COP 4710 Team Project

Final Report

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Organization Overview:

We will be building our database for a banking organization. This organization will serve the banking needs of customers, who will be conducting their transactions at physical bank locations staffed by tellers and bank managers. The main purpose of the database is to track the transactions and current balance of customers' accounts, with a secondary purpose of tracking the staffing and transaction metrics of individual bank locations. The customer will be able to view their account balance, while the tellers will process transactions to/from/between accounts (deposit/withdraw/transfer). The database will also keep track of management and employee responsibilities.

Business Rules:

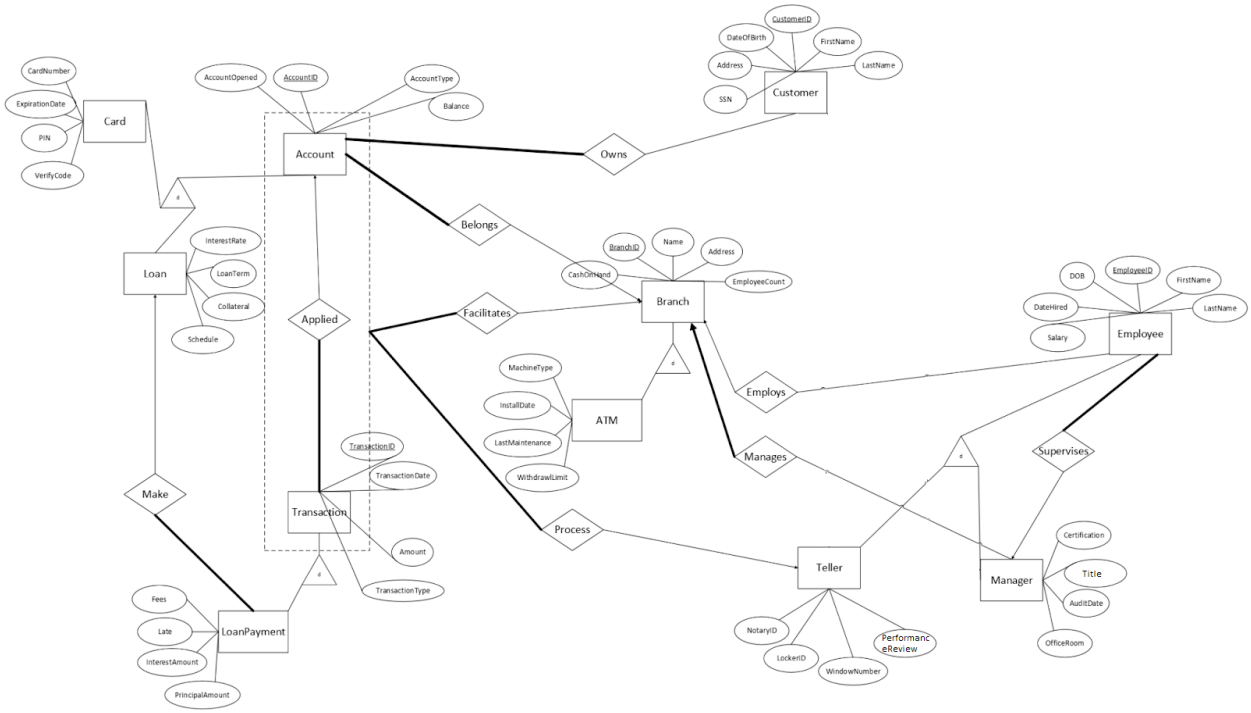
Sources used for Ideas:
https://www.geeksforgeeks.org/er-diagram-of-bank-management-system/
http://ijeais.org/wp-content/uploads/2024/4/IJAER240404.pdf
https://www.scaler.com/topics/er-diagram-for-bank-database/

***Note*: Business rules defining relationships will have entities bolded and underlined and the relationship italicized**

1. An **Account** is an entity with attributes of AccountID (Int), AccountType (String), Balance (Float), AccountOpened (Date)
2. An **Account** can be *owned* by many **Customers** (ex: joint accounts) but must have at least one owner, and a **Customer** can *own* many **Accounts**.
3. An **Account** must *belong* to a **Branch** (typically the place it's opened at).
4. A **Customer** is an entity with attributes of CustomerID (Int, Key), FirstName (String), LastName (String), DateOfBirth (Date), Address (String), SSN (Int)
5. A **Customer** cannot open an **Account** without a SSN and valid Address with proof of residence, in other words these cannot be NULL.
6. A **Loan** is a subtype of **Account** and has additional attributes of LoanID (key), InterestRate (Float), LoanTerm (Date) which is the date of the end of the loan, Collateral (String), and Schedule (String) which is the rate of repayment (either monthly, quarterly, biannually, or annually).
7. A **Loan**'s InterestRate must be a positive float value, and its balance must be a negative value (as a calculation of debt)
8. A **Card** is a subtype of **Account** and has additional attributes of CardNumber (Int), ExpirationDate (Date), PIN (Int) which is the 5-digit code you enter for swipe transactions, and VerifyCode (Int) which is the three additional numbers found on the back of the card that you are constantly asked for in online purchases.
9. A **Card**'s ExpirationDate must be a future date. Cards with past/present ExpirationDates are invalid.

