valued Attributes

- ❖ An attribute that can have only a single value.
- ❖ E.g., student ID, date of birth.

NOTE: Single-valued attribute not necessary a simple attribute.

E.g., STUDENT_ID → 06JAD88888

(06 = year of enrollment, J = Johor branch, A = SAS, D=Diploma and 88888 = Student Number.)

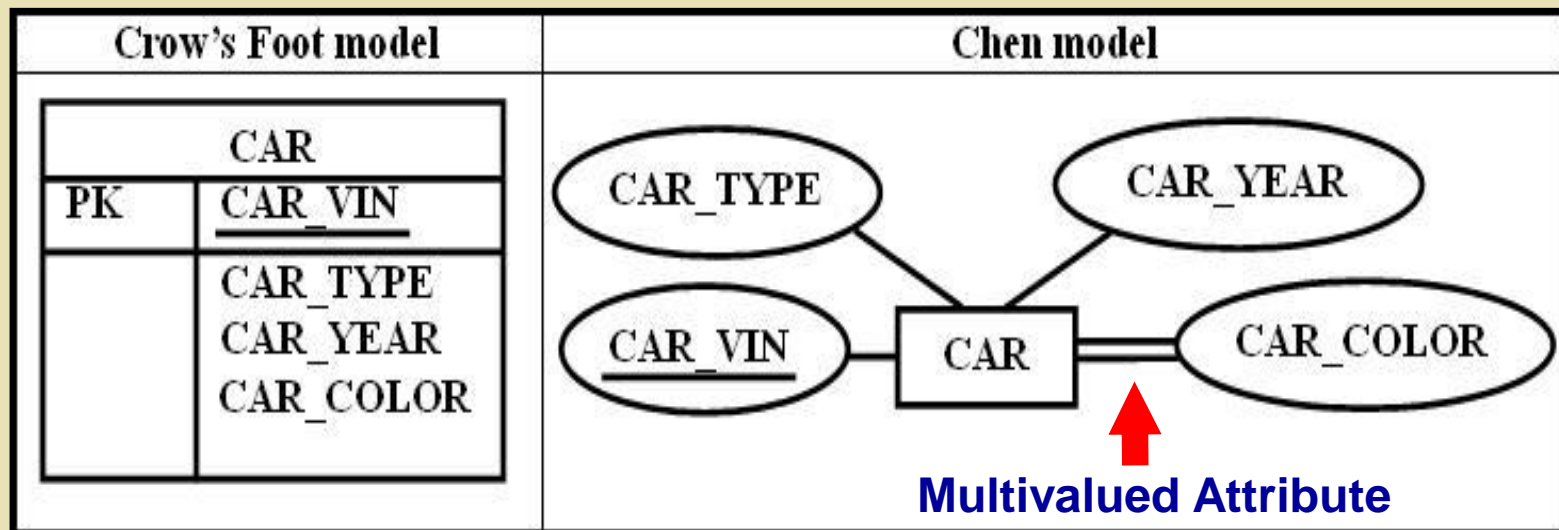
Types Of Attributes

Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

4. Multivalued Attributes

- ❖ An attribute that can have many values.
- ❖ E.g., An **employee** may have **different phone numbers**.
- ❖ A **car** may have **many colors**.



NOTE: VIN = Vehicle Identification Number

Types Of Attributes

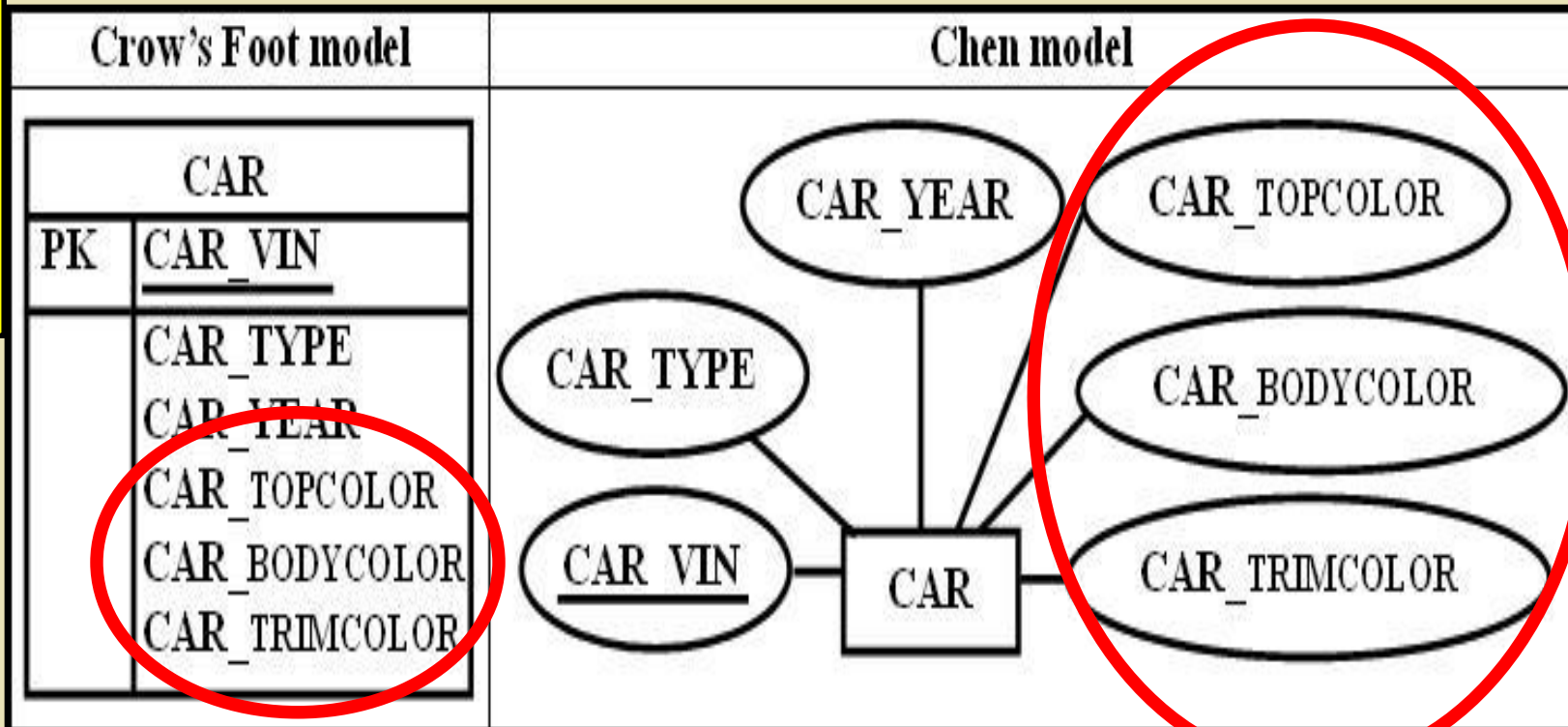
Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

NOTE: Do not implement the multivalued attributes in the relational DBMS.

Two Solutions:

A) Splitting a Multivalued Attributes.



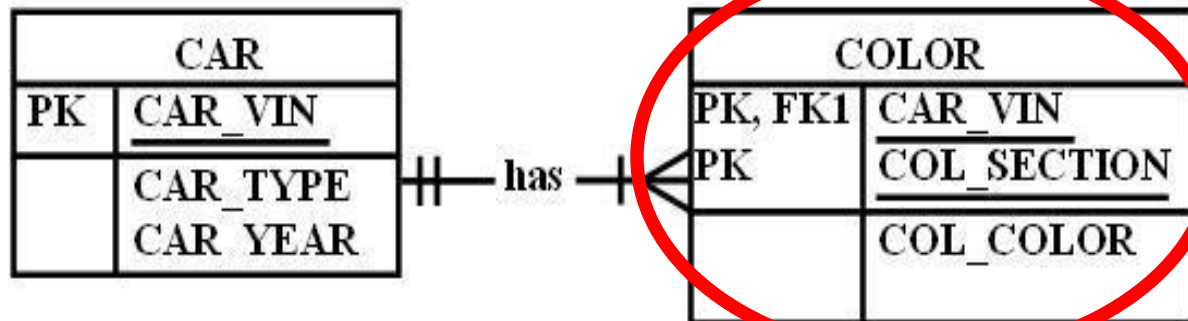
Types Of Attributes

Types:

