Homework 3.
1.264, Fall 2004
Data model for chemical manufacturer
Due: Monday, October 4, 2004

Group homework

A. Overview

In this homework, you will build the data model that will support your Web application. You must include all the entities and relationships that the requirements specify and that are present in the dataset you have been provided, as described in homework 2.

The dataset is on the servers. We’ll show you how to use MS Access to quickly examine the data. Refer to problem set 2 and your requirements for data definitions and a description of the features that must be supported by your data. You don’t need the dataset to do the data model, but it’s there if you want to look at it.

B. Data model

The assignment is to build the data model for the chemical manufacturer. A recommended set of steps is given, although you are free to approach this as you wish. You should use Visio; select the Database modeling tool (see class or recitation notes).

You are allowed to make the following assumptions:

- The international or UN number can be used as a primary or foreign key in all entities in which it appears. All chemical data has UN numbers.
- All UN numbers that are in the Isolation and Emergency Response data are in the Chemical Product data, so the Product entity can be the parent entity in these relationships.

1. Define the Chemical Product entity. Use international (UN) number as the primary key. This defines a unique chemical product at the manufacturer level.

2. Create a separate ChemicalName entity to hold the multiple names associated with each UN number. Don’t keep any chemical names in the Chemical Product entity.
   a. Build the relationship from ChemicalName to ChemicalProduct. In this entire homework, build the relationships right after building each new entity. Visio will help create the foreign/primary key.

3. Create a domain (validation) entity to store the valid values of the chemical class data (1 through 9, with decimal subdivisions). Chemical class should be a foreign key in the Chemical Product entity you define, which Visio will create automatically for you when you create the relationship.

4. Place the quantity limits in a separate QuantityLimit entity, by passenger and cargo vehicle. These should not be in the Chemical Product entity. The separate entity should hold the UN number, vehicle type (cargo or passenger) and quantity limit.
a. You will need a vehicle type domain entity.

   a. You do not need to keep the multiple chemical names in the Emergency Response entity. Use the UN number as the primary key. (The UN number can be used to get the list of the multiple names derived from the Product entity.)
   b. Decide whether the ISOLATION attribute is necessary or not.

6. Define two entities based on Emergency Detail.
   a. Decide the primary keys and relationships to the previous emergency response entity. This takes a bit of thought.

7. Define an entity based on Isolation.
   a. You do not need the multiple chemical names; use the UN number as the primary key.

8. Define the chemical classes, groups and their relationships:
   a. You have already defined a Chemical Class validation entity in step 3 above. It should contain all the classes (1-9) found in the database, including decimal numbers such as 1.1.
   b. Define a Chemical Group validation entity, containing just the values A, B, C, D and E, corresponding to the groups in the distributor and carrier datasets.
   c. Define the mapping between Chemical Classes and Chemical Groups, as defined in the carrier and distributor descriptions in homework 2:
      i. Group A contains class 7
      ii. Group B contains class 1
      iii. Group C contains classes 2, 3 and 8
      iv. Group D contains classes 4, 5 and 6
      v. Group E contains class 9
      Do this by adding chemical group data to the chemical class entity.

9. Define the carrier entity. Use the certificate number as the unique identifier. Include all the carrier attributes except the modes it operates and the groups it handles, which are more complex relationships.

10. Define the distributor entity in the same way as the carrier.

11. Define a Modes entity. Include the 4 modes (highway, rail, water, air) in a separate validation entity.
    a. Then relate the carriers to the modes that they can offer. This is a many-many relationship, so you’ll need an associative table.
    b. Do the same for the modes that the distributors can use.

12. Define entities and relationships between the carriers and the chemical groups they transport. Do the same for the distributors and the chemical groups they can receive. These are also many-many relationships that require associative tables.
13. Define an entity to hold the manufacturer orders. This contains data specific to the entire order. See homework 2 for what the order contains.

14. Define an entity to hold the order detail for each order. (There can be many items ordered in a single order.) See homework 2.
   a. This contains line item details for the order: it stores the individual chemical products and the related data (container, quantity, price) in the order. Note that you should store the price of each product, since prices change frequently and the price in the product catalog at a later time may not be the price in effect when the order was placed. It is common practice to store current price in each order.

15. Define a container domain (validation) entity. It has 4 rows: cylinder, drum, pail and custom. Use it to validate the container type on orders.

16. You do not need to define validation (domain) entities for state, city and zip code.

17. If you have additional requirements from your homework 2 solutions, include them.

18. For all entities: define the primary key, foreign keys (if any), all attributes and all relationships.

You should have about 20 entities as your final result. Your model should be in fifth-normal form; if you follow the suggestions in the homework, it will be, with the exception of the state, city and zip code data. (Purists might debate large spill vs. small spill and a few other items!)

C. UML Diagrams

Based on your requirements from homework 2, create UML diagrams as follows:

1. Use case diagram(s) for your order entry process, including handling of out-of-stock, credit check or purchase order checking, and mode or carrier selection.
2. Deployment diagram for the key hardware, network and software components for your system. We haven’t covered this material yet in class; use prior knowledge and the requirements in homework 2 to create an initial diagram. We won’t grade off if you don’t have the hardware or network configured correctly.
3. State diagram for your order entry process, as you defined in your requirements.
4. Collaboration or sequence diagram for users browsing your chemical product catalog, carrier information, and emergency handling information. Make this consistent with your requirements. At a minimum, your internal corporate users must have access to all this information (even if you didn’t explicitly identify this as a requirement!) You may choose either a collaboration or sequence diagram; just do one or the other.

D. Assignment

1. Hand in the data model electronically.
a. You should use the Visio drawing tool, but you may use other tools if you wish.

b. Please make your model fit on one page if possible, no more than two pages otherwise.

c. Please lay out your model so that it is clear: avoid relationship lines crossing each other, place related entities near each other, etc.

2. The data model must include all entities, keys (primary and foreign), attributes, and relationships (including their types, such as one-to-many). You don't need to indicate which attributes are mandatory (not null), unique or indexed. Indicate keys explicitly for each entity.
   a. Include domain relations (validation entities).
   b. If there are many-to-many relationships, represent them explicitly as a pair of many-to-one relationships with an intermediate entity.

3. Hand in the UML diagrams electronically.
   a. You should use the Visio drawing tool, but you may use other tools if you wish.

4. If you use another tool, please identify what you used, and please submit your homework in a format, such as PDF, that we can read without having your software. Please check with a TA before using a tool other than Visio.