Lab Session 05

(Relational Modeling)

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SQL Data Modeler

Oracle SQL Developer Data Modeler is a standalone, independent product, available for download from the Oracle Technology Network (OTN). SQL Developer Data Modeler runs on Windows, Linux and Mac OS X.

Logical Models:

The logical model in SQL Developer Data Modeler includes standard logical modeling facilities, such as drawing entities and relationships etc.

Relational Models:

The SQL Developer Data Modeler relational model is an intermediate model between the logical model and the physical models. It supports relational design decisions independent of the constraints of the target physical platform(s). All many-to-many relationships and all super type/sub-types entity hierarchies are resolved during forward engineering (transformation) of the logical model, or part of it, to a relational model.

Physical Model:

A physical data model defines all of the logical database components and services that are required to build a database or can be the layout of an existing database.

A physical data model consists of the table's structure, column names and values, foreign and primary keys and the relationships among the tables.

Data Modeling for a Small Database

We will use SQL Developer Data Modeler to create models for a simplified library database

Entities Included will be:

- Books
- patrons (people who have library cards)
- Transactions (checking a book out, returning a book, and so on).

We are using only a subset of the possible steps for the

Top-Down Modeling approach.

1. Develop the Logical Model.
2. Develop the Relational Model.
3. Generate DDL.
4. Save the Design.

1.Develop the logical model

The logical model for the database includes three entities:

Books (describes each book in the library),

Patrons (describes each person who has a library card), and

Transactions (describes each transaction involving a patron and a book).

Before we create the entities, we will create some domains that will make the entity creation (and later DDL generation) more meaningful and specific.

- **Adding Domains**

  In planning for our data needs, we have determined that several kinds of fields will occur in multiple kinds of records, and many fields can share a definition. For example, we have decided that:

- The first and last names of persons can be up to 25 characters each.
- Street address lines can be up to 40 characters.
- City names can be up to 25 characters.
- State codes (United States) are 2-character standard abbreviations.
- Zip codes (United States postal codes) can be up to 10 characters (*nnnnn-nnnn*).
- Book identifiers can be up to 20 characters.
- Other identifiers are numeric, with up to 7 digits (no decimal places).
- Titles (books, articles, and so on) can be up to 50 characters.

  These added domains will also be available after we exit Data Modeler and restart it later.

Steps to add domains:

1. Click Tools, then Domains Administration.
2. In the Domains Administration dialog box, add domains with the following definitions. Click Add to start each definition, and click Apply after each definition.
3. When we have finished defining these domains, click Save. This creates a file named defaultdomains.xml in the domains directory (folder) under the location where we installed Data Modeler.
4. Optionally, copy the defaultdomains.xml file to a new location (not under the Data Modeler installation directory), and give it an appropriate name, such as library_domains.xml. We can then import domains from that file when we create other designs.

5. Click Close to close the dialog box.

Creating Entities

Creating the book Entity:

- Create the Books entity as follows:
- In the main area (right side) of the SQL Developer Data Modeler window, click the Logical tab.
- Click the New Entity icon.
- Click in the logical model pane in the main area; and in the Logical pane press, diagonally drag, and release the mouse button to draw an entity box. The Entity Properties dialog box is displayed.
- Click General on the left, and specify as follows:
- Name: Books
- Click Attributes on the left, and use the Add (+) icon to add the following attributes, one at a time. (For data types, select from the Domain types except for Rating, which is a Logical type.)

Name	Datatype	Other Information and Notes
book_id	Domain: Book Id	Primary UID (unique identifier). (The Dewey code or other book identifier.)
title	Domain: Title	M (mandatory, that is, must not be null).
author_last_name	Domain: Person Name	M (mandatory, that is, must not be null).
author_first_name	Domain: Person Name	25 characters maximum.
rating	Logical type: NUMERIC (Precision=2, Scale= 0)	(Librarian's personal rating of the book, from 1 (poor) to 10 (great).)

Creating the Patrons Entity

Attribute Name	Type	Other Information and Notes
patron_id	Domain: Numeric Id	Primary UID (unique identifier). (Unique patron ID number, also called the library card number.)
last_name	Domain: Person Name	M (mandatory, that is, must not be null). 25 characters maximum.
first_name	Domain: Person Name	(Patron's first name.)
street_address	Domain: Address Line	(Patron's street address.)
city	Domain: City	(City or town where the patron lives.)
state	Domain: State	(2-letter code for the state where the patron lives.)
zip	Domain: Zip	(Postal code where the patron lives.)
location	Domain:Address	Oracle Spatial geometry object representing the patron's geocoded address.