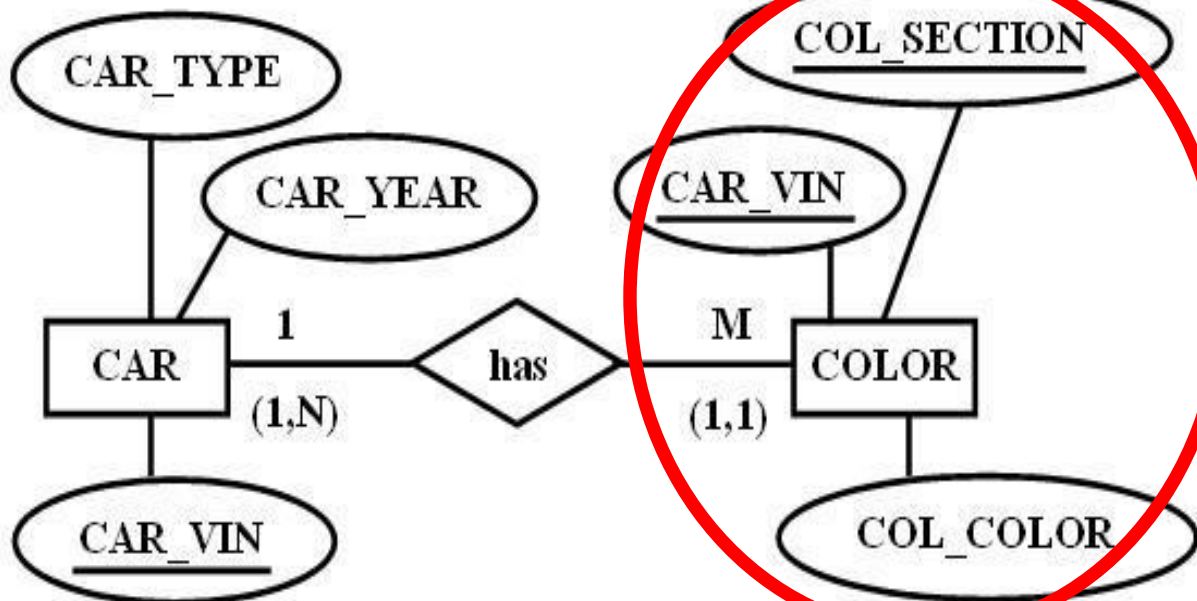
1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

B) Create New ENTITY SET from Multivalued Attributes.

Crow's Foot model



Chen model



SECTION	COLOR
Top	Black
Body	Yellow
Trim	Black

Types Of Attributes

Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

5. Derived Attributes

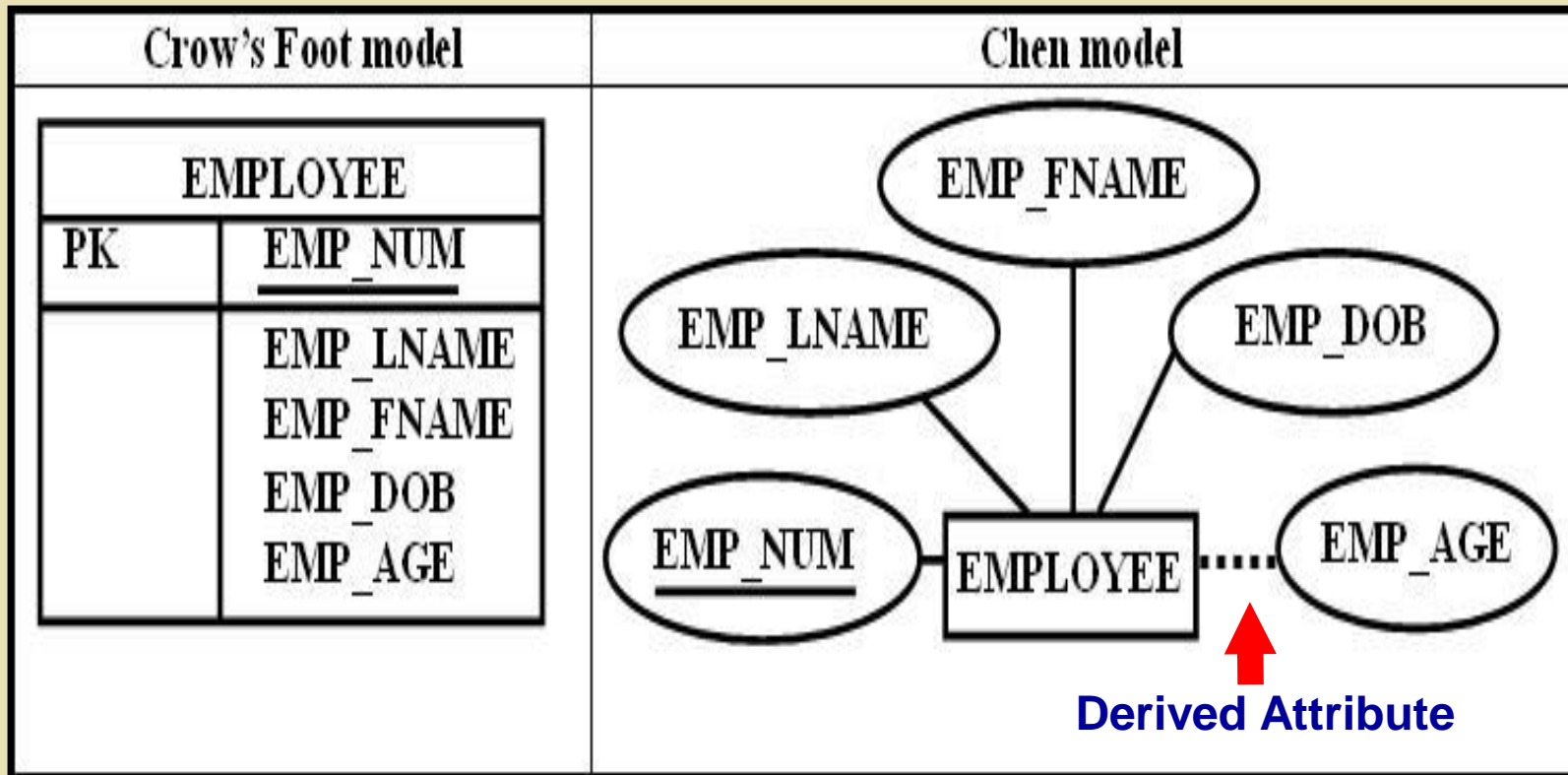
- ❖ An attribute whose value is **computed / calculated** (derived) from another attributes.
- ❖ Derived attributes need not to be physically stored in database.
- ❖ Can be derived by using an algorithm.
- ❖ E.g., TOTAL derived from multiplying QUANTITY and UNIT PRICE.

Types Of Attributes

Types:

1. Composite Attributes
2. Simple Attributes
3. Single-valued Attributes
4. Multivalued Attributes
5. Derived Attributes

❖ E.g., an employee's age can be computed by subtracting the birth date from the current date.