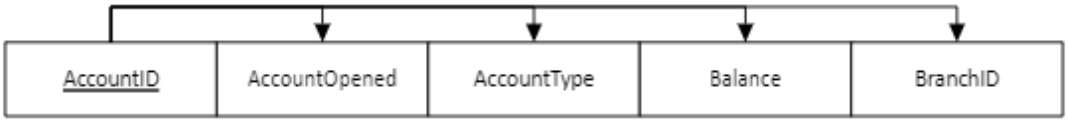
10. A **Transaction** is an entity with attributes of TransactionID (Int, Key), TransactionDate (Date), Amount (Float), and TransactionType (String) which can be used to define categories for further processing.
11. Every **Transaction** is *applied* to exactly one **Account**, but an **Account** can have multiple **Transactions**.
12. A **LoanPayment** is a subtype of **Transaction**, with additional attributes of Late (Boolean), Fees (Int) for late payment, InterestAmount (Float), and PrincipalAmount (Float).
13. A **LoanPayment** is *made* towards a **Loan**. A **Loan** can have many **LoanPayments** and each LoanPayment is associated with exactly one Loan.
14. A **Branch** is an entity with attributes of BranchID (Int, Key), Name (String), Address (String), EmployeeCount (Int, Nullable), and CashOnHand (Int) for the amount of physical money in the Branch's possession which should be kept above a certain limit and is particularly important for the subtype **ATM**.
15. An **ATM** is a subtype of **Branch**, with additional attributes of MachineType (Int), InstallDate (Date), LastMaintenance (Date), and WithdrawalLimit (Int).
16. A Branch can *facilitate* many **Transactions**, and each **Transaction** must be tied to exactly one **Branch**.
17. An **Employee** is an entity with attributes of EmployeeID (Int, Key), FirstName (String), LastName (String), DOB (Date), and Salary (Float).
18. A **Branch** can have many **Employees** but each Employee *works* at one Branch
19. A **Teller** is a subtype of **Employee**, with additional attributes of NotaryID (Int) for the ID of their Notary stamp, LockerID (Int) for the locker that they store their personal effects during work, WindowNumber (Int), and PerformanceReview (Boolean) for whether they are under performance review.
20. A **Teller** can *process* many **Transactions**, and each **Transaction** must be *processed* by exactly one **Teller**.
21. A **Manager** is a subtype of **Employee**, with additional attributes of Title(String), AuditDate (Date) for the date of the last performed Audit at the **Branch** they are managing, OfficeRoom (String) for the room designation of their office, and Certification (String) for the certification that makes them qualified for wealth management (ex: degree or CPA etc cert)..
22. A **Manager** *manages* one **Branch**, and all **Branches** have at least one **Manager**, with some (large) branches having multiple managers.
23. A **Manager** *supervises* many **Employees** but each Employee must be *supervised* by one Manager.

ER Diagram:



Normalization and DDL statements

Accounts:



The table Accounts has columns that all contain singular values and does not have repeating rows or columns. The above diagram does not show any partial or transitive dependencies, therefore the table is in 3NF.

SQL:

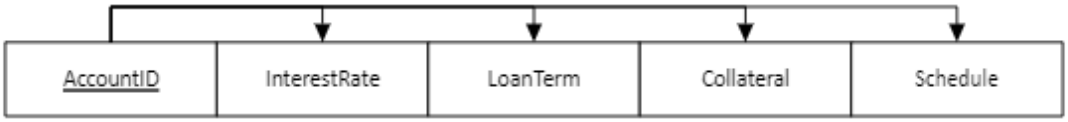
```
CREATE TABLE Accounts(
AccountID INT PRIMARY KEY,
AccountOpened DATE,
AccountType VARCHAR(100),
Balance DECIMAL(9,2) DEFAULT 0.00,
BranchID INT NOT NULL,
CONSTRAINT Belongs FOREIGN KEY (BranchID) REFERENCES Branches(BranchID)
);
```

Cards:

The table Cards has columns that all contain singular values and does not have repeating rows or columns. The above diagram does not show any partial or transitive dependencies, therefore the table is in 3NF.

SQL:
CREATE TABLE Cards(
AccountID INT PRIMARY KEY,
CardNumber BIGINT,
ExpirationDate DATE CHECK (ExpirationDate > CURRENT_DATE),
PIN INT,
VerifyCode INT,
FOREIGN KEY (AccountID) REFERENCES Accounts(AccountID) ON DELETE CASCADE
);

Loans:



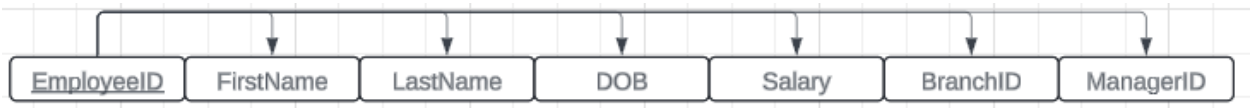
The table Loans has columns that all contain singular values and does not have repeating rows or columns. The above diagram does not show any partial or transitive dependencies, therefore the table is in 3NF.

SQL:
CREATE TABLE Loans(
AccountID INT PRIMARY KEY,
InterestRate FLOAT CHECK (InterestRate > 0),
LoanTerm DATE,
Collateral VARCHAR(100),
Schedule VARCHAR(100),
Balance DECIMAL(15, 2) CHECK (Balance < 0),
FOREIGN KEY (AccountID) REFERENCES Accounts(AccountID) ON DELETE CASCADE
);

Employees:

EmployeeID	FirstName	LastName	DOB	Salary	BranchID	ManagerID

...	...	...	...	...	...	...



