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**<figure 2.14>**

employee (person name, street, city)

works (person name, company name, salary)

company (company name, city)

**<figure2.15>**

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)

**2.1 Consider the relational database of Figure 2.14. What are the appropriate**

**primary keys?**

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employee (person name, street, city)

works (person name, company name, salary)

company (company name, city)

**2.6 Consider the following expressions, which use the result of a relational**

**algebra operation as the input to another operation. For each expression,**

**explain in words what the expression does.**

**a. year≥2009(takes) ⋈ student**

-select the students who are taking more than 1 courses in 2009

and show the natural join table of students

and the table of the courses, the two tables are connected by the course

(For each student who takes at least one course in 2009, display

the students information along with the information about what

courses the student took. The attributes in the result are:

ID, name, dept name, tot cred, course id, section id, semester, year, grade)

**b. year≥2009(takes ⋈ student)**

-natural join the table of students

and the courses they take then select the item that students take more

than one class, the two tables are connected by the course(Same as (a); selection can be done before the join operation.)

**c. ID,name,course id (student ⋈ takes)**

-list the ID, name, course id of students who take a class

**2.7 Consider the relational database of Figure 2.14. Give an expression in the relational algebra to express each of the following queries:**

**a. Find the names of all employees who live in city “Miami”.**

**b. Find the names of all employees whose salary is greater than $100,000.**

**c. Find the names of all employees who live in “Miami” and whose**

**salary is greater than $100,000.**

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a. ∏name (σ city = “Miami” (employee))

b. ∏name (σ salary > 100000 (employee))

c. ∏name (σ city = “Miami” ∧ salary>100000 (employee))

**2.8 Consider the bank database of Figure 2.15. Give an expression in the relational algebra for each of the following queries.**

**a. Find the names of all branches located in “Chicago”.**

**b. Find the names of all borrowers who have a loan in branch “Downtown”.**

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a. ∏branch name (σ branch city = “Chicago” (branch))

b. ∏customer name (σ branch name = “Downtown” (borrower ⋈ loan))

**2.9 Consider the bank database of Figure 2.15.**

**a. What are the appropriate primary keys?**

-The primary keys of the various schema are underlined. Although

in a real bank the customer name is unlikely to be a primary key,

since two customers could have the same name, we use a simplified

schema where we assume that names are unique. We allow customers

to have more than one account, and more than one loan.

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)

**b. Given your choice of primary keys, identify appropriate foreign keys.**

-The foreign keys are as follows

i. For loan: branch name referencing branch.

ii. For borrower: Attribute customer name referencing customer and

loan number referencing loan

iii. For account: branch name referencing branch.

iv. For depositor: Attribute customer name referencing customer and

account number referencing account

**2.12 Consider the relational database of Figure 2.14. Give an expression in the**

**relational algebra to express each of the following queries:**

**a. Find the names of all employees who work for “First Bank Corporation”.**

**b. Find the names and cities of residence of all employees who work for**

**“First Bank Corporation”.**

**c. Find the names, street address, and cities of residence of all employees**

**who work for “First Bank Corporation” and earn more than $10,000**

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a. ∏personname(σcompanyname=“First Bank Corporation”(works))

b. ∏personname,city(employee ⋈ (σname=“First Bank Corporation”(works)))

c. ∏personname, street , (σ( company name = “First Bank Corporation” ∧ salary > 10000) ( works ⋈ employee ))

**2.13 Consider the bank database of Figure 2.15. Give an expression in the relational algebra for each of the following queries:**

**a. Find all loan numbers with a loan value greater than $10,000.**

**b. Find the names of all depositors who have an account with a value**

**greater than $6,000.**

**c. Find the names of all depositors who have an account with a value**

**greater than $6,000 at the “Uptown” branch.**

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a. ∏loan number (σ amount > 10000 ( loan )

b. ∏ customer name (σ balance > 6000 ( depositor ⋈ account ))

c. ∏ customer name (σ balance > 6000 ∧ branch name = “ Uptown ” ( depositor ⋈ account ))