

# CSE 370 – Database Systems

## Theory Section 05 / 06 | Assignment 02 | Sample Solution

Spring 2023

### Question 1 [CO1] : 20 Points

Suppose that each of the following Update operations (a-j) is applied directly to the database state shown in Figure A2\_1. Discuss all integrity constraints violated by each operation (check Figure A2\_2 for Referential integrity constraints on the database of Figure A2\_1), if any, and the different ways of enforcing these constraints.

#### 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

Figure A2\_1 : COMPANY database.

## EMPLOYEE

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

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
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## DEPT\_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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## PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
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## WORKS\_ON

<u>Essn</u>	<u>Pno</u>	Hours
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## DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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Figure A2\_2 : Referential integrity constraints on the COMPANY database of Figure A2\_1.

a. Insert <'Gavin', 'F', 'Harrison', '943775543', '1972-06-21', '2365 Newcastle Rd, Bellaire, TX', 'M', 58000, '888665555', 1> into EMPLOYEE.

**Answer:**

No constraint violations.

b. Insert <'ProductA', 4, 'Bellaire', 2> into PROJECT.

**Answer:**

Violates referential integrity because Dnum=2 and there is no tuple in the DEPARTMENT relation with Dnumber=2. We may enforce the constraint by: (i) rejecting the insertion of the new PROJECT tuple, (ii) changing the value of Dnum in the new PROJECT tuple to an existing Dnumber value in the DEPARTMENT relation, or (iii) inserting a new DEPARTMENT tuple with Dnumber=2.

c. Insert <'Production', 4, '943775543', '2007-10-01'> into DEPARTMENT.

**Answer:**

Violates both the key constraint and referential integrity. Violates the key constraint because there already exists a DEPARTMENT tuple with Dnumber=4. We may enforce this constraint by: (i) rejecting the insertion, or (ii) changing the value of Dnumber in the new DEPARTMENT

tuple to a value that does not violate the key constraint. Violates referential integrity because Mgr\_ssn='943775543' and there is no tuple in the EMPLOYEE relation with Ssn='943775543'. We may enforce the constraint by: (i) rejecting the insertion, (ii) changing the value of Mgr\_ssn to an existing Ssn value in EMPLOYEE, or (iii) inserting a new EMPLOYEE tuple with Ssn='943775543'.

**d.** Insert <'677678989', NULL, '40.0'> into WORKS\_ON.

**Answer:**

Violates both the entity integrity and referential integrity. Violates entity integrity because Pno, which is part of the primary key of WORKS\_ON, is null. We may enforce this constraint by: (i) rejecting the insertion, or (ii) changing the value of Pno in the new WORKS\_ON tuple to a value of Pnumber that exists in the PROJECT relation. Violates referential integrity because Essn='677678989' and there is no tuple in the EMPLOYEE relation with Ssn='677678989'. We may enforce the constraint by: (i) rejecting the insertion, (ii) changing the value of Essn to an existing Ssn value in EMPLOYEE, or (iii) inserting a new EMPLOYEE tuple with Ssn='677678989'.

**e.** Insert <'453453453', 'John', 'M', '1990-12-12', 'Spouse'> into DEPENDENT.

**Answer:**

No constraint violations.

**f.** Delete the WORKS\_ON tuples with Essn = '333445555'.

**Answer:**

No constraint violations.

**g.** Delete the EMPLOYEE tuple with Ssn = '987654321'.

**Answer:**

Violates referential integrity because several tuples exist in the WORKS\_ON, DEPENDENT, DEPARTMENT, and EMPLOYEE relations that reference the tuple being deleted from EMPLOYEE. We may enforce the constraint by: (i) rejecting the deletion, or (ii) deleting all tuples in the WORKS\_ON, DEPENDENT, DEPARTMENT, and EMPLOYEE relations whose values for Essn, Ssn, Mgr\_ssn, and Super\_ssn, respectively, is equal to '987654321'.

**h.** Delete the PROJECT tuple with Pname = 'ProductX'.

**Answer:**

Violates referential integrity because two tuples exist in the WORKS\_ON relations that reference the tuple being deleted from PROJECT. We may enforce the constraint by: (i) rejecting the deletion, or (ii) deleting the tuples in the WORKS\_ON relation whose value for Pno=1 (the value for the primary key Pnumber for the tuple being deleted from PROJECT).

i. Modify the Mgr\_ssn and Mgr\_start\_date of the DEPARTMENT tuple with Dnumber = 5 to '123456789' and '2007-10-01', respectively.

**Answer:**

No constraint violations.

j. Modify the Super\_ssn attribute of the EMPLOYEE tuple with Ssn = '999887777' to '943775543'.

**Answer:**

Violates referential integrity because the new value of Super\_ssn='943775543' and there is no tuple in the EMPLOYEE relation with Ssn='943775543'. We may enforce the constraint by: (i) rejecting the deletion, or (ii) inserting a new EMPLOYEE tuple with Ssn='943775543'.