The above diagram is in 3NF because it has an identified primary key with atomic values, has no repeating groups, and does not have any partial or transitive dependencies.

SQL:
CREATE TABLE Employees (
EmployeeID INT PRIMARY KEY,
FirstName VARCHAR(100) NOT NULL,
LastName VARCHAR(100) NOT NULL,
DOB DATE NOT NULL,
Salary DECIMAL(9,2) DEFAULT 0.00 NOT NULL,
BranchID INT,
ManagerID INT NOT NULL,
FOREIGN KEY (BranchID) REFERENCES Branches,
FOREIGN KEY (ManagerID) REFERENCES Employees(EmployeeID)
);

Tellers:

EmployeeID	NotaryID	LockerID	WindowNumber	PerformanceReview
...	...	...	...	...

The above diagram is in 3NF because it has an identified primary key with atomic values, has no repeating groups, and does not have any partial or transitive dependencies.

SQL:
CREATE TABLE Tellers (
EmployeeID INT PRIMARY KEY,
NotaryID INT,
LockerID SMALLINT,
WindowNumber SMALLINT,
PerformanceReview BOOLEAN,
FOREIGN KEY (EmployeeID) REFERENCES Employees ON DELETE CASCADE
);

Managers:

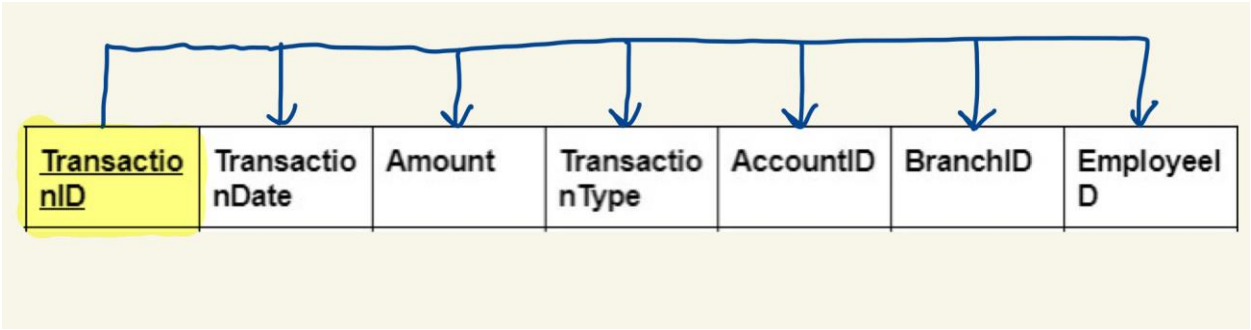
EmployeeID	Title	AuditDate	OfficeRoom	Certification	BranchID
…	…	…	…	…	…

The above diagram is in 3NF because it has an identified primary key with atomic values, has no repeating groups, and does not have any partial or transitive dependencies.

SQL:
CREATE TABLE Managers (
EmployeeID INT PRIMARY KEY,
Title VARCHAR(100) NOT NULL,
AuditDate DATE,
OfficeRoom VARCHAR(100),
Certification VARCHAR(100),
BranchID INT NOT NULL,
FOREIGN KEY (EmployeeID) REFERENCES Employees ON DELETE CASCADE,
FOREIGN KEY (BranchID) REFERENCES Branches
);

Transactions:

TransactionID	**TransactionDate**	**Amount**	**TransactionType**	**AccountID**	**BranchID**	**EmployeeID**
…	…	…	…	…	…	…



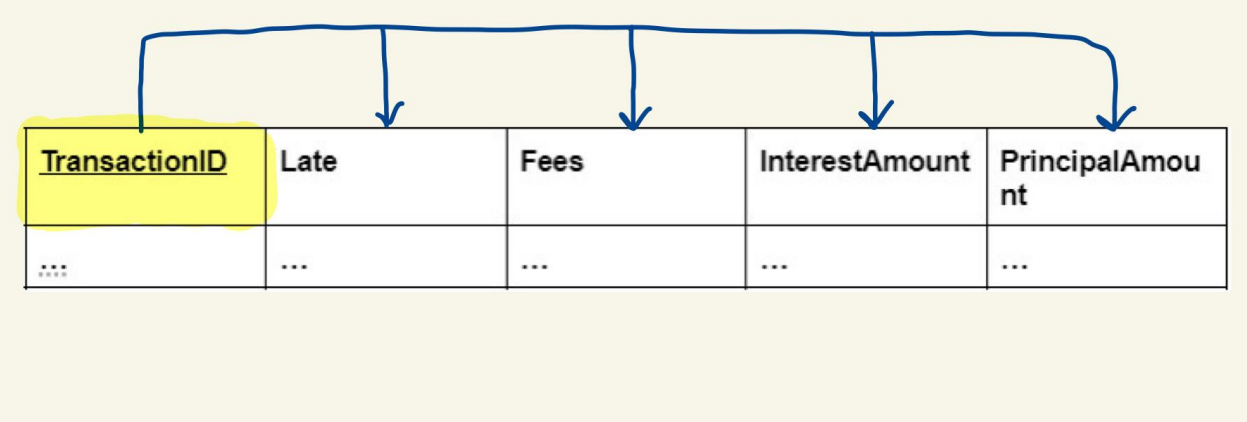
In the Transactions table above, a primary key is defined so all rows are unique, values are atomic, and there are no repeating groups so it passes 1NF. According to the dependency diagram, there aren't any partial or transitive dependencies, so it also passes 2NF and 3NF. As a result, the table is in 3NF.

