Database Management Systems – MCIS 5133
Dr. Cheng Hong
Homework 4 – Spring 2022

Name: Saranya Balasubramaniyan
Student ID: 999901316
Section: 001

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
	John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
	Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
	Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4
	Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
	Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
	Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
	Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
	James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1988-05-22
	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

WORKS_ON	ESSN	PNO	HOURS
	123456789	1	32.5
	123456789	2	7.5
	666884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0
	999887777	30	30.0
	999887777	10	10.0
	987987987	10	35.0
	987987987	30	5.0
	987654321	30	20.0
	987654321	20	15.0

PROJECT	PNAME	PNUMBER	PLOCATION	DNUM
	ProductX	1	Bellaire	5
	ProductY	2	Sugarland	5
	ProductZ	3	Houston	5
	Computerization	10	Stafford	4
	Reorganization	20	Houston	1
	Newbenefits	30	Stafford	4

DEPENDENT	ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP
	333445555	Alice	F	1986-04-05	DAUGHTER
	333445555	Theodore	M	1983-10-25	SON
	333445555	Joy	F	1958-05-03	SPOUSE
	987654321	Abner	M	1942-02-28	SPOUSE
	123456789	Michael	M	1988-01-04	SON
	123456789	Alice	F	1988-12-30	DAUGHTER
	123456789	Elizabeth	F	1967-05-05	SPOUSE

Specify the following queries on the database schema shown in above Figure using the **relational algebra** discussed in class. This is not asking you to write SQL queries.

1. Retrieve the names of employees who work on the 'Newbenefits' project.

TEMP_PRJ(PNO) ← $\pi_{PNUMBER}$ ($\sigma_{PNAME='Newbenefits'}$(PROJECT))
TEMP_WORKSON(SSN) ← π_{ESSN} (WORKS_ON ★ TEMP_PRJ)
RESULT(First_Name,Last_Name) ← $\pi_{FNAME,LNAME}$ (TEMP_WORKSON ★ EMPLOYEE)

Explanation:
- **WORKS_ON ★ TEMP_PRJ –** Join attribute: PNO
- **TEMP_WORKSON ★ EMPLOYEE** – Join attribute: SSN

2. Find the names of employees that works for 'Administration' department

TEMP_DEPT(DNO) ← $\pi_{DNUMBER}$ ($\sigma_{DNAME='Administration'}$(DEPARTMENT))
RESULT(First_Name, Last_Name) ← $\pi_{FNAME,LNAME}$ (EMPLOYEE ★ TEMP_DEPT)

Explanation:
EMPLOYEE ★ TEMP_DEPT – Join attribute: DNO

3. Retrieve the names of department managers who do not work on any project. (You may assume if Hours in works_on is always positive. An employee does not work on any project if his/her ssn is not in works_on)

TEMP_MGRSSN(ESSN) ← π_{MGRSSN}(DEPARTMENT)
TEMP_PRJSSN ← π_{ESSN} (WORKS_ON)
TEMP_NOPRJ_MGR ← TEMP_MGRSSN - TEMP_PRJSSN
RESULT(First_Name, Last_Name) ← $\pi_{FNAME,LNAME}$ (EMPLOYEE $\bowtie_{SSN=ESSN}$ TEMP_NOPRJ_MGR)

4. Find the names and addresses of employees who work on at least one project located in Stafford.

TEMP_STAFFOD_PROJ ← $\pi_{PNUMBER}$ ($\sigma_{PLOCATION='Stafford'}$(PROJECT))
TEMP_STAFFORD_ESSN ← π_{ESSN} (TEMP_STAFFOD_PROJ $\bowtie_{PNUMBER=PNO}$ WORKS_ON)
RESULT(First_Name,Last_Name,Address) ← $\pi_{FNAME,LNAME,ADDRESS}$
(EMPLOYEE $\bowtie_{SSN=ESSN}$ TEMP_STAFFORD_ESSN)

5. List the last names of female employees who have no dependents.

FEMALE_EMP ← π_{SSN} ($\sigma_{SEX = 'F'}$ (EMPLOYEE))
EMPS_WITH_DEP(SSN) ← π_{ESSN}(DEPENDENT)
FEM_EMP_NO_DEPENDENT ← (FEMALE_EMP - EMPS_WITH_DEP)
RESULT(Last_Name) ← π_{LNAME} (FEM_EMP_NO_DEPENDENT ★ EMPLOYEE)

6. Find the average salary of all female employees who works for 'Administration' department

ADMIN_DEPT(DNO) ← $\pi_{DNUMBER}$ ($\sigma_{DNAME='Administration'}$(DEPARTMENT))
FEMALE_EMP ← $\sigma_{SEX = 'F'}$ (EMPLOYEE)
ADMIN_FEMALE_EMP_SALARY ← π_{SALARY} (FEMALE_EMP ★ ADMIN_DEPT)
$\Im_{AVERAGE\ SALARY}$ (ADMIN_FEMALE_EMP_SALARY)

Explanation:
FEMALE_EMP ★ ADMIN_DEPT – Join attribute: DNO

7. For each department, list the department name and the total number of project controlled by the department.

DEPT(DNAME,DNUM) ← $\pi_{DNAME,DNUMBER}$ (DEPARTMENT)
DEPT_PRJ ← $\pi_{DNAME,PNUMBER}$ (DEPT ⋆ PROJECT)
$_{DNAME}\Im_{COUNT\ PNUMBER}$ (ADMIN_FEMALE_EMP_SALARY)

Explanation: **DEPT ⋆ PROJECT –** Join attribute: DNUM

8. Retrieve the names of employees who work on every project controlled by department 5

DEPT5PRJ ←ρ_{PNO} ($\pi_{PNUMBER}$ ($\sigma_{DNUM=5}$(PROJECT)))
EMP_PRJ← $\rho_{SSN,PNO}$ ($\pi_{ESSN,PNO}$ (WORKS_ON))
EMP_SSN_DEP5PRJ ← EMP_PRJ ÷ DEPT5PRJ
RESULT ← $\pi_{FNAME,LNAME}$ (EMP_SSN_DEP5PRJ ⋆ EMPLOYEE)

9. For each employee, retrieve employee's name, and the total hours working in projects

EMP ← $\pi_{FNAME,LNAME,SSN}$ (EMPLOYEE)
PRJ(SSN,HOURS) ← $\pi_{ESSN,HOURS}$ (WORKS_ON)
EMP_PRJ ← $\pi_{FNAME,LNAME,HOURS}$ (EMP ⋆ PRJ)
$_{(FNAME\ AND\ LNAME)}\Im_{SUM\ HOURS}$ (EMP_PRJ)