Data Base for Banking Systems

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1. Introduction

The development of database for any kind of system requires the understanding and working of the particular organisation. In our group we tried to develop a database for Banking system. The analysis of the working of Banks and the need for database in the sector is the primary task in development of an database for banking system.

2 Creating Entities and Attributes

2.1 Points to be Considered

* The bank is organized into branches. Each branch is located in a particular city and is identified by a unique name. The bank monitors the assets of each branch.
* Bank customers are identified by their unique IDs. The bank stores Customer's ID, name and the street and city where the customer lives.
* Customers may have accounts, and can take out loans. A customer may be associated with a particular banker, who may act as financial advisor for the Customer.
* Bankers are also identified by their unique ID. The bank administration stores the name and email address of each employee, for the communication with Customers

2.2 Entities and Attributes

1. Branch-Schema = (branch-name, assets, branch-city)

branch-name is the name of a branch of the bank.

assets is the amount of money at the branch.

branch-city is the city at which the branch of the bank is located.

2. Account-Schema = (account-number, category, balance)

Account-number is the number of a saving account owned by a customer

category is the category of currency of the saving account such as HK dollars and foreign country's currency.

balance is the current balance of the amount of money in the saving account owned by a customer

3. Loan-Schema = (branch-name, loan-number, amount)

branch-name is the name of a branch which grants the loan. loan-number is the identifier of the loan.

amount is the amount of money in the loan.

4. Customer-schema = (customer-ID, customer-name, customer-street, city)

Customer-ID is the identifier of a customer of the bank.

Customer-name is the name of the customer

Customer-street is the street in the address of customer

Customer-city is the city in the address of customer

5. Credit-card-schema = (credit-card-number, limit, expiry-date)

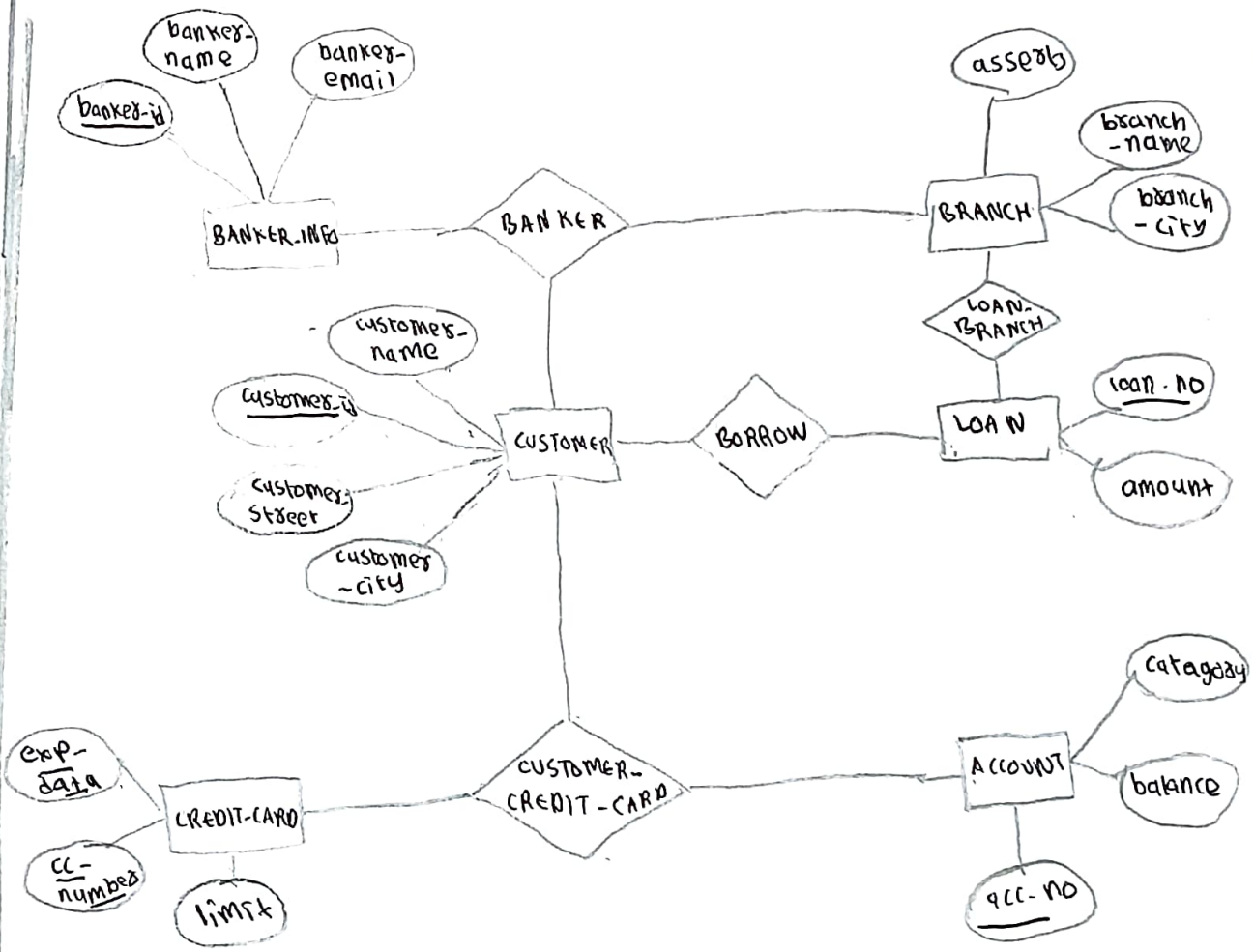
credit-card-number is the number printed on a credit card issued by the bank to a customer