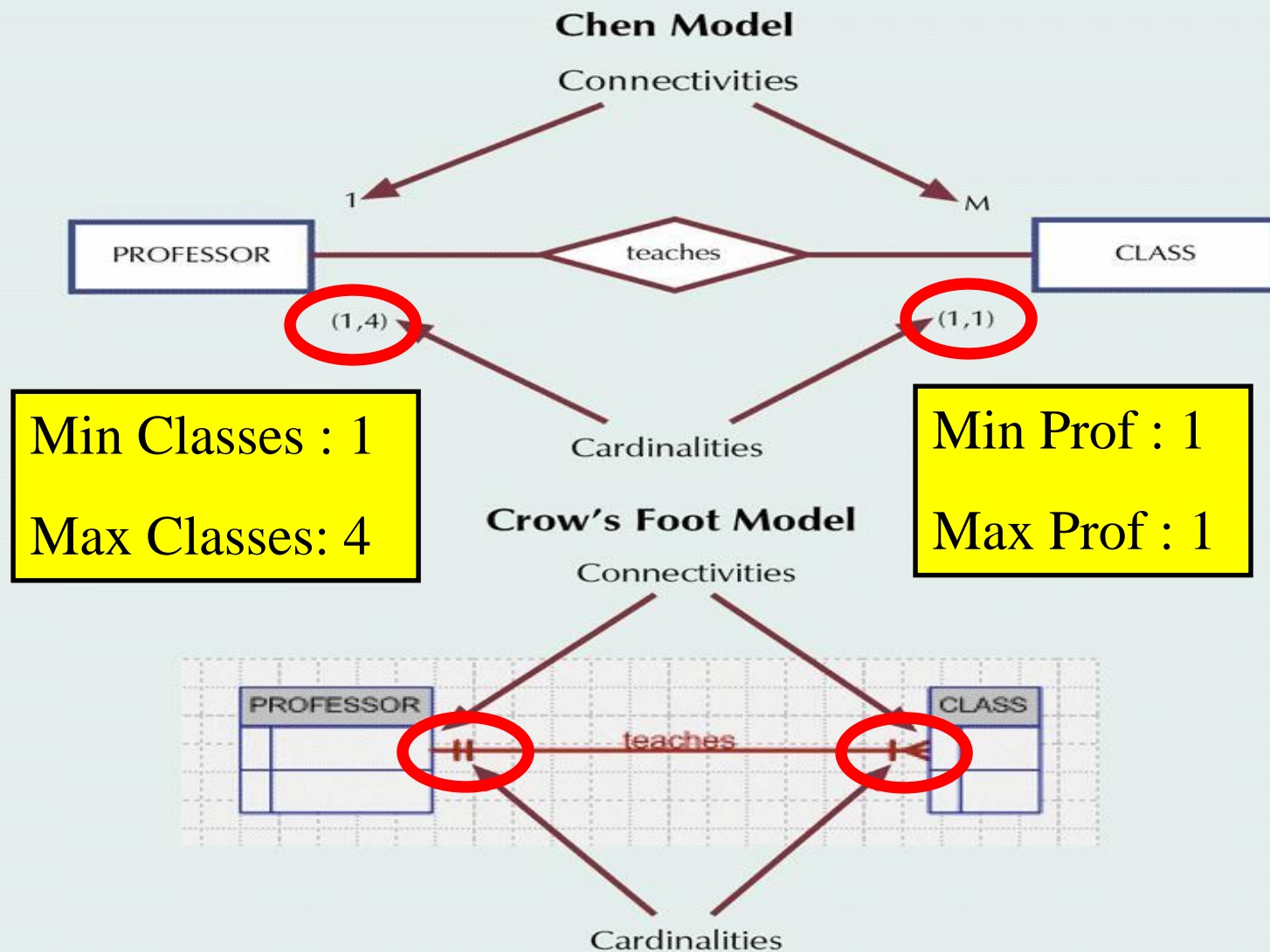


FORMULA: $\text{INT}((\text{DATE}() - \text{EMP_DOB}) / 365.25)$



1.3) Relationships

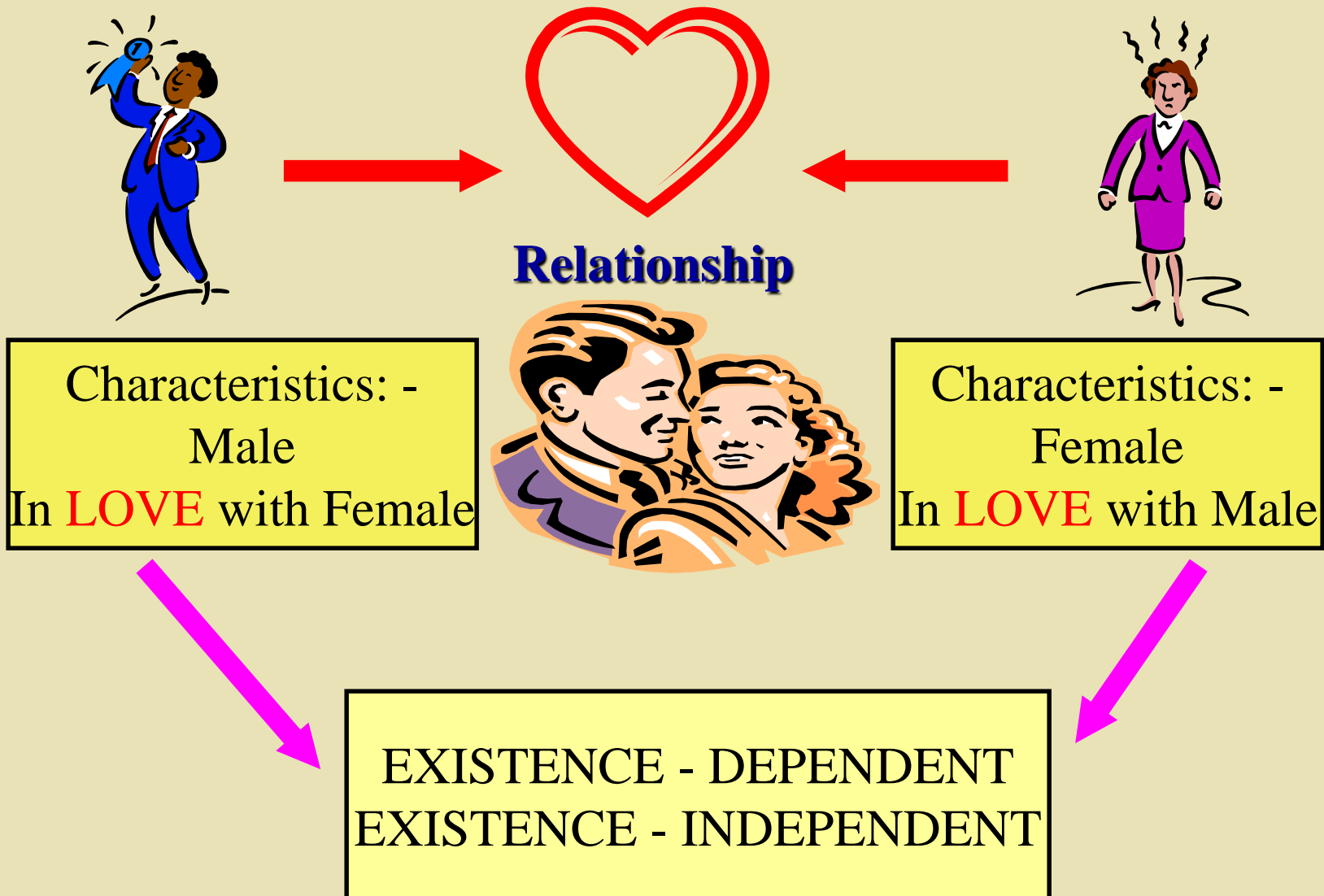
- ❖ An **association (linking)** between **entities**.
- ❖ **Entities** that **participate in a relationship** are called **participants**.
- ❖ **Relationship name** is an active or a passive verb operate in both directions, e.g., a CUSTOMER may **generate** many INVOICES; each INVOICE is **generated** by one CUSTOMER.
- ❖ **Connectivity** describes relationship classification: **1:1**, **1:M**, **M:N**
- ❖ **Cardinality** expresses number of entity occurrences associated with one occurrence of related entity.



Knowing MIN and MAX is useful : -

Example: Ensure classes can only be taught unless it has at least 10 students. Similarly, if a class can only hold 30 students, use cardinality to limit the enrollment of the class.

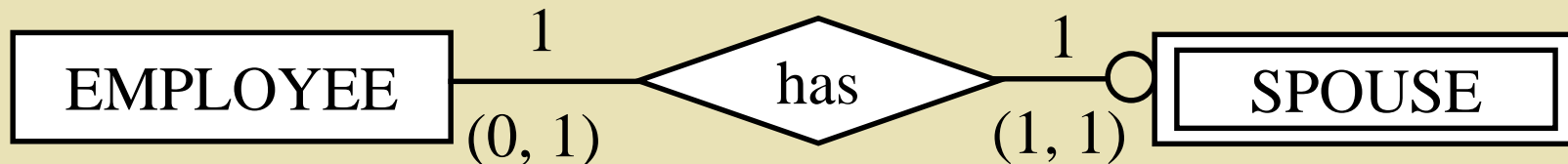
1.4) Relationship Strength



Relationship strength examines **how** existence dependence fits into the relationship framework.

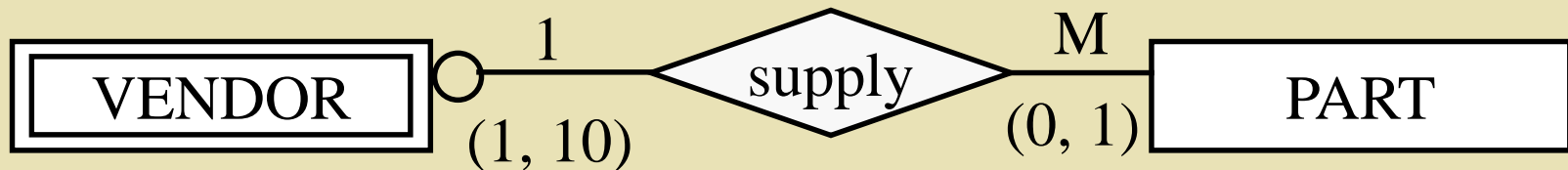
Existence-dependent

- ❖ Entity's existence **depends on** existence of related entities.



