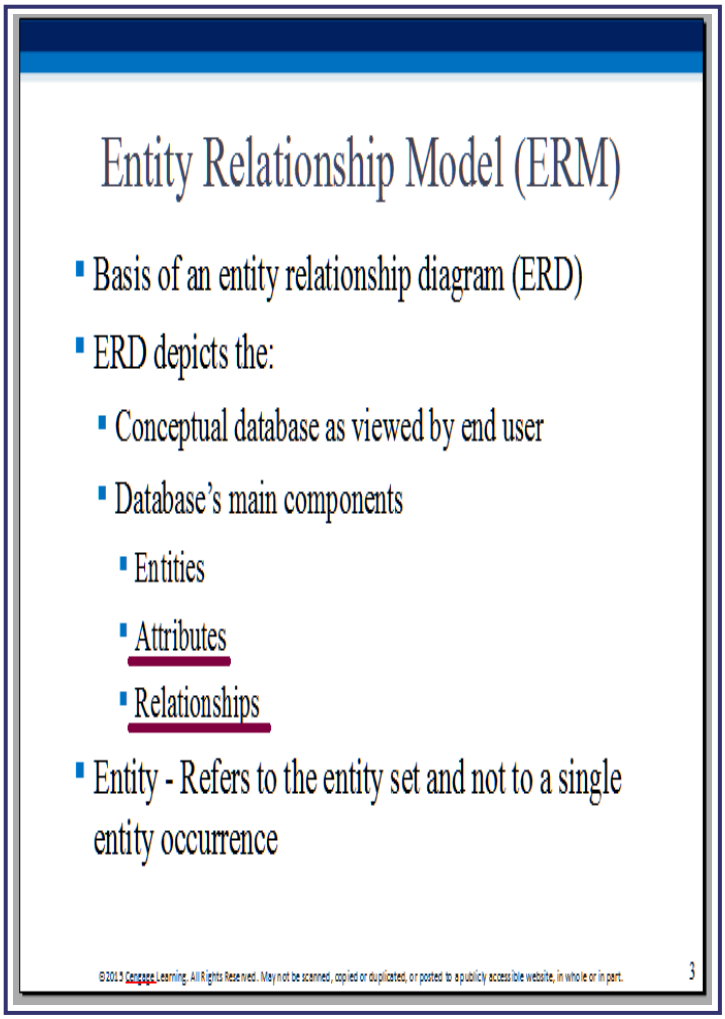
1/34 11:12:30 ***

ER


Entity Relationship Model (ERM)
Basis of an entity relationship diagram (ERD)
ERD depicts the:
Conceptual database as viewed by end user
Database's main components
Entities
Attributes
Relationships
Entity - Refers to the entity set and not to a single entity occurrence
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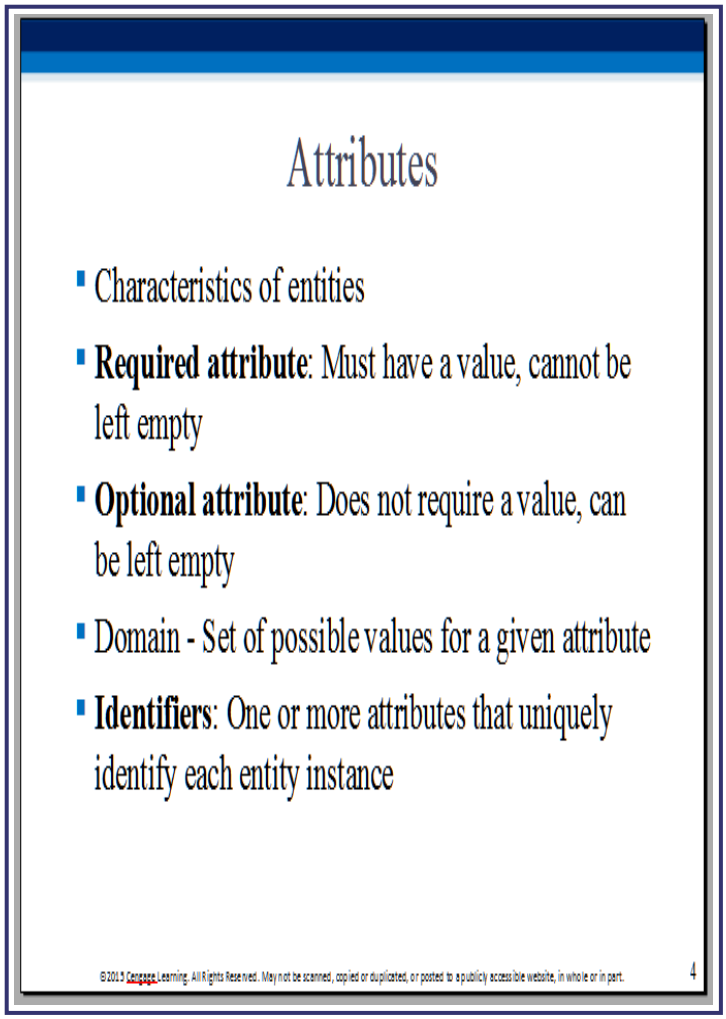
3



An identifier is also called a KEY, or PRIMARY KEY - **this is one of the 'key' concepts in all of database theory!!** We'll talk much more about keys later.

