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Project 1

Relations

Relation: Account

(Account_ID ;*Account_TypeID*; *Balance*; Loans; CD_Rate_ID; *Account_Type*; Account_Opened; Account_Closed)

- The Account relation identifies attributes of each account.
- There will be one tuple for each account made.
- Customer will not be saved in this relation.
- Account Type will identify if account is a checking, savings, CD, or loans account by ID.
- If item is in a (CD account/Loans account) then the time frame will be selected by corresponding ID otherwise will be null.
- Checking and saving account will go by account balance otherwise null.
- Account_Open and Account_Closed will hold dates where the customer opened or closed accounts

Relation: Account_Per_Customer (Composite Primary Key)

(Account_ID; Customer_ID)

- In this relation it will grant the Customers to share accounts
- More than one customer can be under one account
- Identifies all customers under each account

Relation: Account_Type

(Account_Type_ID; *Account_Type*; Annual_Interest_Rate)

- This relation identifies all possible Account types
- Limited to Checking, Savings, CD Account, and Loans
- Will have different rates if the account type is a CD Account or Loan

Relation: Customer

(Customer_ID; Customer_First; Customer_Last; Customer_Address; Customer_State; Customer_ZipCode; Customer_SS; Customer_Password; Customer_Drivers_License; Customer_Email)

- This relation shows the attributes of all customers, most of which are unique.
- There is one tuple for each customer.

Relation: CD_Rates

(CD_Rate_ID; Time_Frame; CD_Rate_Percentage; CD_Penalty)

- This relation only applies for CD Accounts where customers gain money over time but there is a penalty if the customer pull money out prematurely(breaks the timeframe of his/her contract)

Relation: Transaction_Type

(Transaction_TypeID; *Transaction_Type*; Transaction_Fee)

- This relation identifies all possible transaction types
- Limited to Branch_Deposit, Branch_Withdrawals, Branch_Payment, Online_Deposit, Online_Withdrawals, Online_Payment, ATM_Deposit, ATM_Withdrawals.
- Each of these Transaction types have unique Transaction_iDs which are “100”, “101”,”102”,”200”,”201”,”202”,”300”,”301”. These numbers are respective to the transactions on the bullet point on the top of this one.

Relation: Transactions History

(Transaction_ID; *Customer_ID*; Customer_First; Customer_Last; *Account_ID*; Transaction_Date; *Account_Type*; *Transaction_Type_ID*; *Branch_Address*; *Location_ID*; *Staff_ID*; *ATM_ID*; Transaction_Deposit_Amount; Transaction_Withdrawals_Amount; Transaction_Payment_Amount; *Balance*)

- This relation identifies each time a customer makes a transaction.
- Each action is stored from location to amount deposited/withdrawn and the final balance after each transaction.
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Relation: Branches

(Location_ID; Staff_ID; *Branch_Address*; Branch_State; Branch_Zip)

- In this relation the Location and Staff ID are both primary keys which means the Staff can work in multiple locations.
- LocationID and the branch address, state and zip will match when it is called.

Relation: Bank_Staff

(Staff_ID; Staff_First; Staff_Last; *Branch_Address*; Staff_Title; Staff_Salary; *Location_ID*)

- In this relation each bank staff has a unique ID and also shows where the staff works even if it is on multiple locations.
- This relation will also provide staff name and other unique attributes

Relation: Rating

(Rating_ID; Customer_ID; Staff_ID; Rating_Amount; Rate_Date)

- In this relation the Customer can give each staff a unique rating for their service.
- The rating Id will keep track of now many ratings there are and every time a customer rates a Staff.
- Each customer can only rate the same staff once.
- Rating amount will be a number from one to ten
- Rate date will log the time the rating was given.

Relation: ATM_Location

(*Location_ID*; *ATM_ID*; ATM_Address; ATM_Name; ATM_City)

- This relation will show where ATMs are.
- Location and ATMID are both primary keys so each location can have multiple ATMs

Questions

1) **Create a monthly bank statement. Identify the 1-month transaction history for [customer=James Lin]. Display the customer's name, type of transaction, amount of transaction, date and location of transaction.**

JamesLin ← $\delta_{Customer_{First}=\text{James}\wedge\text{Customer}_{\text{Last}}=\text{Lee}}(Customer)$

A← $\delta_{JamesLin.Customer_{ID}=Accounts_{Per_{Customer}}.Customer_{ID}}(JamesLin \times \text{Accounts}_{\text{Per}_{Customer}})$

