Advanced Data Base
(8trd157)
Lab1 : *(project phase 1 of 4)*

Conceptual Data Model Design using E/R and Relational Methods
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General Objective of the Data Base Project *(4 phases)*

Model, design and implement a secure, interactive and multi-user system using 3 relational DBMS*)*: Oracle 8i *(Unix),* Access *(Windows),* Open/Ingres *(Unix)* . An object DBMS *(Oracle Codasyl, Unix, Open/VMS)* will be shown for demo only. The development team will need 3 system analysts and one DBA *(Data Base Administrator)* for the design of all data models *(global/partial, conceptual /logical)* and the implementation of the complete system supporting a centralized and a distributed access using a client/server method.

The centralized access will use SQL, PL/SQL, C and PHP programming languages to access the data base; the distributed access will use more than one server and the integration of a personal data base. The distributed access will use Oracle client et Access/odbc.

1 Objective of lab1: project phase 1 of 4
Create a global conceptual data model and 5 partial data models using 2 different types of data model: network *(Entity/Relationship)* and relational.

2 Description
The general manager of an industry plant wants to improve the productivity of the actual system whose purpose is to control the inventory in the central store in order to satisfy the needs of the three departments involved :

- Maintenance Department where technicians go to the central store to get the necessary parts to repair equipments.

- Purchasing Department makes sure that parts are always available in the central store. If some parts, under the responsibility *(electrical, office, network, computer, vehicles, ...)* of a purchasing agent have to be reordered, a purchasing agent will check different suppliers *(price, delivery delay, unit, ...)* before preparing a purchase order and sending it to a given supplier. The purchasing department supervisor assigns the responsability of each part to a purchasing agent. He can also check the number of purchase orders prepared by each one with the total value of all purchase orders for a certain period in order to balance the task of each purchasing agent.

- Store Department where each storekeeper controls the parts in the store; if a technician needs some parts, he gives to the storekeeper a signed authorized request to receive the specified parts . The storekeeper keeps the inventory file up to date. If the number of parts is below the minimum quantity, he will phone to the purchasing agent responsible for these parts to prepare a purchase order. The storekeeper supervisor is responsible of all storekeepers and the store.

Each computer system analyst works in a different department to implement application programs for their local users. Each one of these 3 analysts could use a different environment *(ex. VB, Java, PHP, C#, C++, Delphi, Windows, Solaris, VMS, Linux, MacOS, PC, Sun, Mac, Access, Oracle, Ingres, Codasyl DBMS, MySQL, ...).* A DBA *(Data Base Administrator)* is responsible for the design of the centralized and the distributed database, its implementation and optimization after analyzing the security, confidentiality and the type of access for end users and developers. The DBA must fill the needs of each system analyst and programmer in the company by creating the appropriate data model and its corresponding data base that will support all user transactions ; the DBA is also responsible of the data base security and confidentiality.

Each program will be called on any user station connected to the company's LAN but some transactions must be accessible to the user by an HTTP client like "Internet Explorer" after being authenticated; for example, only a purchasing agent could prepare and send a purchase order directly from a hôtel room by using an internet access.

2.1 Maintenance Department

Technicians working for this department need to know the part number, the part name, the cost of one unit, the unit *(ex. gram, box, unit, kg, ...),* the minimum quantity that should be in stock, the actual quantity in stock and the quantity on order of each part or any component of this part. There is no difference between a part and a component which is also a part. A part may or may not be a component of another part. For example, an engine and a crankshaft are both a part but the crankshaft is a component of the engine and the engine is a component of a given car. Technicians would like to display all the components of a part *(explosion of a part)* and all parts where a given part is a component for them *(implosion of a part).* Technicians are responsible to create or delete a component.

2.2 Purchasing Department

Many **Purchasing Agents** ***(PA)*** work for the purchasing department under the responsability of the purchasing department supervisor. Each PA is responsible of a set of logically related parts *(ex. office parts, vehicles, network equipments, electricital parts, plumbing parts, external consulting contracts, ...).* Only the agent responsible for a given part may prepare a purchase order for that part. When a new part is assigned by the supervisor to an agent, the agent will create a part in the system *(no_part, part_name)* and will specify at the same time the minimum quantity to be in stock according to the technicians. The unit price of a part will be determined by a simple calculation as soon as a purchase order is created. The last purchase order will always fix the same price for all parts already in the store.

Daily reports coming from the StoreKeepers *(SK)* show to the purchasing agents the parts that need to be re-ordered *(quantity in stock <= minimum quantity).* A PA can then check different suppliers catalog to choose a product for a particular part. The following information is available for each supplier :

supplier_number, supplier_name, supplier_address, supplier_contact_name and the catalog of his products specifying the product_number, product_name, the product_unit (integer being a multiple of a unit part) and the supplier_ unit_price.

