Lab 06

Exercise 1:

Company Database

employee(fname, minit, lname, ssn, bdate, address, sex, salary, superssn, dno)
deptartment(dname, dnumber, mgrssn, mgrstartdate)
dept_locations(dnumber, dlocation)
project(pname, pnumber, plocation, dnum)
works_on(essn, pno, hours
dependent(essn, dependent_name, sex, bdate, relationship)

1. **Retrieve the names of all employees in department 5 who work more than 10 hours per week on the 'ProductX' project.**

   (a) Join first.

   $$emp\_all \leftarrow employee \bowtie_{ssn=essn} works\_on \bowtie_{pno=pnumber} project$$
   $$emp\_OK \leftarrow \sigma_{dno=5 \text{ and } pname='ProductX' \text{ and } hours>10.0}(emp\_all)$$
   $$answer \leftarrow \pi_{fname,minit,lname}(emp\_OK)$$

   (b) Selects first.

   $$emp\_Dept\_5 \leftarrow \sigma_{dno=5}(employee)$$
   $$proj\_Prod\_X \leftarrow \sigma_{pname='ProductX'}(project)$$
   $$emp\_Dept\_5\_Prod\_X \leftarrow emp\_Dept_5 \bowtie_{ssn=essn} works\_on \bowtie_{pno=pnumber} proj\_Prod\_X$$
   $$emp\_OK \leftarrow \sigma_{hours>10.0}(emp\_Dept\_5\_Prod\_X)$$
   $$answer \leftarrow \pi_{fname,minit,lname}(emp\_OK)$$

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

   $$emp\_with\_Deps \leftarrow employee \bowtie_{ssn=essn \text{ and } fname=dependent\_name} dependent$$
   $$answer \leftarrow \pi_{fname,minit,lname}(emp\_with\_Deps)$$

3. **Find the names of all employees who are directly supervised by 'Franklin Wong'.**

   $$wong\_SSN \leftarrow \pi_{ssn}(\sigma_{lname='Wong' \text{ and } fname='Franklin'}(employee))$$
   $$answer \leftarrow \pi_{fname,minit,lname}(employee \bowtie_{superssn=ssn} wong\_ssn)$$

4. **For each project, list the project name and the total hours per week (by all employees) spent on that project.**

   $$proj\_hours(pno, total\_hours) \leftarrow_{pno} \mathcal{F}_{sum\ hours}(works\_on)$$
   $$answer \leftarrow \pi_{pname,total\_hours}(projs\_hours \bowtie_{pno=pnumber} project)$$

5. **Retrieve the names of all employees who work on every project.**

$$emp\_proj(ssn, pnumber) \leftarrow \pi_{essn,pno}(works\_on)$$
$$proj \leftarrow \pi_{pnumber}(projects)$$
$$answer \leftarrow \pi_{fname,minit,lname}((emp\_proj \div proj) * employees)$$

6. **Retrieve the names of all employees who do not work on any project.**

$$emps\_on\_projs(ssn) \leftarrow \pi_{essn}(works\_on)$$
$$emps\_on\_projs\_with\_names \leftarrow emps\_on\_projs * employee$$
$$answer \leftarrow \pi_{fname,minit,lname}(employees - emps\_on\_projs\_with\_names)$$

7. **For each department, retrieve the department name and the average salary of all employees working in that department.**

$$dept\_with\_avgsal(dnumber, avgsal) \leftarrow_{dno} \mathcal{F}_{avg\ salary}(employee)$$
$$answer \leftarrow \pi_{dname,avgsal}(dept\_with\_avgsal * department)$$

8. **Retrieve the average salary of all female employees.**

$$answer \leftarrow \mathcal{F}_{avg\ salary}(\sigma_{sex='female'}(employee))$$

9. **Find the names and addresses of all employees who work on at least one project located in Houston, but whose department has no location in Houston.**

$$emps\_work\_in\_Houston \leftarrow \pi_{fname,minit,lname,address}($$
$$\sigma_{plocation='Houston'}(employee *_{(ssn),(essn)} works\_on *_{(pno),(pnumnber)} project))$$

