

CIDM 6350 Project: Database design and Implementation

Total Points: 200 (20% of the course's final grade)

- Due on : Monday, July 04, 11:59pm

Note: This assignment file has 6 pages

Objective: Assess your understanding of database design process and applications

Skills needed: given a business description that uses a traditional file-based information system, and you make the best effort to create a more efficient database system for this business based on the given description. To Complete this project you need to know How to:

- 1- Identify the system requirements
- 2- Identify main system entities and their attributes
- 3- Identify the relationships between the entities and their cardinalities
- 4- Create and refine conceptual and logical models for the system
- 5- Translate Entities and relationships into Implementation
- 6- Apply Normalization process to avoid data anomalies
- 7- Use Keys concepts to implement relationships and enforce integrity constraints
- 8- Write MySQL Data Definition commands to build the database from the design
- 9- Write MySQL Data Access Control Commands to create/modify user access privileges
- 10- Write MySQL Commands to create system requested data views
- 11- Write MySQL SELECT queries to process the data and provide answers to questions of interest

Requirements & Submission:

1. You need to submit the following seven files:
 - a) **Task 1- i)** One PDF file contains your design (ERD) and your assumptions and justifications.
ii) One or MySQL DDL script file to create the database
 - b) **Task 2- i)** One MySQL script of “Insert Into” commands
ii) One pdf file contains screenshots of the “Select* limit 10” output of each table.
 - c) **Task 3-** One MySQL DCL script file to create Views, Users, Roles, and set access privileges
 - d) **Task 4- i)** One MySQL DML script file Contains all queries of task 4 (both 4.1 and 4.2)
ii) One PDF file contains screenshots of the results of each query of task 4.2
2. You **must** include **your name** (and the group name if you work with one) at the beginning of each file
3. Submit on WTCClass (“Resources >> Project >> Project)

Introduction:

In this project, you will design and implement a database for keeping track of customer information for a *company called XYZ-Utility* that provides a utility service to customers at their addresses.

You will first design an ERD diagram for this company's database application. Then, you will need to map the ERD into a relational database schema and implement it on MySQL DBMS, load some data into the created database, and create some SQL queries to update and query the data.

The system description and requirements are given in the following section

System Description and requirements:

XYZ-Utility Company which provides Utility services to Customers at their addresses (You may think of Gas service as an example). Customers subscribe for the service by signing a contract with the company which contains the service activation date, the customer address, the meter number installed at the customer address, the initial Meter reading, and customer's billing rate. The billing rate may change according to company's incurred cost and type of customers (e.g. residential, business, gov., etc.). The company bills its customers according to their consumption which is measured by Meter installed at their address and the billing rate. Each Meter is assigned a unique number, and the reading of the meter is recorded monthly by a company employee who is assigned the reading task. Each Reader is assigned a list of addresses and Meter numbers to read on specific date. The Reader visits the customer location and records the Meter reading and the date of the reading. The customer consumption of each billing cycle is calculated by subtracting the previous billing Meter reading from the current Meter reading. The customer cost is calculated by multiplying the customer consumption by the billing rate (specified in the contract) ~~and adding 6% tax and fees~~. Customers are billed after each reading, and given 30 days to pay their bill without penalties. A customer may have one or more addresses (e.g., residential and business) and consequently may have Multiple Contracts. Only one Meter is installed at each address and only one Meter is associated with a contract. Each Contract is billed separately if the customer has multiple addresses (contracts). Customer can activate or deactivate the service at his address at any date, and these activation/deactivation dates should be recorded. Meters are fixed at the installation addresses, however customers can change their addresses. Consequently, the same meter/address can be assigned to multiple customers but not at the same time period, so the activation and deactivation dates are important to determine which customer is using which meter at any given time. Customer may pay entire bill in one payment or make multiple payments for each bill. For simplicity, ignore late payment fees. When customer makes a payment for a bill, the payment amount, date, and method (check, card, etc.) are recorded and the remaining balance for that bill is updated.

Currently XYZ-Utility uses traditional file-based system for its data where it keeps track of the Customers information, Meter readings, Bills, Payments, and Employee Reading assignments. The **attached excel** file has a sample of this file based system data. **You need to reorganize and use this data to test your database**

As you can see, the current file-based system has all different kinds of update, delete, insert, issues due to redundancy and lack of normalization. In addition, answering questions about customers, due dates, bills, and Employees' reading assignments is difficult.

Tasks:

Task 1- (Design and implementation)

Your task is to use the description above and the given sample data **excel file** (*from the current traditional file system*) to design a an efficient database system for XYZ-Utility Company to help this business query their data with ease and avoid all possible update, insert, and redundancy issues that exist in their current file-based system.