The serial number of the supplier product is different from the part number. Each company is independant and may use its own codification system.

The purchasing agent (PA) could call the contact person of a given supplier to make sure that the data read from their catalog is correct and verify the delivery delay. He will then prepare a purchase order with the following information and send it to the supplier :

purchasing_agent_name, purchase_order_number, purchase_order_date, supplier_number, supplier_name, supplier_address, supplier_contact_name and for each product ordered : the *supplier_product_number, supplier_product_name, product_unit, quantity_ordered, unit_price and purchase_order_total.*

The PA then modifies the inventory file by updating the quantity_ordered and the revised price of the cost of each unit part. The last purchase order always fixes the price of the corresponding part based on the unit cost of the suppler product *(an integer which is a multiple of the part_unit (alpha-numeric) (see annex 2).* This knowledge gives you the possibility of modifying easily the ordered quantity of part and its unit price by dividing or multiplying these data by the product_unit of the supplier.

Note: No profit is added and no other cost *(no transportation cost, no custom fee, no broker cost and all taxes included)* need to be considered to simplify all calculations.

A PA is responsible for creating a new part and all information concerning suppliers and their products. He also wants to access all previous purchase orders already sent to a given supplier in the past for a given part number. Before authorizing the payment of the supplier for a purchase order, he will wait for a storekeeper to confirm that the shipping is complete *(all products purchased in that purchase order has been received).* A status "completed" will be written on a copy of this purchase order and sent to the account payable department. After the payment, a status "paid" will be stamped on this copy *(however this transaction is not considered in this lab).*

The **Purchasing Department Supervisor (PDS)** wants to be able to do these transactions:

- Create a purchasing agent *(employee_number, PA_name)*
- Assign a part under the responsability of a PA.
- Modify the responsability of a part from one PA to another PA.
- Display the number of purchase orders and the total value sent by a given PA since a given date.
- Display each PA *(employee_number, PA_name)* with the total and list of all parts *(part_number, part_name)* under his responsability.

2.3 Store Department

When a maintenance technician needs a new part, he checks by calling a **StoreKeeper *(SK)*** if the required quantity of this part *(part_number, quantity_stock)* is available in the store. Then he goes to the store and he gives to the storekeeper a signed authorization form specifying the part_number and the quantity of each part needed. The storekeeper gives the physical parts to the technician and updates the part quantity *(part_number, quantity_ stock).*

Everyday, SK's prepare the lists of all parts that need to be re-ordered by PA's because the actual quantity in stock is less than the minimum recommended. Each list is sent to the right PA. Twice a year, SK's check the actual quantity in stock and compare with the value *(quantity_in_stock)* for each part. They will then update the value in their inventory file and prepare a report mentioning the loss for the company and the parts involved.

When a supplier ships his products following a purchase order, the storekeeper is responsible to check and validate this delivery. He will get a copy of the purchase order and according to the required quantity, each product will be verified. The corresponding inventory part file *(part_number, quantity_ordered, quantity_stock)* will then be updated accordingly to the quantity received and the supplier_product_unit . If the quantity received is more than the requested quantity, it will returned to the supplier. The purchase order will be updated at the same time *(quantity_ordered).* Many deliveries could be done for one purchase order.

The **StoreKeeper Supervisor (SKS)** would like to know 1) the number of parts in the store having a different part number, 2) the value and the total number of all parts actually in the store including those having the same part numbers.

3 Methodology recommended for the lab

- Download the visio_demo.vsd *(2007 or 2003 visio file)* and the transaction table *(Excel file)* from the web site.

- For the first user type *(ex. PA type)* identify the transactions needed in the transaction table *(transaction_name, description)* and draw with the downloaded visio symbols *(entity, relation)* the partial E/R data model to support those transactions. Do not forget to name each entity, attribute and relation with a meaningful identification. Save this visio file under the name *"partial_data_model_user***"*. Complete the transaction table *(entity, key, access, frequency, ...)* and verify if each transaction will be able to be executed using your data model then save it under the name *"transaction_user***"*. Copy this data model to another visio file called *"global conceptual E/R Data Model" (hybrid method for complex data model).*

- Proceed the same for another user type *(ex. technician).* Make another copy of the transaction table, fill it with the needed transactions for this user and create the corresponding partial data model file with the name *"partial_data_model_user%%%"* and the *"transaction_user%%%"*. Update your global conceptual data model to support all actual partial data models.

