

CS 542 Homework Assignment 4 (100 Points)

Due: 11:59 p.m. on 03/05/2023

HW Objective: The goal of this HW4 is to practice the concepts and techniques of the relational algebra and SQL queries.

HW Deliverables:

1. Submit all your work in a zip file, **Problem 1 to 3a** in on PDF file and **Problem 3b** in the SQL file to Canvas.
2. Title the .pdf file “**lastName_firstName_assignment4.pdf**”.
3. Title the .sql file “**lastName_firstName_problem3b.sql**”.

Note:

- (1) *This homework is to be done by each student individually. No help besides the textbook, materials, and the instructor should be taken. Copying any answers or part of answers from other sources (including your classmates) will earn you a grade of zero.*
- (2) *You should double-check your work before submitting your solution.*
- (3) *Your solution must be typed. No handwriting submission is allowed.*
- (4) *Assignments are accepted in their assigned Canvas drop box without penalty if they are received by 11:59PM EST on the due date, or 10% of the graded score is deducted for the late submission per day. Work submitted after one week of its original due date will not be accepted.*

Given the following **partial** schemas and table instances for a company database, please provide the solution for the below problems.

For each relation, the attribute(s) of the primary key is(are) underlined. In addition, the following foreign key constraints hold:

Relation Schemas	Meaning and Additional Information
Employee(<u>SSN</u> : string, Fname: string, Minit: string, Lname: string, Address: string, Sex: string, Salary: real, SuperSSN: string, Dno: string)	<ul style="list-style-type: none">▪ SuperSSN is a foreign key that references Employee(SSN).▪ Dno is a foreign key that references Department(Dnumber).▪ SuperSSN is the social security number of the supervisor.
Department(<u>Dnumber</u> : string, Dname: string, MgrSSN: string)	<ul style="list-style-type: none">▪ MgrSSN is a foreign key that references EMPLOYEE(SSN).
Dept-Locations(<u>Dnumber</u> : string, <u>Dlocation</u> : string)	<ul style="list-style-type: none">▪ Dnumber is a foreign key that references Department(Dnumber).
Comp_Project(<u>Pnumber</u> : string, Pname: string, Plocation: string, Dnum: string)	<ul style="list-style-type: none">▪ Dnum is a foreign key that references Department(Dnumber).
Works_on(<u>ESSN</u> : string, <u>Pno</u> : string, Hours: real)	<ul style="list-style-type: none">▪ ESSN is a foreign key that references Employee(SSN).▪ Pno is a foreign key that references Comp_Project(Pnumber).
Dependent(<u>ESSN</u> : string, <u>Dependent-name</u> : string, Sex: string, Relationship: string)	<ul style="list-style-type: none">▪ ESSN is a foreign key that references Employee(SSN).▪ ESSN is the social security number of the corresponding Employee.

Employee

SSN	FNAME	MINIT	LNAME	ADDRESS	SEX	SALARY	SUPERSSN	DNO
123456789	John	B	Smith	731 Fondren, Houston TX	M	30000	333445555	5
333445555	Franklin	T	Wong	638 Voss, Houston TX	M	40000	888665555	5
999887777	Alicia	J	Zelaya	3321 Castle, Spring TX	F	25000	987654321	4
987654321	Jennifer	S	Wallace	291 Berry, Bellaire TX	F	43000	888665555	4
666884444	Ramesh	K	Narayan	975 FireOak, Humble TX	M	38000	333445555	5
453453453	Joyce	A	English	5631 Rice, Houston TX	F	25000	333445555	5
987987987	Ahmad	V	Jabbar	980 Dallas, Houston TX	M	25000	987654321	4
888665555	James	E	Borg	450 Stone, Houston TX	M	55000	(null)	1

Department

DNUMBER	DNAME	MGRSSN
5	Research	333445555
4	Administration	987654321
3	Research	333445555
1	Headquarters	888665555

Dept-Locations

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

Works_on

ESSN	PNO	HOURS
123456789	1	32.5
123456789	2	7.5
666884444	3	40
453453453	1	20
453453453	2	20
333445555	2	10
333445555	3	10
333445555	10	10
333445555	20	10
999887777	30	30
999887777	10	10
987987987	10	35
987987987	30	5
987654321	30	20
987654321	20	15
888665555	20	(null)