Creating the Transactions Entity:

Attribute Name	Type	Other Information and Notes
tranction_id	Domain: Numeric Id	Primary UID (unique identifier). (Unique transaction ID number)
transaction_date	Logical type: Datetime	M (mandatory, that is, must not be null). Date and time of the transaction.
transaction_type	Domain: Numeric Id	M (mandatory, that is, must not be null). (Numeric code indicating the type of transaction, such as 1 for checking out a book.)

Creating Relations between Entities

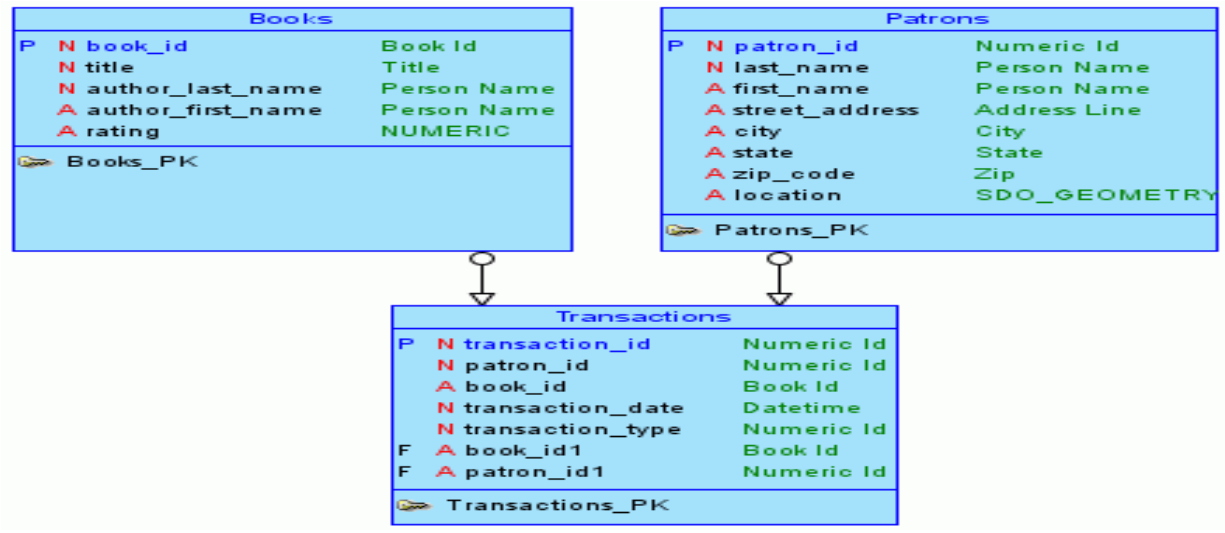
Relations show the relationships between entities: one-to-many, many-to-one, or many-to-many. The following relationships exist between the entities:

Books and Transactions: one-to-many. Each book can be involved in multiple sequential transactions. Each book can have zero or one active checkout transactions; a book that is checked out cannot be checked out again until after it has been returned.

Patrons and Transactions: one-to-many. Each patron can be involved in multiple sequential and simultaneous transactions. Each patron can check out one or many books in a visit to the library, and can have multiple active checkout transactions reflecting several visits; each patron can also return checked out books at any time.

Steps to Create Relationships:

1. In the logical model pane in the main area, arrange the entity boxes as follows: Books on the left, Patrons on the right, and Transactions either between Books and Patrons or under them and in the middle. (If the pointer is still cross-hairs, click the Select icon at the top left to change the pointer to an arrow.)
2. Click the New 1: N Relation icon.
3. Click first in the Books box, then in the Transactions box. A line with an arrowhead is drawn from Books to Transactions.
4. Click the New 1: N Relation icon.
5. Click first in the Patrons box, then in the Transactions box. A line with an arrowhead is drawn from Patrons to Transactions.
6. Optionally, double-click a line (or right-click a line and select Properties) and view the Relation Properties information.



2. Develop the Relational Model

The relational model for the library tutorial database consists of tables that reflect the entities of the logical model (Books, Patrons, and Transactions) and all attributes of each entity. In the simplified data model for this tutorial, a single relational model reflects the entire logical model; however, for other data models we can create one or more relational models, each reflecting all or a subset of the logical model. (To have a relational model reflect a subset of the logical model, use the "filter" feature in the dialog box for engineering a relational model.).