- Proceed the same for the 3 remaining user types, each one having their own transaction table and partial data model. The global conceptual data model will now be complete.

- Before mapping the E/R data model to the relational data model, contact an assistant professor or the professor to validate your models, it will save you a lot of time.

- Proceed with the mapping of the global conceptual data model to the relational form. Underline the appropriate keys (1 line == 1 table).

- Normalize the global conceptual relational data model *(one table, one line).* Check if the 3rd , 4th or 5th normal form would be better.

- Extract from this global relational data model the partial relational data model for each one of the 5 user types.

4. Format of the team report

Create a Word document. Use copy to get your Visio and Excel files from the previous steps and paste them in your document. This document will continue to grow with each lab. The final report is the result of lab1, lab2, lab3, lab4 and lab6 . This report will be sent by email (pgirard@uqac.ca) before **June 24th 2013** and should be formatted this way :

Final Report
(respect the following order)

- one title page specifying the name of the project, project team identification *(student names, UQAC code and TUT code, date),* username and password to test all labs with name of C programs (lab4) et URL (lab6)

- one page for the table of contents *(sections and page number)*

- one page for the global conceptual E/R data model *(entities, relations, attributes)* (LAB1)
- one page for the global relational data model (1 table ➔ 1 line) (LAB2)
- one page for the global relational data model (graphical representation) (LAB2)
- execution showing the creation of tables &views and the loading of data for all tables (LAB2)

Repeat 5 times the 5 following steps *(for each user type: technician, PA, PDS, SK, SKS)*

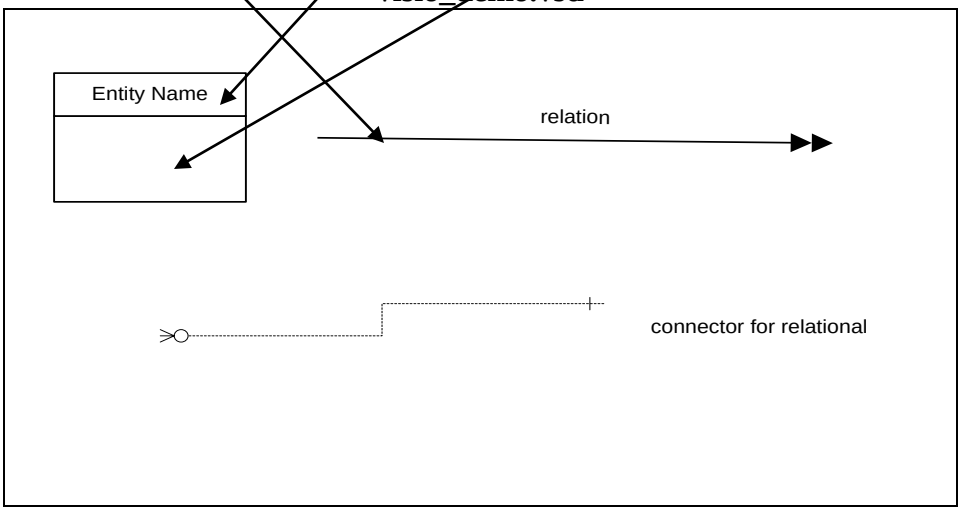
- one page for the user type transaction table (LAB1)
- one page for the partial conceptual E/R data model, (LAB1)
- one page for the partial relational data model (1 table ➔ 1 line) (LAB2)
- pages showing the execution of all transactions of a user type (LAB3)
- listing and execution of a transaction in a C program (LAB4)
- listing of all html and PHP programs and the URL to test your program and the result *(screen capture)* (LAB6)

Annex 1

1. E/R and Class Data Model Symbols

This file can be downloaded from the web site. You need only these 2 symbols to create your E/R data models. Just duplicate them, change their names, fill attributes and use appropriate relations with a meaningful name. To enter text, click on **A** in the top menu of Visio. Connect relations using the entity anchor points. Balance your data model to be easily understandable *(complex relations)* and try to prevent the crossing of lines.

visio_demo.vsd



2. Table defining each user transactions *(to be downloaded from web site or use Excel)*

transaction_table.xls

Transaction	Description	Entity	Access type	Key	Freq.	Response time

ANNEX 2

Example of a purchase order form

Company XXXXX

Purchase order number _____ **Date: _____**

VENDOR:
Supplier ID _____
Name: _____
Address: _____
_____
Contact: _____

AGENT
name _____

product_id	product name	quantity	unit	unit_price	total

Total _____

Charge to account # _____

signature 1 : _____ date _____

signature 2 : _____date _____

signature 3 : _____date _____