PostgreSQL:

```
CREATE TABLE Transactions (
TransactionID SERIAL PRIMARY KEY,
TransactionDate DATE NOT NULL,
Amount DECIMAL(8, 2) NOT NULL CHECK (amount > 0.00 AND amount <= 250000.00),
TransactionType VARCHAR(100) NOT NULL,
AccountID INT NOT NULL,
BranchID INT NOT NULL,
EmployeeID INT NOT NULL,
FOREIGN KEY (AccountID) REFERENCES Accounts(AccountID),
FOREIGN KEY (BranchID) REFERENCES Branches(BranchID),
FOREIGN KEY (EmployeeID) REFERENCES Employees(EmployeeID)
);
```

Loan Payments:

TransactionID	**Late**	**Fees**	**InterestAmount**	**PrincipalAmount**
…	…	…	…	…



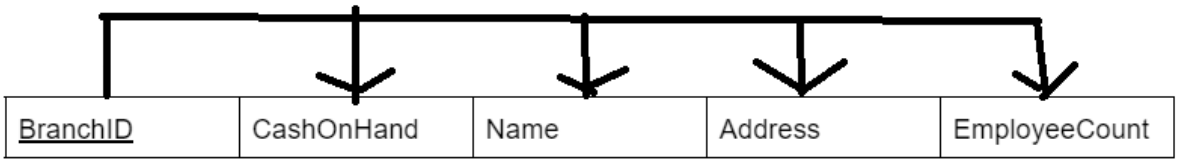
In the Loan Payments table above, a primary key is defined so all rows are unique, values are atomic, and there are no repeating groups so it passes 1NF. According to the dependency diagram, there aren't any partial or transitive dependencies, so it also passes 2NF and 3NF. As a result, the table is in 3NF.

PostgreSQL:

```
CREATE TABLE LoanPayments (
TransactionID INT PRIMARY KEY,
LoanID
Late BOOLEAN NOT NULL,
Fees DECIMAL(7, 2) DEFAULT 0.00,
InterestAmount DECIMAL(7, 2) NOT NULL,
PrincipalAmount DECIMAL(9, 2) NOT NULL,
FOREIGN KEY (TransactionID) REFERENCES Transactions(TransactionID) ON DELETE
CASCADE
);
```

Branches:

BranchID	CashOnHand	Name	Address	EmployeeCount



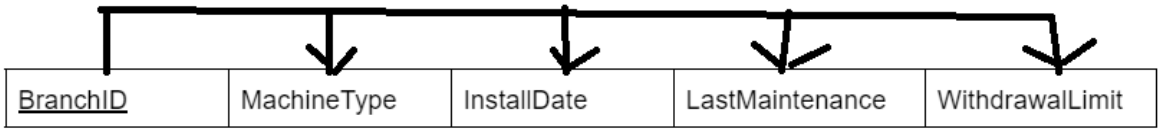
The Branches table is in 3NF. The primary key is defined meaning all rows are unique, its values are atomic, and there are no repeating groups; therefore it is in 1NF. The dependency diagram also shows that there are no partial or transitive dependencies, meaning it is in 2NF and 3NF. Therefore, the table is at least 3NF.

SQL:

```
CREATE TABLE Branches(
BranchID INT PRIMARY KEY,
CashOnHand DECIMAL(12,2) DEFAULT 0.00,
BranchName VARCHAR(100),
Address VARCHAR(100),
EmployeeCount INT
);
```

ATMs:

BranchID	MachineType	InstallDate	LastMaintenance	WithdrawalLimit

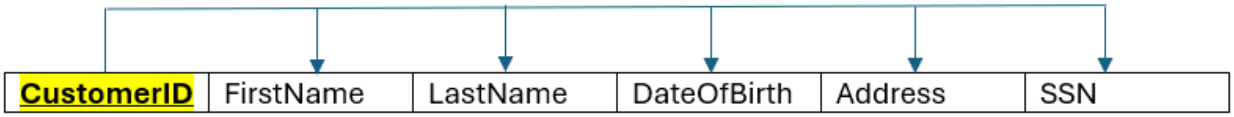


The ATMs table is in 3NF. The primary key is defined meaning all rows are unique, its values are atomic, and there are no repeating groups; therefore it is in 1NF. The dependency diagram also shows that there are no partial or transitive dependencies, meaning it is in 2NF and 3NF. Therefore, the table is at least 3NF.

