Relational Model:
Examples

Banking Example

branch (branch_name, branch_city, assets)

customer (customer_name, customer_street, customer_city)

account (account_number, branch_name, balance)

loan (loan_number, branch_name, amount)

depositor (customer_name, account_number)

borrower (customer_name, loan_number)

Banking Example

branch (branch_name, branch_city, assets)

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Example *branch* relation

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

Example *loan* relation

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

Example *borrower* relation

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

Example Queries

- Find all loans of over $1200

$$\sigma_{amount > 1200}(loan)$$

- Find the loan number for each loan of an amount greater than $1200

$$\prod_{loan\_number}(\sigma_{amount > 1200}(loan))$$

- Find the names of all customers who have a loan, an account, or both, from the bank

$$\prod_{customer\_name}(borrower) \cup \prod_{customer\_name}(depositor)$$

Example Queries

- Find the names of all customers who have a loan at the Perryridge branch.

$$\Pi_{customer\_name}\,(\sigma_{branch\_name=\text{“Perryridge”}}\,(\sigma_{borrower.loan\_number\,=\,loan.loan\_number}(borrower\ x\ loan)))$$

- Find the names of all customers who have a loan at the Perryridge branch but do not have an account at any branch of the bank.

$$\Pi_{customer\_name}\,(\sigma_{branch\_name\,=\,\text{“Perryridge”}}\,(\sigma_{borrower.loan\_number\,=\,loan.loan\_number}(\text{borrower x loan}))) - \Pi_{customer\_name}(\text{depositor})$$

Example Queries

- Find the names of all customers who have a loan at the Perryridge branch.
  - Query 1

$$\Pi_{\text{customer\_name}} (\sigma_{\text{branch\_name} = \text{“Perryridge”}} (\sigma_{\text{borrower.loan\_number} = \text{loan.loan\_number}} (\text{borrower} \times \text{loan})))$$

  - Query 2

$$\Pi_{\text{customer\_name}} (\sigma_{\text{loan.loan\_number} = \text{borrower.loan\_number}} ((\sigma_{\text{branch\_name} = \text{“Perryridge”}} (\text{loan})) \times \text{borrower}))$$

Example Queries

- Find the largest account balance
  - Strategy:
    - Find those balances that are *not* the largest
      - Rename *account* relation as *d* so that we can compare each account balance with all others
    - Use set difference to find those account balances that were *not* found in the earlier step.
  - The query is:

$$\Pi_{balance}(account) - \Pi_{account.balance}$$
$$(\sigma_{account.balance < d.balance} (account \times \rho_{d} (account)))$$

Bank Example Queries

- Find the names of all customers who have a loan and an account at bank.

$$\Pi_{customer\_name}(borrower) \cap \Pi_{customer\_name}(depositor)$$

- Find the name of all customers who have a loan at the bank and the loan amount

$$\Pi_{customer\_name,\ loan\_number,\ amount}(borrower \bowtie loan)$$

Bank Example Queries

- Find all customers who have an account from at least the “Downtown” and the Uptown” branches.
  - Query 1

$$\Pi_{customer\_name}(\sigma_{branch\_name = \text{“Downtown”}}(depositor \bowtie account)) \cap$$

$$\Pi_{customer\_name}(\sigma_{branch\_name = \text{“Uptown”}}(depositor \bowtie account))$$