Existence-independent

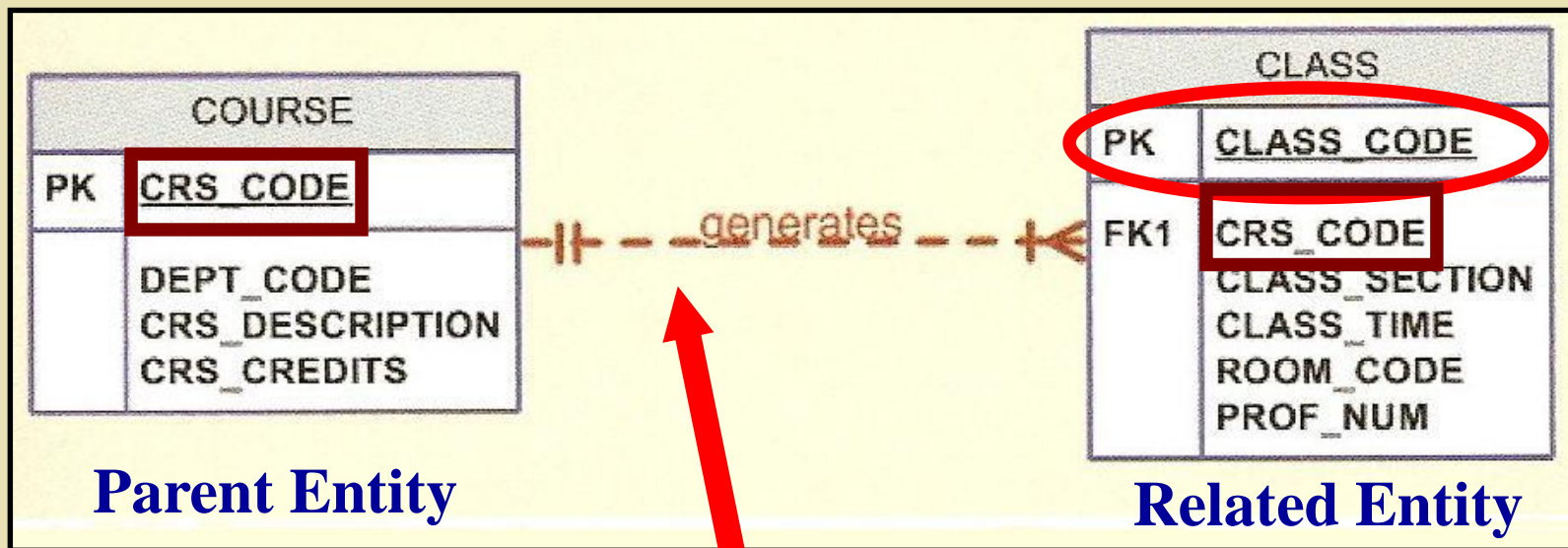
- ❖ Entities **can exist apart** from related entities.



(Assume that some of the parts produced / manufactured IN-HOUSE.)

Weak (non-identifying) Relationships

- ❖ One entity is **existence-independent** on another.
- ❖ Exist if the PK of related entity doesn't contain PK component of parent entity.



DASH line indicates weak relationship.

NOTE: Chen model does not differentiate between a WEAK & STRONG relationships.

Relational Representation of Weak Relationship

Table name: STUDENT

Database name: CH04_Tiny College

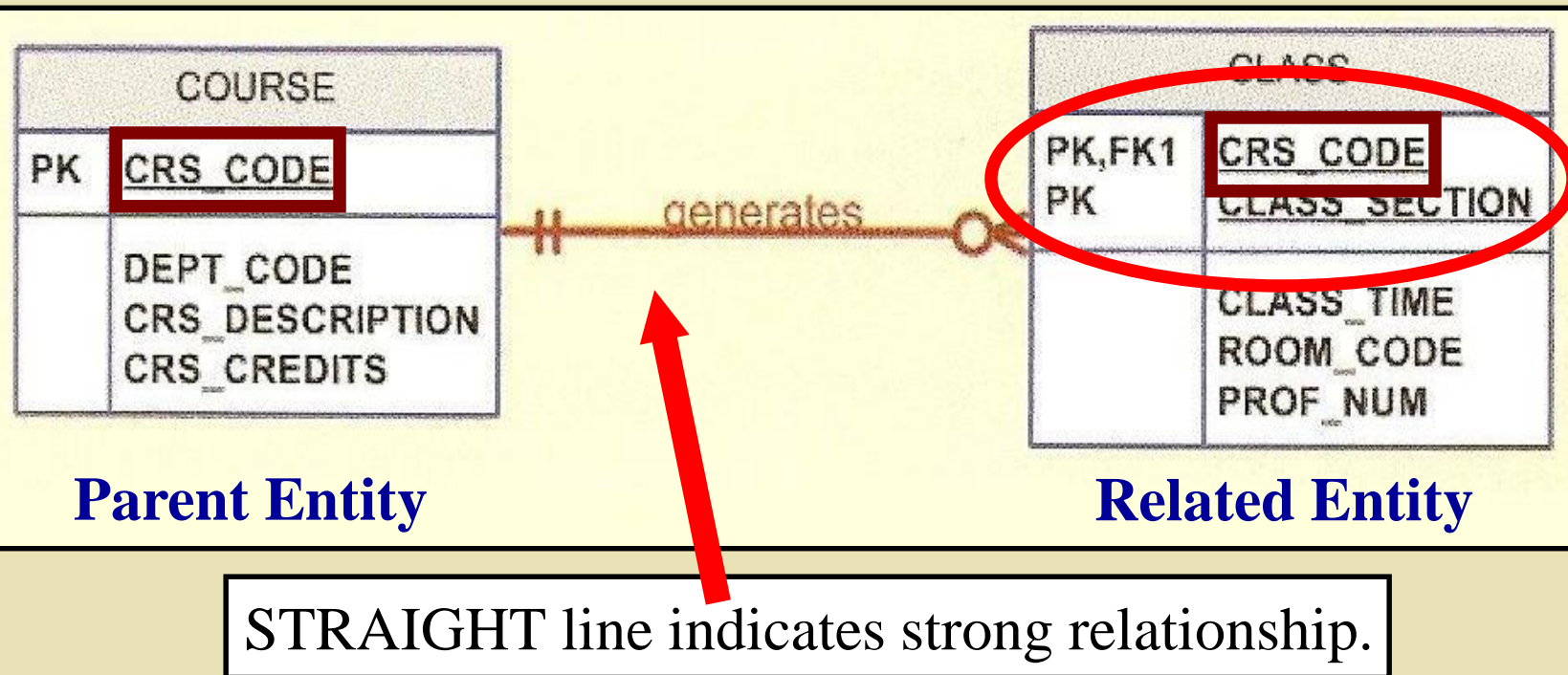
	CRS_CODE	DEPT_CODE	CRS_DESCRIPTION	CRS_CREDIT
▶ +	ACCT-211	ACCT	Accounting I	3
+	ACCT-212	ACCT	Accounting II	3
+	CIS-220	CIS	Intro. to Microcomputing	3
+	CIS-420	CIS	Database Design and Implementation	4
+	MATH-243	MATH	Mathematics for Managers	3
+	QM-261	CIS	Intro. to Statistics	3
+	QM-362	CIS	Statistical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

Strong (identifying) Relationships

- ❖ One entity is existence-dependent on another.
- ❖ Exist if the PK of related entity contains PK component of parent entity.



STRONG (tight) or WEAK (loose) ???

Depends on Primary Keys of the Related Entity. :- CLASS.

