

7.16. Consider the following set of requirements for a UNIVERSITY database that is used to keep track of students' transcripts. This is similar but not identical to the database shown in Figure 1.2:

- a. The university keeps track of each student's name, student number, Social Security number, current address and phone number, permanent address and phone number, birth date, sex, class (freshman, sophomore, ..., graduate), major department, minor department (if any), and degree program (B.A., B.S., ..., Ph.D.). Some user applications need to refer to the city, state, and ZIP Code of the student's permanent address and to the student's last name. Both Social Security number and student number have unique values for each student.
- b. Each department is described by a name, department code, office number, office number, and college. Both name and code have unique values for each department.
- c. Each course has a course name, description, course number, number of semester hours, level, and offering department. The value of the course number is unique for each course.
- d. Each section has an instructor, semester, year, course, and section number. The section number distinguishes sections of the same course that are taught during the same semester/year; its values are 1, 2, 3, ..., up to the number of sections taught during each semester.
- e. A grade report has a student, section, letter grade, and numeric grade (0, 1, 2, 3, 4 for F, D, C, B, A, respectively).

Design an ER schema for this application, and draw an ER diagram for the schema. Specify key attributes of each entity type, and structural constraints on each relationship type. Note any unspecified requirements, and make appropriate assumptions to make the specification complete.

7.17. Composite and multivalued attributes can be nested to any number of levels. Suppose we want to design an attribute for a STUDENT entity type to keep track of previous college education. Such an attribute will have one entry for each college previously attended, and each such entry will be composed of college name, start and end dates, degree entries (degrees awarded at that college, if any), and transcript entries (courses completed at that college, if any). Each degree entry contains the degree name and the month and year the degree was awarded, and each transcript entry contains a course name, semester, year, and grade. Design an attribute to hold this information. Use the conventions in Figure 7.5.

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{Address_phone( {Phone(Area_code,Phone_number)},Address(Street_address  
(Number,Street,Apartment_number),City,State,Zip) )}
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Figure 7.5

A complex attribute:
Address_phone.

7.18. Show an alternative design for the attribute described in Exercise 7.17 that uses only entity types (including weak entity types, if needed) and relationship types.

7.23. Consider the ER diagram shown in Figure 7.21 for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans.

- List the strong (nonweak) entity types in the ER diagram.
- Is there a weak entity type? If so, give its name, partial key, and identifying relationship.
- What constraints do the partial key and the identifying relationship of the weak entity type specify in this diagram?
- List the names of all relationship types, and specify the (min, max) constraint on each participation of an entity type in a relationship type. Justify your choices.
- List concisely the user requirements that led to this ER schema design.
- Suppose that every customer must have at least one account but is restricted to at most two loans at a time, and that a bank branch cannot have more than 1,000 loans. How does this show up on the (min, max) constraints?

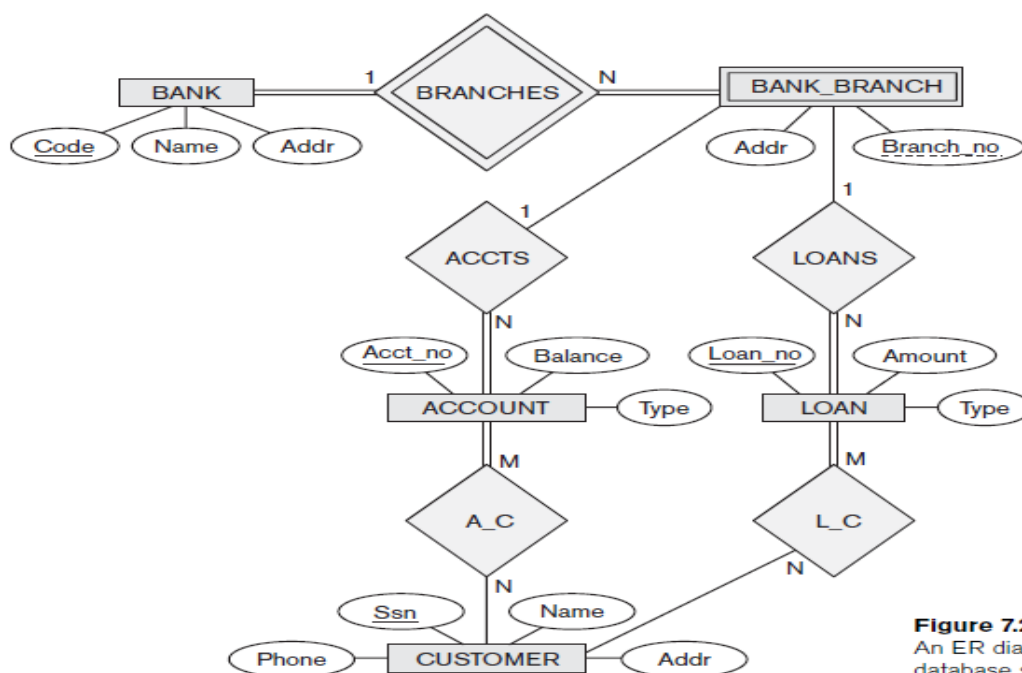


Figure 7.21
An ER diagram for a BANK
database schema.

7.27. Cardinality ratios often dictate the detailed design of a database. The cardinality ratio depends on the real-world meaning of the entity types involved and is defined by the specific application. For the following binary relationships, suggest cardinality ratios based on the common-sense meaning of the entity types. Clearly state any assumptions you make.

Entity 1	Cardinality Ratio	Entity 2
1. STUDENT	_____	SOCIAL_SECURITY_CARD
2. STUDENT	_____	TEACHER
3. CLASSROOM	_____	WALL
4. COUNTRY	_____	CURRENT_PRESIDENT
5. COURSE	_____	TEXTBOOK
6. ITEM (that can be found in an order)	_____	ORDER
7. STUDENT	_____	CLASS
8. CLASS	_____	INSTRUCTOR
9. INSTRUCTOR	_____	OFFICE
10. EBAY_AUCTION_ITEM	_____	EBAY_BID