Limit is the maximum amound of money that a customer can consume using the credit-card

expiry-date is the expiry date of the credit-card

2.3. Entity - Relationship Model diagram

* Mandatory participation between Branch and loan: Every loan in the loan table must be associated with a branch in the Branch table. This is denoted by a Solid line Connecting Branch to loan in ERD.



* Mandatory participation between Customer and Customer-credit-card: Every loan credit card in the customer-credit-card table must be associated with a customer in the customer table. This is denoted by a solid line connecting customer to customer-credit-card in the ERD.

2.4 Relational Model Tables

Branch Table

branch-name	asse·ts	branch-city
Clear Water Bay	6,000,000	Hong Kong
Downtown	12,000,000	Edmonton
Howe	9,000,000	Vancouver
McEwan	6,000,000	Calgary
Signal Hill	8,000,000	Calgary
Tsuen Wan	8,000,000	Hong Kong

Loan Table

branch-name	loan-number	amount
Clear Water Bay	1	150,000
Howe	2	20,000
Howe	3	60,000
McEwan	4	80,000
Signal Hill	5	90,000
Signal Hill	6	20,000
Downtown	7	30,000
Downtown	8	10,000
Clear water Bay	9	250,000
Tsuen Wan	10	10,000

Borrower Table

Customer-id	loan-number
C8392380569	1
C8392380569	9
C8954385123	10

C2389490434	4
C9384899234	5
C09302380 83	6
C3487327487	7
C32498938449	8
C3948938442	3
C2394898948	2

Customer Table:

customer_id	customer-name	Customer-street	customer-city
C8392380567	Amy	Ping Ting Road	Hong Kong
C8954385123	Bob	Texaco Road	Hong Kong
C2389490434	Carson	Deer Foot Trail	Calgary
C9384899234	David	University Drive	Calgary
C09302380 83	John	Ogden Road	Calgary
C3487327487	Linda	Kings Way Drive	Edmonton
C32498938449	Mandy	Victoria Road	Edmonton
C3948938442	Paul	Horn by Road	Vancouver
C2394898948	Ricky	Howe Road	Vancouver