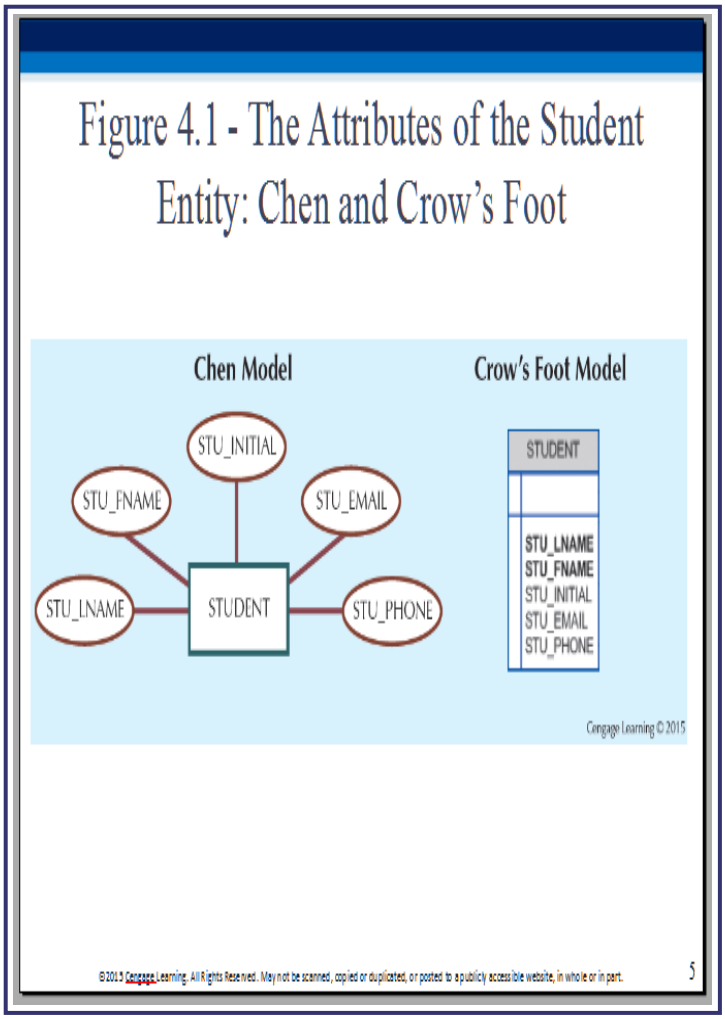


Figure 4.1 - The Attributes of the Student Entity: Chen and Crow's Foot
Chen Model
Crow's Foot Model
STU_INITIAL
STU_FNAME
STU_EMAIL
STU_LNAME
STUDENT
STU_PHONE
STUDENT
STU_LNAME
STU_FNAME
STU_INITIAL
STU_EMAIL
STU_PHONE
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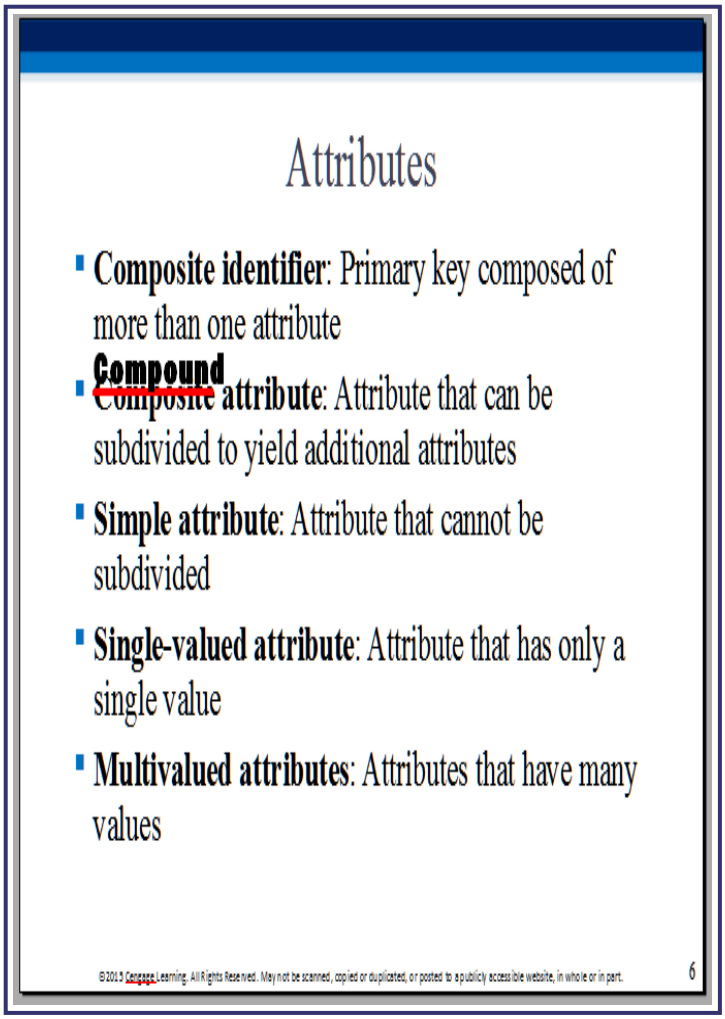
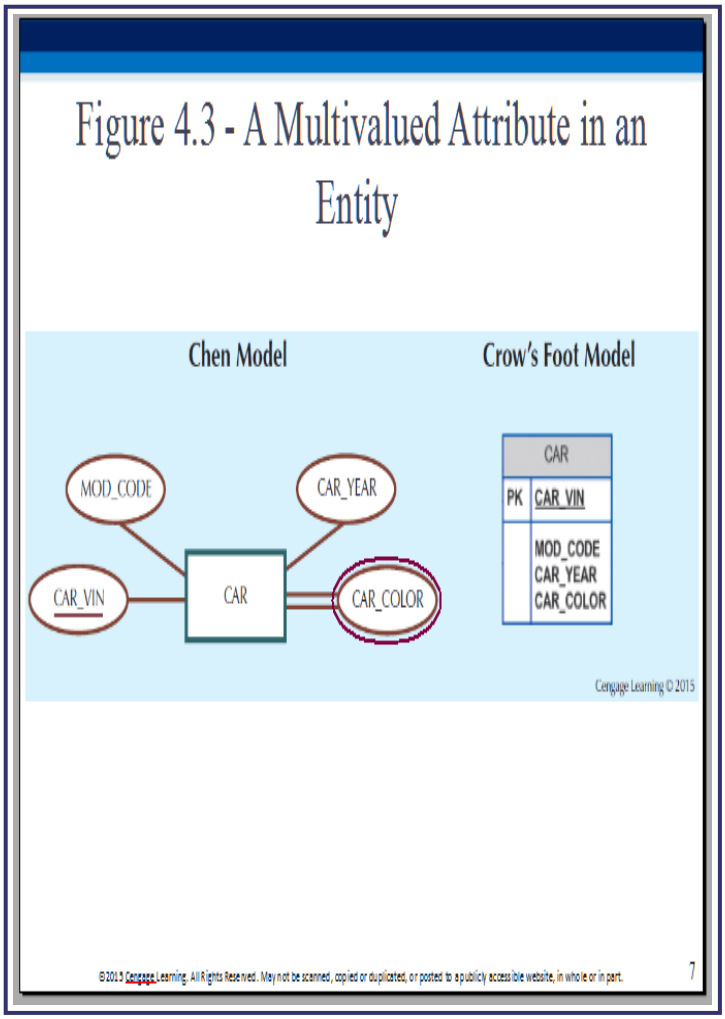
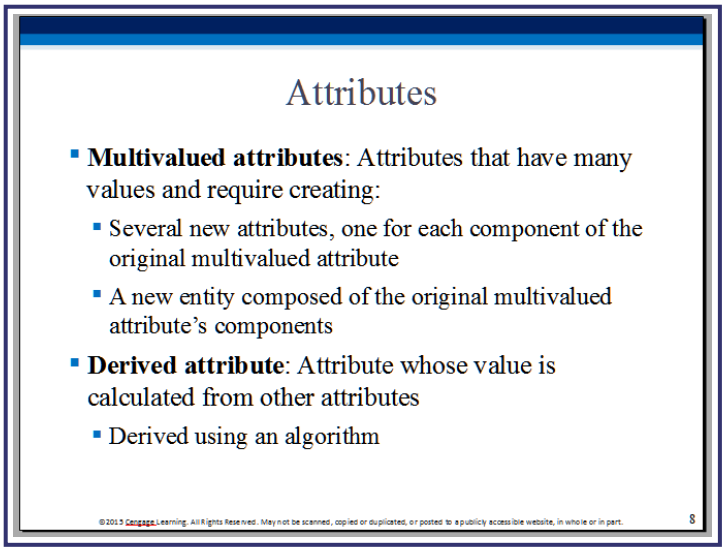
5