10. **List the names of all department managers who have no dependents.**

$$dept\_mgrs(ssn) \leftarrow \pi_{mgrssn}(department)$$
$$emps\_with\_deps(ssn) \leftarrow \pi_{essn}(dependent)$$
$$answer \leftarrow \pi_{fname,minit,lname}(employee * (dept\_mgrs - emps\_with\_deps))$$

Exercise 2

A) How many copies of the book titled The Lost Tribe are owned by the library branch whose name is 'Sharpstown' ?

$$\begin{aligned} \text{Sharps\_id} &\leftarrow \pi_{\text{Branch\_id}}(\sigma_{\text{Branch\_name}='\text{Sharpstown}'}(\text{Library\_Branch})) \\ \text{Tribe\_id} &\leftarrow \pi_{\text{Book\_id}}(\sigma_{\text{Title}='\text{The Lost Tribe}'}(\text{Book})) \\ \text{Answer} &\leftarrow \pi_{\text{No\_of\_copies}}(\text{Book\_Copies} * \text{Sharps\_id} * \text{Tribe\_id}) \end{aligned}$$

B)

How many copies of the book titled 'The Lost Tribe' are owned by each library branch?

$$\text{THE\_LOST\_TRIBE} \leftarrow \sigma_{\text{Title='The Lost Tribe'}}(\text{BOOK})$$
$$\text{RESULT} \leftarrow \pi_{\text{BranchId, No-Of\_Copies}}(\text{THE\_LOST\_TRIBE} * \text{BOOK\_COPIES})$$

C) Retrieve the names of all borrowers who do not have any books checked out

$$\text{None\_id} \leftarrow \pi_{\text{Card\_no}}(\text{Borrower}) - \pi_{\text{Card\_no}}(\text{Book\_Loans})$$
$$\text{Answer} \leftarrow \pi_{\text{Name}}(\text{Borrower} * \text{None\_id})$$

D)

For each book that is loaned out from the 'Sharpstown' branch and whose DueDate is today, retrieve the book title, the borrower's name, and the borrower's address.

$$\text{ST} \leftarrow \pi_{\text{BranchId}}(\sigma_{\text{BranchName='Sharpstown'}}(\text{LIBRARY\_BRANCH}))$$
$$\text{DUE\_TODAY} \leftarrow \sigma_{\text{DueDate='Today'}}(\text{BOOK\_LOANS})$$
$$\text{ST\_BOOKS} \leftarrow \pi_{\text{BookId, CardNo}}(\text{ST} * \text{DUE\_TODAY})$$
$$\text{RESULT} \leftarrow \pi_{\text{Title, Name, Address}}(\text{BOOK} * \text{ST\_BOOKS} * \text{BORROWER})$$

E)

For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

$$\text{LOANED\_B} \leftarrow \text{BranchId}\ \Im\ \text{Count}_{\text{BookId}}(\text{BOOK\_LOANS})$$
$$\text{RESULT} \leftarrow \pi_{\text{BranchName, Count\_BookId}}(\text{LOANED\_B} * \text{LIBRARY\_BRANCH})$$

f) Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out

$$\begin{aligned} \text{Loan\_counts} &\leftarrow \rho_{(\text{Card\_no},\text{Book\_count})}({}_{\text{Card\_no}}\Im_{\text{Count}(\text{Book\_id})}(\text{Book\_Loans})) \\ \text{Big\_borrowers} &\leftarrow \sigma_{\text{Book\_count}>5}(\text{Loan\_counts}) \\ \text{Answer} &\leftarrow \pi_{\text{Name},\text{Address},\text{Book\_count}}(\text{Big\_borrowers} * \text{Borrower}) \end{aligned}$$

g)

For each book authored (or coauthored) by 'Stephen King,' retrieve the title and the number of copies owned by the library branch whose name is 'Central.'

$$\text{SK} \leftarrow \sigma_{\text{AuthorName='Stephen King'}}(\text{BOOK\_AUTHORS})$$
$$\text{SK\_B} \leftarrow \pi_{\text{BookId, Title}}(\text{SK} * \text{BOOK})$$
$$\text{CENTRAL} \leftarrow \sigma_{\text{BranchName='Central'}}(\text{LIBRARY\_BRANCH})$$
$$\text{RESULT} \leftarrow \pi_{\text{Title, No\_Of\_Copies}}(\text{SK\_B} * \text{BOOK\_COPIES} * \text{CENRAL})$$