Homework 3 Solutions

1. Find every department that has a location in Chicago

$$\pi_{\text{DNUMBER}}(\sigma_{(\text{DLOCATION} = \text{“Chicago”})}(\text{DEPT\_LOCATIONS}))$$

2. Find every project managed by a department with a location in Chicago

$$\pi_{\text{PROJECT.pnumber}}(\sigma_{(\text{PROJECT.dnum} = \text{DEPT\_LOCATIONS.dnumber}) \text{ AND } (\text{DEPT\_LOCATIONS.dlocation} = \text{“Chicago”})}(\text{PROJECT} \times \text{DEPT\_LOCATIONS}))$$

3. Find every department whose manager works on a project managed by a department with a location in Chicago

π (σ (DEPARTMENT X WORKS_ON X PROJECT X DEPT_LOCATIONS))

DEPARTMENT.dnumber

(DEPARTMENT.mgrssn = WORKS_ON.essn)
AND (WORKS_ON.pno = PROJECT.pnumber)
AND (PROJECT.dnum = DEPT_LOCATIONS.dnumber)
AND (DEPT_LOCATIONS.dlocation = "Chicago")

4. Find every department that doesn't have a location in Chicago

$$\pi_{\text{DNUMBER}}(\text{DEPARTMENT}) - [\pi_{\text{DNUMBER}}(\sigma_{(\text{DLOCATION} = \text{“Chicago”})}(\text{DEPT\_LOCATIONS}))]$$

5. Find every department that manages at least two projects

$$\pi_{\text{PROJ1.dnum}}\ \sigma_{\text{(PROJ1.pnumber != PROJ2.pnumber) AND (PROJ1.dnum = PROJ2.dnum)}}\ ((\rho_{PROJ1}(PROJECT)\ X\ \rho_{PROJ2}(PROJECT)))$$

6. Find every employee who manages at least three departments (I'm writing "DEPT" instead of "DEPARTMENT" to save space)

$$\pi_{\text{DEPT1.mgrssn}}\ \sigma_{\begin{array}{l}(\text{DEPT1.mgrssn} = \text{DEPT2.mgrssn})\\ \text{AND } (\text{DEPT2.mgrssn} = \text{DEPT33.mgrssn})\\ \text{AND } (\text{DEPT1.dnumber} \mathrel{!}= \text{DEPT2.dnumber})\\ \text{AND } (\text{DEPT2.dnumber} \mathrel{!}= \text{DEPT3.dnumber})\\ \text{AND } (\text{DEPT1.dnumber} \mathrel{!}= \text{DEPT3.dnumber})\end{array}}\ ((\rho_{\text{DEPT1}}(\text{DEPT}) \times \rho_{\text{DEPT2}}(\text{DEPT} \times \rho_{\text{DEPT3}}(\text{DEPT}))))$$

7. Find every employee who neither has any supervisees nor manages any department

$$[\ \pi_{ssn}(\text{EMPLOYEE}) - \pi_{superssn}(\text{EMPLOYEE})]$$

$$\cap \quad [\ \pi_{ssn}(\text{EMPLOYEE}) - \pi_{mgrssn}(\text{DEPARTMENT})]$$

8. Find every employee who either has no supervisees or manages no department (or both)

$$[\ \pi_{ssn}(\text{EMPLOYEE}) - \pi_{superssn}(\text{EMPLOYEE})]$$

$$\cup\ [\ \pi_{ssn}(\text{EMPLOYEE}) - \pi_{mgrssn}(\text{DEPARTMENT})]$$

9. Find every employee who supervisees exactly two other employees (I'm using "EMP" instead of "EMPLOYEE" to save space.)

$$[\ \pi_{EMP1.superssn}\ \sigma_{(EMP1.superssn = EMP2.superssn)\ AND\ (EMP1.ssn \neq EMP2.ssn)\ AND\ (EMP1.superssn \neq EMP1.ssn)\ AND\ (EMP2.superssn \neq EMP2.ssn)}\ ((\rho_{EMP1}(EMP) \times \rho_{EMP2}(EMP)))\ ]$$

$$-\ [\ \pi_{EMP1.superssn}\ \sigma_{(EMP1.superssn = EMP2.superssn)\ AND\ (EMP2.superssn = EMP3.superssn)\ AND\ (EMP1.ssn \neq EMP2.ssn)\ AND\ (EMP2.ssn \neq EMP3.ssn)\ AND\ (EMP1.ssn \neq EMP3.ssn)\ AND\ (EMP1.superssn \neq EMP1.ssn)\ AND\ (EMP2.superssn \neq EMP2.ssn)\ AND\ (EMP3.superssn \neq EMP3.ssn)}\ ((\rho_{EMP1}(EMP) \times \rho_{EMP2}(EMP \times \rho_{EMP3}(EMP)))]$$