FYI - here is a page on the various types of attributes.



In Crow's Foot notation, 'bold' attributes are 'required' (can't be null).


Attributes
Multivalued attributes: Attributes that have many values and require creating:
Several new attributes, one for each component of the original multivalued attribute
A new entity composed of the original multivalued attribute's components
Derived attribute: Attribute whose value is calculated from other attributes
Derived using an algorithm
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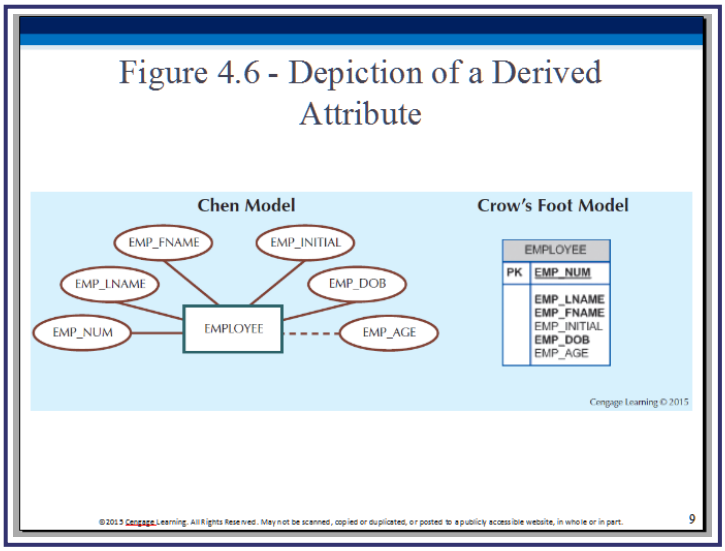
Figure 4.6 - Depiction of a Derived Attribute
Chen Model
Crow's Foot Model
EMP_FNAME
EMP_INITIAL
EMP_LNAME
EMP_DOB
EMP_NUM
EMPLOYEE
EMP_AGE
EMPLOYEE
PK
EMP_NUM
EMP_LNAME
EMP_FNAME
EMP_INITIAL
EMP_DOB
EMP_AGE
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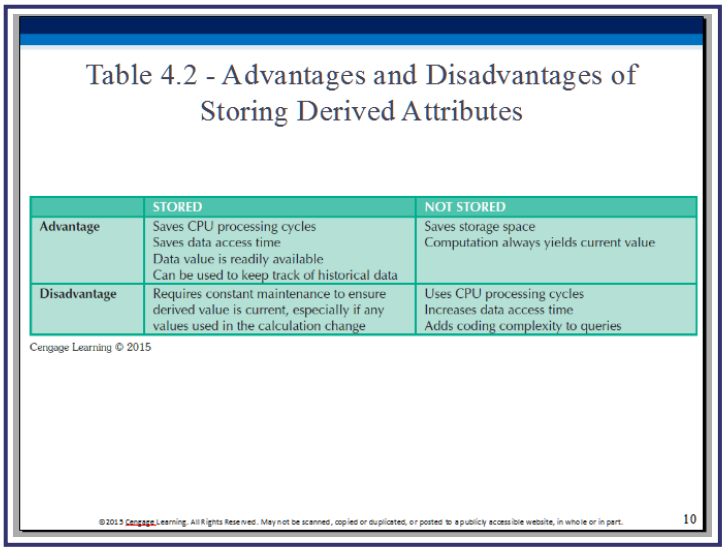

Table 4.2 - Advantages and Disadvantages of Storing Derived Attributes

	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

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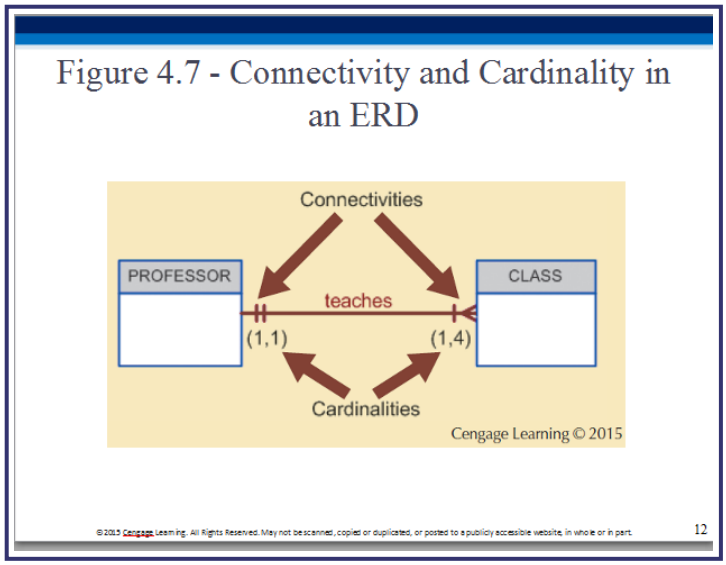
Relationships

