In this text, the actions to enforce required parents are documented using referential integrity actions on the table design diagrams. The actions to enforce required children are documented by using Figure 6-28(b) as a boilerplate document. An additional complication is that a table can participate in many relationships. Triggers written to enforce the minimum cardinality on one relationship may interfere with triggers written to enforce the minimum cardinality on another relationship. This problem is beyond the scope of this text, but be aware that it exists. The principles for enforcing minimum cardinality are summarized in Figure 6-33.

A database design for the View Ridge Gallery is shown in Figures 6-37, 6-38, 6-39, 6-40, and 6-41. You should understand this design because it will be used throughout the remainder of this book.

Key Terms

action
alternate key (AK)
association table
candidate key
cascading deletion
cascading update
component design
data constraint
database design
DBMS reserved word
default value
domain constraint
interrelation constraint
intersection table
intrarelation constraint
minimum cardinality enforcement action
MUST constraint
MUST COVER constraint
MUST NOT constraint
null status
parent mandatory and child mandatory (M-M)
parent mandatory and child optional (M-O)
parent optional and child mandatory (O-M)
parent optional and child optional (O-O)
range constraint
referential integrity (RI) action
surrogate key
SQL Server IDENTITY ({StartValue}, {Increment}) property
systems analysis and design
systems development life cycle (SDLC)
trigger

Review Questions

6.1 Identify the three major tasks for transforming a data model into a database design.

6.2 What is the relationship between entities and tables? Between attributes and columns?

6.3 Why is the choice of the primary key important?

6.4 What are the three characteristics of an ideal primary key?

6.5 What is a surrogate key? What are its advantages?

6.6 When should you use a surrogate key?

6.7 Describe two disadvantages of surrogate keys.

6.8 What is the difference between an alternate key and a candidate key?

6.9 What does the notation LastName (AK2.2) mean?

6.10 Name four column properties.

6.11 Explain why primary keys may never be null, but alternate keys can be null.

6.12 List five generic data types.

6.13 Describe three ways that a default value can be assigned.

6.14 What is a domain constraint? Give an example.

6.15 What is a range constraint? Give an example.

6.16 What is an intrarelation constraint? Give an example.

6.17 What is an interrelation constraint? Give an example.

6.18 What tasks should be accomplished when verifying normalization of a database design?

6.19 Describe two ways to represent a 1:1 strong entity relationship. Give an example other than one in this chapter.

6.20 Describe how to represent a 1:N strong entity relationship. Give an example other than one in this chapter.

6.21 Describe how to represent an N:M strong entity relationship. Give an example other than one in this chapter.

6.22 What is an intersection table? Why is it necessary?

6.23 What is the difference between the table that represents an ID-dependent association entity and an intersection table?

6.24 List four uses for ID-dependent entities.

6.25 Describe how to represent an association entity relationship. Give an example other than one in this chapter.

6.26 Describe how to represent a multivalued attribute entity relationship. Give an example other than one in this chapter.

6.27 Describe how to represent a archetype/instance entity relationship. Give an example other than one in this chapter.

6.28 What happens when an instance entity is given a non-ID-dependent identifier? How does this change affect relationship design?

6.29 What happens when the parent in an ID-dependent relationship is given a surrogate key? What should the key of the child become?

6.30 Describe how to represent a mixed entity relationship. Give an example other than one in this chapter.

6.31 Describe how to represent a supertype/subtype entity relationship. Give an example other than one in this chapter.

6.32 Describe two ways to represent a 1:1 recursive relationship. Give an example other than one in this chapter.

6.33 Describe how to represent a 1:N recursive relationship. Give an example other than one in this chapter.

6.34 Describe how to represent an N:M recursive relationship. Give an example other than one in this chapter.

6.35 In general, how are ternary relationships represented? Explain how a binary constraint may impact such a relationship.

6.36 Describe a MUST constraint. Give an example other than one in this chapter.

6.37 Describe a MUST NOT constraint. Give an example other than one in this chapter.

6.38 Describe a MUST COVER constraint. Give an example other than one in this chapter.

6.39 Explain, in general terms, what needs to be done to enforce minimum cardinality.

6.40 Explain the need for each of the actions in Figure 6-28(a).

6.41 Explain the need for each of the actions in Figure 6-28(b).

6.42 State which of the actions in Figure 6-28 must be applied for M-O relationships, O-M relationships, and M-M relationships.