Comp_Project

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

Dependent

ESSN	DEPENDENT_NAME	SEX	RELATIONSHIP
333445555	Alice	F	Daughter
333445555	Theodore	M	Son
333445555	Joy	F	Spouse
987654321	Abner	M	Spouse
123456789	Michael	M	Son
123456789	Alice	F	Daughter
123456789	Elizabeth	F	Spouse

Problem 1 (30 Points):

Suppose each of the following update operations is applied directly to the database instance given above. Discuss all integrity constraints (e.g., primary key, candidate key, foreign key, and domain constraints if any) violated by each operation and **explain the reason for each violation in detail**.

Note: You **DON'T** develop, implement, and update the above given DB, e.g., **TestBed.sql**, and then execute the following statements to test the constraints. **TestBed.sql** script is **NOT** fully completed and implemented. You should base upon your concept and knowledge understanding that we discussed, as well as the above table description and data instances to provide the solutions to Problem 1.

- a) Insert <'94377554', 'Robert', 'F', 'Scott', '2365 Newcastle Rd, Bellaire, TX', 'M', 58000, '77755 3333', '1'> into EMPLOYEE.
- b) Insert <'3', null> into Dept_Locations.
- c) Insert <'1', 'Headquarters', '234567891'> into DEPARTMENT.
- d) Insert <'888665555', null, 40.0> into WORKS_ON.
- e) Insert <'453453453', 'Michael', 'M', 'SPOUSE'> into DEPENDENT.
- f) Delete the DEPARTMENT tuples with *Dnumber* = '5'.
- g) Delete the EMPLOYEE tuple with *SSN* = '999887777'.
- h) Delete the COMP_PROJECT tuple with *Pname* = 'ProductX'.
- i) Modify the *Dnumber* of the DEPARTMENT tuples with *Dname* = 'Research' to 7.
- j) Modify the *SuperSSN* attribute of the EMPLOYEE tuple with *SSN* = '666884444' to '345678912'.
- k) Modify the *Hours* attribute of the WORKS_ON tuple with *Pno* = 30 to 10.

Problem 2 (35 Points):

Specify the following queries on the given database schema using **relational algebra**.

- a) Retrieve the SSNs and names (Lname, Fname) of all employees in department 4 who work more than 5 hours per week on both 'ProductX' and 'ProductY' projects.
- b) List the SSNs and names of employees who have no dependents.
- c) Find the SSNs and names of employees who are directly supervised by a supervisor who is directly supervised by 'James Borg'.
- d) Retrieve the SSNs and names of employees who work on at least one project.
- e) Retrieve the SSNs and names of employees who work on every project located in Stafford.
- f) Retrieve the name of the department with *Dnumber* = 5, and the lowest salary of the male employees who work in that department.

- g) Retrieve the highest salary of all employees (the SSNs and names (Lname, Fname)) who work in the department with Dnumber = 4.
- h) Find the SSNs, names (Lname, Fname) and addresses of employees who work on at least one project located in Houston and whose department has a location in Houston.
- i) List the SSNs and last names of department managers who have the spouse as the dependent.

Problem 3 (35 Points):

Use Oracle WPI DB to run the given **TestBed.sql** script to deploy the database and construct the corresponding **SQL queries** for the above Problem 2 questions. Your solutions of this problem should include:

- a) Attach all SQL queries and the corresponding query results in the **pdf document**.
- b) Submit a **script file** that includes all the SQL queries in (a). Your script file will be graded only if it executes as one script file without syntax errors or another similar problem.

Note: **TestBed.sql** script is **NOT** fully completed and implemented. It is only for you to test your SQL. You should base upon the logic of Relation Algebra in Problem 2 to help you complete this task.

Grading:

Criteria	Possible Points
Problem 1: Suppose each of the following update operations (a ~ k) is applied directly to the database instance given above. Discuss all integrity constraints (e.g., primary key, candidate key, foreign key, and domain constraints if any) violated by each operation and explain the reason for each violation in detail .	30
Problem 2: Specify the following queries (a ~ i) on the given database schema using relational algebra .	35
Problem 3: Use Oracle WPI DB to run the given TestBed.sql script to deploy the database and construct the SQL queries for the above Problem 2 questions.	35
Total	100