STRONG :- Does inherit from Parent ENTITY

WEAK :- Does not inherit from Parent ENTITY



Relational Representation of Strong Relationship

Table name: COURSE

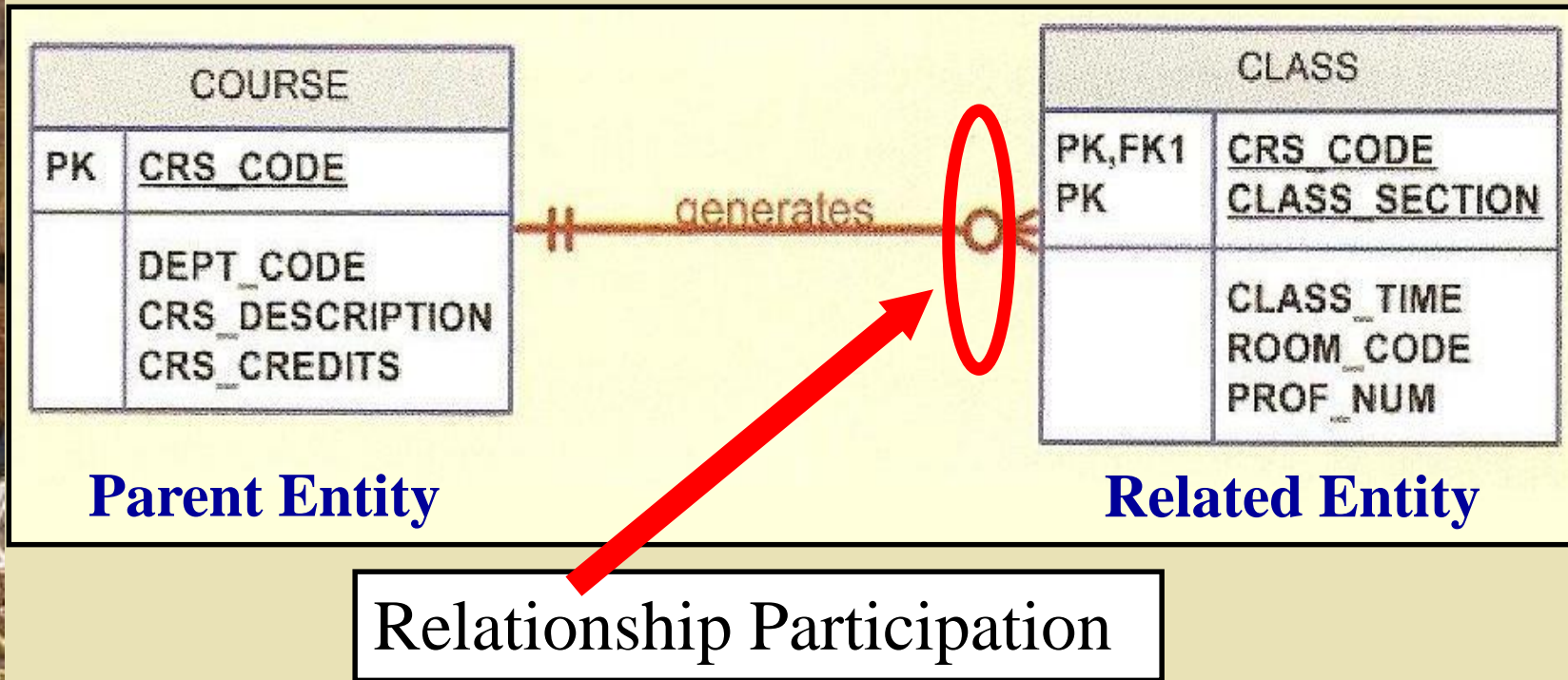
Database name: Ch04_TinyCollege_Alt

	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

4.1.5) Relationship Participation



LEFT or RIGHT ???



The **ORDER** in which tables are created and loaded is very important.

COURSE (Parent Entity) then **CLASS** (Related Entity) or "1" then "M" to avoid the possibility of referential integrity errors !



Relationship Participation (Optional Vs. Mandatory)

❖ Optional (Weak Entity):

- ✚ One entity occurrence (row) does **not require** a corresponding entity occurrence in a particular relationship.

❖ Mandatory (Strong Entity):

- ✚ One entity occurrence (row) **requires** a corresponding entity occurrence in a particular relationship.
- ✚ If **no optionality symbol** is shown on ERD, it is mandatory.
- ✚ **It is a must!**

Optional Relationships

Chen Model



Crow's Foot Model

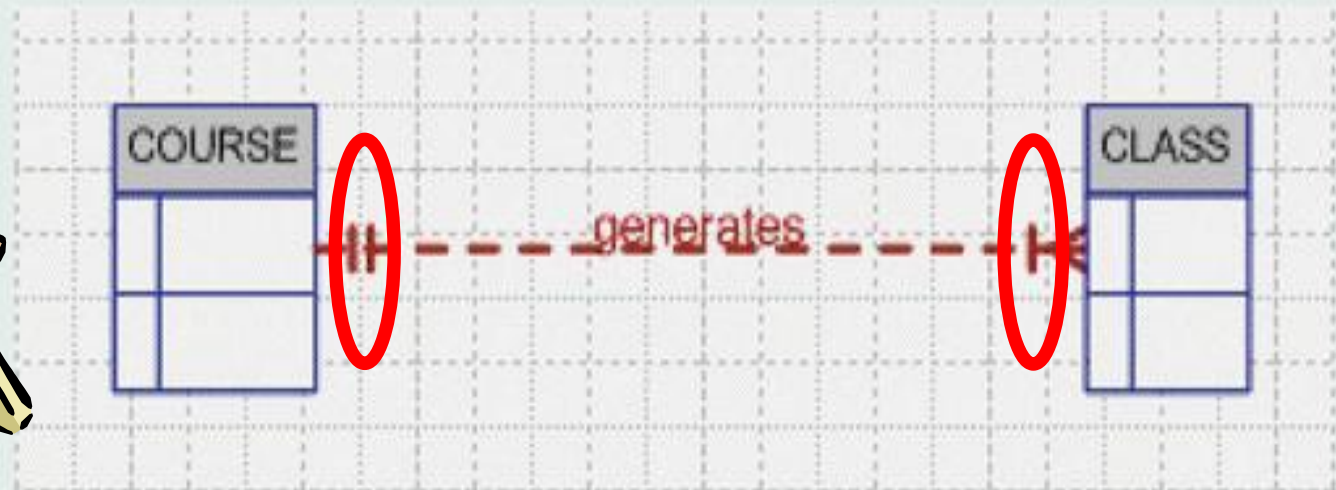


Mandatory Relationships

Chen Model



Crow's Foot Model



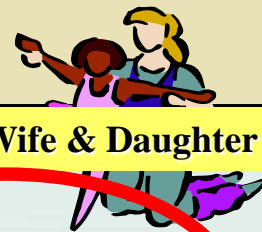
Relationship Strength and Weak Entity

❖ Weak entity meets two conditions:

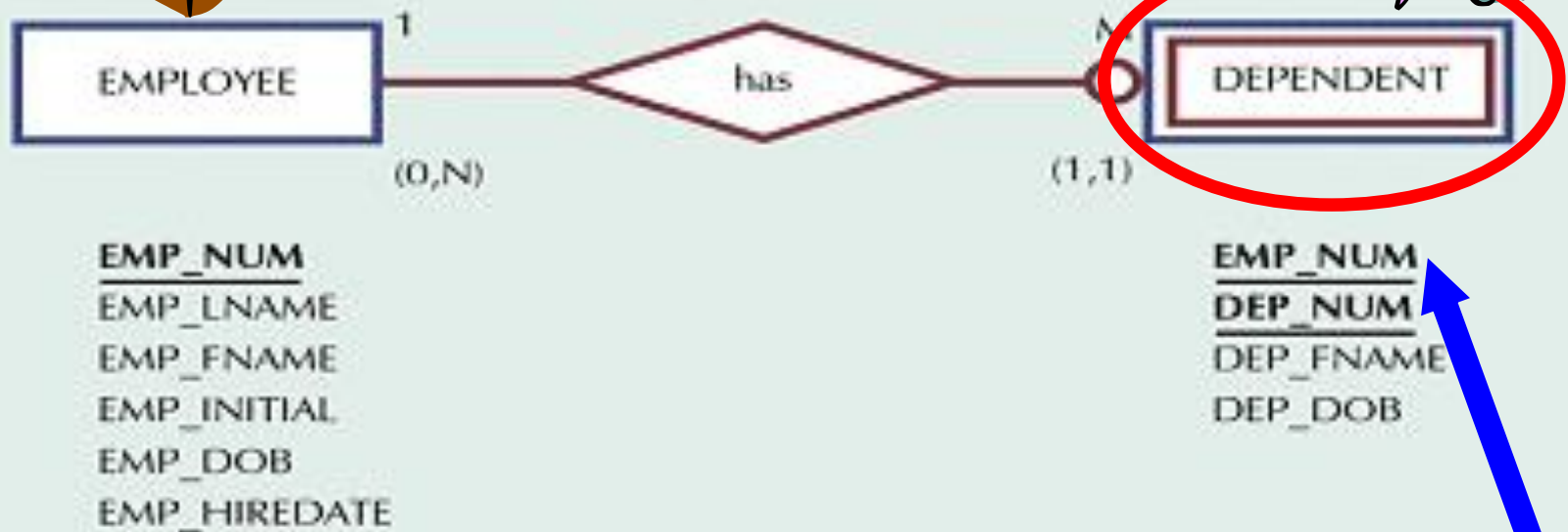
- ✚ **Existence-dependent:** Cannot exist without entity with which it has a relationship.
- ✚ Has **primary key** that is **partially or totally derived** from the **parent entity** in the relationship.

