Database Architecture - Project 1

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Database Architecture – Project 1

MultiLease Management System: Part 1

INTRODUCTION

You are a Database Administrator working for a small software solutions firm. You have been assigned to help develop a customer vehicle leasing management system.

MultiLease is a small leasing company that specializes in one particular make of vehicle. The owner, Mike Lee, is considering expanding his inventory to include other manufacturers. Before committing to any new arrangements, Mike wants to improve the sales and account management system. Currently, each department completes its own paperwork and maintains its own records with its own software application. Departments communicate details by telephone or paper. Several costly mistakes have resulted in the loss of too many good customers.

To improve customer service and avoid communication errors, MultiLease' owner wants one system that provides employees with access to all administrative functions. The new application will provide an integrated interface, so Sales Associates can record new vehicle lease contracts, and the Account Managers can easily obtain customer account information. Mike wants access to all features of the new application. Naturally, built-in security features prevent unauthorized individuals from obtaining sensitive information.

Mr. Lee's long term plans include company expansion into new markets. He would like to open new branches in the future.

You are part of a team of IT professionals hired to implement a business solution for MultiLease's administrative problem. Your team understands the importance of integrating current business practices, rules and documentation into any new system.

OBJECTIVES

During this project, you will:

- Translate user requirements into a logical data model.
- Normalize a database design.
- Create a database, tables, and constraints using T-SQL.
- Create a default database diagram.
- Use Enterprise Manager to create clustered indexes and relationships.
- Populate a database with test data.
- Write scripts containing T-SQL statements that perform frequently used tasks.

TIME REQUIRED

You are given 10 hours of class time for this project. However, to complete this project on time, you are expected to work beyond regular college hours. A good estimate is two to three hours of homework per school day, which is 4 to 6 hours of homework over the next two days.

MATERIALS REQUIRED

The following software and textbook resources are required:

Software

- Microsoft Office Suite
- Microsoft SQL Server 2000 Enterprise Edition
- Windows 2000/2003/XP

Textbooks

- *SQL Server 2000 Database Design and Implementation* by Thomas Moore (2002).

PROJECT SPECIFICATION SECTIONS

BUSINESS REQUIREMENTS SECTION

General Requirements

The MultiLease Management System enables Sales Associates and Account Managers to effectively manage customer leases. The systems analyst on your team has drafted a system chart that describes the proposed application based on interviews to discover Mr. Lee's requirements, company documents, and employee work habits and requirements.