B← $\delta_{A.Account_{ID}=Accounts.Account_{ID}}(A \times \text{Accounts})$

C← $\delta_{B.Customer_{ID}=Transaction_{History}.Customer_{ID}}(B \times \text{Transaction}_{\text{History}})$

D←

$\Pi_{C.Customer_{Id}\left(\delta_{Transaction_{Date}\geq 05/01/2023\wedge\text{Tansaction}_{\text{Date}}\leq 05/30/2023}(Transaction_{History})\right)-\Pi_{Customer_{ID}}(C)}$

E← $\delta_{D.Location_{ID}=Branches,Location_{ID}}(D \times \text{Branches})$

F← $\delta_{E.Location_{ID}=ATM_{Location}.Location_{ID}}(E \times \text{ATM}_{\text{Location}})$

Answer← $\Pi_{Customer_{First},Customer_{Last},Account_{Type},Transaction_{Date},Address,ZipCode,State}(F)$

2) **Identify accounts with no in-person branch activity in the last year for [state] customers. Display the customer's name, account number and balance.**

A← $\delta_{Transaction_{Date}\geq 02/02/2022}(Transaction)$

B← $\Pi_{Customer_{ID}}(Customer) - \Pi_{Customer_{ID}}(A)$

C← $\delta_{Transaction_{Type_{ID}}='200'\vee'201'\vee'202'\vee'300'\vee'301'}(Transaction_{Type})$

D← $\Pi_{Customer_{ID}}(B) - \Pi_{Customer_{ID}}(C)$

E← $\delta_{D.Customer_{Name}=Customer.Customer_{Name}}(D \times \text{Customer})$

F← $\delta_{E.Account_{ID}=Accounts_{Per_{Customer}}.Account_{ID}}(E \times \text{Accounts\_Per\_Customer})$

G← $\delta_{F.Balance=Account.Balance}(F \times \text{Accounts})$

Answer← $\Pi_{Customer_{Name},Account_{ID},Balance}(G)$

3) Identify withdrawals performed at the [drug store=CVS] ATM at [address=15 Main Street] this [date=1/1/1998]. Display the customer's name, account number, transaction amount and date of transaction.

WithDrawalAtCVS←
$\delta_{ATM_{ID}="CVS12" \wedge \text{ATM}_{\text{Address}}='15Main' \wedge \text{Transaction}_{\text{Date}}='01-01-1998'}(Transaction_{History})$
B← $\Pi_{WithDrawalAtCVS.Customer_{ID}} - \Pi_{Transaction_{History}.Customer_{ID}}(WithdrawalAtCVS \times \text{Transaction}_{\text{History}})$
C← $\Pi_{Customer_{Name},Account_{ID},Transaction_{Date},Transaction_{Amount}}(B)$

4) Identify [state=NY] customers without a transaction in the [date=02/20/2023]. Display the customer's name and email.

A← $\delta_{State="NY"}(Customer)$
B← $\Pi_{Customer_{ID}}(Customer) - \Pi_{Customer_{ID}}(A)$
C← $\Pi_{B.Customer_{ID}}\left(\delta_{Transaction_{Date}='null' \wedge \text{date}("02-20-2023")}(Transaction_{History})\right) - \Pi_{Account_{ID}}(A \times Transaction_{History})$
Answer← $\Pi_{Customer_{First},Customer_{Last},Customer_{Email}}(C)$

5) Identify deposits by zip code in the [date]. Display 3 columns: zip code, number of transactions and total dollar amount of deposits. Display 1 row for each zip code.

DepositsByDate← $\delta_{Transaction_{Date}='01-05-2023'}(Transaction_{History})$
A← $\Pi_{Deposit_{By_{Date}}.Transaction_{ID}}(DepositByDate) - \Pi_{Tranaction_{History}.Transaction_{ID}}(Transaction_{History})$
$\rho_{Answer(ZipCode,Transactions,TotalDollarAmountDeposit)} Zipcode\Im_{count\ zipcode.tranaction_{id}}\Im_{sum\ zipcode.deposit\_amount}$

6) Identify the total number of active [state=NY] customers. Display the number. Describe your criteria used to identify an active customer.