You first build an ERD for the database and make sure it is normalized, then write MySQL DDL script to implement it. ---

-Task "1" Deliverables:

- 1- One PDF file contains detailed crow's foot ERD for your database system design
- 2- One MySQL DDL script file to create the database

Task 2-(Insertion of the sample testing data)

After implementing the database, and to prove the usefulness of your database-based system Design, you need to extract useful data from the given sample data (attached excel file) and insert it in your implemented database.

Note: that the structure of your tables could be different from the excel files (because the current system may have some redundancies and other issues that you need to avoid in your design). So you may need to create a new set of csv files from the excel files and then **import** them into your tables (use the *import wizard in MySQL workbench*), or you may create an SQL script of “**insert into**” statements to insert the data.

Keep in mind that the attached data tables used in the file-based system **are not normalized**. Also, feel free to add any **other attribute(s)** that was not mentioned in the description, to any of the entities in your design if you think it serves a useful purpose.

- Task “2” Deliverables:

- 1-One pdf file contains screenshots of the “Select* limit 10” output of each table after inserting the data.
- 2- One MySQL script of “Insert Into” commands. You can generate that from MySQL after importing the data with the import data wizard

Task 3- (User access control)

To test the database with users with different roles, add each of the given employees as users to MySQL DBMS and assign each user roles corresponding to his/her position (Manager, Reader, Customer service).

Use the concatenation of the first letter of the employee’s First Name and his last name as his user name and his default initial password (for example, the employee “Evaleen Madelin”, who has the role Reader, her user name will be eMadelin, and the her initial password will be the same as her user name)

Each user is given privileges according to his/her role as follows:

Reader: should only view the Meters information (number, model, address) and only those assigned to him for reading, and not allowed to see customer names or other information. He can add/update Meter readings (Date, Meter Reading)

Customer service: can view/edit/add customer information and Bills, but not the employee who is assigned to read the customer’s meter.

Manager: can view/edit/add/delete all information, and can assign/change the assignment of Meter readings to Reading employees.

You need to create the roles above and assign privileges to them, then assign each user a role according to his position. You may also need to create views to limit access to information according to the user role.

-Task 3 deliverables:

One **SQL script file** : contains SQL DCL to :

- a) create views
- b) create the three roles and assign them access privileges as explained above
- c) create users with a password that expires, and assign them the role according to their position

Task 4-(SQL DML queries to update the database and answer Informational questions)

4.1 Informational Queries: Login as a user with the specified role then Write and run queries to answer each of the following (A sample Screenshots of the output of these IQs are given in the last page)

IQ1--(Role: Customer service) How many customers with balance (unpaid bills total) greater than \$0? And then List their names and balances

IQ2--(Role: Reader) List all readings (include dates, meter numbers, and addresses) assigned to the logged-in user himself (e.g.” GCreighton”)

IQ3--(Role: Customer service) List all meter readings, bills and payments made for each customer at all of his addresses.

IQ4--(Role: Manager) How many readings have been made by employee “Genvieve Creighton” in the interval between the two specified dates ('05/01/2019 and 12/30/2019)?

IQ5--(Role: Manager) Given a customer bill numbers (1004, 1005,1002), find and list the names of the readers of the 1st and last reading in that bill?

IQ6--(Role: Manager) Who is the customer with highest consumption within the given date range ('5/1/2019' - '12/30/2019')?

IQ7--(Role: Manager) What is the average consumption in all bills in the interval between the given billing dates ('5/1/2019' - '12/30/2019')?

IQ8--(Role: Manager) Who are the customers whose total consumption is above average in previous query (Q7) during that interval?

4.2 Update Queries: Login as a user with the specified role then Write and run the following queries to

UQ1--(Role: Customer service) Add a new customer “ John Doe” whose ID is “1111” and lives on “12345 East Yale Av., Canyon, TX” to the database

UQ2--(Role: Manager) Assign the employee “Genvieve Creighton” the task of reading the following meters (40, 34) on “9/3/2018” and “12/13/2019” respectively

UQ3--(Role: Reader) make the user Genvieve add a new reading for each Meter in his assignments list.

UQ4--(Role Customer Service) Add new bills for the newly entered readings by calculating consumptions based on the previous and last readings.

