

Homework 4
1.264, Fall 2013
Data model for the aircraft parts distributor
Due: Monday, October 7

This is an almost-two week homework; it is almost twice as long as usual. You should complete the first half of it by October 2.

A. Overview

In this homework, you will build the data model that will support your Web application. The dataset is on the course Web site; we will cover how to examine it briefly in class or office hours. Refer to problem set 2 and your requirements for data definitions and a description of the features that must be supported by your data.

B. Data model

The assignment is to build the data model for the aircraft parts distributor. A recommended set of steps is given but you are free to approach this differently if you wish. You must use Visual Paradigm; select the Entity Relationship Diagram.

You are allowed to make the following assumptions:

- a. You do not need to define the data type of any attribute: it will default to Visual Paradigm's default setting.
 - b. You do not need to model which parts can be handled by which modes.
1. Define an entity for MIDO (the FAA manufacturing inspection district offices):
 - a. Select an appropriate primary key
 - b. Include only data that depends on the entire key, e.g. MIDO-specific data.
 2. Define an entity for PMA Holder (parts manufacturer approval), or the manufacturers of the replacement parts. Use the same steps as for the MIDO entity.
 3. Define an entity for ApprovalMeans. Same steps. This is a domain (validation) entity to store the valid values of approval means.
 4. Define an entity for Customer. The customer is the airline or individual buying parts from you. You may wish to distinguish between aircraft and balloon parts customers. Same steps.
 5. Define an entity for Aircraft Manufacturer.
 - a. Select an appropriate primary key.

- b. You may add facts about address, contact information, etc. even though we have no data on those attributes right now. You may want to indicate its type: jet aircraft or balloon.
6. Define an entity for the Aircraft Models:
 - a. Use a composite key as the primary key: aircraft manufacturer and aircraft model together define a unique aircraft
 - b. Validate manufacturer; create a foreign key relationship with the Manufacturer table.
 7. Define an entity for Original Aircraft Part. This is the ‘replacement for’ data element.
 - a. Use a composite primary key, since a combination of aircraft manufacturer and part number is necessary to uniquely define a part.
 - b. There is only a single part name in the source data; you may use it both for the original and replacement part name.
 - c. Validate the portion of the primary key that must be present in another table to be valid, as a foreign key.
 8. Define an entity for Replacement Parts: This is the first really complex entity.
 - a. Use a composite key as the primary key: PMA holder and part number. This defines a unique aircraft replacement part.
 - b. Add appropriate facts about the replacement aircraft part to this entity. Remember that an attribute must be a function of the key, the entire key and nothing but the key.
 - c. Establish the validation or foreign key relationships that define this entity. Validate PMAHolder, MIDO, the original part (called ReplacementFor) and its manufacturer as a compound foreign key (both from the OriginalPart entity), and ApprovalMeans.
 9. Define the relationship between Aircraft Models and Replacement Parts. If it is many-to-many, define the intermediate entity necessary, along with the appropriate relationships between it and Aircraft Models and Replacement Parts.
 - a. Can an Aircraft Model have more than one replacement part?
 - b. Can a replacement part replace more than one Aircraft Model?
 - c. If the answer to both of these questions is ‘yes’, you have a many-to-many relationship. Define the intermediate (associative) entity and the relationships, using foreign keys.
 10. Define an entity for Transportation Carrier and related items. You will need entities for mode, and an entity that stores which carriers provide which modes. (No detailed hints provided, but you’ll need a Modes entity and an entity to relate carriers and modes.)
 11. Define an entity for Orders.

- a. This contains data specific to the entire order, such as the customer, shipping address, date, payment, and the like.
 - b. Don't call the entity Order, since that is an SQL keyword! Call it OrderHeader or similar.
 - c. Treat purchase order versus credit card as simply as you wish. It is ok in this homework, for simplicity, to just have a single attribute that hold the credit card or purchase order number, since we're not modeling payment in detail.
12. Define an entity for Order Details.
- a. This contains line item details for the order: it stores the individual parts and the related data in the order. Note that you should store the price of each part, since prices may change and the price in the parts catalog at a later time may not be the price in effect when the order was placed.
 - b. Similarly, keep other data, such as the approval means, for the same reason.
 - c. You may need to keep quantity ordered and quantity shipped attributes, if you handle partial shipments or back orders. The details depend on your group's requirements.
13. Define any additional entities that your requirements call for. Include any domain entities necessary.
- a. You do not need to define domain (validation) entity(s) for state, city and zip code.
 - b. You may need to define entities for valid order status, manufacturer or customer type (aircraft or balloon), etc. These depend on your own requirements.
 - c. You may need entities for payment type (credit cards versus purchase orders), depending on your requirements.
14. Define the relationships among all entities where hints were not given.
- a. For all entities in the data model, define all attributes, the primary key, and foreign keys (if any). The keys may be composite.
15. A few more details to complete your model:
- a. Each replacement part is inspected by a MIDO office.
 - b. Replacement parts from the same PMA holder can be inspected by different MIDOs.
 - c. An approval is for the replacement part. It may be issued by any one of the MIDOs.
 - d. You don't have to model a relationship from MIDO to PMA Holder. The relationship is between MIDO and replacement part.
16. **For all entities: define the primary key, foreign keys (if any), all attributes and all relationships. You do not have to choose a data type for each attribute (integer, etc.) You do not have to worry about which attributes can be null or must be unique (other than primary keys).**

You should have about 15 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. (State and city are weak functions of zip code, so this is technically a violation of third normal form.)

C. Assignment

1. Hand in the data model electronically on the course Web site.
 - a. You must use the Visual Paradigm drawing tool.
 - 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., as much as possible.
2. The data model must include all entities, keys (primary and foreign), attributes, and relationships (including their types, such as one-to-many). Indicate keys explicitly for each entity. Include domain relations (validation entities). You do not need to be careful about null, unique or data type for attributes.

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