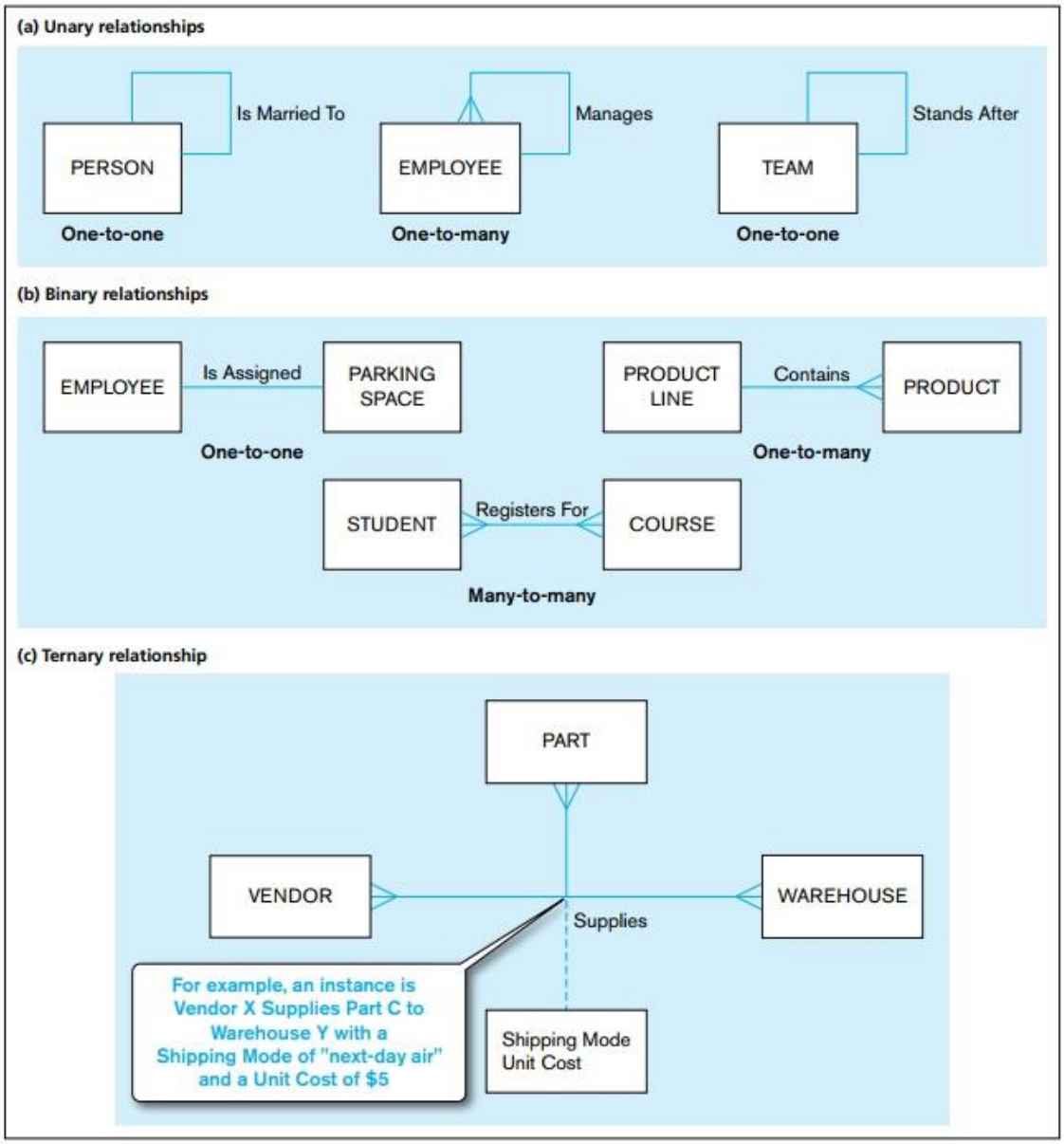
DEGREE OF A RELATIONSHIP

The **degree** of a relationship is the number of entity types that participate in that relationship. The three most common relationship degrees in E-R models are unary (degree 1), binary (degree 2), and ternary (degree 3). Higher-degree relationships are possible, but they are rarely encountered in practice. Examples of unary, binary, and ternary relationships appear in Figure 2-12.