- Association between entities that always operate in both directions
- **Participants**: Entities that participate in a relationship
- **Connectivity**: Describes the relationship classification
- **Cardinality**: Expresses the minimum and maximum number of entity occurrences associated with one occurrence of related entity

Connectivity vs cardinality



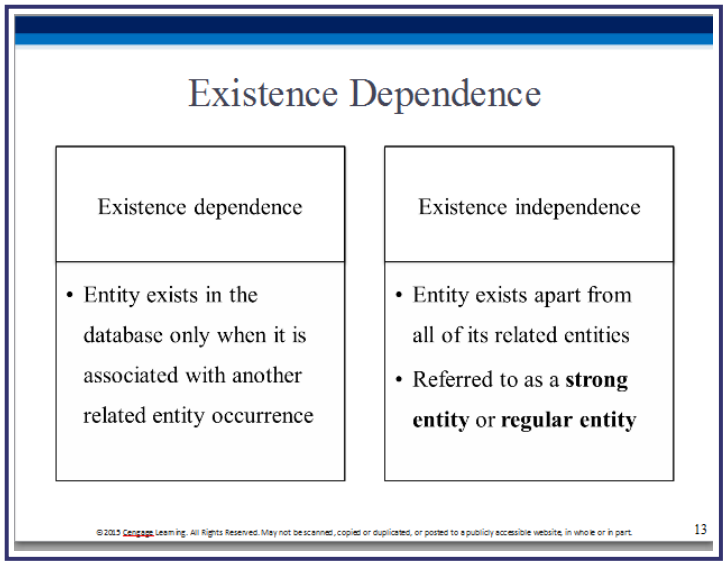
Connectivity: 1:1, 1:M or M:N (three diff ways by which two entities are related).

Cardinality: (min,max) for 1:1, 1:M or M:N (eg. 1:1 can have (1,0) as its cardinality, 1:M can have (0,4) as its cardinality). Sometimes, min is called 'modality' (and max is cardinality). The 'inside' symbols denotes min, and the outside ones, max.

Confusingly, the # rows in a table is ALSO called table's cardinality (and, # of columns is called the table's degree).

Also confusingly, 1:1, 1:M, M:N are called 'cardinality ratios'!

'Can I exist apart from you?'



Existence independence implies a strong entity; but, existence dependence (alone, ie. by itself) does NOT imply a weak entity (there needs to be one more condition, based on 'relationship strength', for it to become 'weak').

In other words, **we need to look at where the FK in the dependent entity is located.**

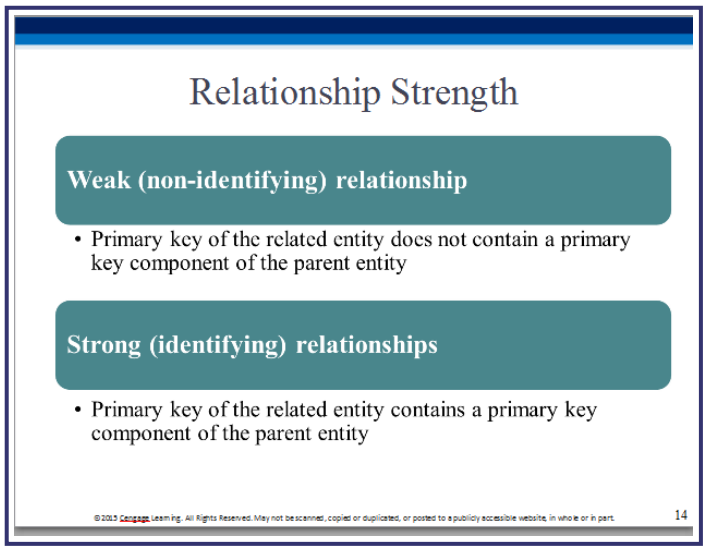
Existence dependence

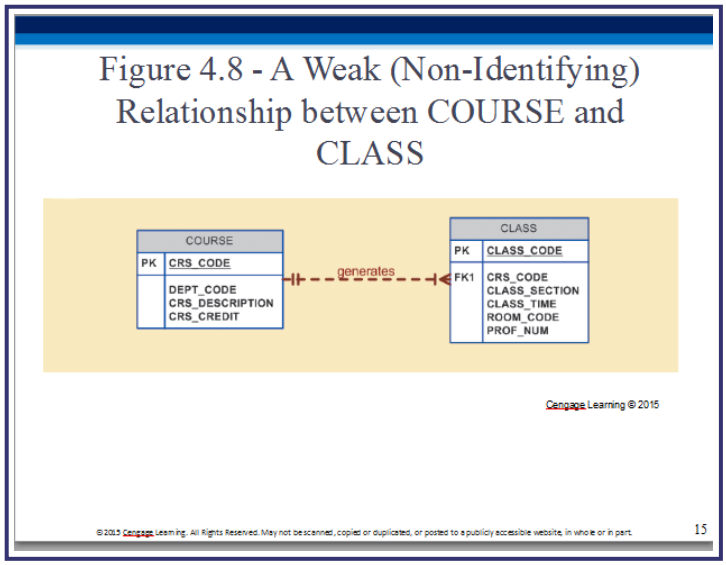
An entity B is "existent dependent" on another entity A, if, a row in B can only exist when its FK is NOT NULL, ie. a corresponding entry exists in A.

Eg. if A is EMPLOYEE and B is DEPENDENT, a dependent (eg. child) in B can only exist if there is a corresponding employee (eg. Dad) in A. THIS ALONE DOES NOT MAKE 'B' A WEAK ENTITY!

Weak vs strong relationship

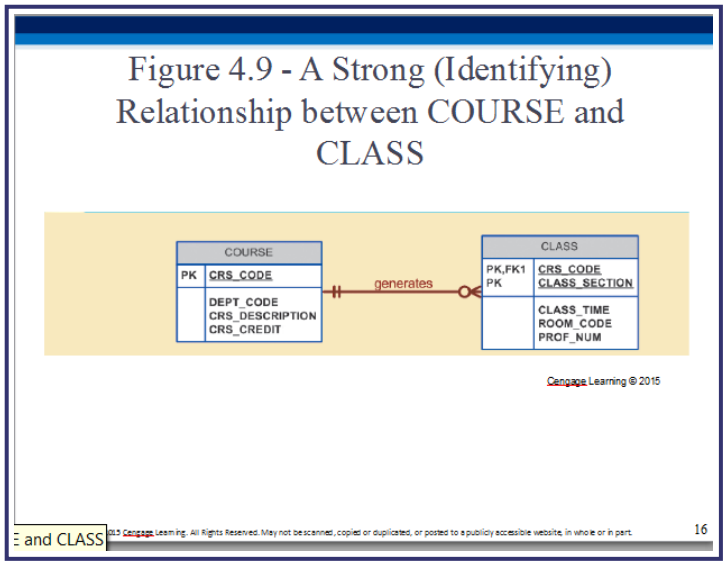
Again, it's all about the FK [WHERE it goes], in the dependent entity!