Customer-credit-card-Table:

customer-id	Credit-card-number	account-number
C8392380567	0000-1111-1111-1111	0-1-2222-3333-4444
C8954385123	0000-2222-2222-2222	0-1-2222-2222-2222
C2389490434	0000-3333-3333-3333	0-1-3333-3333-3333
C9384899234	0000-4444-4444-4444	0-1-4444-4444-4444
C09302380 83	0000-5555-5555-5555	0-1-5555-5555-5555
C3487327487	0000-6666-6666-6666	0-1-6666-6666-6666
C32498938449	0000-7777-7777-7777	0-1-7777-7777-7777
C3948938442	0000-8888-8888-8888	0-1-8888-8888-8888
C2394898948	0000-9999-9999-0000	0-1-9999-9999-0000

Accounts Table:

account-number	Category	balance
0-1-2222-3333-4444	Hong Kong dollars	10,000.00
0-1-2222-3333-5555	Hong Kong dollars	500,000.00
0-1-2222-2222-2222	Hong Kong dollars	2,000.00
0-1-3333-3333-3333	Canadian dollars	1,000.00
0-1-4444-4444-4444	Canadian dollars	5,000.00
0-1-5555-5555-5555	Canadian dollars	5,000.00
0-1-6666-6666-6666	Canadian dollars	3,000.00
0-1-7777-7777-7777	Canadian dollars	2,000.00
0-1-8888-8888-8888	Cananadian dollars	1,000.00
0-1-9999-9999-0000	Canadian dollars	1,000.00
0-1-9999-9999-1111	Canadian dollars	2,000.0

Banker-~~branch~~ Table:

banker-id	customer-id ~~banker-name~~	branch-~~email~~ id
Clear Water Bay	C8392380567	sta-rosana
Downtown	C3487327487	sta-carina
Howe	C3448938442	sta-gloria
McEwan	C9384849234	sta-elaina
Signal Hill	C0930238083	sta-wynne
Signal Hill	C8954385123	sta-shirley
Tsuen wan	C8954385123	sta-kadora

~~Branch~~ ~~Banker~~ Credit-Card-Table:

credit-card-number ~~branch-name~~	limit ~~customer-i~~	expiry-date
0000-1111-1111-1111	5,000.00	1-may-02
0000-1111-1111-2222	10,000.00	1-Dec-05
0000-1222-2222-2222	5,000.00	1-Dec-03
0000-3333-3333-3333	3,000.00	1-Nov-04
0000-4444-4444-4444	20,000.00	1-Jan-03
0000-5555-5555-5555	10,000.00	1-Jan-05

0000-6666-6666-6666	10,000-00	1-Apr-04
0000-7777-7777-7777	10,000-00	1-Jan-05
0000-8888-8888-8888	20,000,00	1-Jan-02
0000-9999-9999-0000	3,000.00	1-Jan-03
0000-9999-9999-1111	10,000-00	1-Jan-0

Thus the above are the tables that are formed from the conversion of ER-Model to Table

3. Deriving Dependencies

3.1 Functional Dependencies

In this section we defined the functional dependencies possible for each table. These FD's are further useful in making normalisation.

1. Branch-schema:

branch-name → assets, branch-city

The name of the branch is primary key of the relation schema. Branch-schema. Each branch has an amount of money (assets) and is located in a city.

2. loan-schema:

Loan-number → amount, branch-name

The identifier loan number is the primary key of the relation schema loan-schema. Each loan is of a certain ammount of money and is granted by a branch of the bank.

3. Borrower-Schema:

Loan-number → customer-id

The identifier loan-number is the primary key of the relation schema Borrow-schema. Each loan is

borrowed by a customer of the bank.

4. Customer-schema:

customer-id → customer-name, customer-street, customer-city

The name of the customer is the primary key of the relation schema customer-schema. Each customer has a street and a city in his or her address.

5. Credit-card-schema:

Credit-card-number → limit, expiry-date

The credit-card-number is primary key of the relation schema credit-card-schema. Each credit card has a limit on the amount of money that its owner can consume and also an expiry date.

6. Account-schema:

account-number → category, balance

The account-number is the primary key of the relation schema. Each saving account has a unique account-number, a category type and a current balance value.

7. Banker-schema:

branch-name, customer-id → banker-id

The branch name and the customer-id together give the primary key of the relation schema Banker-schema. Each customer is served by a banker in a branch of the bank.

