

Banking Management Service

CS 4400: Introduction to Database Systems

Course Project: Spring 2022 Semester

Version History

Version	Date	Notes
0	February 1, 2022	Initial release
1	February 4, 2022	Minor changes to the Scenario Description & Sample Data Elements
2	February 23, 2022	Additional clarification on data types, null values and Phase 2 info

Scenario Description

The following is a text description of the system you are being tasked to develop. The system requirements – explicit and implicit – are included in this document, and they need to be identified and reflected in your Enhanced Entity-Relationship Diagram (EERD).

You are being asked to design and develop a system to manage bank accounts and assets. This system will support a banking oversight effort to track banks, their employees and customers, and the assets contained in the various accounts. Employees will work at the banks to provide services to customers, and customers will open various types of accounts to manage their assets. The main operations of the system will include customers depositing into, transferring between, and withdrawing from their various accounts, and keeping track of the asset balances at various levels (e.g., bank, customer, account, etc.).

Attributes that are used to identify entities in our system will normally consist of fifty (50) or fewer alphanumeric characters in some regular pattern/format. This will be the default format for entity-identifying and "entity unique" attributes in our system unless otherwise noted. Dates will be represented in the "yyyy-mm-dd" date format; this will be the default format for dates in our system unless otherwise noted.

Our system must provide access for various persons (i.e., user roles) in the system. The main three roles are administrators, employees, and customers. Administrators have access to all of the system's capabilities, and are charged with making sure that the system is functioning correctly with respect to the given requirements. Employees work at one or more banks, and have access to the capabilities at these banks to allow them to monitor and manage various accounts. Finally, customers open accounts at these banks to help them manage their assets (i.e., money and similar funds), and have access to the capabilities needed to view the status of their accounts and to update the balances as needed. Each person must be an administrator, employee, or customer.

To avoid conflicts of interest and potential security issues, however, administrators are not allowed to be employees or customers. Otherwise, however, an individual may be an employee and a customer if desired. All roles in the system must have a distinct identifier, which is normally represented as an alphanumeric string. All employees and customers in the system must also keep track of the date that the person first joined/accessed the system, along with the individual's name, address, Social Security Number (or other valid tax identifier) and date of birth. Names, addresses, SSNs, etc. are not needed for administrators – for security purposes, their

information is maintained in a separate database. We will make the reasonable assumption that the selected tax identifier will be unique for all bank users.

Since employees are allowed to work at one or more banks, the system must keep track of each employee's monthly salary, along with the number of times that they have been paid, and the total of all money that they've earned as an employee. Though employees can work at multiple banks concurrently (i.e., over the same period of time) as part of the bank's "exchange" programs, some positions are too demanding for an employee to perform successfully when their attention is divided. As one example, if an employee is serving as the manager for one bank, then that employee is not allowed to manage or work at any other banks concurrently.

Customers interact with banks by opening and maintaining access to accounts that are offered by the banks. The system must record the date of the customer's last transaction for each account to which they have access, which includes deposits, transfers, withdrawals, or other similar actions as designated by the bank that manages that account. The system must also be able to display the total balance of all accounts that are accessible by the customer. Finally, it's important to the bank to be able to provide important notices, updates, and advertisements to their current customers. Therefore, the system must keep a listing of valid contacts for each customer. A valid contact consists of a type (e.g., mobile, home, fax, email) along with the specific contact address (e.g., 123-456-7890, gpburdell3@gatech.edu). These aren't the only types of contacts, and more might be added later. Also, each customer might have many different contacts.

Banks are the institutions that manage funds and other assets on behalf of their customers. Each bank is owned by a corporation, where a corporation is a larger organization that pools the assets of the various banks that it owns. Ownership of a bank cannot be shared. Each corporation has a unique identifier, a unique short name, a unique long name (e.g., "BofA" versus "Bank of America"), and a reserved assets value. The reserved assets value represents the money that has been saved from previous transactions, and is different than the current total of the assets possessed by all of the banks that are owned by that corporation.

Banks provide various types of accounts to their customers, and these accounts have different strengths and weaknesses. Each bank has a unique identifier that distinguishes it from all other banks, even those banks owned by different corporations. Each bank also has a name, unique address, and a reserved assets value (somewhat similar to a corporation), which is different from the current total of the assets contained in all of the accounts that are sponsored by that bank. Banks must hire sufficient employees to provide timely service to their customers, which includes a manager and at least one employee. A bank may have many employees, but never more than one manager at a time.