-Task 4 deliverables:

- a- **SQL script file:** Contains all queries of task 4 (both 4.1 and 4.2)
- b- **PDF file** : Contains screenshots of the results of each query of task 4.2

Resources:

1-Lectures and Assignments

2-Textbook: Appendixes B and C at the end of the Textbook have some database design examples you can use as guide to your design

3-MySQL documentation website : <https://dev.mysql.com/doc/>

Grading Rubric: [Total points: 200]

Tasks		Possible Points
TASK 1	1 -Analysis and Design Phase (ERD)	
	ERD detailed Crow's foot is presented using drawing tool (e.g. Draw.io)	10
	All main Entities present	15
	All relationships present with correct Cardinalities	15
	2- DDL (SQL script file: SQL DDL)	
	correct creation of the database schema	5
	correct creation of the Tables, including : Correct DDL statement and PKs,FKs, Data types, all other constraints	10
	Correct Relationship mapping, including correct placement of FKs at correct side of each relationship	10
	Correct Normalization of the tables	10
		75 points
TASK 2	Insertion of the sample testing data	
	Screenshots correctly shows insertion of data	10
	SQL script shows Correct "Insert Into" statements to insert the given data	10
	-2 points will be deducted on every missing row or incorrect insert into statement of each table	
		20 points
TASK 3	DCL (SQL script file : SQL DCL)	
	Correct creation of views	5
	Correct creation of the Roles	5
	Correct creation of users	5
	Correct assignment of access privileges to roles	5
	Correct assignment of roles to users	5
		25 points
Task 4	4.1- SQL script for Querying the data	
	Correct SQL SELECT statements to answer queries in Task 4.1 8 queries x 4 points	40
	4.2- SQL script for Updating data	
	Correct Updates statements to update the tables as specified in Task 4.2 4 queries x 4 points	16
	All task 4.1 Queries OUTPUT screen shots are present and correct	9
		65 points
Scripts and Output	Correct script Execution	
	Entire "DDL" script runs without errors	5
	Entire "DCL" script runs without errors	5
	Entire "DML" script runs without errors	5
		15 points
TOTAL POINTS		200

Best of success

The following are some Sample Screenshots of the IQs in task 4: (Note: you may have some values repeated over the rows in your queries outputs, which is normal. If you want you could use `group_concat()` sql function to get outputs similar to the given ones below, but it is not required)

IQ1:

customers with balance over \$0
2

Customer Name	Balance
Kalie Gratton	102.800
Bat Scamel	34.060

IQ2:

Employee Name	Meter #	address	Reading Date
Genieve Creighton	27	36 Laurel Center Canyon TX 79015	2019-04-15
Genieve Creighton	27	36 Laurel Center Canyon TX 79015	2019-05-15
Genieve Creighton	27	36 Laurel Center Canyon TX 79015	2019-06-15
Genieve Creighton	16	656 Weeping Birch Avenue Canyon TX 79016	2019-11-23

IQ3:

	Cust ID	Cust Name	Custaddress	prev. reading	prev. reading date	current reading	cur. reading date	Bill #	Bill date	Bill Tot.	Amount paid	Payment Date
▶	113	Johnath Dun	2768 Clarendon Trail Canyon TX 79015	3851.000	2020-05-06	4060.000	2020-06-06	1002	2020-06-06	71.06	71.060	2020-06-07
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	211.000	2019-04-15	411.000	2019-05-15	1001	2019-05-15	98.00	98.000	2019-05-20
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	411.000	2019-05-15	670.000	2019-06-15	1003	2019-06-15	126.91	126.910	2019-06-20
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	670.000	2019-06-15	830.000	2019-07-15	1004	2019-07-15	78.40	78.400	2019-07-16
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	830.000	2019-07-15	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	454	Kalie Gratton	07245 Dottie Junction Canyon TX 79015	1350.000	2018-09-21	1870.000	2018-10-21	1007	2018-10-21	202.80	100.000	2018-10-22
	454	Kalie Gratton	07245 Dottie Junction Canyon TX 79015	1870.000	2018-10-21	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	856	Ruperta Horsewood	656 Weeping Birch Avenue Canyon TX 79016	400.000	2019-10-23	730.000	2019-11-23	2007	2019-11-23	135.30	100.000	2019-11-25
	856	Ruperta Horsewood	656 Weeping Birch Avenue Canyon TX 79016	400.000	2019-10-23	730.000	2019-11-23	2007	2019-11-23	135.30	35.300	2019-12-10
	856	Ruperta Horsewood	656 Weeping Birch Avenue Canyon TX 79016	730.000	2019-11-23	NULL	NULL	NULL	NULL	NULL	NULL	NULL
	1010	Bat Scamel	656 Weeping Birch Avenue Canyon TX 79016	269.000	2018-08-19	400.000	2018-09-19	2006	2018-09-19	34.06	NULL	NULL
	1125	Roxi Falvey	22509 Holmberg Point Canyon TX 79016	341.000	2017-12-04	612.000	2018-01-05	1005	2017-12-04	102.98	102.980	2017-12-06
	1125	Roxi Falvey	22509 Holmberg Point Canyon TX 79016	612.000	2018-01-05	890.000	2018-02-05	1006	2018-01-05	105.64	105.640	2018-01-08
	1125	Roxi Falvey	22509 Holmberg Point Canyon TX 79016	890.000	2018-02-05	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Or (Using Group Concat)

