

Chapter 4B Objectives

- Understand
 - How ERD components affect database design and implementation
 - That real-world database design often requires the reconciliation of conflicting goals

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Developing an ER Diagram

- Database design is an iterative process
- Building an ERD includes the following:
 1. Create detailed narrative of organization's description of operations
 2. Identify business rules based on description of operations
 3. Identify main entities and relationships from business rules
 4. Develop initial ERD
 5. Identify attributes and primary keys that adequately describe entities
 6. Review and revise the ERD

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Developing an E-R Model

- Information Gathering/Preliminary Investigation
 - interviewing the end users
 - examining the business forms and reports.
 - Write results/description of the investigation
- Determine Entities
 - 'things' you want to collect, keep, or know
- Create general rules governing relationships among Entities
 - Relationship Rules come from the Business Rules of the organization
 - Result will help define all foreign keys

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Refining an E-R Model

- M:N Relationship
 - Convert the M:N relationship to a composite (bridge) entity consisting of the parent tables' primary keys.
- 1:M Relationships
 - Create the foreign key by putting the primary key of the "one" in the table of the "many".
 - "One" -- Parent table
 - "Many" -- Dependent table
 - Define Relationship Participation:
 - Both sides are MANDATORY.
 - Both sides are OPTIONAL.
 - One side is OPTIONAL and one side is MANDATORY.

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Refining an E-R Model

- Weak Entity
 - Put the key of the parent table (strong entity) in the weak entity.
 - The weak entity relationship conforms to the same rules as the 1:M relationship, except foreign key restrictions.
- 1:1 Relationships
 - If both entities are in mandatory participation in the relationship and they do not participate in other relationships, it is most likely that the two entities should be part of the same entity.

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Developing an ERD Tiny College Example

- Tiny College – needs a data base to keep it's information.
- Define Business rules & determine Data Entities
 - Tiny College is divided into several schools
 - Each school is composed of several departments.
 - Each school is administered by a dean. A 1:1 relationship exists between DEAN and SCHOOL.
 - Each dean is a member of a group of administrators (ADMINISTRATOR). Deans also hold professorial rank and may teach a class (PROFESSOR).

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Developing an ER Diagram

- Tiny College Business Rules (cont.)
 - Each school is composed of several departments.
 - The smallest number of departments operated by a school is one, and the largest number of departments is indeterminate (N).
 - Each department belongs to only a single school.
 - Each department may offer courses
 - Each department may have many professors assigned to it
 - Each professor may teach up to four classes; each class is section of course

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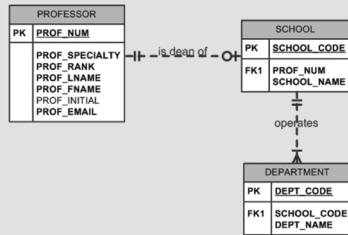
- Business Rules(cont.)
 - Each department has several students
 - Each student has only a single major and is associated with a single department
 - Each student has an advisor in his or her department
 - Each advisor counsels several students
 - Student may enroll in several classes, but (s)he takes each class only once during any given enrollment period
 - A class is taught in a room and the room in the building

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Developing an ER Diagram

FIGURE 4.26 The first Tiny College ERD segment



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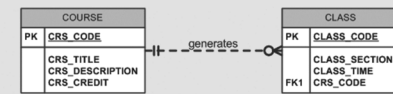
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FIGURE 4.27 The second Tiny College ERD segment



FIGURE 4.28 the third Tiny College ERD segment



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FIGURE 4.29 the fourth Tiny College ERD segment

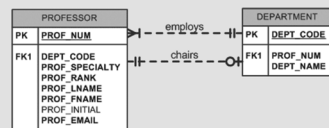
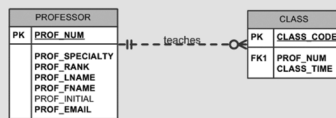


FIGURE 4.30 the fifth Tiny College ERD segment



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FIGURE 4.31 the sixth Tiny College ERD segment

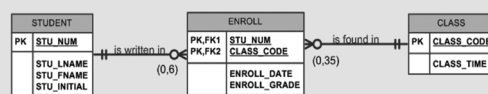
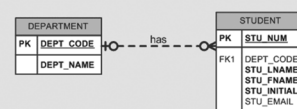


FIGURE 4.32 the seventh Tiny College ERD segment



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FIGURE 4.33 The eighth Tiny College ERD segment

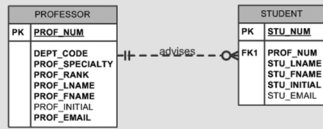
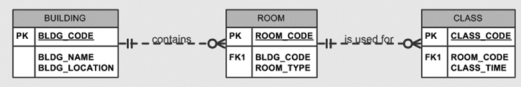


FIGURE 4.34 The ninth Tiny College ERD segment



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Developing an ER Diagram

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."