Criteria for Active Customer is active in the last 6 Months from today.
ActiveNYCustomer←
$\delta_{Today(\square)=10/02/2022}(Transaction) \wedge \delta_{Customer_{State}="NY"}(Customer)$
A← $\delta_{Customer.Customer_{ID}=Transaction_{History}.Customer_{ID}}(Customer \times \text{Transaction}_{\text{History}})$
B← $\Pi_{Transaction_{History}.Customer_{ID}}(Customer) - \Pi_{Customer_{ID}}(Active_{Customer})$
Answer← $\Pi_{\Im_{Count_{\square}Transaction_{ID}}}(B)$

7) Identify deposits and withdrawals for all [account type=Checking] in the [date=10/14/2021] by branch. Display 4 columns: Branch state, branch address, total deposits and withdrawals and number of transactions. Display 1 row for each branch address.

DepositsAndWithdrawals←
$\delta_{Account_{type}='Checking' \wedge \text{Transaction}_{\text{Date}}='10-14-2021'}(Transaction_{History})$
A← $\delta_{DepositsAndWithdrawals.Location_{ID}=Branches.Location_{ID}}(DepositsAndWithdrawals \times$ Branches)
$\rho_{Answer}(\text{Branch}_{\text{Address}}, Branch_{State}, Total_{Deposits_{and_{Withdrawals}}}, Number_{Of_{Transactions}})$
$branch_{Address}, branch_{state} \Im_{sum\ deposits \wedge \text{withdrawals}} \Im_{count\ Transaction_{Id}}$

8) Identify staff with low customer ratings in the last [date=week]. Display the staff name, number of ratings and average rating. Display 1 row for each staff.

4 or lower stars = low rating
LastWeek← $\delta_{Rate_{Date} \geq "1-21-2019"} \wedge \delta_{Rate_{Date} \leq \text{1-28-2019}}(Rating)$
A← $\delta_{Branch_{staff}.Staff_{ID}=Rating.Staff_{ID}}(Branch_{Staff} \times \text{Last}_{\text{Week}})$
B← $\Pi_{Staff_{ID}}\left(\delta_{Rating_{Amount} \Im_{Avg\ Staff_{Id}.Rating_{Amount} \leq '4'}(Rating)}\right) - \Pi_{Staff_{Id}}(A)$
Answer← $\Pi_{Staff_{First}, Staff_{Last}, \Im_{count\ Ratings}, \Im_{Avg\ Ratings}}(B)$

9) Identify the number of transactions performed by staff at the [address=15 MainSt] branch in the last [date=01-23-2023]. Display 3 columns: staff first name, last name and number of transactions.

LastMonth← $\delta_{Transaction_{Date} \geq "01-23-2023"}(Transaction_{History})$
A← $\delta_{LastMonth.Staff_{ID}=Bank_{Staff}.Staff_{ID}}(LastMonth \times$ Bankstaff)
B←
$\Pi_{A.Staff_{ID}}(\delta_{Branch_{Address}=\text{15 Main St} \wedge \text{Transaction}_{\text{Type}_{ID}}='100'^{\wedge}'101'^{\wedge}'102'}(Transaction_{History}))$
Answer← $\Pi_{Staff_{First}, Staff_{Last}, \Im_{count\ Transaction_{ID}}}(B)$

10) Identify all accounts that were closed in the [date=03-17-2022]. Display the customer's name, account number and final balance.

LastWeek← $\delta_{Account_{Closed}="03-17-2022"}(Account)$

A← $\delta_{LastWeek.Account_{ID}=Account_{Per_{Customer}}.Account_{ID}}(LastWeek \times Account_{Per_{Customer}})$

B← $\delta_{A.Customer_{ID}=Customer.Customer_{ID}}(A \times \text{Customer})$

Answer← $\Pi_{Customer_{First},Customer_{Last},Account_{ID},Balance}(B)$

11) Identify the best bank customers in [location=ZipCode->11354]. Display the customer's name and balance of all accounts. Describe your criteria used to identify the best customers.

Criteria for best bank customer has greater than or equal to $1,000,000.

CustomersInNY← $\delta_{Customer_{ZipCode}='11354' \wedge \text{Customer}_{\text{State}}='NY'}(Customers)$

A← $\delta_{CustomerInNY.CustomerID=Account_{Per_{Customer}}.Customer_{ID}}(CustomerInNY \times \text{Account}_{\text{Per}_{\text{Customer}}})$

B← $\Pi_{A.Account_{ID}}(\delta_{Balance \geq '1000000'}(Account)) - \Pi_{Account_{Id}}(A)$

C← $\delta_{B.Account_{Id}=Account.Account_{ID}}(B \times \text{Account})$

Answer← $\Pi_{Customer_{First},Customer_{Last},Balance}(C)$