

## Assignment-2 Solution

1. Consider the relational database of Figure below, where the primary keys are underlined.  
Give an expression in the relational algebra to express each of the following queries:

employee (person-name, street, city)  
works (person-name, company-name, salary)  
company (company-name, city)  
manages (person-name, manager-name)

- a. Find the names of all employees who work for First Bank Corporation.

Ans:  $\Pi_{person-name} (\sigma_{company-name = "First Bank Corporation"} (works))$

- b. Find the names and cities of residence of all employees who work for First Bank Corporation.

Ans:  $\Pi_{person-name, city} (\sigma_{company-name = "First Bank Corporation"} (employee \bowtie works))$

- 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 per annum.

Ans:  $\Pi_{person-name, street, city} (\sigma_{(company-name = "First Bank Corporation" \wedge salary > 10000)} (works \bowtie employee))$

- d. Find the names of all employees in this database who live in the same city as the company for which they work.

Ans:  $\Pi_{person-name} (employee \bowtie works \bowtie company)$

- e. Modify the database so that Jones now lives in Newtown.

Ans:  $employee \leftarrow \Pi_{person-name, street, "Newtown"} (\sigma_{person-name = "Jones"} (employee)) \cup (employee - \sigma_{person-name = "Jones"} (employee))$

- f. Give all employees of First Bank Corporation a 10 percent salary raise.

Ans:  $works \leftarrow \Pi_{person-name, company-name, 1.1 * salary} (\sigma_{(company-name = "First Bank Corporation")}(works)) \cup (works - \sigma_{company-name = "First Bank Corporation"}(works))$

- g. Delete all tuples in the works relation for employees of Small Bank Corporation.

Ans:  $works \leftarrow works - \sigma_{company\_name = "Small Bank Corporation"}(works)$

- i. Find the names of all employees in this database who do not work for First Bank Corporation.

Ans:  $\Pi_{person-name} (\sigma_{company-name \neq "First Bank Corporation"} (works))$

- j. Find the company with the most employees.

Ans:  $t1 \leftarrow company\_name Gcount\_distinct\ person\_name (works)$   
 $t2 \leftarrow \max_{num\_employees} (\rho_{company\_strength}(company\_name, num\_employees)(t1))$   
 $\Pi_{company\_name} (pt3(company\_name, num\_employees)(t1) \bowtie pt4(num\_employees)(t2))$

2. Consider the following relations:

Doctor(SSN, FirstName, LastName, Specialty, YearsOfExperience, PhoneNum)

Patient(SSN, FirstName, LastName, Address, DOB, PrimaryDoctor\_SSN)

Medicine(TradeName, UnitPrice, GenericFlag)

Prescription(Id, Date, Doctor\_SSN, Patient\_SSN)



Prescription\_Medicine(Prescription\_Id, TradeName, NumOfUnits)

Write the relational algebra expressions for the following queries.

a. List the trade name of generic medicine with unit price less than \$50.

Ans:  $\pi_{TradeName}(\sigma_{genericFlag=True \wedge UnitPrice < 50}(Medicine))$

b. List the first and last name of patients whose primary doctor named 'John Smith'.

$R1 \leftarrow \pi_{SSN}(\sigma_{FirstName='John' \text{ and } LastName='Smith'}(Doctor))$

$Result \leftarrow \pi_{FirstName, LastName}(R1 \bowtie_{SSN=PrimaryDoctor\_SSN}(Patient))$

c. List the first and last name of doctors who are not primary doctors to any patient.

$R1 \leftarrow \pi_{SSN}(Doctor) - \pi_{SSN}_{PrimaryDoctor\_SSN}(Patient)$

$Result \leftarrow \pi_{FirstName, LastName}(R1 \bowtie Doctor)$

d. For medicines written in more than 20 prescriptions, report the trade name and the total number of units prescribed.

Ans:  $R1 \leftarrow \rho_{TradeName, CNT} \leftarrow count(Prescription\_Id), SUM \leftarrow sum(NumOfUnits) (Prescription\_Medicine)$

$Result \leftarrow \pi_{TradeName, SUM}(\sigma_{CNT > 20}(R1))$

e. List the SSN of patients who have 'Aspirin' and 'Vitamin' trade names in one prescription.

$R1 \leftarrow \pi_{ID \leftarrow PM1.Prescription\_Id}(\rho_{PM1}(Prescription\_Medicine) \bowtie_{PM1.Prescription\_Id = PM2.Prescription\_Id} \rho_{PM2}(Prescription\_Medicine) \wedge PM1.TradeName='Aspirin' \text{ AND } PM2.TradeName='Vitamin')$

$Result \leftarrow \pi_{Patient\_SSN}(R1 \bowtie Prescription)$

f. List the SSN of distinct patients who have 'Aspirin' prescribed to them by doctor named 'John Smith'.

$R1 \leftarrow \pi_{ID}(\sigma_{FirstName='John' \text{ AND } LastName='Smith'}(Doctor) \bowtie_{SSN=Doctor\_SSN} Prescription)$

$R2 \leftarrow \pi_{ID \leftarrow Prescription\_Id}(\sigma_{TradeName='Aspirin'}(Prescription\_Medicine)) \cap R1$

$Result \leftarrow \delta(\pi_{Patient\_SSN}(R2 \bowtie Prescription))$

g. List the first and last name of patients who have no prescriptions written by doctors other than their primary doctors.

$R1 \leftarrow \pi_{SSN}(Patient \bowtie_{SSN=Patient\_SSN \text{ AND } Doctor\_SSN \neq PrimaryDoctor\_SSN} Prescription)$

$R2 \leftarrow \pi_{SSN}(Patient) - R1$

$Result \leftarrow \pi_{FirstName, LastName}(R2 \bowtie Patient)$