CS303: Assignment 1

B Siddharth Prabhu
200010003@iitdh.ac.in

4 September 2022

1 Answers to Question 1: Banking on Databases

Given database tables are as follows:

```
Branch (branch_name, branch_city, assets)
customer (customer_name, customer_street, customer_city)
loan (loan_number, branch_name, amount)
borrower (customer_name, loan_number)
account (account_number, branch_name, balance)
depositor (customer_name, account_number)
```

(a) Relational Algebra

(i) Find the names of all branches located in "Chicago".

$$\Pi_{branch\_name}(\sigma_{branch\_city=\text{“}Chicago\text{”}}(Branch))$$

(ii) Find the names of all borrowers who have a loan in the branch "Downtown".

$$A \leftarrow loan \bowtie borrower$$

$$\Pi_{customer\_name}(\sigma_{branch\_name=\text{“}Downtown\text{”}}(A))$$

(b) Forging keys

Table Name	Primary Key (PK)	Foreign Key (Referencing Table)
Branch	branch_name	-
customer	customer_name, customer_street, customer_city	-
loan	loan_number	(branch_name) references Branch
borrower	customer_name, loan_number	(customer_name) references customer, (loan_number) references loan
account	account_number	(branch_name) references Branch
depositor	customer_name, account_number	(customer_name) references customer, (account_number) references account

Table 1: Appropriate Primary and Foreign Keys for the Banking schema

Note: If we rule out multiple people depositing to some account, and multiple people borrowing from an account, then the primary key of depositor would be (account_number) and that of borrower would be (loan_number). Also, ideally we would want some kind of customer_id. In this case, people with the same name living on the same street would be considered the same, though it's the best this database can do. Hence, the table above has been made based on these kinds of assumptions!

(c) More Relational Algebra!

(i) Find all loan numbers with a loan value greater than $10,000.

$$\Pi_{loan\_number}(\sigma_{amount>10000}(loan))$$

(ii) Find the names of all depositors who have an account with a value greater than $6,000.

$$A \leftarrow account \bowtie depositor$$

$$\Pi_{customer\_name}(\sigma_{balance>6000}(A))$$

(iii) Find the names of all depositors who have an account with a value greater than $6,000 at the "Uptown" branch

$$A \leftarrow account \bowtie depositor$$

$$\Pi_{customer\_name}(\sigma_{(balance>6000)\wedge(branch\_name=\text{“}Uptown\text{”})}(A))$$

---

2 Answers to Question 2: Relational Algebra Outputs

(i) Select names of those users who are older than 25 years of age.

$$\Pi_{Name}(\sigma_{age>25}(User))$$

Name
Victor
Jane

(ii) Select those users whose Id is greater than 2, OR their age is NOT 31.

$$\sigma_{(Id>2) \vee (age!=31)}(User)$$

Id	Name	Age	Gender	OccupationId	CityId
1	John	25	Male	1	3
2	Sara	20	Female	3	4
3	Victor	31	Male	2	5
4	Jane	27	Female	1	3

(iii) Join the tables User and Occupation by considering the 'OccupationId' column.

$$\sigma_{User.OccupationId = Occupation.OccupationId}(User \times Occupation)$$

Id	Name	Age	Gender	User. OccupationId	CityId	Occupation. OccupationId	Occupation Name
1	John	25	Male	1	3	1	Software Engineer
2	Sara	20	Female	3	4	3	Pharmacist
3	Victor	31	Male	2	5	2	Accountant
4	Jane	27	Female	1	3	1	Software Engineer

(iv) Join User, Occupation, City naturally, i.e., Natural join those tables using appropriate columns.

$$User \bowtie Occupation \bowtie City$$

Id	Name	Age	Gender	OccupationId	CityId	OccupationName	CityName
1	John	25	Male	1	3	Software Engineer	Boston
2	Sara	20	Female	3	4	Pharmacist	New York
3	Victor	31	Male	2	5	Accountant	Toronto
4	Jane	27	Female	1	3	Software Engineer	Boston

(v) Get all names and genders of users from Boston.

$$\Pi_{Name,\ Gender}(\sigma_{CityName=\text{“}Boston\text{”}}(User \bowtie City))$$

Name	Gender
John	Male
Jane	Female