SQL:

```
CREATE TABLE ATM(
BranchID INT PRIMARY KEY,
MachineType VARCHAR(100),
InstallDate DATE,
LastMaintenance DATE,
WithdrawalLimit DECIMAL,
FOREIGN KEY (BranchID) REFERENCES Branches(BranchID) ON DELETE CASCADE
);
```

Customers:

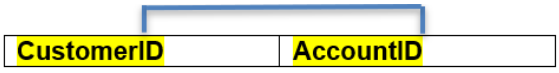


In the Customer table above, a primary key is defined so all rows are unique, values are atomic, and there are no repeating groups so it passes 1NF. According to the dependency diagram, there aren't any partial or transitive dependencies, so it also passes 2NF and 3NF. As a result, the table is at least in 3NF

SQL:

```
CREATE TABLE customers (
    CustomerID SERIAL PRIMARY KEY,
    FirstName VARCHAR(50) NOT NULL,
    LastName VARCHAR(50) NOT NULL,
    DateOfBirth DATE NOT NULL,
    Address TEXT NOT NULL,
    SSN CHAR(11) NOT NULL UNIQUE
);
```

Customer Accounts / Owns:



In the Customer Accounts / Owns table above, a primary key is defined so all rows are unique, values are atomic, and there are no repeating groups so it passes 1NF. According to the dependency diagram, there aren't any partial or transitive dependencies, so it also passes 2NF and 3NF. As a result, the table is at least in 3NF

SQL:

```
CREATE TABLE Owns (
    CustomerID INT,
    AccountID INT,
    PRIMARY KEY (CustomerID, AccountID),
    FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID) ON DELETE
CASCADE,
    FOREIGN KEY (AccountID) REFERENCES Accounts(AccountID) ON DELETE CASCADE
);
```

Data Dictionary:

Table Name	Attribute Name	Contents	Type	Format	Range	Required	PK OR FK	FK REFERENCED TABLE
Accounts	AccountID	Account ID	INT			Y	PK	
	AccountOpened	Opened date	DATE	YYYY-MM-DD				
	AccountType	Type of account	VARCHAR(100)					
	Balance	Amount in account	DECIMAL(9,2)					
	BranchID	Branch ID	INT			Y	FK	Branches
Cards	AccountID	Account ID	INT			Y	PK, FK	Accounts
	CardNumber	Number on card	INT					
	Expiration Date	Expiration on card	DATE	YYYY-MM-DD	> CURRENT_DATE			
	PIN	PIN for card	INT					
	VerifyCode	Security code on card	INT	XXX				
Loans	AccountID	Account ID	INT			Y	PK, FK	Accounts
	InterestRate	Interest rate on loan	DECIMAL(9,2)	XX.XX	> 0			
	LoanTerm	Date loan ends	DATE	YYYY-MM-DD				
	Collateral	Item used as collateral	VARCHAR(100)					

	Schedule	How often payments made	VARCHAR(100)					
	Balance	Amount left on loan	DECIMAL(9,2)		< 0			
Employees	EmployeeID	Identifier of Employee	INT	########		Y	PK	
	FirstName	First name	VARCHAR(100)	XXXXXXX..		Y		
	LastName	Last name	VARCHAR(100)	XXXXXXX..		Y		
	DOB	Date of Birth	DATE	YYYY-MM-DD		Y		
	Salary	Yearly Salary	DECIMAL(9, 2)	#######.##		Y		
	BranchID	Identifier of Branch they work at	INT	########		N	FK	Branches
	ManagerID	Identifier of the employee's supervisor	INT	########		Y	FK	Managers (EmployeeID)
Tellers	EmployeeID	Identifier of Teller	INT	########		Y	PK, FK	Employees
	NotaryID	Identifier of their unique Notary Stamp	INT	########		N		
	LockerID	Identifier of their assigned locker for personal effects	SMALLINT	##		N		

	WindowNumber	Identifier of the Window they work at	SMALLINT	##		N		
	PerformanceReview	True/False whether they are under performance review	BOOLEAN	True/False		N		
Managers	EmployeeID	Identifier of Manager (Employee)	INT	######		Y	PK, FK	Employees
	Title	Specific Job Title	VARCHAR(100)	XXXXXXX..		Y		
	AuditDate	Date of last performed internal audit	DATE	YYYY-MM-DD		N		
	OfficeRoom	Designation of room of their office	VARCHAR(100)	XXXXXXX..		N		
	Certification	Qualification used for their wealth management authority (degree, CPA cert, etc)	VARCHAR(100)	XXXXXXX..		N		
	BranchID	Identifyer of the Branch that they manage	INT	######		Y	FK	Branches
Transactions	TransactionID	Transaction ID	INT	######	NA	Y	PK	
	TransactionDate	Date of transaction	DATE	YYYY-MM-DD	NA	Y		
	Amount	Amount of money	DECIMAL(8,	######.##	0.01-250000.	Y		

		transferred	2)		00			
	TransactionType	Type of transaction	VARCHAR(100)	XXXXXXX…	NA	Y		
	AccountID	Account ID	INT	########	NA	Y	FK	Accounts
	BranchID	Branch ID	INT	###	NA	Y	FK	Branches
	EmployeeID	Employee ID	INT	######	NA	Y	FK	Employees
Loan Payments	TransactionID	Transaction ID	INT	###	NA	Y	PK, FK	Transactions
	Late	Indicates whether loan is overdue	BOOLEAN	TRUE/FALSE	NA	Y		
	Fees	Fees associated with payment	DECIMAL(7, 2)	#####.##	NA	N		
	InterestAmount	Amount of interest charged	DECIMAL(7, 2)	#####.##	NA	Y		
	PrincipalAmount	Amount of payment that reduces the loan’s principal	DECIMAL(9, 2)	########.##	NA	Y		
Branches	BranchID	Branch ID	INT			Y	PK	
	CashOnHand	Amount of Cash stored at the bank currently	DECIMAL(11,2)	###.##		Y		
	Name	Name of Branch	VARCHAR(100)			Y		
	Address	Address of Branch	VARCHAR(100)			Y		
	Employee	Numbers of	INT					