	Cust ID	Cust Name	Custaddress	prev. reading	current reading	Bill #	Bill date	Bill Tot.	Amount paid	Payment Date
▶	113	Johnath Dun	2768 Clarendon Trail Canyon TX 79015	3851.000	4060.000	1002	2020-06-06	71.06	71.060	2020-06-07
	454	Kalie Gratton	07245 Dottie Junction Canyon TX 79015	1350.000	1870.000	1007	2018-10-21	202.80	100.000	2018-10-22
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	211.000	411.000	1001	2019-05-15	98.00	98.000	2019-05-20
				411.000	670.000	1003	2019-06-15	126.91	126.910	2019-06-20
				670.000	830.000	1004	2019-07-15	78.40	78.400	2019-07-16
				830.000						
	856	Ruperta Horsewood	656 Weeping Birch Avenue Canyon TX 79016	400.000	730.000	2007	2019-11-23	135.30	100.000	2019-11-25
				400.000	730.000	2007	2019-11-23	135.30	35.300	2019-12-10
				730.000						
	1010	Bat Scamel	656 Weeping Birch Avenue Canyon TX 79016	269.000	400.000	2006	2018-09-19	34.06	NULL	NULL
	1125	Roxi Falvey	22509 Holmberg Point Canyon TX 79016	341.000	612.000	1005	2017-12-04	102.98	102.980	2017-12-06
				612.000	890.000	1006	2018-01-05	105.64	105.640	2018-01-08
				890.000						

Or (including Balance)

	Cust ID	Cust Name	Custaddress	prev. reading	current reading	Bill #	Bill date	Bill Tot.	Amount paid	Payment Date	balance
▶	113	Johnath Dun	2768 Clarendon Trail Canyon TX 79015	3851.000	4060.000	1002	2020-06-06	71.06	71.060	2020-06-07	0.000
	454	Kalie Gratton	07245 Dottie Junction Canyon TX 79015	1350.000	1870.000	1007	2018-10-21	202.80	100.000	2018-10-22	102.800
	454	Kalie Gratton	36 Laurel Center Canyon TX 79015	211.000	411.000	1001	2019-05-15	98.00	98.000	2019-05-20	0.000
				411.000	670.000	1003	2019-06-15	126.91	126.910	2019-06-20	
				670.000	830.000	1004	2019-07-15	78.40	78.400	2019-07-16	
				830.000							
	856	Ruperta Horsewood	656 Weeping Birch Avenue Canyon TX 79016	400.000	730.000	2007	2019-11-23	135.30	100.000	2019-11-25	35.300
				400.000	730.000	2007	2019-11-23	135.30	35.300	2019-12-10	
				730.000							
	1010	Bat Scamel	656 Weeping Birch Avenue Canyon TX 79016	269.000	400.000	2006	2018-09-19	34.06	NULL	NULL	34.060
	1125	Roxi Falvey	22509 Holmberg Point Canyon TX 79016	341.000	612.000	1005	2017-12-04	102.98	102.980	2017-12-06	0.000
				612.000	890.000	1006	2018-01-05	105.64	105.640	2018-01-08	
				890.000							

IQ4:

Readings by (Genvieve Creighton) between '2019-5-1' and '2019-12-30'
▶ 3

If we want to list them

Employee Name	Meter #	address	Reading Date
▶ Genvieve Creighton	27	36 Laurel Center Canyon TX 79015	2019-05-15
Genvieve Creighton	27	36 Laurel Center Canyon TX 79015	2019-06-15
Genvieve Creighton	16	656 Weeping Birch Avenue Canyon TX 79016	2019-11-23

IQ5:

Bill #	Bill date	prev. reading	prev. reading date	Reader 1	current reading	cur. reading date	Reader 2
▶ 1002	2020-06-06	3851.000	2020-05-06	Lancelot Tschiersch	4060.000	2020-06-06	Bernita Munson
1004	2019-07-15	670.000	2019-06-15	Genvieve Creighton	830.000	2019-07-15	Gaspar McCaskill
1005	2017-12-04	341.000	2017-12-04	Cherye Buey	612.000	2018-01-05	Gaspar McCaskill

IQ6:

Cust ID	Cust Name	total Consumption between '2019-5-1' and '2019-12-30'
▶ 454	Kalie Gratton	619

IQ7:

Average Cons. of all bills between '2019-5-1' and '2019-12-30'
▶ 237.2500

IQ8:

CustID	Name	total Cons.
▶ 454	Kalie Gratton	619
856	Ruperta Horsewood	330