6.43 Explain what must be done for the DBMS to enforce required parents.

6.44 What design decisions must be made to enforce required parents?

6.45 Explain why the DBMS cannot be used to enforce required children.

6.46 What is a trigger? How can triggers be used to enforce required children?

6.47 Explain why the enforcement of M-M relationships is particularly difficult.

6.48 Explain the need for each of the design decisions in Figure 6-33.

6.49 Explain the implications of each of the minimum cardinality specifications in Figure 6-38.

6.50 Explain the rationale for each of the entries in the table in Figure 6-40.

Project Questions

6.51 Answer Project Question 5.56 if you have not already done so. Design a database for your model in Project Question 5.56. Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for a required parent, if any, and the form in Figure 6-28(b) for a required child, if any.

6.52 Answer Project Question 5.57 if you have not already done so. Design a database for your model in Project Question 5.57(c). Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

6.53 Answer Project Question 5.58 if you have not already done so. Design a database for your model in Project Question 5.58(d). Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

6.54 Answer Project Question 5.59 if you have not already done so. Design databases for your model in Project Question 5.59(a) and for the model in Figure 5-57. Your designs should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

6.55 Answer Project Question 5.60 if you have not already done so. Design a database for your model in Project Question 5.60(e). Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

6.56 Answer Project Question 5.61 if you have not already done so. Design a database for your model in Project Question 5.61(c). Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

6.57 Answer Project Question 5.62 if you have not already done so. Design a database for your model in Project Question 5.62(d). Your design should include a specification of tables and attributes as well as primary, candidate, and foreign keys. Also specify how you will enforce minimum cardinality. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

Case Questions

Washington State Patrol Case Questions

Answer the Washington State Patrol Case Questions in Chapter 5 if you have not already done so. Design a database for your data model from Chapter 5.

A. Convert this data model to a database design. Specify tables, primary keys, and foreign keys. Using Figure 6-41 as a guide, specify column properties.

B. Describe how you have represented weak entities, if any exist.

C. Describe how you have represented supertype and subtype entities, if any exist.

D. Create a visual representation of your database design as a Crow's Foot E-R diagram similar to the one in Figure 6-37.

E. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

San Juan Sailboat Charters Case Questions

San Juan Sailboat Charters (SJSBC) is an agency that leases (charters) sailboats. SJSBC does not own the boats. Instead, SJSBC leases boats on behalf of boat owners who want to earn income from their boats when they are not using them, and SJSBC charges the owners a fee for this service. SJSBC specializes in boats that can be used for multiday or weekly charters. The smallest sailboat available is 28 feet in length and the largest is 51 feet in length.

Each sailboat is fully equipped at the time it is leased. Most of the equipment is provided at the time of the charter. Most of the equipment is provided by the owners, but some is provided by SJSBC. The owner-provided equipment includes equipment that is attached to the boat, such as radios, compasses, depth indicators and other instrumentation, stoves, and refrigerators. Other owner-provided equipment, such as sails, lines, anchors, dinghies, life

preservers, and equipment in the cabin (dishes, silverware, cooking utensils, bedding, and so on), is not physically attached to the boat. SJSBC provides consumable supplies, such as charts, navigation books, tide and current tables, soap, dish towels, toilet paper, and similar items. The consumable supplies are treated as equipment by SJSBC for tracking and accounting purposes.