	Count	Employees Employed at a Branch						
ATMs	BranchID	Branch ID	INT			Y	PK, FK	
	MachineType	Type of Machine	VARCHAR(100)			Y		
	InstallDate	When ATM was Installed	DATE	YYYY-MM-DD		Y		
	LastMaintenance	When ATM last had Maintenance	DATE	YYYY-MM-DD		Y		
	WithdrawalLimit	Max Cash able to be withdrawn	DECIMAL(9,2)	####.##		Y		
Customers	CustomerID	Identifier of Customer	INT			Y	PK	
	FirstName	Customer's first name	VARCHAR(100)			Y		
	LastName	Customer's last name	VARCHAR(100)			Y		
	DateOfBirth	Customer's legal date of birth	DATE	YYYY-MM-DD		Y		
	Address	Customer's address	TEXT			Y		
	SSN	Social Security Number	DECIMAL(9,0)	XXX-XX-XXXX		Y		
Customer Accounts	CustomerID	Identifier of the Customer	INT			Y	PK, FK	Customers (CustomerID)

		owning the Account						
	AccountID	Identifier of the Account being owned by the Customer	INT			Y	PK, FK	Accounts (AccountID)

Table Entries

Name	Number of Entries
Branches	20
ATM	10
Employees	20
Managers	10
Tellers	10
Accounts	20
Cards	10
Loans	10
Transactions	21
LoanPayments	10
Customers	10
Owns	20

Interesting Updates & Results

```
UPDATE LoanPayments
SET Fees = Fees * 1.20
WHERE Late = TRUE AND PrincipalAmount > 1000.00;
```

This update is interesting because it compounds late fees by 20%, a simple and efficient way to implement automated late fee compounding on all accounts with a single instruction. More specific qualifiers can be added to the WHERE conditional if necessary.

```
UPDATE Transactions
SET Amount = Amount + 100.00
WHERE AccountID = 1 AND TransactionType =  'Deposit';
```

This update is interesting because it adds 100 to all deposit transactions for accountID 1, which seems like a fix for some bug or mistake that caused all records from this account to underreport by 100.

```
UPDATE Transactions
SET Amount = Amount * 2.00
WHERE BranchID = 1 AND AccountID < 11;
```

This update is interesting because it seems like evidence of embezzlement. A bad actor is perhaps using the intersection of branchID and low accountID (which typically is given to management) to double their money without using specific names or accountIDs.

```
UPDATE Transactions
SET Amount = 5000.00
WHERE TransactionType = 'Withdrawal' AND Amount > 5000.00;
```

This update is interesting because it's a blanket operation that works on all transactions that are withdrawals and of an amount larger than 5000. The result is that all withdrawal transactions over 5000 are capped to 5000 instead.

Constraints Check Results

```
-- Integrity
INSERT INTO Branches (BranchID, CashOnHand, BranchName, Address, EmployeeCount)
VALUES
(1, 30000.00, 'Dupe', 'Dupe', 10);
```

This query results in an error: ERROR: Key (branchid)=(1) already exists.duplicate key value violates unique constraint "branches_pkey", since you can’t have two entries with the same primary key.

```
-- Check
UPDATE Cards
SET expirationdate = '2023-06-27'
WHERE accountid = 1;
```

This query results in an error: ERROR: Failing row contains (1, 5579747144710460, 2023-06-27, 1992, 505).new row for relation "cards" violates check constraint "cards_expirationdate_check", since the expiration date is in the past instead of the future.

```
UPDATE Loans
SET balance = 100
WHERE accountid = 11;
```

This query results in an error: ERROR: Failing row contains (11, 34.01, 2026-03-26, Vehicles, Biweekly, 100.00).new row for relation "loans" violates check constraint "loans_balance_check", because loan balances have to be negative, not positive.

```
UPDATE Loans
SET interestrate = -10.00
WHERE accountid = 11;
```

This query results in an error: ERROR: Failing row contains (11, -10, 2026-03-26, Vehicles, Biweekly, -1500.00).new row for relation "loans" violates check constraint "loans_interestrate_check", because interest rates have to be positive, not negative.

```
UPDATE Transactions
SET Amount = 500000.00
WHERE TransactionID = 15;
```

This query results in an error: ERROR: Failing row contains (15, 2025-10-30, 500000.00, Deposit, 4, 10, 9010).new row for relation "transactions" violates check constraint "transactions_amount_check", since amounts have to be below 250,000 which 500,000 isn’t.

```
-- Referential
INSERT INTO ATM (BranchID, MachineType, InstallDate, LastMaintenance, WithdrawalLimit)
VALUES
(99, 'BadFK', '1990-01-01', '1990-01-01', 5000.00);
```

This query results in an error: ERROR: Key (branchid)=(99) is not present in table "branches".insert or update on table "atm" violates foreign key constraint "atm_branchid_fkey", because the FK being referenced doesn’t exist in the Branches table.

```
INSERT INTO Owns (CustomerID, AccountID)
VALUES (999, 1);
```

