Homework 2

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Q1

a. List the names of all employees in department 5 who work more than 10 hours per week on the Product X project.

$$\begin{gathered}\mathrm{WD5} \leftarrow \sigma_{\mathrm{Dno}\,=\,5}(\mathrm{EMPLOYEE}) * \rho_{\mathrm{Ssn},\,\mathrm{Pno},\,\mathrm{Hours}}(\mathrm{WORKS\_ON}) \\ \mathrm{WD5X} \leftarrow \mathrm{WD5} * \rho_{\mathrm{Pno}}(\pi_{\mathrm{Pnumber}}(\sigma_{\mathrm{Pname}\,=\,\text{'Project X'}}(\mathrm{PROJECT}))) \\ \mathrm{RESULT} \leftarrow \pi_{\mathrm{Fname},\,\mathrm{Lname}}(\sigma_{\mathrm{Hours}\,>\,10}(\mathrm{WD5X}))\end{gathered}$$

b. List the names of all employees who have a dependent with the same first name as themselves.

$$\begin{gathered}\mathrm{DEP\_EMP} \leftarrow \mathrm{DEP} \bowtie_{\mathrm{Essn}\,=\,\mathrm{Ssn}} \mathrm{EMPLOYEE} \\ \mathrm{RESULT} \leftarrow \sigma_{\mathrm{Fname}=\mathrm{Dependent\_name}}(\mathrm{DEP\_EMP})\end{gathered}$$

c. List the names of employees who are directly supervised by Franklin Wong.

$$\begin{gathered}\mathrm{FW\_SSN} \leftarrow \pi_{\mathrm{Ssn}}(\sigma_{(\mathrm{Fname}\,=\,\text{'Franklin'})\wedge(\mathrm{Lname}\,=\,\text{'Wong'})}(\mathrm{EMPLOYEE})) \\ \mathrm{FW\_EMP} = \mathrm{EMPLOYEE} \bowtie_{\mathrm{Super\_ssn}\,=\,\mathrm{fw.Ssn}} \mathrm{FW\_SSN} \\ \mathrm{RESULT} \leftarrow \pi_{\mathrm{Fname},\,\mathrm{Lname}}(\mathrm{FW\_EMP})\end{gathered}$$

d. List the names of employees who work on every project.

$$\begin{gathered}\mathrm{E\_WO} \leftarrow \pi_{\mathrm{Essn},\,\mathrm{Pno}}(\mathrm{WORKS\_ON}) \\ \mathrm{P\_NO(Pno)} \leftarrow \pi_{\mathrm{Pnumber}}(\mathrm{PROJECT}) \\ \mathrm{RESULT} \leftarrow \pi_{\mathrm{Fname},\,\mathrm{Lname}}((\mathrm{E\_WO} \div \mathrm{P\_NO}) \bowtie_{\mathrm{Essn}\,=\,\mathrm{Ssn}} \mathrm{EMPLOYEE})\end{gathered}$$

e. List the names of employees who do not work on any project.

$$\text{E\_NW} \leftarrow \pi_{\text{Ssn}}(\text{EMPLOYEE}) - \rho_{\text{Ssn}}(\pi_{\text{Essn}}(\text{WORKS\_ON}))$$
$$\text{RES} \leftarrow \pi_{\text{Fname, Lname}}(\text{E\_NW} \ * \ \pi_{\text{Fname, Lname, Ssn}}(\text{EMPLOYEE}))$$

f. List the names and addresses of employees who work on at least one project located in Houston but whose department has no location in Houston.

$$\text{R1} \leftarrow (\text{EMPLOYEE} \bowtie_{\text{Ssn = wo.Essn}} \text{WORKS\_ON}) \bowtie_{\text{Pno = Pnumber}} \text{PROJECT}$$
$$\text{R2} \leftarrow \text{R1} \bowtie_{\text{Dnum = Dnumber}} (\text{DEPARTMENT} * \text{DEPT\_LOCATIONS})$$
$$\text{R3} \leftarrow \sigma_{(\text{Plocation = 'Houston'}) \wedge (\text{Dlocation} \neq \text{'Houston'})}(\text{R2})$$
$$\text{RESULT} \leftarrow \pi_{\text{Fname, Lname, Address}}\text{R3}$$

g. List the names of department managers who have no dependents.