The most important job of a bank is to sponsor (i.e., provide and maintain) accounts. An account will not exist unless it is sponsored by a bank. There are different types of accounts, but each account has a balance, which represents the amount of money currently in the account. Each account also has a special code/identifier that is unique within that bank, but not necessarily unique across all banks. Accounts are also designed to serve different purposes. Some accounts are "checking" accounts, and are designed to allow customers to deposit and withdraw money on a regular basis to pay for expenditures, etc.

These checking accounts are very different from "interest-bearing" accounts. Each interest-bearing account earns an interest amount on a regular (e.g., normally monthly) basis, and must keep track of the date when the last deposit was placed. Interest-bearing accounts are further divided into "savings" accounts and "market" accounts. Savings accounts allow customers to earn interest but are penalized if the account balance falls below a certain amount. The minimum balance for each may vary and must be tracked separately for each savings

account. Market accounts allow customers to earn interest but are penalized if the customer exceeds a maximum number of withdrawals within a certain period. Each market account must keep track of the actual number of withdrawals that have been made so far, and the maximum number of withdrawals allowed. Per banking policy, accounts must be distinctly checking, savings or market – combinations of the different types are not allowed. We must also keep track of the list of fees (e.g., admin, processing, late payment) that are applicable for each interest-bearing account.

There are also potential ties between certain types of accounts. As one example, a customer may elect to set up overdraft protection for a designated checking account. In this case, the checking account is linked to one savings account. If a withdrawal is made from that checking account that exceeds the current balance, then the balance of the savings account is used to compensate for the difference. If this protection is used, then the date of the event, and the amount of the difference that had to be borrowed from savings must be recorded. A checking account can only be linked to one savings account for this type of protection. Similarly, a savings account can only be used to protect a single checking account.

Though an account can only be sponsored by one bank, the account can be shared by many customers. The system must keep track of the date that each customer began sharing (i.e., was added to) a given account, along with the total number of customers who are sharing the account at any given time. An account must have at least one customer but might also have many different customers. And the account balance will be represented using U.S. Dollars as the currency. And each account must fit into one of the aforementioned categories: checking, savings, or market.

The main goal of the system is to assist the users (e.g., administrators) in ensuring that all transactions are being executed accurately. To do this, the system must be able to record and/or display the total current balances for each customer, account, bank, and corporation. It must also be able to record and/or display the number of banks owned by each corporation, the number of accounts sponsored by each bank, and the number of accounts accessible by each customer.

The system will also be used to perform analytics on the customer data and identify trends. This will involve queries about the names and addresses of customers and banks, and the system should be designed to ensure that records can be queried accurately. For example, the bank might want to send emails to customers with a more personal touch by using their first name, so some queries will require that we identify customers with specific first or last names. In other cases, customers might want to locate nearby banks, so other queries will be used to search for customers with a matching city, state or zip code.

Sample Data Elements

The following data is provided to assist you in visualizing and/or validating the system design you are being tasked to develop. You are not required to submit this data. The intent is that you can use the data to check if your EERD can store the data values, relationships, etc. that we've provided in a reasonable manner. If there are elements of the data that can't be represented in an appropriate attribute, entity, or relationship, then perhaps you need to revise your design.

Similarly, if there are attributes, entities, relationships, etc. that haven't been used after you've stored all the data, then perhaps your design has unnecessary elements. This exercise doesn't guarantee that your EERD is fully correct, but it does offer some validation that you are on the correct track.

Evie Alfaro is an employee at the Wells Fargo #1 Bank, which is owned by the Wells Fargo corporation. She has an identifier of ealfaro4 and joined the system on 27 December 2021. She lives at 314 Five Fingers Way, Atlanta, Georgia 30301, and has an SSN of 278-78-7676. She has a monthly salary of \$5,600 (U.S. Dollars) and has received 3 payments with a total of \$17,100 earned so far. She was born on 6 June 1960. She also works at Wells Fargo #2 Bank, which is also owned by the Wells Fargo corporation.

The Wells Fargo corporation has an identifier of WF, a short name of "Wells Fargo", and a long name of "Wells Fargo Bank, National Association". It also has a reserved assets value of \$33 Million U.S. Dollars.