This query results in an error: ERROR: Key (customerid)=(999) is not present in table "customers".insert or update on table "owns" violates foreign key constraint "owns_customerid_fkey", because the FK being referenced (999) doesn’t exist in the Customers table.

```
INSERT INTO Owns (CustomerID, AccountID)
VALUES (101, 999);
```

This query results in an error: ERROR: Key (accountid)=(999) is not present in table "accounts".insert or update on table "owns" violates foreign key constraint "owns_accountid_fkey", because the FK being referenced (999) doesn’t exist in the Accounts table.

```
-- Not Null
INSERT INTO Branches (BranchID, CashOnHand, BranchName, Address, EmployeeCount)
VALUES
(NULL, 25000.00, 'Error', 'Error', 10);
```

This query results in an error: ERROR: Failing row contains (null, 25000.00, Error, Error, 10).null value in column "branchid" of relation "branches" violates not-null constraint, because the branchID cannot be NULL by constraint as well as regular dbms format.

```
INSERT INTO Customers (CustomerID, FirstName, LastName, DateOfBirth, SSN, Address)
VALUES (111, NULL, 'NullName', '1990-01-01', '111-22-3333', '789 Willow St, Lincoln, IL');
```

This query results in an error: ERROR: Failing row contains (111, null, NullName, 1990-01-01, 789 Willow St, Lincoln, IL, 111-22-3333).null value in column "firstname" of relation "customers" violates not-null constraint, because that constraint requires that column to be not null.

```
INSERT INTO LoanPayments (TransactionID, Late, Fees, InterestAmount, PrincipalAmount)
VALUES
(1, FALSE, 100.00, 29.32, NULL);
```

This query results in an error: ERROR: Failing row contains (1, f, 100.00, 29.32, null).null value in column "principalamount" of relation "loanpayments" violates not-null constraint, because the principalamount being inserted is null, which violates the constraint.

Queries & Results

-- (Aggregation) Find the amount of accounts associated with each branch. List them in descending order and display total balance across all accounts

```
SELECT branches.branchname,
COUNT(*) AS accounts,
SUM(accounts.balance) AS balance_sum
FROM Accounts
JOIN branches on accounts.branchid = branches.branchid
GROUP BY
branches.branchname
ORDER BY
accounts DESC;
```

This query results in the table:

	branchname character varying (100)	accounts bigint	balance_sum numeric
1	ATM9	4	16525.00
2	ATM	3	13277.00
3	ATM2	3	25104.00
4	ATM6	3	19449.00
5	ATM4	2	6718.00
6	ATM1	2	6234.00
7	ATM7	1	4247.00

Plus more rows that are too much for the window to display.

-- (Aggregation, Subquery) Find branches that have average balances higher than the average branch of overall accounts

```
SELECT branches.branchname,
AVG(balance) AS average_balance
FROM Accounts
JOIN branches on accounts.branchid = branches.branchid
WHERE
accounts.balance > (SELECT AVG(accounts.balance) FROM accounts)
GROUP BY
branches.branchname
ORDER BY
average_balance DESC;
```

This query results in the table:

	branchname character varying (100)	average_balance numeric
1	ATM2	8368.0000000000000000
2	ATM3	7788.0000000000000000
3	ATM6	7291.5000000000000000
4	ATM	6153.0000000000000000
5	ATM9	5894.0000000000000000
6	ATM1	5607.0000000000000000

```
-- (Aggregation, Subquery) We want to find the average salary of tellers at each branch (including branches with no tellers), ordered from highest to lowest.
SELECT
	b.BranchName,
	ROUND(AVG(ts.Salary),2) AS av
FROM Branches AS b LEFT JOIN (
	SELECT
		e.EmployeeID,
		e.BranchID,
		e.Salary
	FROM Employees AS e JOIN Tellers AS t
		ON e.EmployeeID = t.EmployeeID
	) AS ts ON b.BranchID = ts.BranchID
GROUP BY b.BranchName
ORDER BY av DESC NULLS LAST;
```

This query results in the table:

	branchname character varying (100)	av numeric
1	Coconut	122761.67
2	Square	106000.00
3	Birch Mayfield	105000.00
4	Baker	103039.00
5	Gigantic	96750.00
6	Pine Centerville	50000.00
7	ATM	[null]

```
-- We want to find the names of Managers born before the year 1964, ordered by their DOB in descending order.
SELECT
	FirstName,
	LastName,
	DOB
FROM Employees AS e JOIN Managers AS m
	ON e.EmployeeID = m.EmployeeID
WHERE DOB < '1964-01-01'
ORDER BY DOB DESC;
```

This query results in the table:

	firstname character varying (100)	lastname character varying (100)	dob date
1	Seth	Sanford	1960-08-02
2	Christie	Leonard	1952-02-23

```
-- (Subquery) Get total withdrawals from ATMs that have been used this year
SELECT Branches.BranchName, Branches.Address, (
	SELECT SUM(Transactions.Amount)
	FROM Transactions
	WHERE Transactions.BranchID = Branches.BranchID
	AND Transactions.TransactionType = 'Withdrawal'
	AND Transactions.TransactionDate >= '2024-01-01'
) AS TotalWithdrawals
FROM Branches
JOIN ATM ON Branches.BranchID = ATM.BranchID
```

```
WHERE ATM.BranchID IN (
        SELECT DISTINCT Transactions.BranchID
        FROM Transactions
        WHERE Transactions.TransactionType = 'Withdrawal'
        AND Transactions.TransactionDate >= '2024-01-01'
        AND Transactions.Amount > 500
)
ORDER BY TotalWithdrawals DESC;
```

