

1. Give an UML class design for a database recording information about teams, players, and their fans, including:
 - A. For each team, its name, its players, its team captain (one of its players), and the colors of its uniform.
 - B. For each player, his/her name.
 - C. For each fan, his/her name, favorite teams, favorite players, and favorite color.

2. Render the teams/players/fan database of Exercise 1 in the E/R model. Remember that a set of colors is not a suitable attribute type for teams. How can you get around this restriction?

3. In this and following exercises we shall consider two design options in the E/R model for describing births. At a birth, there is one baby (twins would be represented by two births), one mother, any number of nurses, and any number of doctors. Suppose, therefore, that we have entity sets Babies, Mothers, Nurses, and Doctors. Suppose we also use a relationship Births, which connects these four entity sets, as suggested in Fig. 1. Note that a tuple of the relationship set for Births has the form : (baby, mother, nurse, doctor)

If there is more than one nurse and/or doctor attending a birth, then there will be several tuples with the same baby and mother, one for each combination of nurse and doctor.

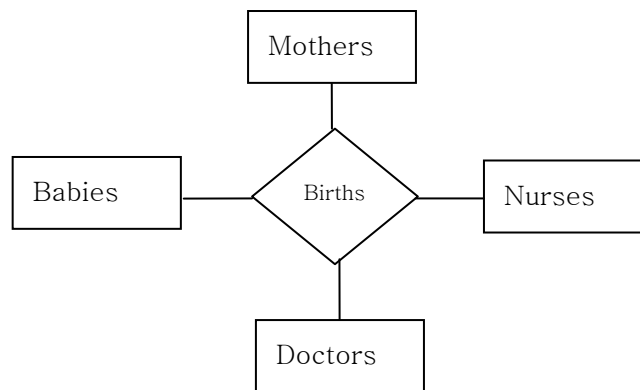


Figure 1. Representing births by a multi-way relationship

There are certain assumptions that we might wish to incorporate into our design. For each, tell how to add arrows or other elements to the E/R diagram in order to express the assumption.

- A. For every baby, there is a unique mother.
- B. For every combination of a baby, nurse, and doctor, there is a unique mother.
- C. For every combination of a baby and a mother there is a unique doctor.

4. Let us consider a database of warships, and its expression in UML. Each warship has the following information associated with it:

- A. Its name.
- B. Its displacement (weight), in tons.
- C. Its type, e.g., battleship, destroyer.

In addition, there are the following special kinds of ships that have some other information:

- A. Gunships are ships that carry large guns, such as battleships or cruisers. For these ships, we wish to record the number and bore of the main guns.
- B. Carriers hold aircraft. For these we wish to record the length of the flight deck and the set of air groups assigned to them.
- C. Submarines, which can travel under water. For these we wish to record their maximum safe depth. You may assume no gunship or carrier is a submarine.
- D. Battlecarriers are both gunships and carriers, and have all the information associated with either.

Answer the following questions:

- I. Give the UML class design for this hierarchy of classes.
- II. Show how the battlecarrier *Ise* would be represented. It had a displacement of 36,000 tons, mounted 8 14-inch guns, had a 200-foot flight deck, and carried air groups “1 and 2

5. Repeat Exercise 4 for the E/R model

6. We may think of relationships in the E/R model as having keys, just as entity sets do. Let R be a relationship among the entity sets E_1, E_2, \dots, E_n . Then a key for R is a set K of attributes chosen from the attributes of E_1, E_2, \dots, E_n such that if (e_1, e_2, \dots, e_n) and (f_1, f_2, \dots, f_n) are two different tuples in the relationship set for R , then it is not possible that these tuples agree in all the attributes of K . Now, suppose $n = 2$; that is, R is a binary relationship. Also, for each i , let K_i be a set of attributes that is a key for entity set E_i . In terms of E_1 and E_2 , give a smallest possible key for R under the assumption that:
- A. R is many-many.
 - B. R is many-one from E_1 to E_2 .
 - C. R is many-one from E_2 to E_1 .
 - D. R is one-one.