8. Banker-schema: banker-id → branch-name

Each banker works in one branch of the bank

9. Banker-info-schema:

banker-ID → banker-name, banker-email

The banker-ID is the primary key of the relation Schema Banker-info-schema. Each banker who works in the bank has a unique banker-ID, a name and an email address for communication.

3.2 Multi-valued Dependencies

The following are the multivalued dependencies of our schemas.

1. Customer-credit-card-schema:

Customer-ID →→ credit_card-number

Each customer has a number of credit cards itself is sued by the bank, which are identified by the numbers pointed on the credit crads.

2. Customer-credit-Card-schema:

Customer-ID →→ account-number

Each customer has a number of saving accounts in the bank, which are identified by the saving account numbers. The owner of a credit card can use it to access the current balance of all the Saving accounts that he or she has in the bank.

4. Normalisation

The process of removing the anomalies and redundancy of data is call Normalization. Tables are normalized after converting them to relational model to Er model by using FD's and it is very important process in making a good database.

1. Branch Table:

branch-name → assets, branch_city

* All the attributes are in atomic level so the table is in First Normal Form.
* We can observe that there is only one functional dependency in which the primary key branch-name is determining the other non-prime attributes.
* So, we can say that the table is free of partial dependency and it is already in 1NF.
* The table satisfies Second Normal Form.
* By observation, we can say that the branch table is free from the transitive dependence
* So, the table satisfies Third Normal Form.
* As only the super key (branch-name) is determining the other attributes and it is already 3NF, so, we can say that the table satisfies BCNF Form conditions.

2. Loan Table:

loan-number -> amount, branch-name.

* It is in 1NF as all the attributes are in atomic level.
* It satisfies conditions of 2NF as there are no PD's and it is already in 1NF.
* It satisfies 3NF conditions as there are no transitive dependencies and it is already in 2NF
* It satisfies BCNF Form conditions as the only super key

3.

loan-number -> customer-id

* The table meets the 1NF as all the attributes contains only atomic values.
* There is only one FD in the table, where the primary key "loan-number" determines the non-prime attributes. This indicates that the table is free from partial dependencies (PD) and satisfies the 2NF.
* The table is also free from transitive dependencies which means that is free from partial dependencies

which means that it meets the requirements of the Third Normal Form (3NF)

* Additionally, the table satisfies the conditions of the BCNF because the super key "loan-number" determines all other attributes.

4. Credit-card-table:

credit-card-number -> limit, expiry-date

* The given table is in 1NF as all attributes are atomic
* The table is in 2NF as the primary key determines all non-key attributes.
* The table is in 3NF as it is free from transitive dependencies
* The table satisfies the conditions of BCNF as the super key determines all the other attributes.

5. Account Table:

account-number -> category, balance

* The table is in 1NF as all attributes contain atomic values.
* The table is in 2NF because there are no partial dependencies and it satisfied 1NF.
* The table meets the requirements of 3NF as it is free from transitive dependencies and satisfies the requirements of 2NF
* The table satisfies the conditions of BCNF because there is only one super key that determines all the other attributes.

6. Banker Table:

banker-id -> branch-name

* The given table satisfies the requirements of the highest normal form, which is the BCNF. It meets the conditions of 1NF by containing atomic values, 2NF by having no partial dependencies, 3NF by

having no transitive dependencies, and BCNF by having only one super key that determines all other attributes.

7. branch table:

branch-name, customer-id → banker-id

banker-id → branch-name

The table meets the requirements of 3NF To convert it into BCNF, since "banker-id" is not a superkey, and it only determines one attributes "branch-name", the table is not in BCNF. To bring it into BCNF, we need to decompose the table into two tables:

Table 1: branch-name, customer-id, banker-id

Table 2: banker-id, branch-name

Now, both tables satisfy the condition for BCNF and the FD's are preserved.

8. Customer-credit-card Table:

No Functional dependencies are there, so the table can be upto BCNF, To convert it in UNF the following multivalue dependencies are removed.