$$\text{DMGR\_NODP(Ssn)} \leftarrow \pi_{\text{Mgr\_ssn}}(\text{DEPARTMENT}) - \pi_{\text{Essn}}(\text{DEPENDENT})$$
$$\text{R} \leftarrow \text{EMPLOYEE} \bowtie_{\text{Ssn = dm.Ssn}} \text{DMGR\_NODP}$$
$$\text{RESULT} \leftarrow \pi_{\text{Fname, Lname}}(\text{R})$$

Q2

a. Retrieve the names of students enrolled in the Automata class during the fall 2009 term.

$$\text{AUTO} \leftarrow \sigma_{\text{Ctitle = 'Automata'}}(\text{CATALOG})$$
$$\text{F19} \leftarrow \sigma_{\text{Term = 'fall 2019'}}(\text{ENROLLS})$$
$$\text{RESULT} \leftarrow \pi_{\text{Fname, Lname}}(\text{STUDENTS} * \text{COURSES} * \text{AUTO} * \text{F19})$$

b. Retrieve the Sid values of students who have enrolled in CSc226 and CSc227.

$$\text{E\_6O7} \leftarrow \sigma_{(\text{Cno = 226}) \wedge (\text{Cno = 227})}(\text{ENROLLS} * \text{COURSES})$$
$$\text{RESULT} \leftarrow \pi_{\text{Sid}}(\text{STUDENTS} * \text{C})$$

c. Retrieve the Sid values of students who have enrolled in CSc226 or CSc227.

$$\text{E\_6A7} \leftarrow \sigma_{(\text{Cno = 226}) \vee (\text{Cno = 227})}(\text{ENROLLS} * \text{COURSES})$$
$$\text{RESULT} \leftarrow \pi_{\text{Sid}}(\text{STUDENTS} * \text{C})$$

d. Retrieve the names of students who have not enrolled in any class.

$$\rho_{\mathrm{S}}(\mathrm{STUDENTS}),\ \rho_{\mathrm{C}}(\mathrm{COURSES})$$
$$\mathrm{NEC} \leftarrow \mathrm{S} \bowtie_{\mathrm{Sid}\,=\,\mathrm{nc.Sid}}\ \rho_{(\mathrm{nc.Sid})}(\pi_{\mathrm{Sid}}(\mathrm{S}) - \pi_{\mathrm{Sid}}(\mathrm{C}))$$
$$\mathrm{RESULT} \leftarrow \pi_{\mathrm{Fname,\ Lname}}(\mathrm{NEC})$$

e. Retrieve the names of students who have enrolled in all courses in the CATALOG table.

$$\mathrm{ECC} \leftarrow \pi_{\mathrm{Sid,\ Cno}}(\mathrm{ENROLLS} * \mathrm{COURSES} * \mathrm{CATALOG})$$
$$\mathrm{CNO} \leftarrow \pi_{\mathrm{Cno}}(\mathrm{CATALOG})$$
$$\mathrm{S(s.Sid,\ Fname,\ Lname)} \leftarrow \mathrm{STUDENTS}$$
$$\mathrm{RESULT} \leftarrow \pi_{\mathrm{Fname,\ Lnamet}}((\mathrm{ECC} \div \mathrm{CNO}) \bowtie_{\mathrm{Sid}\,=\,\mathrm{s.Sid}}\ \mathrm{S})$$

Q3

a. Retrieve the names of parts that cost less than $20.00

$$\pi_{\mathrm{Pname}}(\sigma_{\mathrm{Price}<20.00}(\mathrm{PARTS}))$$

b. Retrieve the names and cities of employees who have taken orders for parts costing more than $50.00

$$\mathrm{P\_G50} \leftarrow \sigma_{\mathrm{Price}>50.00}(\mathrm{PARTS})$$
$$\mathrm{RES} \leftarrow \pi_{\mathrm{Ename,\ City}}(\mathrm{P\_G50} * \mathrm{ODETAILS} * \mathrm{ORDERS} * \mathrm{EMPLOYEES} * \mathrm{ZIP})$$

c. Retrieve the pairs of customer number values of customers who live in the same ZIP Code

$$\pi_{(\mathrm{Cno,\ c1.Cno})}(\mathrm{CUSTOMERS} \bowtie_{(\mathrm{Zip}\,=\,\mathrm{c1.Zip}) \wedge (\mathrm{Cno}\,\neq \mathrm{c1.Cno})}\ \mathrm{CUSTOMERS})$$

d. Retrieve the names of customers who have ordered parts from employees living in Wichita