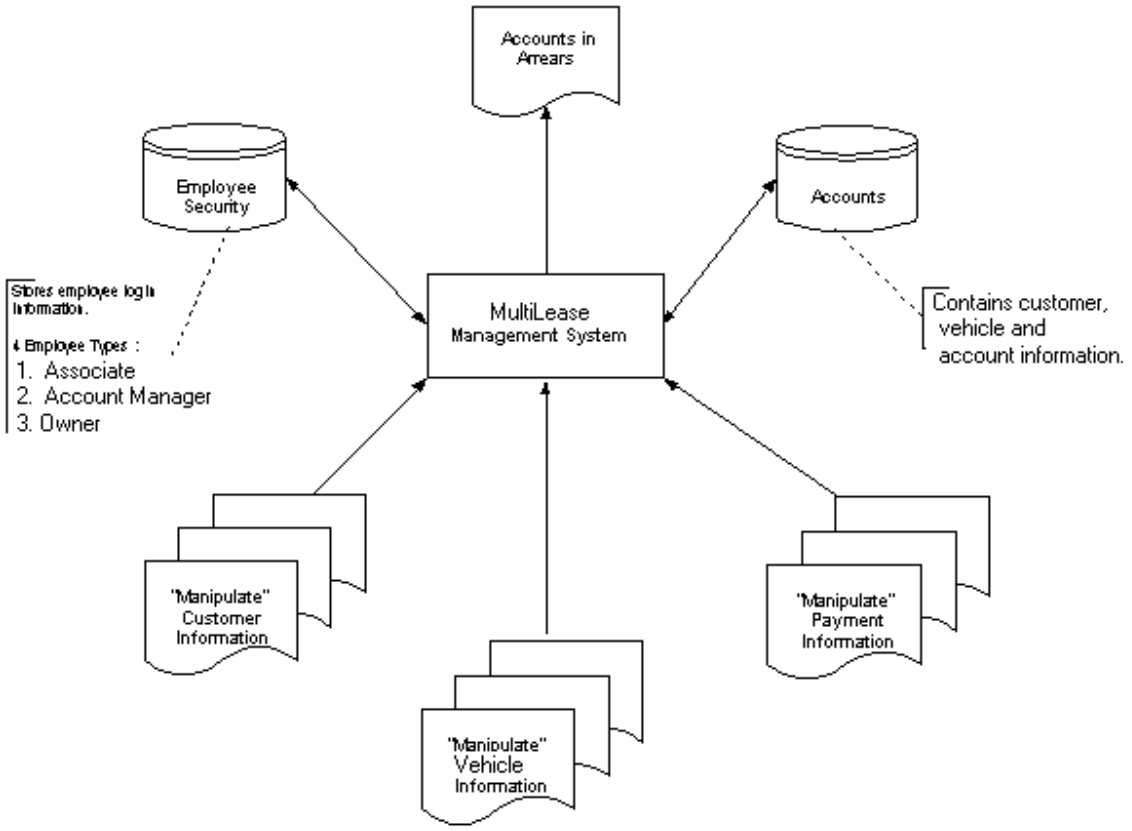

Figure 1: System flowchart for the MultiLease Management System

In this proposed system, Sales Associates will complete the initial paper-based contract, recording vehicle particulars between the customer and MultiLease. Following the contract acceptance, Sales Associates will be responsible for inputting the new customer information, vehicle inventory information and new lease payment information, contained in the original paper-based contracts and documents, into the system.

Account Managers will maintain customer relationships by collecting lease payments, collecting overdue accounts, dealing with customer concerns or complaints, and terminating the lease contract when the car is returned at the end of the lease.

Mike Lee, the owner, will be able to perform all functions.

Data Requirements

This section describes which databases are required and what information must be stored in each.

The MultiLease Management System will consist of the following two databases:

- ML_Employee database
- MultiLease database

Currently, the ML_Employee database is a Microsoft Excel spreadsheet, which stores employee information including loginIDs and passwords. There are no tables defined within this database.

For future scalability and access from different regions possibly by the Internet, the systems analyst suggests that the MultiLease application use SQL Server as the backend database instead of Microsoft Access. The MultiLease database will be used for storing information about leases, customers, and billing. Eventually, if Mr. Lee opens new branches, the database will need to accommodate locations.

The systems analyst suggests that, for additional security, the employee data in the existing Excel spreadsheet be moved to its own SQL Server database. He has provided you with a copy of the Excel spreadsheet (ML_Employees.xls), which is available on your project work disk.

Both the MultiLease database and the MultiLease employees database can, for now, exist on one server.

Data Rules

Mr. Lee wants you to include his business rules in the new MultiLease database:

- Lease terms cannot exceed 4 years. The usual is 3 years. Typically leases are 1, 2, 3, or 4 years.
- Number of monthly payments on a lease cannot exceed 48 months. The usual is 36 months.
- Vehicles cannot have power locks if they do not have air conditioning.
- The first payment on a lease must be after the contract date.
- Payment is due on the monthly anniversary of the contract date.
- When a customer leases a car, their contract shows the maximum number of kilometres they can drive without paying extra money (this extra money is called a **premium charge**.) If a customer drives the car more than the maximum number of kilometres, they must pay the premium charge when they return the vehicle at the end of the lease. **The maximum distance permitted for any lease cannot exceed 150,000 km.** For example, if a customer signed a lease with maximum 150,000 km, and the customer actually drives 160,000 km before returning the car, they owe MultiLease 10,000 km times the premium charge when they return the vehicle.

- The Vehicle VIN is unique.
- All modifications to lease agreements must be tracked.

The systems analyst has already begun analyzing the data requirements of the accounts database.

