

Purdue University
Computer Science Department
CS 448: Introduction to Database Systems
Prof: Bharat Bhargava

CS 448 – Homework #2

Due: 09/26/2016

Reference: Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition

Question 1

What are the main phases of database design. What needs to be done by the user and what needs to be done by the database administrator? What is involved in physical database design?

Question 2

What is a user transaction? What properties must be maintained for a transaction by the database system?

Question 3

5.11 (p.166) a), f), k)

Question 4

5.18 (p.169)

Question 5

6.13 (p.214)

Question 6

6.16 (p.214) c), e), h)

- 5.9. Define foreign key. What is it?
5.10. What is a transaction? How does it differ from an update?

Exercises

- 5.11. Suppose that each of the following update operations is applied directly to the database state shown in Figure 5.6. Discuss *all* integrity constraints violated by each operation, if any, and the different ways of enforcing these constraints.
- Insert <'Robert', 'F', 'Scott', '943775543', '1952-06-21', '2365 Newcastle Rd, Bellaire, TX', M, 58000, '888665555', 1> into EMPLOYEE.
 - Insert <'ProductA', 4, 'Bellaire', 2> into PROJECT.
 - Insert <'Production', 4, '943775543', '1998-10-01'> into DEPARTMENT.
 - Insert <'677678989', NULL, '40.0'> into WORKS_ON.
 - Insert <'453453453', 'John', 'M', '1970-12-12', 'spouse'> into DEPENDENT.
 - Delete the WORKS_ON tuples with Essn = '333445555'.

- g. Delete the EMPLOYEE tuple with Ssn = '987654321'.
- h. Delete the PROJECT tuple with Pname = 'ProductX'.
- i. Modify the Mgr_ssn and Mgr_start_date of the DEPARTMENT tuple with Dnumber = 5 to '123456789' and '1999-10-01', respectively.
- j. Modify the Super_ssn attribute of the EMPLOYEE tuple with Ssn = '999887777' to '943775543'.
- k. Modify the Hours attribute of the WORKS_ON tuple with Essn = '999887777' and Pno = 10 to '5.0'.

Figure 5.6
One possible database state for the COMPANY relational database schema.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	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	1968-01-19	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

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

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
888665555	20	NULL

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

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
-------	-------	-------	------------	-------	---------	-----	--------	-----------	-----

DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
-------	----------------	---------	----------------

DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
----------------	------------------

PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
-------	----------------	-----------	------

WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
-------------	------------	-------

DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
-------------	-----------------------	-----	-------	--------------

Figure 5.5
Schema diagram for
the COMPANY
relational database
schema.

OPTIONAL(Salesperson_id, Serial_no, Date, Sale_price)

SALE(Salesperson_id, Serial_no, Date, Sale_price)

SALESPERSON(Salesperson_id, Name, Phone)

First, specify the foreign keys for this schema, stating any assumptions you make. Next, populate the relations with a few example tuples, and then give an example of an insertion in the SALE and SALESPERSON relations that *violates* the referential integrity constraints and of another insertion that does not.

- 5.18. Database design often involves decisions about the storage of attributes. For example a Social Security Number can be stored as one attribute or split into three attributes (one for each of the three hyphen-delineated groups of numbers in a Social Security Number—XXX-XX-XXXX). However, Social Security Number is usually represented as just one attribute. The decision is based on how the database will be used. This exercise asks you to think about specific situations where dividing the SSN is useful.
- 5.19. Consider a STUDENT relation in a UNIVERSITY database with the following attributes (Name, Ssn, Local_phone, Address, Cell_phone, Age, Gpa). Note that the cell phone may be from a different city and state (or province) from the local phone. A possible tuple of the relation is shown below:

Cell_phone Age Gpa

- 6.13. What is meant by a *safe expression* in relational calculus?
- 6.14. When is a query language called relationally complete?

Exercises

- 6.15. Show the result of each of the example queries in Section 6.5 as it would apply to the database state of Figure 5.6.
- 6.16. Specify the following queries on the COMPANY relational database schema shown in Figure 5.5, using the relational operators discussed in this chapter. Also show the result of each query as it would apply to the database state of Figure 5.6.
- Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project.
 - List the names of all employees who have a dependent with the same first name as themselves.
 - Find the names of all employees who are directly supervised by 'Franklin Wong'.
 - For each project, list the project name and the total hours per week (by all employees) spent on that project.
 - Retrieve the names of all employees who work on every project.
- 6.18. Consider the table BOOKS which is used to enforce referential integrity constraints in the database state of Figure 5.6. Specify the following queries:
- How many books are currently in the library branch in San Francisco?
 - How many books are currently in the library branch in San Francisco that have not been borrowed?
 - Retrieve the names of all books that have not been borrowed.
 - For each book, list the Due_date and the number of times the book has been borrowed.
 - For each book, list the number of times the book has been borrowed.
 - Retrieve the names of all books that have not been borrowed.

- f. Retrieve the names of all employees who do not work on any project.
 - g. For each department, retrieve the department name and the average salary of all employees working in that department.
 - h. Retrieve the average salary of all female employees.
 - i. 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.
 - j. List the last names of all department managers who have no dependents.
- 6.17. Consider the AIRLINE relational database schema shown in Figure 5.8, which was described in Exercise 5.12. Specify the following queries in relational algebra:
- a. For each flight, list the flight number, the departure airport for the first leg of the flight, and the arrival airport for the last leg of the flight.