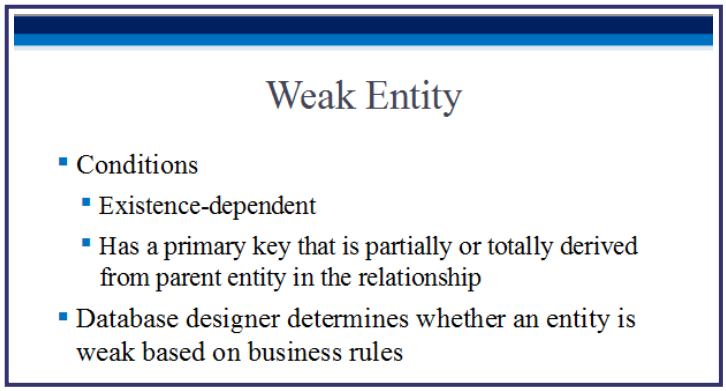
So, here, CLASS is **not** a weak entity.

Strong ("common PK") course-class relation



CLASS is now a weak entity (because: it is existence dependent, AND has a strong relationship).

Weak entity [two conditions]



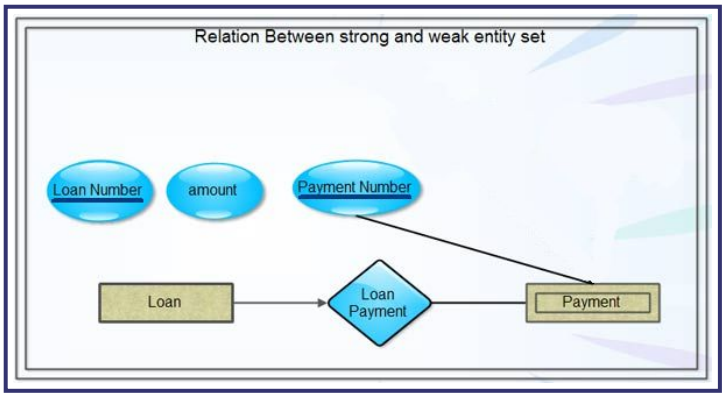
A weak entity needs to satisfy two conditions: existence dependence, strong (identifying/owning) relationship with a parent.

Note that a weak entity implies existence dependence, but existence dependence does not imply a weak entity!

Note too that a weak entity implies a strong ("owning" or "identifying") relationship.

Removing the controlling (owning) entity's key from a weak entity's PK will result in **duplicates** for remaining PK(s) - THAT is what makes it 'weak'.

Weak entity - example



Payment cannot exist independent of Loan, AND needs Loan's key to be part of its own key, so it is a weak entity.

Weak entity

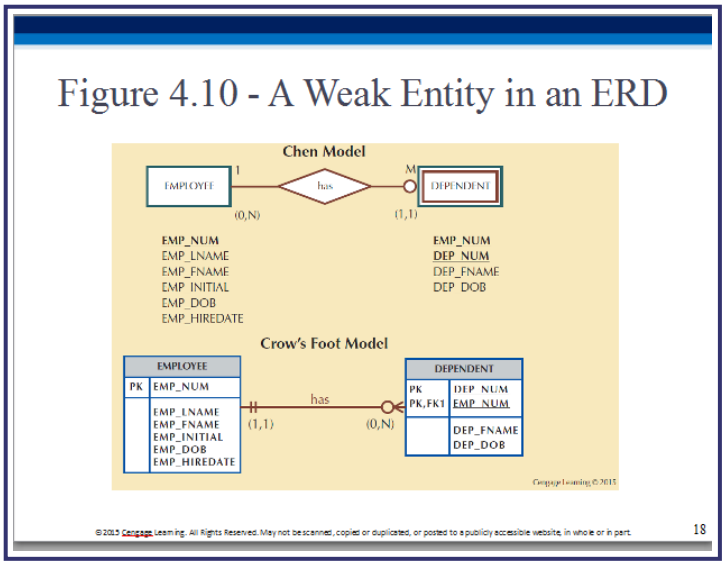


Figure 4.10 - A Weak Entity in an ERD
Chen Model
EMPLOYEE
1
has
M
DEPENDENT
(0,N)
(1,1)
EMP_NUM
EMP_LNAME
EMP_FNAME
EMP_INITIAL
EMP_DOB
EMP_HIREDATE
EMP_NUM
DEP_NUM
DEP_FNAME
DEP_DOB
Crow's Foot Model
EMPLOYEE
PK
EMP_NUM
EMP_LNAME
EMP_FNAME
EMP_INITIAL
EMP_DOB
EMP_HIREDATE
has
(1,1)
(0,N)
DEPENDENT
PK
DEP_NUM
PK,FK1
EMP_NUM
DEP_FNAME
DEP_DOB
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Weak entity

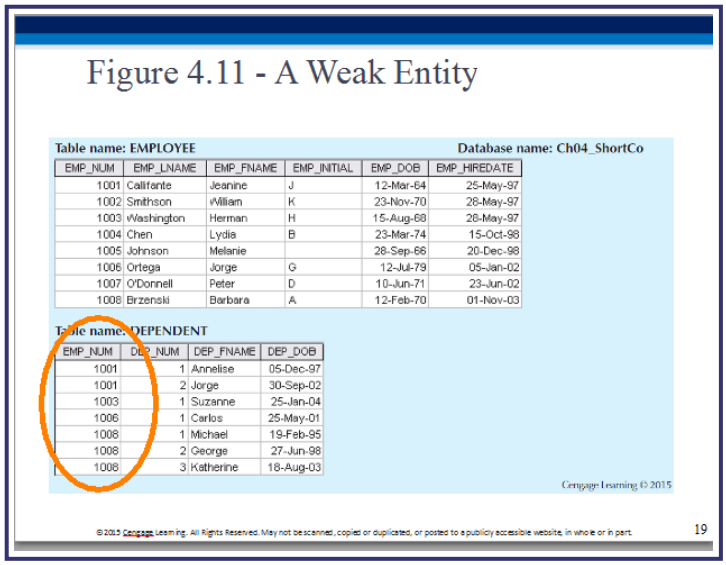

Figure 4.11 - A Weak Entity

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	26-May-97
1003	Washington	Herman	H	15-Aug-68	26-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

