Module Exercise 7.5: CS 5012: RA Banking

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Banking DB Schema

- branch (branch-name, branch-city, assets)
- customer (customer-name, customer-street, customer-city)
- account (account-number, branch-name (FK), balance)
- loan (loan-number, branch-name (FK), amount)
- depositor (customer-name, account-number (FK))
- borrower (customer-name, loan-number (FK))

Banking DB Tables

Branch Table

branch-name	branch-city	assets
Brighton	Brooklyn	7100000
Downtown	Brooklyn	9000000
Mianus	Horseneck	400000
North Town	Rye	3700000
Perryridge	Horseneck	1700000
Pownal	Bennington	300000
Redwood	Palo Alto	2100000
Round Hill	Horseneck	8000000

Customer Table

customer-name	customer-street	customer-city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	North	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

Account Table

account-number	branch-name	balance
A-101	Downtown	500
A-215	Mianus	700
A-102	Perryridge	400
A-305	Round Hill	350
A-201	Brighton	900
A-222	Redwood	700
A-217	Brighton	750

Loan Table

loan-number	branch-name	amount
L-11	Round Hill	900
L-14	Downtown	1500
L-15	Perryridge	1500
L-16	Perryridge	1300
L-17	Downtown	1000
L-23	Redwood	2000
L-93	Mianus	500

Depositor Table

customer-name	account-number
Hayes	A-102
Johnson	A-101
Johnson	A-201
Jones	A-217
Lindsay	A-222
Smith	A-215
Turner	A-305

Borrower Table

customer-name	loan-number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

Questions

1. Find all loans over $1200.
   a. $\sigma_{(amount>1200)}(loan)$
   b. Results in:

loan-number	branch-name	amount
L-14	Downtown	1500
L-15	Perryridge	1500
L-16	Perryridge	1300
L-23	Redwood	2000

2. Find the loan number for each loan of an amount greater than $1200.
   a. $\pi_{loan-number}(\sigma_{(amount>1200)}(loan))$
   b. Results in:

loan-number
L-14
L-15
L-16
L-23

3. Find the names of all customers who have a loan, an account, or both from the bank.
    a. $\pi_{(customer-name)}((customer \bowtie depositor) =\bowtie= (customer \bowtie borrower))$
    b. Results in:

customer-name
Hayes
Johnson
Jones
Lindsay
Smith
Turner
Adams
Curry
Jackson
Williams

    - $\bowtie$ enforces equality on shared attributes (customer-name)
    - $=\bowtie=$pads with nulls any accounts-number or loan-number that isn't available for the join on customer-name
    - π removes duplicates
4. Find the names of all customers who have a loan and an account at the bank.
    a. $\pi_{(customer-name)}(depositor \bowtie borrower)$
    b. Results in:

customer-name
Hayes
Jones
Smith

    c. $\bowtie$ enforces equality on shared attributes (customer-name)
5. Find the names of all customers who have a loan at the Perryridge branch.
    a. $\pi_{(customer-name)}(borrower \bowtie \sigma_{(branch-name="Perryridge")}(loan))$
    b. Results in:

customer-name
Hayes
Adams

    c. $\bowtie$ enforces equality on shared attributes (loan-number)

6. Find the names of all customers who have a loan at the Perryridge branch, but no account at any branch of the bank.
    a. $\pi_{(customer-name)}\left(borrower \bowtie \sigma_{(branch-name="Perryridge")}(loan)\right) - \pi_{(customer-name)}(depositor)$
    b. Results in:

customer-name
Adams

    c. $-$ finds tuples in the first projection but not the second.

7. Find the names of all customers who have an account at the Downtown and Mianus branches.
    a. $\pi_{(customer-name)}((depositor \bowtie \sigma_{(branch-name=\text{"Downtown"})}(account)) \bowtie (depositor \bowtie \sigma_{(branch-name=\text{"Mianus"})}(account)))$
    b. Results in an empty tuple.
8. Find the total amount each branch has in accounts.
    a. $\pi_{(branch-name,assets)}(branch)$
    b. The above assumes that total amount the branch has in its accounts is the amount in the assets column of the relation.
9. Find the average loan amount of each customer.
    a. customer-name $\mathcal{G}\ avg_{(amount)}(\pi_{(customer-name,amount)}(\text{borrower} \bowtie \pi_{(\text{loan-number,amount})}(\text{loan}))$
    b. Left join the Borrower relation on the projection of loan-number and amount from the Loan relation. From that join, project customer-name and amount. Then, by customer-name, aggregate the average loan amount.
10. Find the names of all customers who have an account at every branch located in Brooklyn.
    a. $\pi_{(customer-name)}(\pi_{(customer-name,branch-name)}(depositor \bowtie account)\% \left(\pi_{(branch-name)}(\sigma_{(branch-city=\text{"Brooklyn"})}branch)\right))$
    b. Use the division operator to only return records that match both the branch-names in branches from Brooklyn.