

CS3402 Tutorial 3:

1. Suppose each of the following Update operations is applied directly to the database below. Discuss *all* integrity constraints violated by each operation, 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

(a) Insert < 'ProductA', 4, 'Bellaire', 2 > into PROJECT.

(b) Insert < 'Production', 4, '943775543', '01-OCT-88' > into DEPARTMENT.

- (c) Insert < '677678989', null, '40.0' > into WORKS_ON.
- (d) Delete the EMPLOYEE tuple with SSN= '987654321'.
- (e) Delete the PROJECT tuple with PNAME= 'ProductX'.
- (f) Modify the SUPERSSN attribute of the EMPLOYEE tuple with SSN= '999887777' to '943775543'.

Answers:

(a) 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.

(b) 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 MGRSSN='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 MGRSSN to an existing SSN value in EMPLOYEE, or (iii) inserting a new EMPLOYEE tuple with SSN='943775543'.

(c) 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'.

(d) 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, ESSN, MGRSSN, and SUPERSSN, respectively, is equal to '987654321'.

(e) 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).

(f) Violates **referential integrity** because the new value of SUPERSSN='943775543' and there is no tuple in the EMPLOYEE relation with SSN='943775543'. We may enforce the constraint by: (i) rejecting the modification, or (ii) inserting a new EMPLOYEE tuple with SSN='943775543'.

2 Consider the relation REFRIG(MODEL#, YEAR, PRICE, MANUF_PLANT, COLOR), which is abbreviated as REFRIG(M, Y, P, U, C), and the following set of F of functional dependencies: $F = \{M \rightarrow U, \{M, Y\} \rightarrow P, U \rightarrow C\}$. Evaluate each of the following as a candidate key for REFRIG, giving reasons why it can or cannot be a key: $\{M\}$, $\{M, Y\}$, $\{M, C\}$

Answers:

- $\{M\}$ IS NOT a candidate key since it does not functionally determine attributes Y or P.
 $\{M\}^+ = \{M, U, C\}$

- $\{M, Y\}$ IS a super key since it functionally determines the remaining attributes P, U, and C.
Also $\{M\}$ and $\{Y\}$ are not the superkey, so $\{M, Y\}$ IS a candidate key.
i.e.

We have $\{M, Y\} \rightarrow P$, and $M \rightarrow U$, by augmentation $\{M, Y\} \rightarrow U$

Since $U \rightarrow C$, by transitivity $M \rightarrow U$, $U \rightarrow C$, gives $M \rightarrow C$; By augmentation $\{M, Y\} \rightarrow C$

Thus $\{M, Y\}^+ = \{M, Y, P, U, C\}$ and $\{M, Y\}$ can be a super key.

$\{M\}^+ = \{M, U, C\}$, $\{M\}$ is not super key.

$\{Y\}^+ = \{Y\}$, $\{Y\}$ is not super key.

So $\{M, Y\}$ is the candidate key.

- $\{M, C\}$ IS NOT a candidate key since it does not functionally determine attributes Y or P.
 $\{M, C\}^+ = \{M, C, U\}$.