❖ Database designer usually determines whether an entity can be described as weak based on the business rules.

Weak Entities in ERD



Chen Model



Crow's Foot Model



Part Derived

Relational Representation of Weak Entity

Table name: EMPLOYEE

Database name: Ch04_ShortCo

	EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_DOB	EMP_HIREDATE
▶	1001	Callifante	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	R	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	25-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

**Jeanine J. Callifante
claims two dependents,
Annelise and Jorge**



1.6) Relationship Degree

- ❖ Indicates number of associated **entities** or **participants**.
- ❖ **Unary relationship / Recursive relationship**
 - ✚ Association is maintained within a single entity.
 - ✚ Recursive, E.g., BANK merges BANK.
 - ✚ Exists between occurrences of the same entity set.
- ❖ **Binary relationship**
 - ✚ Two entities are associated.
- ❖ **Ternary relationship**
 - ✚ Three entities are associated.

NOTE: Binary Relationship is most common. Most higher-order (Ternary / Quaternary / Higher) relationships are decomposed into appropriate equivalent binary relationships whenever possible.

	Crow's Foot model	Chen model
Unary relationship		
Binary relationship		
Ternary relationship		

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.	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.	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	Washington	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

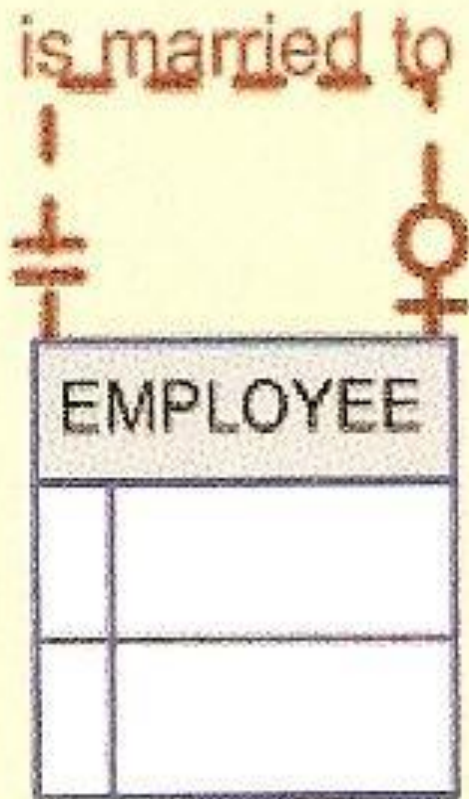
Table name: PRESCRIPTION

DOC_ID	PAT_NUM	DRUG_CODE	PRES_DOSAGE	PRES_DATE
29827	100	DRO	2 tablets every four hours -- 50 tablets total	12-Nov-05
32445	113	OLE	1 teaspoon with each meal -- 250 ml total	14-Nov-05
34409	101	KO15	1 tablet every six hours -- 30 tablets total	14-Nov-05
36221	109	DRO	2 tablets with every meal -- 60 tablets total	14-Nov-05
38995	107	KO15	1 tablet every six hours -- 30 tablets total	14-Nov-05

Recursive Relationship / Unary Relationship

1:1 Unary Relationship

An **EMPLOYEE** may be married to one and only one other **EMPLOYEE**.



Database name: CH04_PartCo

Table name: EMPLOYEE_V1

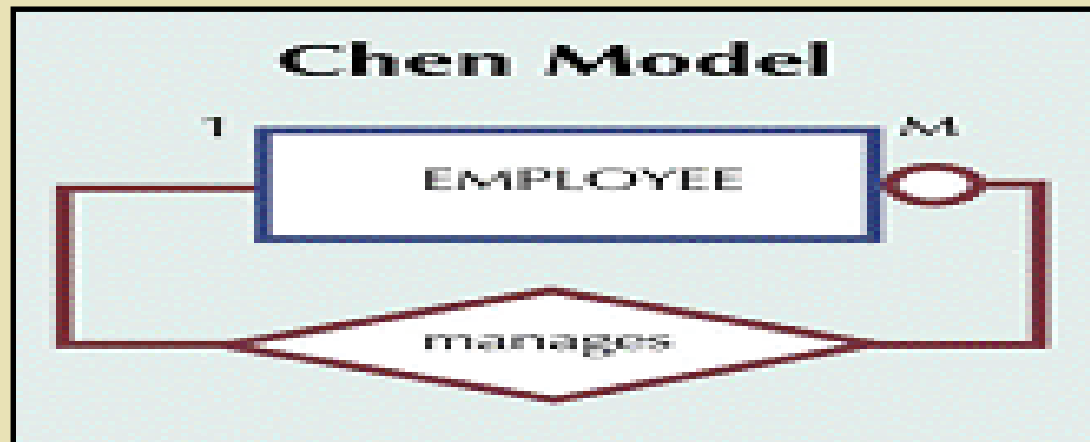
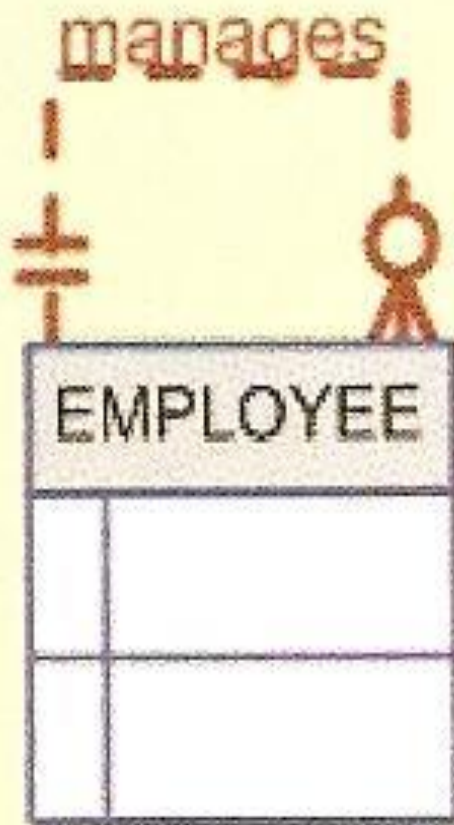
	EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_SPOUSE
▶	345	Ramirez	James	347
	346	Jones	Anne	349
	347	Ramirez	Louise	345
	348	Delaney	Robert	
	349	Shapiro	Anton	346

Recursive Relationship / Unary Relationship

1:M Unary Relationship

An EMPLOYEE may manage many EMPLOYEEs.

Each EMPLOYEE is managed by one EMPLOYEE.



Database name: Ch04_PartCo
Table name: EMPLOYEE_V2

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

Recursive Relationship / Unary Relationship

M:N Unary Relationship

A COURSE may be a prerequisite to many other COURSEs.

Each COURSE may have many other COURSEs as prerequisites.