$$\mathrm{WI\_EMP} \leftarrow \pi_{\mathrm{Eno}}(\sigma_{\mathrm{City}\,=\,\text{'Wichita'}}(\mathrm{EMPLOYEES} * \mathrm{ZIP\_CODES}))$$
$$\mathrm{RESULT} \leftarrow \pi_{\mathrm{Cname}}(\mathrm{CUSTOMERS} * \mathrm{ORDERS} * \mathrm{WI\_EMP})$$

e. Retrieve the names of customers who have ordered parts costing less than $20.00

$$\text{P\_L20} \leftarrow \sigma_{\text{Price}<20.00}(\text{PARTS})$$
$$\text{RESULT} \leftarrow \pi_{\text{Cname}}(\text{P\_L20} * \text{ODETAILS} * \text{ORDERS} * \text{CUSTOMERS})$$

f. Retrieve the names of customers who have not placed an order

$$\pi_{\text{Cname}}((\pi_{\text{Cno}}(\text{CUSTOMERS}) - \pi_{\text{Cno}}(\text{ORDERS})) * \text{CUSTOMERS})$$

g. Retrieve the names of customers who have placed exactly two orders

$$\text{R1} \leftarrow \text{ORDERS} * \text{CUSTOMERS}$$
$$\text{R2(Cno, Cname, Num)} \leftarrow {}_{\text{Cno, Cname}}\Im_{\text{COUNT(Cno)}}(\pi_{\text{Cno, Cname}}(\text{R1}))$$
$$\text{RESULT} \leftarrow \pi_{\text{Cname}}(\sigma_{\text{Num}=2}(\text{R2}))$$

Q5

a. Retrieve the part numbers that are supplied to exactly two projects.

$$\text{R1(Pno, SupTo)} \leftarrow {}_{\text{Pno}}\Im_{\text{COUNT(Jno)}}(\pi_{\text{Pno, Jno}}(\text{SUPPLY}))$$
$$\text{RESULT} \leftarrow \pi_{\text{Pno}}(\sigma_{\text{SupTo}=2}(\text{R1}))$$

b. Retrieve the names of suppliers who supply more than two parts to project ‘J1’.

$$\text{J1} \leftarrow \sigma_{\text{Jname = 'J1'}}(\text{SUPPLY} * \text{PROJECT} * \text{SUPPLIER})$$
$$\text{R1(Sno, Sname, SupTo)} \leftarrow {}_{\text{Sno, Sname}}\Im_{\text{COUNT(Jno)}}(\text{J1})$$
$$\text{RESULT} \leftarrow \pi_{\text{Sname}}(\sigma_{\text{SupTo}>2}(\text{R1}))$$

c. Retrieve the part numbers that are supplied by every supplier.

$$\text{SUPPLIED(Pno, NumS)} \leftarrow {}_{\text{Pno}}\Im_{\text{COUNT(Sno)}}(\text{SUPPLY})$$
$$\text{ALL\_SUPS(Total)} \leftarrow \Im_{\text{COUNT(Sno)}}(\text{SUPLIER})$$
$$\text{RESULT} \leftarrow \pi_{\text{Pno}}(\text{SUPPLIED} \bowtie_{\text{NumS = Total}} \text{ALL\_SUPS})$$

d. Retrieve the project names that are supplied by supplier ‘S1’ only.

$$\text{NUM\_OF\_SUP}(\text{Jno}, \text{NOS}) \leftarrow {}_{\text{Jno}}\Im_{\text{COUNT}(\text{Sno})}(\text{SUPPLY})$$
$$\text{R1} \leftarrow \text{NUM\_OF\_SUP} * \text{SUPPLY} * \text{SUPPLIER} * \text{PROJECT}$$
$$\text{S1\_ONLY} \leftarrow \pi_{\text{Jname}}(\sigma_{(\text{Sname} = \text{S1}) \wedge (\text{NOS} = 1)}(\text{R1}))$$

e. Retrieve the names of suppliers who supply at least two different parts each to at least two different projects

$$\text{SUPPED}(\text{Sno}, \text{Parts}, \text{Projs}) \leftarrow {}_{\text{Sno}}\Im_{\text{COUNT}(\text{Pno}),\ \text{COUNT}(\text{Jno})}(\text{SUPPLY})$$
$$\text{RESULT} \leftarrow \pi_{\text{Sname}}(\sigma_{(\text{Parts} \geq 2) \wedge (\text{Projs} \geq 2)}(\text{SUPPED} * \text{SUPPLIER}))$$