This query results in the table:

	branchname character varying (100)	address character varying (100)	totalwithdrawals numeric
1	ATM3	888 Oak St, Franklin, IL	5600.00
2	ATM1	754 Coconut Square, Springfield, IL	2600.00
3	ATM9	639 Park Alley, Mayfield, IL	2200.00

```
-- (Aggregation) Get Addresses with no ATM installed, just a Bank
SELECT Branches.Address
FROM Branches
LEFT JOIN ATM ON ATM.BranchID = Branches.BranchID
GROUP BY Branches.Address
HAVING COUNT(ATM.BranchID) = 0;
```

This query results in the table:

	address character varying (100)
1	999 Gigantic Ln, Centerville, IL
2	800 Circle Sqr, Springfield, IL
3	732 Birch Rd, Mayfield, IL
4	953 Log St, Lincoln, IL

```
-- (Aggregation) Get the monthly transaction count and total amount for each branch
SELECT
        B.BranchID,
        B.BranchName,
        date_trunc('month', T.TransactionDate)::DATE AS Month,
        COUNT(T.TransactionID) AS TransactionCount,
        SUM(T.Amount) AS TotalTransactionAmount
```

```
FROM
        Transactions T
JOIN
        Branches B ON T.BranchID = B.BranchID
GROUP BY
        B.BranchID, Month
ORDER BY
        Month, B.BranchID;
```

This query results in the table:

	branchid [PK] integer	branchname character varying (100)	month date	transactioncount bigint	totaltransactionamount numeric
14	5	ATM	2028-12-01	1	124.62
15	3	ATM3	2030-04-01	2	5600.00
16	2	ATM2	2030-05-01	1	152.53
17	1	ATM1	2030-07-01	1	2040.72
18	2	ATM2	2031-01-01	1	26000.00
19	10	ATM10	2031-04-01	1	2612.63
20	4	ATM4	2031-06-01	1	4960.01

Total rows: 20 of 20 Query complete 00:00:00.100 Ln 15, Col 8

It's pretty basic since the transactions table is pretty sparse spread over the large time frame, but you can see it's aggregating correctly on 04-2030

```
-- (3+, Aggregation) Get the remaining balance left on each loan, along with associated customer info, and list them in descending order
SELECT
        C.FirstName,
        C.LastName,
        C.SSN,
        L.AccountID,
        L.Balance,
        SUM(LP.PrincipalAmount + LP.InterestAmount) AS TotalLoanPayment,
        (SUM(LP.PrincipalAmount + LP.InterestAmount) + L.Balance) AS RemainingBalance
FROM
        LoanPayments LP
JOIN
        Loans L ON LP.TransactionID = L.AccountID
JOIN
        Owns O ON L.AccountID = O.AccountID
JOIN
        Customers C ON O.CustomerID = C.CustomerID
GROUP BY
        L.AccountID, L.Balance, C.FirstName, C.LastName, C.SSN
```

```
ORDER BY
        RemainingBalance DESC;
```

This query results in the table:

	firstname character varying (50)	lastname character varying (50)	ssn character (11)	accountid integer	balance numeric (15,2)	totalloanpayment numeric	rema num
1	Diana	Johnson	345-67-8901	16	-3000.00	2512.63	
2	Irene	Adler	543-21-0987	11	-1500.00	532.37	
3	Helen	Mirren	654-32-1987	20	-28000.00	26000.00	
4	Jack	Reacher	345-67-1234	12	-12000.00	124.62	
5	Bob	Smith	987-65-4321	14	-26000.00	152.53	
6	Michael	Smith	123-45-6789	13	-38000.00	522.45	

```
-- (Subquery) Find customers with more than one account
SELECT
        C.FirstName,
        C.LastName,
COUNT(o.AccountID) AS NumberOfAccounts
FROM Customers C
JOIN
        Owns O ON C.CustomerID = O.CustomerID
GROUP BY C.CustomerID
HAVING COUNT(O.AccountID) > 1;
```

This query results in the table:

	firstname character varying (50)	lastname character varying (50)	numberofaccounts bigint
1	Michael	Smith	3
2	Helen	Mirren	2
3	Charlie	Brown	2
4	Diana	Johnson	2
5	Edward	Kenway	2
6	George	Harrison	2
7	Bob	Smith	3

```
-- (3+) Get customers with account balances and account types
SELECT
        C.FirstName,
```

```
        C.LastName,
        A.AccountType,
        A.Balance
FROM Customers C
JOIN
        Owns O ON C.CustomerID = O.CustomerID
JOIN
        Accounts A ON O.AccountID = A.AccountID;
```

This query results in the table:

	firstname character varying (50)	lastname character varying (50)	accounttype character varying (100)	balance numeric (9,2)
1	Michael	Smith	Checkings	627.00
2	Bob	Smith	Savings	3515.00
3	Bob	Smith	Checkings	4109.00
4	Charlie	Brown	Savings	2695.00
5	Diana	Johnson	Savings	4421.00
6	Edward	Kenway	Checkings	4643.00
7	Fiona	Gallagher	Savings	8054.00

With more rows not displayed in the window but existing downward.