Relational Algebra: Exer 7.18

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.**

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

$$emps\_depts\_in\_Houston \leftarrow \pi_{fname,minit,lname,address}($$
$$\sigma_{dlocation='Houston'}(employee *_{(dno),(dnumber)} dept\_location))$$

$$answer \leftarrow emps\_work\_in\_Houston - emps\_depts\_in\_Houston$$

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

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