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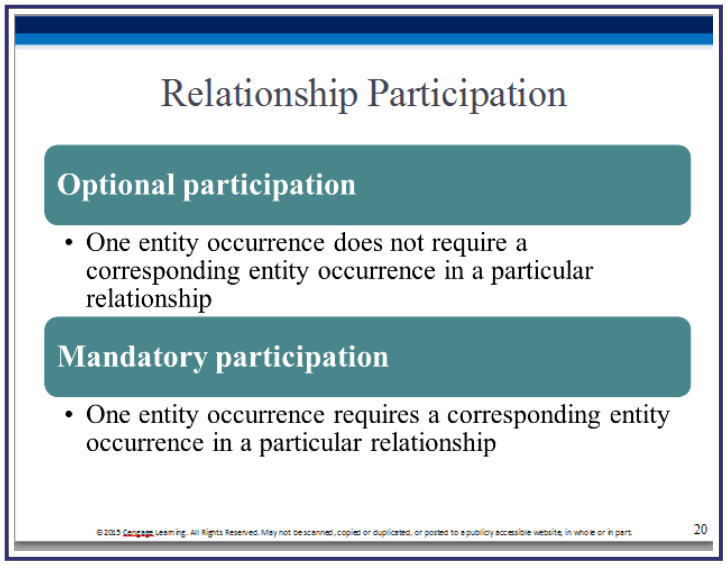
Relationship Participation
Optional participation
• One entity occurrence does not require a corresponding entity occurrence in a particular relationship
Mandatory participation
• One entity occurrence requires a corresponding entity occurrence in a particular relationship
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Table 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.

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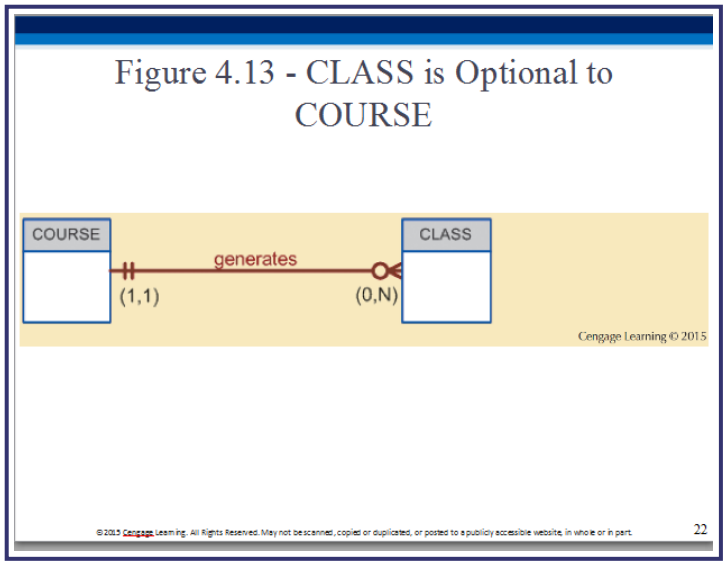
Figure 4.13 - CLASS is Optional to COURSE
COURSE
generates
CLASS
(1,1)
(0,N)
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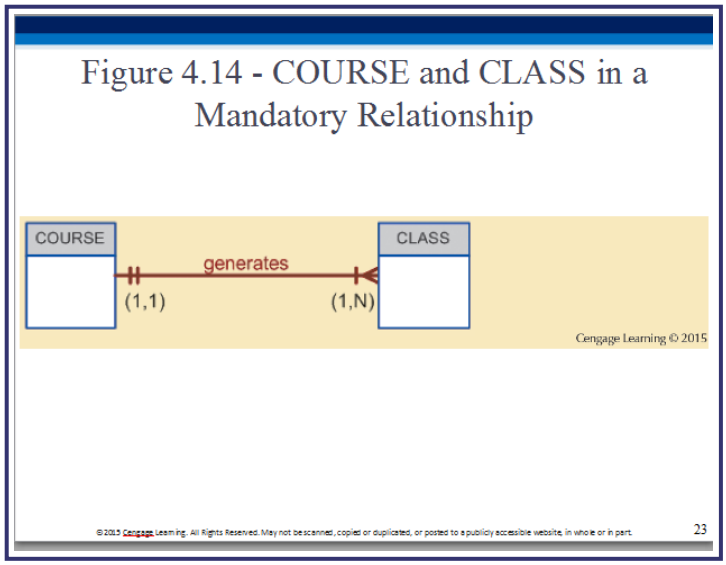
Figure 4.14 - COURSE and CLASS in a Mandatory Relationship
COURSE
generates
CLASS
(1,1)
(1,N)
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Relationship Degree

- Indicates the number of entities or participants associated with a relationship
- **Unary relationship**: Association is maintained within a single entity
  - **Recursive relationship**: Relationship exists between occurrences of the same entity set
- **Binary relationship**: Two entities are associated
- **Ternary relationship**: Three entities are associated