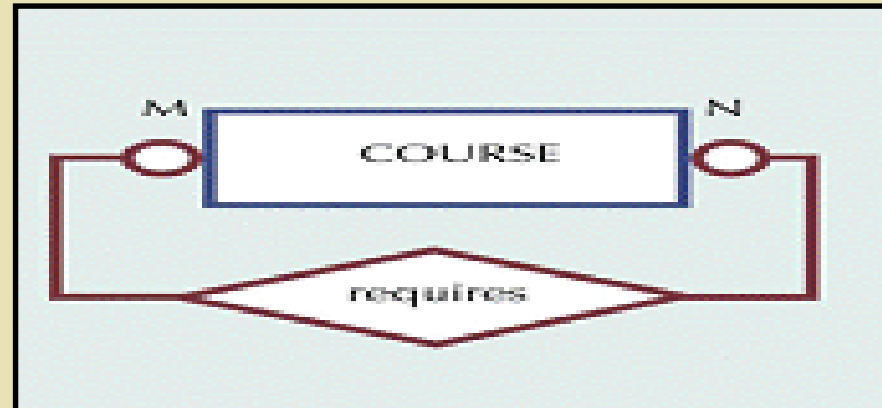
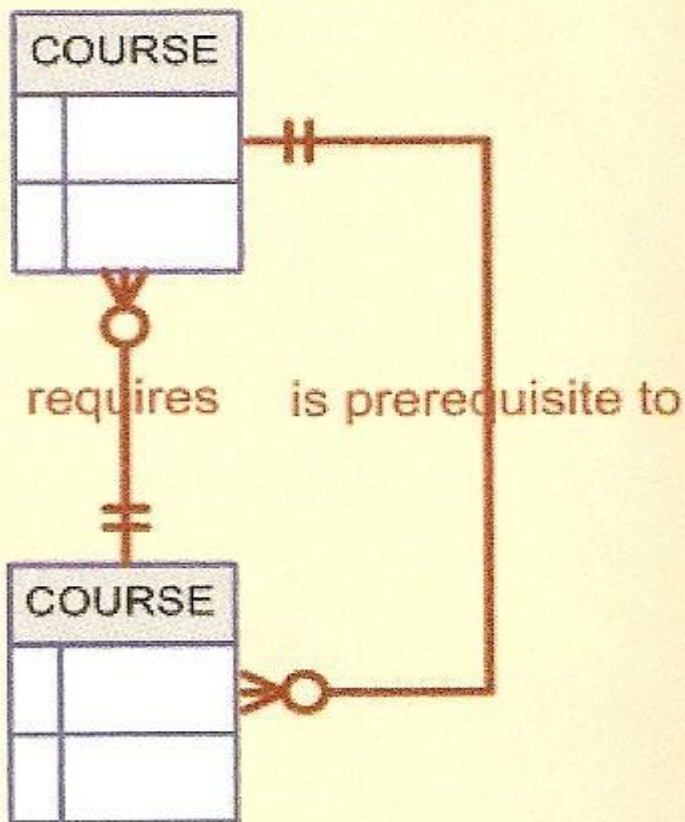


Table name: COURSE

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: PREREQ

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



1.7) Composite / Bridge Entities

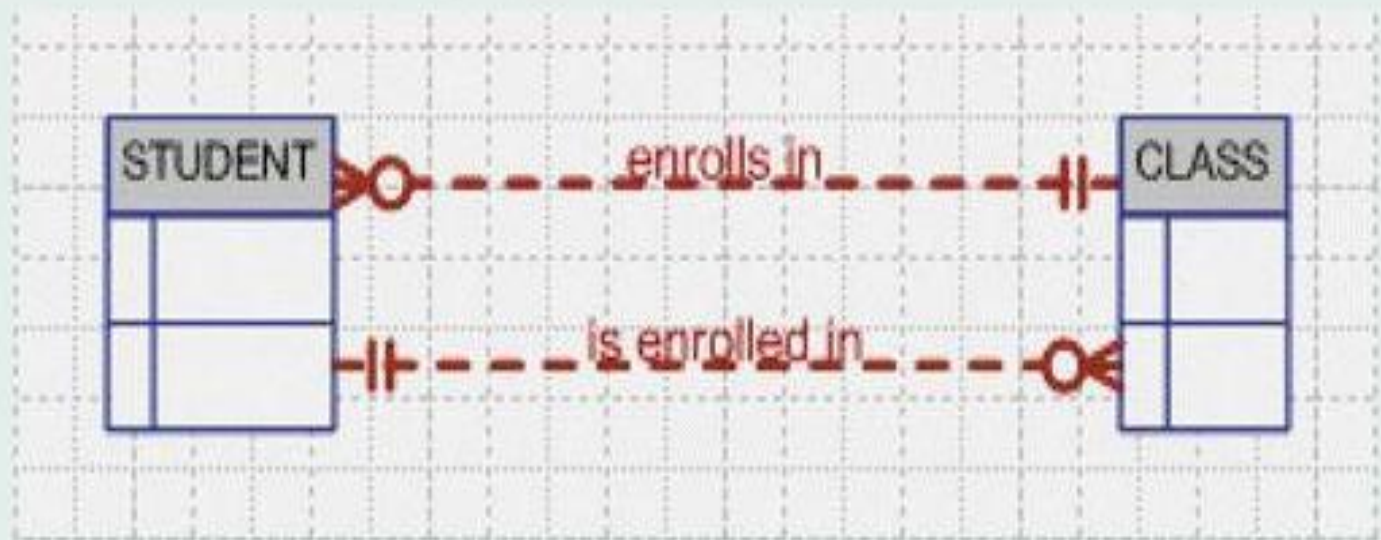
- ❖ Used to “bridge” between **M:N relationships**.
- ❖ Composed of the **primary keys** of each of the **entities** to be connected.
- ❖ May also contain **additional attributes** that play no role in the connective process.

The M:N Relationship between STUDENT and CLASS

Chen Model



Crow's Foot Model



Converting M:N into Two 1:M Relationships

Final Result :- Crow's Foot Model

Bridge Entity

Primary Key:

CLASS_CODE + STU_NUM

STUDENT	
PK	<u>STU_NUM</u>
	STU_LNAME

is written in

ENROLL	
PK,FK2	<u>CLASS_CODE</u>
PK,FK1	<u>STU_NUM</u>
	ENROLL_GRADE

is found in

CLASS	
PK	<u>CLASS_CODE</u>
	CLASS_SECTION
	CRS_CODE
	CLASS_TIME
	ROOM_CODE
	PROF_NUM

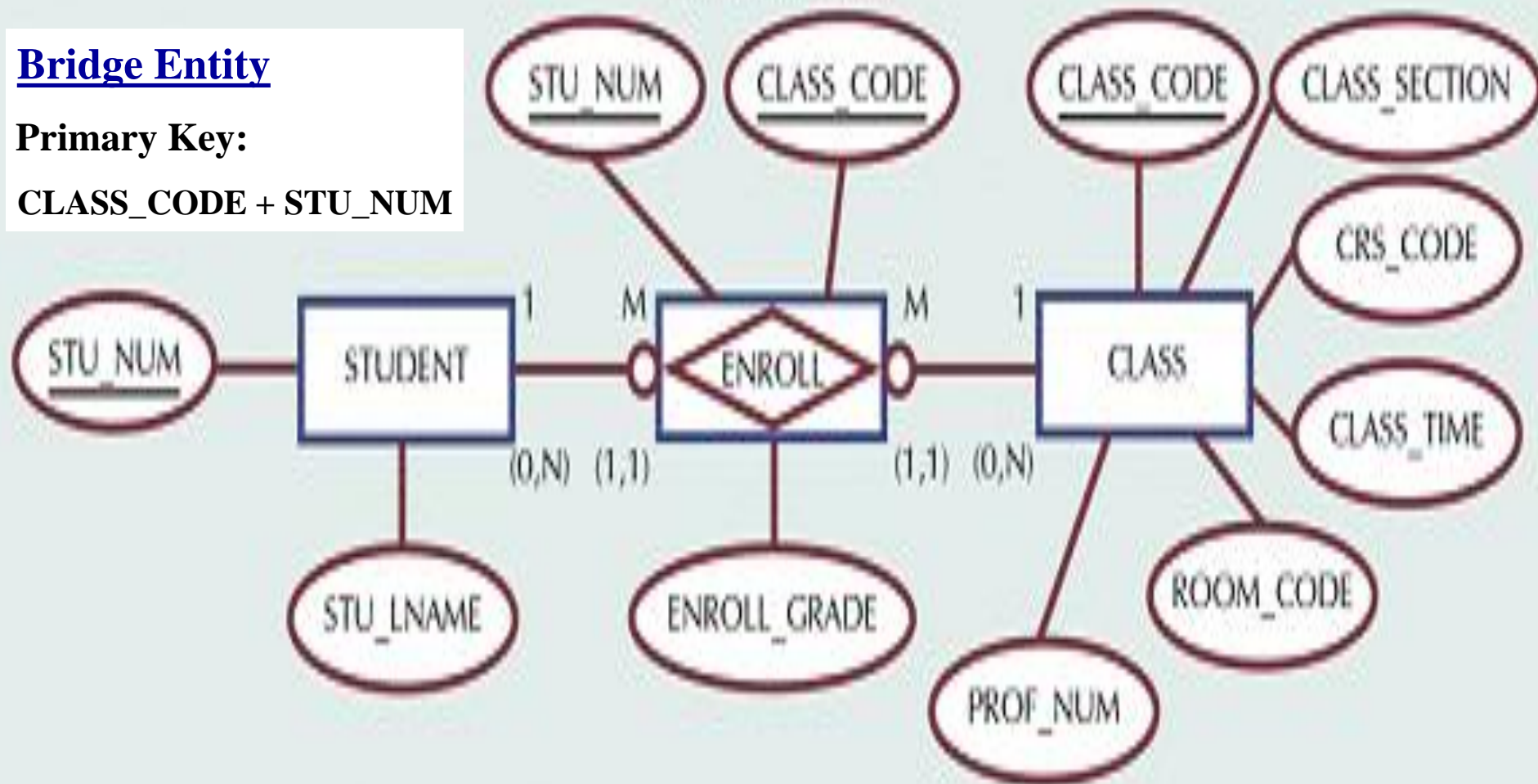
Converting M:N into Two 1:M Relationships