FIGURE 2-12 Examples of relationships of different degrees



Unary Relationship

A **unary relationship** is a relationship between the instances of a *single* entity type. (Unary relationships are also called *recursive relationships*.) Three examples are shown in Figure 2-12a.

Binary Relationship

A **binary relationship** is a relationship between the instances of two entity types and is the most common type of relationship encountered in data modeling. Figure 2-12b shows three examples. The first (one-to-one) indicates that an employee is assigned one parking place, and that each parking place is assigned to one employee.

Ternary Relationship

A **ternary relationship** is a *simultaneous* relationship among the instances of three entity types. A typical business situation that leads to a ternary relationship is shown in Figure 2-12c. In this example, vendors can supply various parts to warehouses. The relationship Supplies is used to record the specific parts that are supplied by a given vendor to a particular warehouse. Thus, there are three entity types: VENDOR, PART, and WAREHOUSE. Don't be confused: A ternary relationship is not the same as three binary relationships. As usual, the presence of an attribute on the relationship Supplies in Figure 2-12c suggests converting the relationship to an associative entity type. Figure 2-14 shows an alternative (and preferable) representation of the ternary relationship shown in Figure 2-12c.

In Figure 2-14, the (associative) entity type SUPPLY SCHEDULE is used to replace the Supplies relationship from Figure 2-12c.

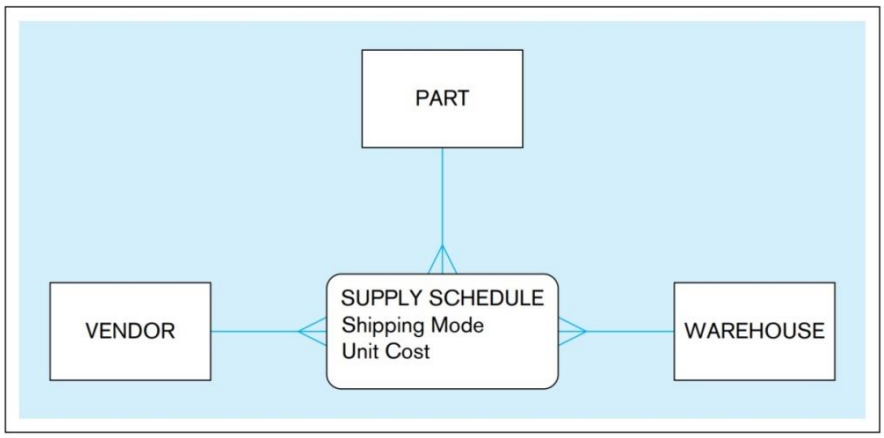


FIGURE 2-14 Ternary relationship as an associative entity

As noted earlier, we do not label the lines from SUPPLY SCHEDULE to the three entities. This is because these lines do not represent binary relationships. To keep the same meaning as the ternary relationship of Figure 2-12c, we cannot break the Supplies relationship into three binary relationships, as we have already mentioned. So, **here is a guideline to follow: Convert all ternary (or higher) relationships to associative entities, as in this example.**

CARDINALITY CONSTRAINTS

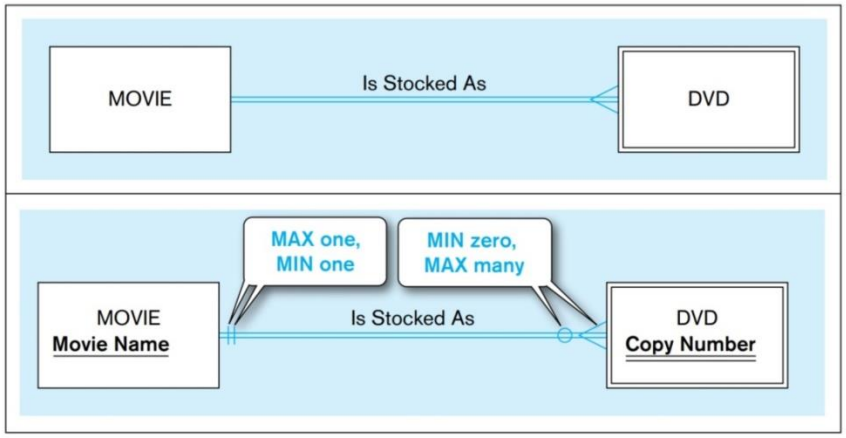
There is one more important data modeling notation for representing common and important business rules. Suppose there are two entity types, A and B, that are connected by a relationship. A **cardinality constraint** specifies the number of instances of entity B that can (or must) be associated with each instance of entity A. For example, consider a video store that rents DVDs of movies. Because the store may stock more than one DVD for each movie, this is intuitively a one-to-many relationship, as shown in Figure 2-16a. Yet it is also true that the store may not have any DVDs of a given movie in stock at a particular time (e.g., all copies may be checked out). We need a more precise notation to indicate the range of cardinalities for a relationship.