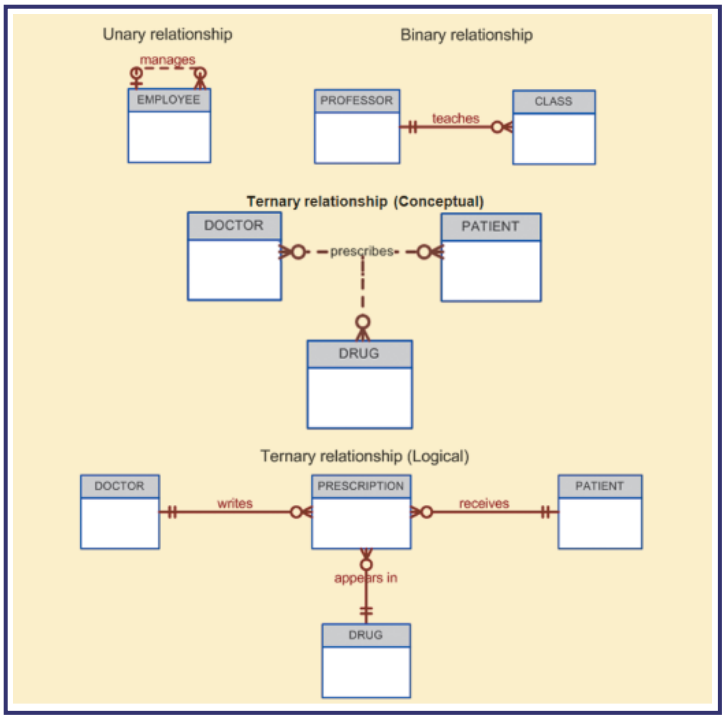
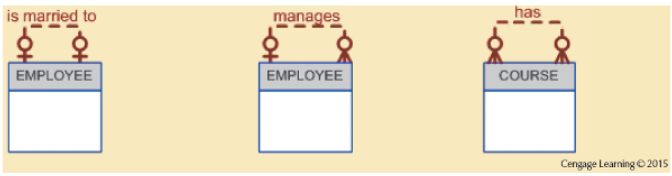

Unary relationship
manages
EMPLOYEE
Binary relationship
PROFESSOR
teaches
CLASS
Ternary relationship (Conceptual)
DOCTOR
prescribes
PATIENT
DRUG
Ternary relationship (Logical)
DOCTOR
writes
PRESCRIPTION
receives
PATIENT
appears in
DRUG

Figure 4.17 - An ER Representation of Recursive Relationships



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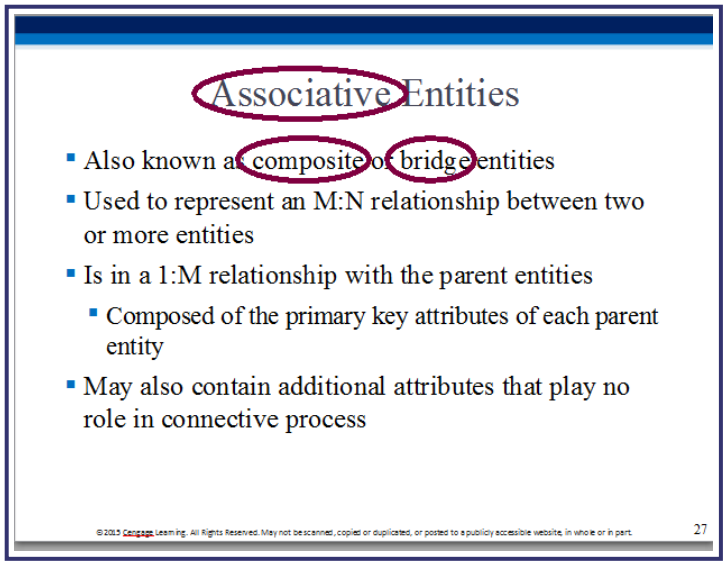
Bridge entities



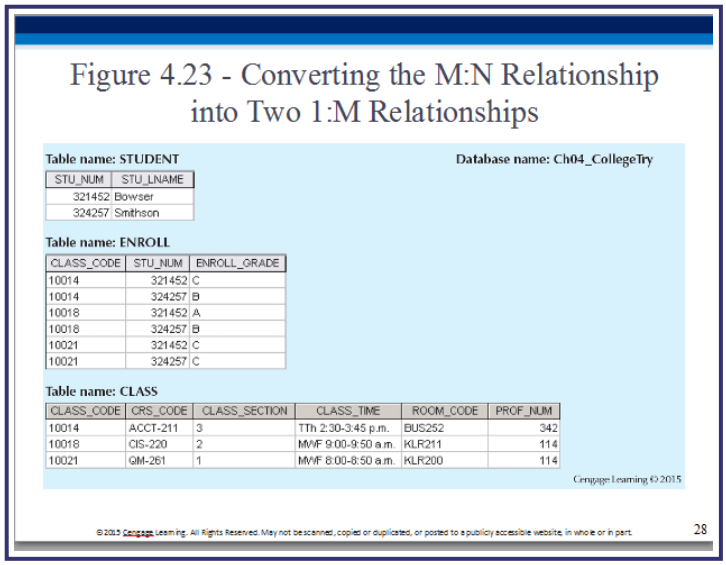


Figure 4.23 - Converting the M:N Relationship into Two 1:M Relationships

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	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

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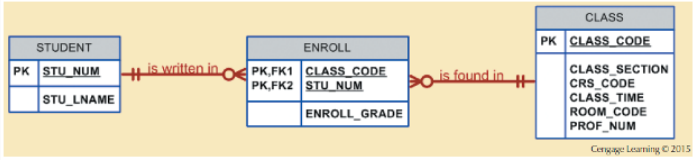
Figure 4.25 - A Composite Entity in an ERD



29

Putting together an ERD

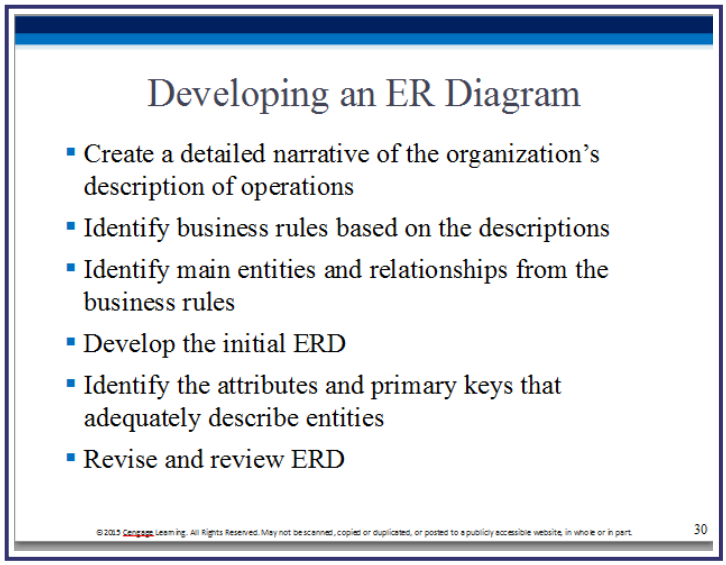
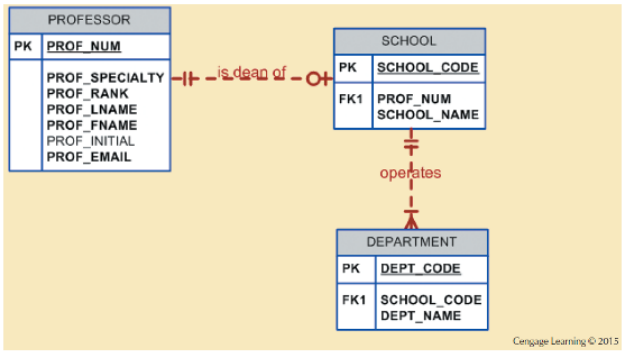
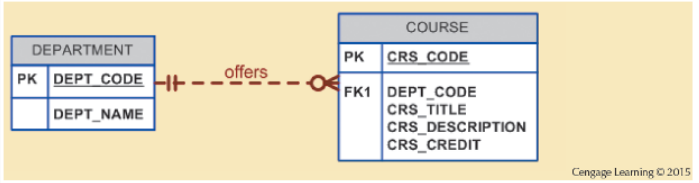