Develop the relational model as follows:

1. With the logical model selected, click **Design**, then **Engineer to Relational Model**. The Engineering dialog box is displayed.
2. Accept all defaults (do not filter), and click **Engineer**. This causes the Relational_1 model to be populated with tables and other objects that reflect the logical model.
3. Optionally, expand the Relational Models node in the object browser on the left side of the window, and expand Relational_1 and nodes under it that contain any entries (such as Tables and Columns), to view the objects created.
4. Change the name of the relational model from Relational_1 to something more meaningful for diagram displays, such as Library (relational). Specifically, right-click Relational_1 in the hierarchy display, select **Properties**, in the General pane of the Model Properties - <name> (Relational) dialog box specify **Name** as Library (relational), and click **OK**.

3. Generate DDL

Develop the physical model as follows:

1. Optionally, view the physical model before we generate DDL statements:
    a. With the Library logical model selected, click Physical, then Open Physical Model. A dialog box is displayed for selecting the type of database for which to create the physical model.
    b. Specify the type of database (for example, Oracle Database 11*g*), and click OK. In the hierarchy display on the left side of the window, a Physical Models node is added under the Library relational model node, and a physical model reflecting the type of database is created under the Physical Models node.
    c. Expand the Physical Models node under Library (the relational model), and expand the newly created physical model and nodes under it that contain any entries (such as Tables and Columns), to view the objects created.
2. Click File, then Export, then DDL File.

3. Select the database type (for example, Oracle Database 11g) and click Generate. The DDL Generation Options dialog box is displayed.
4. Accept all defaults, and click **OK**. A DDL file editor is displayed, with SQL statements to create the tables and add constraints. (Although we can edit statements in this window, do not edit any statements for this tutorial exercise.)
5. Click **Save** to save the statements to a .Sql script file (for example, create_library_objects.sql) on were local system.

Later, run the script (for example, using a database connection and SQL Worksheet in SQL Developer) to create the objects in the desired database.

6. **Close** to close the DDL file editor.

4. Save the Design

Save the design by clicking File, then save. Specify the location and name for the XML file to contain the basic structural information (for example, library_design.xml).

A directory or folder structure will also be created automatically to hold the detailed information about the design

Continue creating and modifying design objects, if we wish. When we are finished, save the design again if we have made any changes, then exit SQL Developer Data Modeler by clicking File, then Exit.

Exercise-1

1. Consider the following set of requirements for a UNIVERSITY database that is used to keep track of students' transcripts.

a) The university keeps track of each student's name, student number, Social Security number, current address and phone number, permanent address and phone number, birth date, sex, class (freshman, sophomore, ..., graduate), major department, minor department (if any), and degree program (B.A., B.S., ..., Ph.D.). Some user applications need to refer to the city, state, and ZIP Code of the student's permanent address and to the student's last name. Both Social Security number and student number have unique values for each student.

b) Each department is described by a name, department code, office number, office phone number, and college. Both name and code have unique values for each department.

c) Each course has a course name, description, and course number, number of semester hours, level, and offering department. The value of the course number is unique for each course.

d) Each section has an instructor, semester, year, course, and section number .The section number distinguishes sections of the same course that are taught during the same semester/year; its values are 1, 2, 3, ..., up to the number of sections taught during each semester.

e) A grade report has a student, section, letter grade, and numeric grade (0, 1, 2, 3, or 4).

f) Design an ER schema for this application, and draw an ER diagram for the schema using Sql data modeler. Perform forward engineering.

Exercise-2

2. Consider a *mail order* database in which employees take orders for parts from customers.

The data requirements are summarized as follows:

a) The mail order company has employees identified by a unique employee number, their first and last names, and a zip code where they are located.

b) Customers of the company are uniquely identified by a customer number. In addition, their first and last names and a zip code where they are located are recorded.

c) The parts being sold by the company are identified by a unique part number. In addition, a part name, their price, and quantity in stock are recorded.

d) Orders placed by customers are taken by employees and are given a unique order number. Each order may contain certain quantities of one or more parts and their received date as well as a shipped date is recorded.

Design an Entity-Relationship diagram for the mail order database and enter the design using Sql data modeler.