The three main tables include:

- Customers
- Vehicles
- Leases

The database includes various lookup tables:

- LeaseTerms
- Models
- Colours
- Types

The following information needs to be recorded about Customers:

- First and Last Name
- Address
- City
- Province
- Postal Code
- Phone Number

The following information needs to be recorded about Leases:

- Date the lease contract begins
- First payment date
- Amount of monthly payment
- Number of monthly payments
- Which vehicle the lease is for
- Which customer the lease is for
- The terms of the lease

The following information needs to be recorded about Vehicles:

- Vehicle VIN
- Model
- Type
- Colour
- Year
- Kilometres on odometer
- Whether or not the vehicle has been leased before
- Book value (current value of vehicle)
- Whether or not the vehicle has automatic transmission, air conditioning and power locks

The following information needs to be recorded about lease terms:

- Number of years
- Maximum kilometres
- Charge for extra mileage (cents/kilometre)

The Models, Colours and Types tables store available car models, colours and types respectively. Examples of car types include trucks, sedans (four door), and coupes (two door).

The following information needs to be recorded about payments. A payment is applied to a **lease** rather than to a customer:

- Date
- Amount
- Lease ID

The following information needs to be recorded about audits:

- Date of change
- The Changed field
- The old value for each field
- The new value for each field
- Lease ID

The Changed field is a true or false field. It should hold a 0 if the field's data did not change and a 1 if it did. For example, if only the first payment date changed, a PaymentDateChanged field requires a 1 value but all other fields in the record require a 0 to indicate they did not change.

Database Usage

The systems analyst has discovered the following facts about how the database will be used:

- Since the way the database is described is fairly normalized, joins will be frequently used in the MultiLease application.
- Most often, an agent will search for a customer by phone number. They will want to know the customer's first and last name initially, and may opt to do a search for other information later on.
- Searches in the Vehicles table typically involve a model and type.
- Searches in the Leases table typically involve a customer and contract date.
- The LeaseTerms, Models, Colours, and Types tables are rarely searched apart from a lease.
- Vehicle information does not tend to change much until a new model year. New customers and lease agreements are added continuously throughout the year.

Payment Procedures

Payments entered into the database incorrectly cannot be deleted. Instead, they are *voided*. A voided payment has a payment value of $0.00. A reason should always be given for a voided payment. By voiding a payment instead of deleting it, MultiLease ensures that it has an accurate record of all payments made, even if some of the entries were originally incorrect. Also, voiding payments prevents employee theft.

Auditing System

In order to keep track of amendments to lease agreements, Mr. Lee would like an auditing system implemented. The auditing system should record whenever changes have been made to the **Leases** table. Specifically, you should record when the changes were made, what fields were affected, and what their old and new values were.

Your Task

Based on the preliminary findings of the systems analyst, you will need to formalize the database design and use SQL Server to build the database. You should complete the following steps:

1. Analyze the data requirements described in the previous section. Decide which tables are required and which fields should go in which table. Normalize your design. If you wish, you may use an entity-relationship diagram.

It is now time for your instructor to check your progress. After you have finished the preliminary design for the MultiLease Management System contact your instructor for a brief review.

2. Using Query Analyzer, create a T-SQL script to create the MultiLease database. Name the database **MLxxxxx**, where xxxxx is your student number. Save your script as step2.sql.
3. Use Enterprise Manager or T-SQL script in Query Analyzer to create the tables in the MultiLease database. You do not need to specify relationships in this script. Save screen prints as `step3A`, `step3B`, etc. or your script as step3.sql.
4. Using Enterprise Manager, create a default database diagram. Add primary keys and relationships where they make sense (you may need to create an additional table to avoid a many-to-many relationship). Print your diagram.
5. Using Query Analyzer, create a script that will create the needed constraints to enforce the data rules Mr. Lee has specified. Do not include the payments for audit tables. Save your script as step5.sql.
6. Using the provided source documents (see pages 10-15 for lease contracts and vehicle purchase), populate your database with test data. Minimally, you need:
    - 3 customers
    - 5 leases with appropriate leasing terms
    - 5 models, types and colours
    - 4 vehicles
7. Using Query Analyzer, create a script that will show a list of customers (first name, last name, and phone number) and the total number of vehicles each has leased. Save your script as step7.sql.
8. Using Query Analyzer, create a script that will show a list of vehicles (vehicle VIN, model, type, colour) that have never been leased. **Note:** You must use an outer join for this query; a subquery is not acceptable. Save your script as step8.sql.