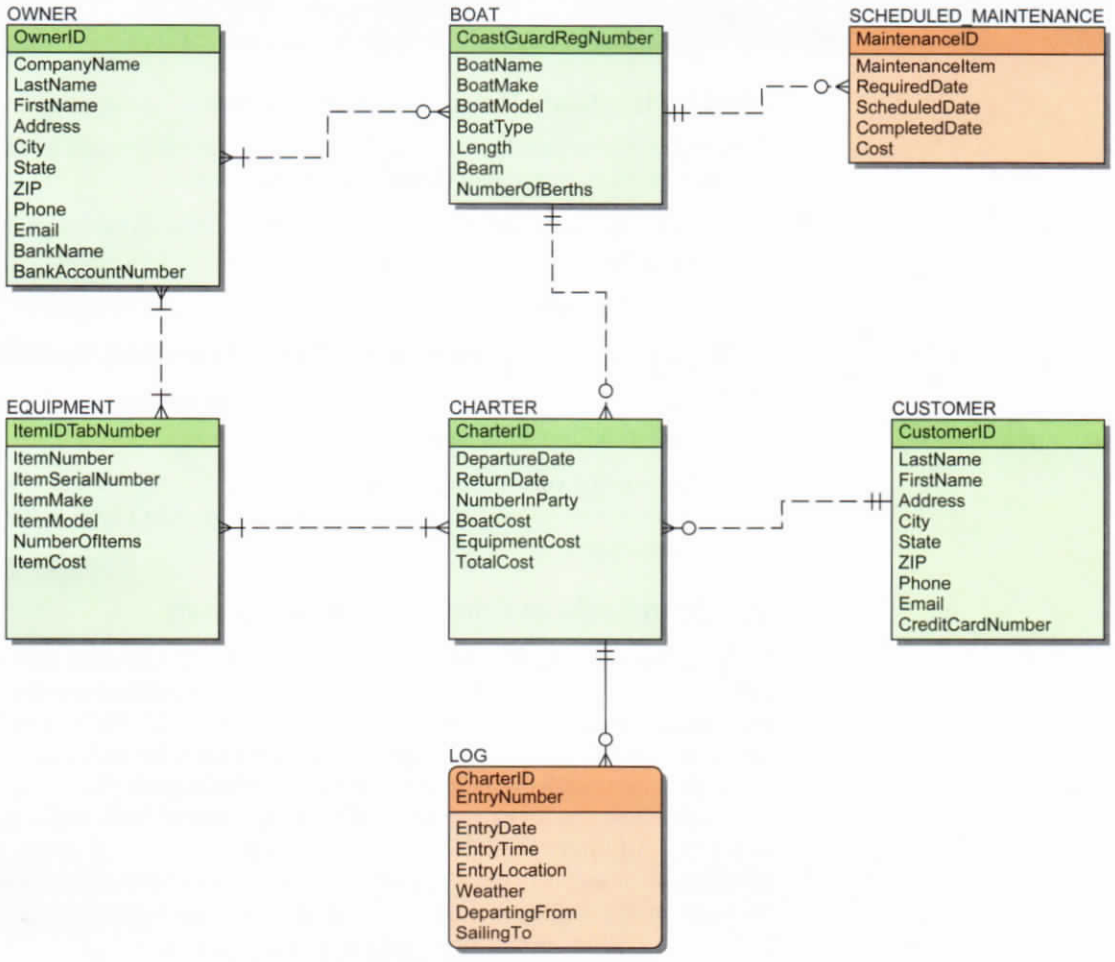
Keeping track of equipment is an important part of SJSBC's responsibilities. Much of the equipment is expensive, and those items not physically attached to the boat can be easily damaged, lost, or stolen. SJSBC holds the customer responsible for all of the boat's equipment during the period of the charter.

SJSBC likes to keep accurate records of its customers and charters, and customers are required to keep a log during each charter. Some itineraries and weather conditions are more dangerous than others, and the data from these logs provide information about the customer experience. This information is useful for marketing purposes, as well as for evaluating a customer's ability to handle a particular boat and itinerary.

Sailboats need maintenance. Note that two definitions of boat are (1) "break out another thousand" and (2) "a hole in the water into which one pours money." SJSBC is required by its contracts with the boat owners to keep accurate records of all maintenance activities and costs.

A data model of a proposed database to support an information system for SJSBC is shown in Figure 6-42. Note that, because the OWNER entity allows for owners to be companies are well as individuals, SJSBC can be included as an equipment owner (note that the cardinalities in the diagram allow SJSBC to own equipment while not owning any boats). Also note that

Figure 6-42
Data Model for San Juan Sailboat Charters



this model relates EQUIPMENT to CHARTER rather than BOAT even when the equipment is physically attached to the boat. This is only one possible way to handle EQUIPMENT, but it is satisfactory to the managers of SJSBC.

A. Convert this data model to a database design. Specify tables, primary keys, and foreign keys. Using Figure 6-41 as a guide, specify column properties.

B. Describe how you have represented weak entities, if any exist.

C. Describe how you have represented supertype and subtype entities, if any exist.

D. Create a visual representation of your database design as a Crow's Foot E-R diagram similar to the one in Figure 6-37.

E. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

The Queen Anne Curiosity Shop

If you have not already done so, complete The Queen Anne Curiosity Shop project at the end of Chapter 5.

A. Convert this data model to a database design. Specify tables, primary keys, and foreign keys. Using Figure 6-41 as a guide, specify column properties.

B. Describe how you have represented weak entities, if any exist.

C. Describe how you have represented supertype and subtype entities, if any exist.

D. Create a visual representation of your database design as a Crow's Foot E-R diagram similar to the one in Figure 6-37.

E. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.

Morgan Importing

If you have not already done so, complete the Morgan Importing project at the end of Chapter 5.

A. Convert this data model to a database design. Specify tables, primary keys, and foreign keys. Using Figure 6-41 as a guide, specify column properties.

B. Describe how you have represented weak entities, if any exist.

C. Describe how you have represented supertype and subtype entities, if any exist.

D. Create a visual representation of your database design as a Crow's Foot E-R diagram similar to the one in Figure 6-37.

E. Document your minimum cardinality enforcement using referential integrity actions for required parents, if any, and the form in Figure 6-28(b) for required children, if any.