The Wells Fargo #1 Bank has an address of 1010 Binary Way, Seattle, Washington 98101, and an identifier of WF_1. The bank has a reserved assets value of \$127,000 U.S. Dollars, and is managed by Sahar Villegas (sville19). Wells Fargo #2 Bank has an address of 337 Firefly Lane, Seattle, Washington 98107, and an identifier of WF_2. The bank has a reserved assets value of \$553,000 U.S. Dollars, and is managed by Maheen McGill (mmcgill4).

Sahar Villegas is the manager of Wells Fargo #1 Bank. He has an identifier of sville19 and joined the system on 16 June 2020. He lives at 10 Downing Road, East Cobb, Georgia 30304, and has an SSN of 354-10-6263. He has a monthly salary of \$8,000 (U.S. Dollars) and has received 4 payments with a total of \$35,000 earned so far. He was born on 16 March 1965.

Maheen McGill is the manager of Wells Fargo #2 Bank. She has an identifier of mmcgill4 and joined the system on 8 September 2020. She lives at 741 Pan American Trace, East Cobb, Georgia 30304, and has an SSN of 623-09-0887. She has a monthly salary of \$9,400 (U.S. Dollars) and has received 3 payments with a total of \$29,100 earned so far. She was born on 23 June 1955.

Roxanne Nairn is an employee at the Bank of America West Region Bank, which is owned by the Bank of America corporation. She has an identifier of rnairn5 and joined the system on 16 August 2021. She lives at 2048 Transparency Road, Atlanta, Georgia 30301, and has an SSN of 404-51-1036. She has a monthly salary of \$5,100 (U.S. Dollars) and has received 5 payments with a total of \$27,400 earned so far. She was born on 13 July 1959.

The Bank of America corporation has an identifier of BA, a short name of "Bank of America", and a long name of "Bank of America Corporation". It also has a reserved assets value of \$51 Million U.S. Dollars.

The Bank of America West Region Bank has an address of 865 Black Gold Circle, Dallas, Texas 75116, and an identifier of BA_West. The bank has a reserved assets value of \$267,000 U.S. Dollars, and is managed by Saqlain McGill (smcgill17).

Saqlain McGill is the manager of Bank of America West Region Bank. He has an identifier of smcgill17 and joined the system on 11 September 2020. He lives at 741 Pan American Trace, East Cobb, Georgia 30304, and has an SSN of 238-40-5070. He has a monthly salary of \$8,800 (U.S. Dollars) and has received 3 payments with a total of \$33,700 earned so far. He was born on 2 June 1954.

Amelia-Rose Whitehead is an employee at the Wells Fargo #2 Bank. She has an identifier of arwhite6 and joined the system on 3 December 2021. She lives at 60 Nightshade Court, Baltimore, Maryland 21217, and has an SSN of 053-87-1120. She has a monthly salary of \$4,700 (U.S. Dollars) and has received 6 payments with a total of \$28,200 earned so far. She was born on 6 June 1960.

Amelia-Rose Whitehead is also customer at Wells Fargo #2 Bank. She can be contacted via mobile phone (333-182-9303) or email (amelia_whitehead@me.com). She gained access to the checking_A account at Wells Fargo

#2 Bank on 10 August 2021. This checking_A account has a balance of \$2,700, and Amelia's last transaction on this account was conducted on 26 January 2022. She gained access to the savings_A account at Wells Fargo #2 Bank on 10 August 2021. This savings_A account has a balance of \$19,400, and Amelia's last transaction on this account was conducted on 11 November 2021.

The checking_A account at Wells Fargo #2 Bank is a checking account. The savings_A account (also at Wells Fargo #2 Bank) is a savings account with an interest rate of 10% and a minimum balance of \$15,000, and where the last deposit was conducted on 5 November 2021. Also, this account is subject to low balance fees.

TJ Talbot is customer at Wells Fargo #2 Bank. He has an identifier of tjtalbot4 and joined the system on 25 March 2020. He lives at 101 Snoopy Woodstock Circle, Salt Lake City, Utah 84108, and has an SSN of 203-46-3005. He can be contacted via mobile phone (845-101-2760), home phone (236-464-1023) or email (tj_forever@aol.com). He was born on 10 May 1978. He gained access to the savings_A account at Wells Fargo #2 Bank on 17 August 2021, and TJ's last transaction on this account was conducted on 3 February 2022.