9. Using Query Analyzer, create a script that will show a list of vehicles (vehicle VIN, model, type, colour) that have air conditioning and power locks. Save your script as step9.sql.
10. Using Query Analyzer, create a script that will show a list of vehicles (vehicle VIN, model, type, colour) and the **largest** *maximum kilometres* field from any time the vehicle has been leased. The query should show ONLY the LARGEST maximum kilometres field. For example, if a vehicle has been leased 3 times, and in one case the maximum number of kilometres is 100,000, another case 150,000, and in the third case 75,000, then the *maximum kilometres* field should be 150,000 in the query result set. Save your script as step10.sql.
11. Create a database using any method named **ML_Exxxxx** where xxxxx is your student number. Import the ML_Employees.xls spreadsheet data into the new database using the DTS Import/Export Wizard.
    - For the Data Source, select Microsoft Excel and the ML_Employees file.
    - In Destination, select the new database you created. Select only Sheet1 (you can preview the results to verify). You do not need to select Transform.
    - After the table is created, rename Sheet1 to Employees, and edit the EMPID field to be the primary key.
    - Notice that the field containing the employees department appears as [Group]. This is to differentiate it from the reserved keyword GROUP in SQL Server.

NOTE: The project for Database Design for SQL Server requires you to continue working with the database you just created. You may want to keep a backup of your work.

Source Data

MultiLease Lease Company – Lease Agreement

Sold to:
Candie Wrapper
1000 Lollipop Lane
Halifax, NS
B1X 1X1

Phone: (902) 123-4567

Lease Vehicle:

2003 SC-430, VIN: 3W9T1-2Q10D-12D0P-2E1R2
km: 0 / book: $90,000

Transmission	Type	Options
☒ Auto	☒ 2dr Coupe	☒ Air
☐ Manual	☐ 4dr Sedan	☒ Power Locks
	☐ Truck	
	☐ SUV	
	☐ Van	

Exterior	Lease	New
☒ Deep Blue	☐ 1 year	☒ New Vehicle
☐ Racey Red	☐ 2 years	☐ Re-lease
☐ Lemon Yellow	☒ 3 years	
☐ Lime Green	☐ 4 years	
☐ Silver Grey		

Lease Terms

Contract Date: 2004/01/15
First Payment: 2004/02/15
Max. Mileage: 120,000 km
Premium: $0.25 / km
Monthly Payment: $650.00 / 36 payments

MultiLease Lease Company – Lease Agreement

Sold to:
Scalli Wag
80 Plank Walk
Halifax, NS
B2L 1L1

Phone: (902) 812-4567

Lease Vehicle:

2000 Pirate, VIN: 7D901-9W120-Z0029-021P2
km: 100,000 / book: $45,000

Transmission	Type	Options
☐ Auto	☒ 2dr Coupe	☒ Air
☒ Manual	☐ 4dr Sedan	☒ Power Locks
	☐ Truck	
	☐ SUV	
	☐ Van	

Exterior	Lease	New
☐ Deep Blue	☒ 1 year	☐ New Vehicle
☒ Racey Red	☐ 2 years	☒ Re-lease
☐ Lemon Yellow	☐ 3 years	
☐ Lime Green	☐ 4 years	
☐ Silver Grey		

Lease Terms

Contract Date: 2004/03/16
First Payment: 2004/04/16
Max. Mileage: 85,000 km
Premium: $0.20 / km
Monthly Payment: $350.00 / 12 payments

MultiLease Lease Company – Lease Agreement

Sold to:
Inna Chambers
2 Politician Street
Halifax, NS
B3M 1M1

Phone: (902) 341-4212

Lease Vehicle:

2003 Expensive, VIN: Z1221-X129A-KO212-9021J
km: 0 / book: $70,000

Transmission	Type	Options
☒ Auto	☐ 2dr Coupe	☒ Air
☐ Manual	☒ 4dr Sedan	☐ Power Locks
	☐ Truck	
	☐ SUV	
	☐ Van	

Exterior	Lease	New
☐ Deep Blue	☐ 1 year	☒ New Vehicle
☐ Racey Red	☒ 2 years	☐ Re-lease
☒ Lemon Yellow	☐ 3 years	
☐ Lime Green	☐ 4 years	
☐ Silver Grey		