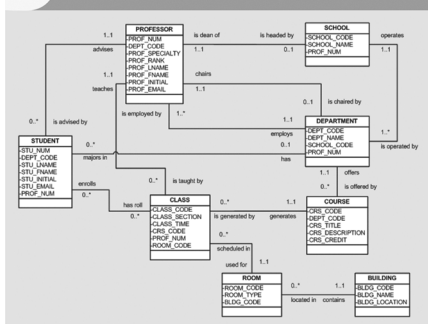
Component chart – shows an entity & relationship. Therefore the entity may be listed several times

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Developing an ER Diagram

FIGURE 4.36 The conceptual UML class diagram for Tiny College



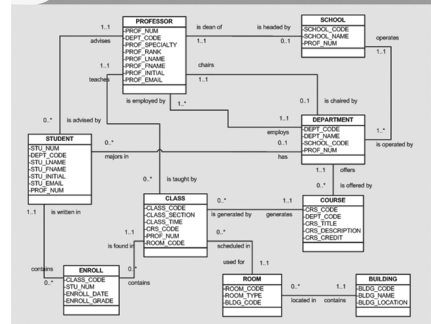
In Visio - Add the cardinality to the Crow's Foot diagram by hand.

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Developing an ER Diagram

FIGURE 4.37 The implementation-ready UML class diagram for Tiny College



Resolve the M:N relationship with a bridge/composite entity.

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- Summary of Tiny College's Entities and Attributes

STUDENT
STU_NUM
STU_FIRST
STU_MIDDLE
STU_LAST
STU_SEX
STU_AGE
STU_GRADE
STU_TRANSFER
DEPT_CODE
TTL_PHONE
EMP_NUM

ENROLL
ENR_NUM
STU_NUM
EMP_NUM
ENR_SECTION
ENR_COURSE
ENR_DATE

CLASS
CLAS_CODE
CLAS_ROOM
CLAS_TIMES
CLAS_INSTR
EMP_NUM

COURSE
COURSE_CODE
COURSE_NAME
COURSE_CREDIT
CLAS_CODE
CLAS_ROOM
CLAS_TIMES
EMP_NUM

EMPLOYEE
EMP_NUM
EMP_LAST
EMP_FIRST
EMP_MIDDLE
EMP_INITIAL
EMP_PHONE
EMP_HIREDATE
EMP_JOB






























PROFESSOR
COURSE_CODE
COURSE_SECTION
EMP_NUM
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EMP_NUM3
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EMP_NUM96
EMP_NUM97
EMP_NUM98
EMP_NUM99
EMP_NUM100

DEPARTMENT
DEPT_CODE
DEPT_NAME
DEPT_PHONE
DEPT_FAX
DEPT_ADDRESS
DEPT_CITY
DEPT_STATE
DEPT_ZIP
DEPT_COUNTRY
DEPT_EXTENSION

SCHOOL
SCH_CODE
SCH_NAME
SCH_PHONE
SCH_FAX
SCH_ADDRESS
SCH_CITY
SCH_STATE
SCH_ZIP
SCH_COUNTRY
SCH_EXTENSION

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FIGURE 4.31 A COMPARISON OF ER MODELING SYMBOLS

	Chen	Crow's Foot	ReinBS	IDEF1X
Entity				
Relationship line				
Relationship				
Option symbol				
One (1) symbol	1			
Many (M) symbol	M			
Composite entity				
Weak entity				

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- 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

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- Interpreting the Business Rules
 - Find Major grouping of Data - NOUNS
 - Find Major relationships between Data - VERBS
 - Verify with the User/Client
- Understructured (high-level conceptual view)
 - Decompose any M:N relationships
 - Review/verify business rules against relational schema
 - How could it be represented in the form
Table(PrimeKey, Attribute2, Attribute3,...)

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ER Diagram Homework Hints

- Overly structured
 - example: Patient Appointment-relationship verbs, sees doctor, sees nurse, has xray,....etc.
 - Delete verbs that will not represent any new or different data sets. Be Careful!
- Cardinality
 - Vocalize the numbers in relationship to the box it is on. That is why there are cardinality symbols at each end of the relationship. “This box representing an Invoice can have one to ten line items” (1,10) “This employee may or may not belong to a department” (0,1)

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ER Diagram Homework Hints

- Mandatory vs Non-mandatory
 - Must be stated in the Business rules
 - Look for statements like “roving employees not attached to a project/department” or “may have” (implies may not have)
 - Where cardinality is (0,x) on one side/entity there will be the **○** symbol on the relationship on the other side/entity.
- Multi-valued attributes
 - Flexibility vs efficiency

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Summary

- 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

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