Minimum Cardinality

The **minimum cardinality** of a relationship is the minimum number of instances of entity B that may be associated with each instance of entity A. In our DVD example, the minimum number of DVDs for a movie is zero. When the minimum number of participants is zero, we say that entity type B is an optional participant in the relationship. In this example, DVD (a weak entity type) is an optional participant in the Is Stocked As relationship. This fact is indicated by the symbol zero through the line near the DVD entity in Figure 2-16b.

FIGURE 2-16 Introducing cardinality constraints
(a) Basic relationship

(b) Relationship with cardinality constraints



Maximum Cardinality

The **maximum cardinality** of a relationship is the maximum number of instances of entity B that may be associated with each instance of entity A. In the video example, the maximum cardinality for the DVD entity type is "many"— that is, an unspecified number greater than one. This is indicated by the "crow's foot" symbol on the line next to the DVD entity symbol in Figure 2-16b.

A relationship is, of course, bidirectional, so there is also cardinality notation next to the MOVIE entity. Notice that the minimum and maximum are both one (see Figure 2-16b). This is called a *mandatory one* cardinality. In other words,

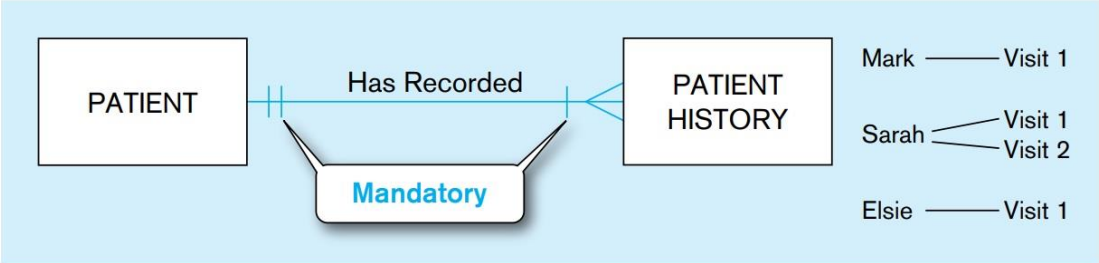
each DVD of a movie must be a copy of exactly one movie. **In general, participation in a relationship may be optional or mandatory for the entities involved. If the minimum cardinality is zero, participation is optional; if the minimum cardinality is one, participation is mandatory.**

Notice that DVD is represented as a weak entity. This is because a DVD cannot exist unless the owner movie also exists. The identifier of MOVIE is Movie Name. DVD does not have a unique identifier. However, Copy Number is a *partial* identifier, which together with Movie Name would uniquely identify an instance of DVD.

Some Examples of Relationships and Their Cardinalities

Following are examples of three relationships that show all possible combinations of minimum and maximum cardinalities. Each example states the business rule for each cardinality constraint and shows the associated E-R notation. Each example also shows some relationship instances to clarify the nature of the relationship. You should study each of these examples carefully.

1. ***PATIENT Has Recorded PATIENT HISTORY (Figure 2-17a)*** Each patient has one or more patient histories. (The initial patient visit is always recorded as an instance of PATIENT HISTORY.) Each instance of PATIENT HISTORY "belongs to" exactly one PATIENT.



2. *EMPLOYEE Is Assigned to PROJECT (Figure 2-17b)* Each PROJECT has at least one EMPLOYEE assigned to it. (Some projects have more than one.) Each EMPLOYEE may or (optionally) may not be assigned to any existing PROJECT (e.g., employee Pete) or may be assigned to one or more PROJECTs.