Lease Terms

Contract Date: 2004/04/01
First Payment: 2004/05/01
Max. Mileage: 150,000 km
Premium: $0.20 / km
Monthly Payment: $600.00 / 24 payments

MultiLease Lease Company – Lease Agreement

Sold to:
Candie Wrapper
1000 Lollipop Lane
Halifax, NS
B1X 1X1

Phone: (902) 123-4567

Lease Vehicle:

2001 Rock, VIN: M21L1-3129S-V1292-L12X1
km: 0 / book: $85,000

Transmission	Type	Options
☐ Auto	☐ 2dr Coupe	☒ Air
☒ Manual	☐ 4dr Sedan	☒ Power Locks
	☒ Truck	
	☐ SUV	
	☐ Van	

Exterior	Lease	New
☐ Deep Blue	☐ 1 year	☒ New Vehicle
☐ Racey Red	☐ 2 years	☐ Re-lease
☐ Lemon Yellow	☐ 3 years	
☐ Lime Green	☒ 4 years	
☒ Silver Grey		

Lease Terms

Contract Date: 2002/02/20
First Payment: 2002/03/01
Max. Mileage: 130,000 km
Premium: $0.15 / km
Monthly Payment: $450.00 / 48 payments

MultiLease Lease Company – Lease Agreement

Sold to:
Inna Chambers
2 Politician Street
Halifax, NS
B3M 1M1

Phone: (902) 341-4212

Lease Vehicle:

2001 Rock, VIN: M21L1-3129S-V1292-L12X1
km: 127,000 / book: $45,000

Transmission	Type	Options
☐ Auto	☐ 2dr Coupe	☒ Air
☒ Manual	☐ 4dr Sedan	☒ Power Locks
	☒ Truck	
	☐ SUV	
	☐ Van	

Exterior	Lease	New
☐ Deep Blue	☒ 1 year	☐ New Vehicle
☐ Racey Red	☐ 2 years	☒ Re-lease
☐ Lemon Yellow	☐ 3 years	
☐ Lime Green	☐ 4 years	
☒ Silver Grey		

Lease Terms

Contract Date: 2004/07/01
First Payment: 2004/07/15
Max. Mileage: 150,000 km
Premium: $0.35 / km
Monthly Payment: $300.00 / 12 payments

One Model Motors Corp. - Invoice

Sold to:
MultiLease Corp.
1200 Motor Way
Halifax, NS
B5A 1K1

Phone: (902) 821-4319

Lease Vehicle:

2003 Speedy, VIN: K219M-K129P-V12BP-210G4
km: 0 / book: $60,000

Transmission	Type	Options
☐ Auto	☒ 2dr Coupe	☒ Air
☒ Manual	☐ 4dr Sedan	☒ Power Locks
	☐ Truck	
	☐ SUV	
	☐ Van	

Exterior

- ☐ Deep Blue
- ☐ Racey Red
- ☐ Lemon Yellow
- ☐ Lime Green
- ☒ Silver Grey

MARKING SCHEME

You are graded on the following components:

Project component	Points
Logical Database Design	**15**
• Suitable logical data model based on user requirements	10
• Normalized design	5
Physical Database Design and Creation	**65**
• Correct database creation script	5
• Correct table creation script	10
• Appropriate selection of constraints	10
• Correct constraint creation	10
• Suitable database diagram	10
• Correct creation of relationships	5
• Database population	5
• Import the Excel spreadsheet into a database	10
T-SQL Scripting	**20**
• Correct script for step 7	5
• Correct script for step 8	5
• Correct script for step 9	5
• Correct script for step 10	5
Total Number of Points Possible:	**100**

WHAT TO SUBMIT

For full marks, you must submit the following items:

- A title page, including your name, student number, instructor's name, and course name in an appropriate cover.
- A print-out of all the T-SQL scripts you created in steps 2, 3, 5, 7, 8, 9 and 10.
- A printout of your database diagram. You will probably want to print this out in landscape.
- A diskette containing scripts for steps 2, 3, 5, 7, 8, 9, and 10.

Before submitting your work, scan your disk using anti-virus software.

PENALTIES

- Late submissions receive a penalty of 5% per day.
- Projects that are more than three days late can be submitted for a maximum grade of 60%.
- Projects contaminated with a virus must be resubmitted and will receive a maximum grade of 60%.