Final Result :- Chen Model

Bridge Entity

Primary Key:

CLASS_CODE + STU_NUM



Converting M:N 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

Bridge Entity

Primary Key:

CLASS_CODE + STU_NUM

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

Exercise 1:

The Artist Database Structure

PAINTER (PTR_NUM, PTR_NAME, PTR_AREACODE, PTR_PHONE)

PAINTING (PNT_NUM, PNT_TITLE, PNT_PRICE, PTR_NUM, GAL_NUM)

GALLERY (GAL_NUM, GAL_OWNER, GAL_AREACODE, GAL_PHONE, GAL_RATE)

Business Rules:

- 1) A painter might paint many paintings. The painter must have painted at least one painting.
- 2) Each painting is painted by one and only one painter.
- 3) One or many paintings might or might not be exhibited in a gallery; that is, Gallery is an optional entity to the Painting entity.

Exercise 1: Crow's Foot Model

PAINTER	
PK	<u>PTR_NUM</u>
	PTR_NAME
	PTR_AREACODE
	PTR_PHONE

PAINTING	
PK	<u>PNT_NUM</u>
	PNT_TITLE
	PNT_PRICE
FK1	PTR_NUM
FK2	GAL_NUM

GALLERY	
PK	<u>GAL_NUM</u>
	GAL_OWNER
	GAL_AREACODE
	GAL_PHONE
	GAL_RATE

-- paints --

exhibits



Exercise 1:

The Artist Database Structure

PAINTER (PTR_NUM, PTR_NAME, PTR_AREACODE, PTR_PHONE)

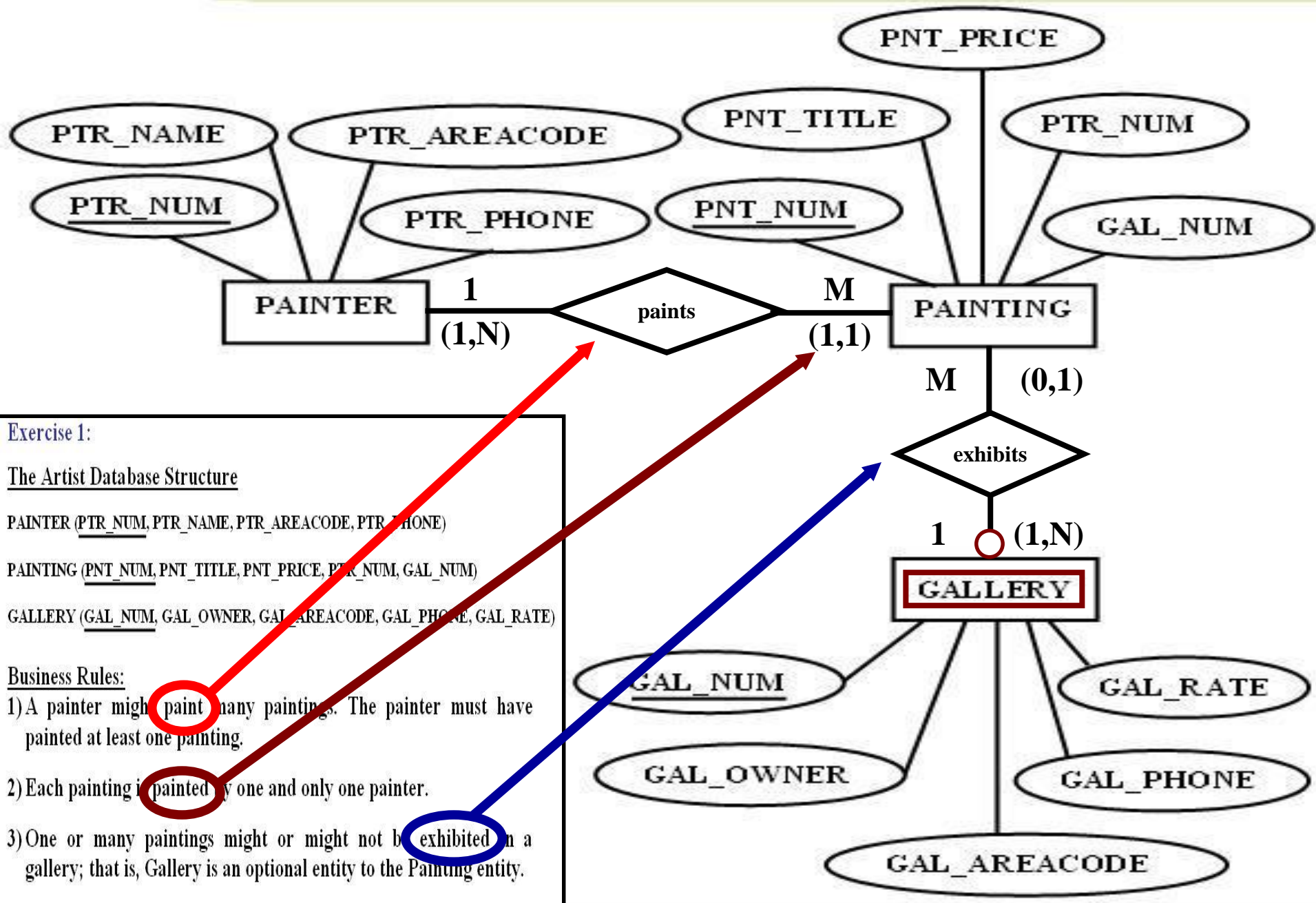
PAINTING (PNT_NUM, PNT_TITLE, PNT_PRICE, PTR_NUM, GAL_NUM)

GALLERY (GAL_NUM, GAL_OWNER, GAL_AREACODE, GAL_PHONE, GAL_RATE)

Business Rules:

- 1) A painter might paint many paintings. The painter must have painted at least one painting.
- 2) Each painting is painted by one and only one painter.
- 3) One or many paintings might or might not be exhibited in a gallery; that is, Gallery is an optional entity to the Painting entity.

Exercise 1: Chen Model



Exercise 2:

Draw an E-R diagram for the following situation. State any assumptions you need to make.

Sweet Home is a real estate agent which manages properties for rent for the properties owners. Each staff member in Sweet Home manages several properties or may not manage any property. Attributes of STAFF include STAFF_ID (the identifier), STAFF_NAME, STAFF_ADDRESS, STAFF_TEL_NO, SALARY, IC#.

Attributes of PROPERTY include PROPERTY_NO (the identifier), PROPERTY_ADDRESS, RENTAL_RATE, NO_OF_ROOM, TYPE, FLOOR_AREA. Each property must be managed by one particular staff member. The property owner may own one or more properties for rent. The attribute of the OWNER include OWNER_NO (the identifier), OWNER_NAME, OWNER_ADDRESS, OWNER_TEL_NO. The property may be owned by one or several owners.

Each customer may rent one or several properties at any one time. The attribute for the CUSTOMER include CUSTOMER_NO (the identifier), CUSTOMER_NAME, CUSTOMER_IC#, CUSTOMER_TEL_NO. The property may be rented by one customer at any time or may not be rented at all.

Exercise 2: Crow's Foot Model

STAFF	
PK	<u>STAFF_ID</u>
	STAFF_NAME
	STAFF_ADDRESS
	STAFF_TEL_NO
	SALARY
	IC#

PROPERTY	
PK	<u>PROPERTY_NO</u>
	PROPERTY_ADDRESS
	RENTAL_RATE
	NO_OF_ROOM
	TYPE
	FLOOR_AREA
	STAFF_ID
	CUSTOMER_NO

OWN	
PK, FK1	<u>OWNER_NO</u>
PK, FK2	<u>PROPERTY_NO</u>
	OWN_STATUS

CUSTOMER	
PK	<u>CUSTOMER_NO</u>
	CUSTOMER_NAME
	CUSTOMER_IC#
	CUSTOMER_TEL_NO

||-- manages --○

holds || FK1
FK2



rents



is belong to



Exercise 2: Chen Model