The Sun Trust corporation has an identifier of ST, a short name of "Sun Trust", and a long name of "Sun Trust Banks/Truist Financial Corporation". It also has a reserved assets value of \$39 Million U.S. Dollars.

There are two administrators in the system with identifiers of dscully5 and fmulder8.

Om Walter is customer at Wells Fargo #2 Bank and Bank of America West Region Bank. He has an identifier of owalter6 and joined the system on 29 April 2020. He lives at 143 Snoopy Woodstock Circle, Salt Lake City, Utah 84108, and has an SSN of 346-51-9139. He can be contacted via home phone (370-186-5341). He was born on 23 October 1971. He gained access to the market_X account Wells Fargo #2 Bank on 1 July 2020. He also gained access to the checking_A and savings_B accounts at Bank of America West Region Bank, both on the same day of 2 September 2020. He has not made any transactions on any of his accounts yet.

The checking_A account at Bank of America West Region Bank is a checking account with a current balance \$1,000. The savings_B account (also at Bank of America West Region Bank) is a savings account with an interest rate of 6% and a current balance of \$8,000. It has a minimum balance of \$10,000, and the last deposit to the account was conducted on 1 September 2021. Also, the savings account is subject to low balance and overdraft fees.

The savings_B account at Bank of America West Region Bank has been setup to provide overdraft protection for the checking_A account (also at Bank of America West Region Bank). There was an attempted withdrawal from the checking_A account back on 8 December 2021, which caused an overdraft of \$600.

The market_X account at Wells Fargo #2 Bank is a market account with an interest rate of 20% and a current balance of \$27,000. There has only been one (1) withdrawal from the account in the current period, and the maximum number of withdrawals allowed is two (2) within a single period. The last deposit to the account was conducted on 23 December 2021. This account is subject to administrative, frequency and fee fees.

Additional Information from the Clients/Customers

The following data was provided after receiving additional requirements and related information from the client or customer. Most of the information addresses the format of the data, including whether certain data elements might be missing. Any new information below should be complimentary to (or override) the earlier information. However, if you feel that there are significant contradictions, then please request clarification.

Additional Constraints

- We have added a password field for all system users, which they must have (it cannot be empty).
- Bank users must have a taxID associated with them. Additionally, it must be fully unique, and we know the format of each tax ID will be as such: '123-45-6789'.
- For states in addresses, we will use their 2-character abbreviation ('GA', 'MD', etc.). Similarly, zip codes will be restricted to their 5-character version instead of the longer 9/10-character version (30332 instead of 30332-1234).
- Corporations must have an ID, short name, and long name.
- Every time a customer opens/joins an account, their date of joining must be recorded.
- You may make other reasonable assumptions about constraints. However, if you feel something is ambiguous or not completely obvious based on the project description/ERD for either the relational or physical schema, please list it as an assumption at the bottom of your relational schema document.

General Considerations

- When considering data types, please be reasonable-obviously we need to be able to fit our data in each domain but using something like **varchar (65000)** is inefficient and unnecessary. And for strings, consider whether **char ()** or **varchar ()** would be more efficient in each case.
- When naming tables and columns, we would strongly advise against using any of MySQL's "keywords/reserved words" as the name, even if it makes sense (two that may be tempting are admin and user). This is because unexpected errors and/or results may happen when those words are also used to define variables-MySQL does not officially support this kind of "overloading" terms. Generally, keywords will show up as bold blue text in MySQL Workbench, but this may not happen for some. The full list of keywords and reserved words in MySQL 8.0 can be found at: <https://dev.mysql.com/doc/refman/8.0/en/keywords.html>.
- Remember that when designating an attribute(s) as a primary key in MySQL, this implicitly assigns both UNIQUE and NOT NULL constraints to the key. In the case of multi-attribute primary keys, only their *combination* must be unique, but *no individual attribute may be null*. For instance, primary keys of (A, 1) and (A, 2) would be OK, but not (null, null) or (A, null).
- The only constraints you need to define in the relational schema are primary and foreign keys. All other constraints (unique, not null, various domains) will be defined in the physical schema along with the primary and foreign keys.
- The starter data we have provided is likely not fully representative of the tables you defined in your schemas. Use the relational & physical schemas you've made to break down the data however you like into your own tables. Any 'missing' data elements in rows may be safely assumed as NULL.