CS303 : DataBases and Information Systems

Assignment 1

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1 Problem 1

Given banking database:

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) Expressions in the relational algebra

i. Names of all branches located in “Chicago”

$$\Pi_{branch\_name}(\sigma_{branch\_city='Chicago'}(Branch))$$

ii. Names of all borrowers who have a loan in the branch “Downtown”

$$\Pi_{customer\_name}(\sigma_{branch\_name='Downtown'}(borrower \bowtie loan)$$

b) Integrity constraints

Table	Primary Key	Foreign keys (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
depositer	customer_name, account_number	(customer_name) references customer, (account_number) references account

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

c) Expressions in the relational algebra

i. All loan numbers with a loan value greater than $10,000

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

ii. Names of all depositors who have an account with a value greater than $6,000

$$\Pi_{customer\_name}(\sigma_{balance>6000}(account \bowtie depositor))$$

iii. Names of all depositors who have an account with a value greater than $6,000 at the "Uptown" branch

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

2 Problem 2

i. Output of $\Pi_{Name}(\sigma_{age>25}(User))$:

Name
Victor
Jane

ii. Output of $\sigma_{(Id>2)\ \vee\ (age!=31)}(User)$:

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. Output of $\sigma_{User.OccupationId\ =\ Occupation.OccupationId}(User \times Occupation)$ **:**

Id	Name	Age	Gender	OccupationId	CityId	OccupationId	OccupationName
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. Output of $User \bowtie Occupation \bowtie City$ **:**

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

Name	Gender
John	Male
Jane	Female