Figure 4.26 - The First Tiny College ERD Segment



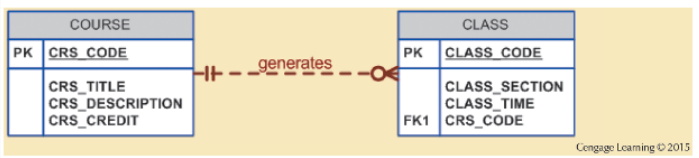
 31

Figure 4.27 - The Second Tiny College ERD Segment



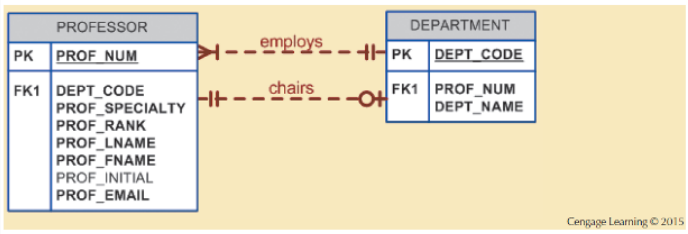
 32

Figure 4.28 - The Third Tiny College ERD Segment



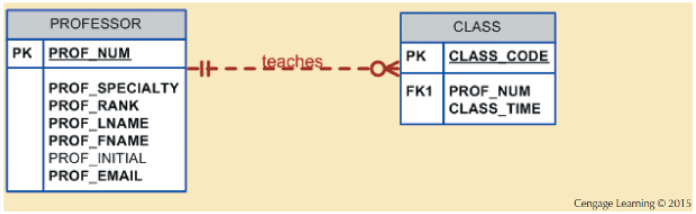
 33

Figure 4.29 - The Fourth Tiny College ERD Segment



 34

Figure 4.30 - The Fifth Tiny College ERD Segment



 35

Figure 4.31 - The Sixth Tiny College ERD Segment

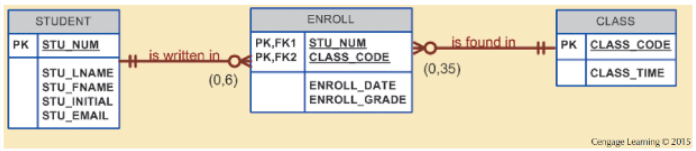


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Figure 4.32 - The Seventh Tiny College ERD Segment

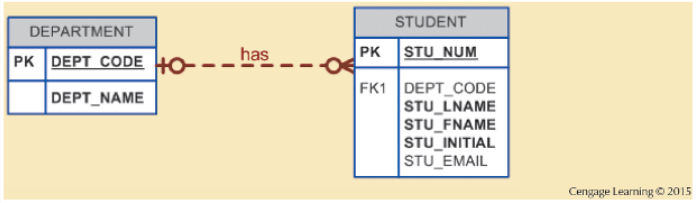

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Figure 4.33 - The Eighth Tiny College ERD Segment

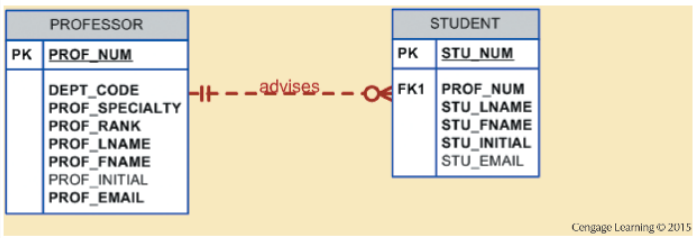

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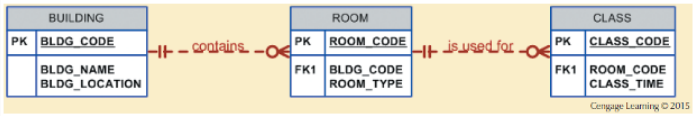
Figure 4.34 - The Ninth Tiny College ERD Segment



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List of entities, relationships, connectivities

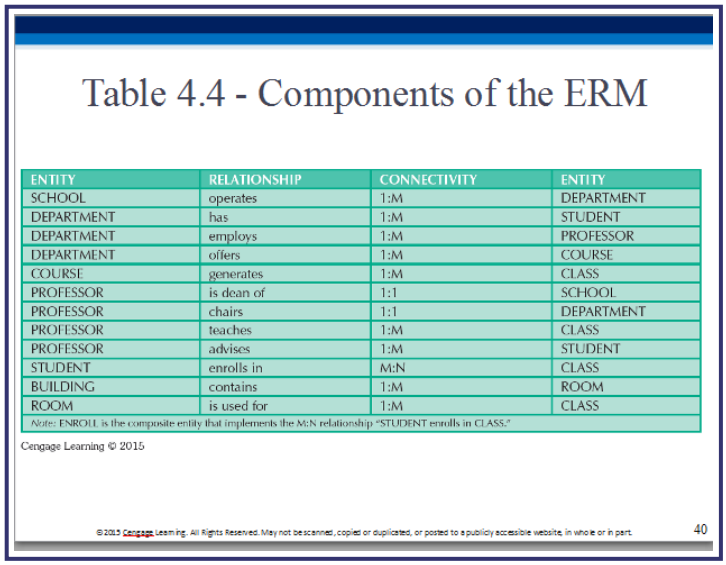

Table 4.4 - Components of the ERM

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."

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The full schema

"All together now!"