### CSU34041

### **Database Constraints**

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## Today's Lecture

- Types of Constraints
- Integrity Constraints in Detail
- Constraint Violations
- Complex Constraints
- Task 5 hand up before class ends



## Integrity vs Security







### Integrity and Security are related but they are not the same

- Integrity is concerned with accidental corruption
- Security is concerned with deliberate corruption

### **Integrity**

Integrity Constraints

### Security

- Security Policies
- Access Control

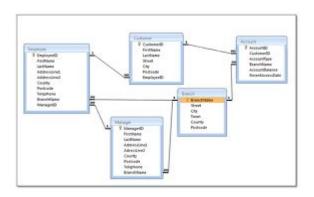


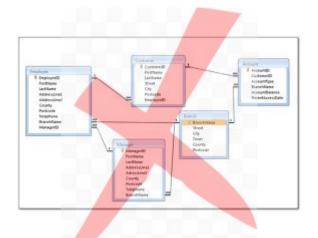
### Relational Model Constraints

- Constraints expressed within the Relational Schema
  - Explicit Constraints



- Semantic Constraints
  - can be expressed in SQL in some cases
  - usually enforced by the application programs







## **Integrity Constraints**



- Three types of integrity constraint are considered part of the relational model:
  - Key
  - Entity Integrity
  - Referential Integrity

The DBMS must be able to enforce these constraints



## **Key Constraints**



- Specifies that there may not be any duplicate entries in key attributes
  - Primary Key
  - Candidate Keys

- Keys are used to uniquely identify a tuple
  - Having a duplicate value in a Key implies that we cannot uniquely identify some tuples



## **Entity Integrity Constraints**

 Specifies that there may not be any NULL values in the Primary Key attribute

The Primary Key is used to uniquely identify each tuple in a relation

 Having NULL in a Primary Key implies that we cannot identify some tuples



## Referential Integrity

Entity constraints are specified on individual relations

- Referential Integrity constraints are specified between two relations
  - Maintains consistency among tuples in the two relations
  - A tuple in one relation that refers to another relation, must refer to an existing tuple in that relation

 A Foreign Key formally specifies a Referential Integrity Constraint between two relations



## **NULL Keys**

- As per the Entity Integrity constraint
  - No part of a Primary Key can be NULL

- However, Foreign Keys in certain circumstances may be NULL
  - A decision must be made during schema design as to whether it is valid for the foreign key to be NULL at any point



## **NULL Key Example**





## **NULL Key Example**

Can GP\_ID be NULL?





### **NULL Key Example** NO! GP\_ID is a primary key DOCTOR Address Name Phone\_num **PATIENT** Date\_of\_Birth Address Name **GP** PPS\_num Phone\_num



## **NULL Key Example**

Can GP be NULL?





## **NULL Key Example**

Yes! GP is only a foreign key so it can be NULL



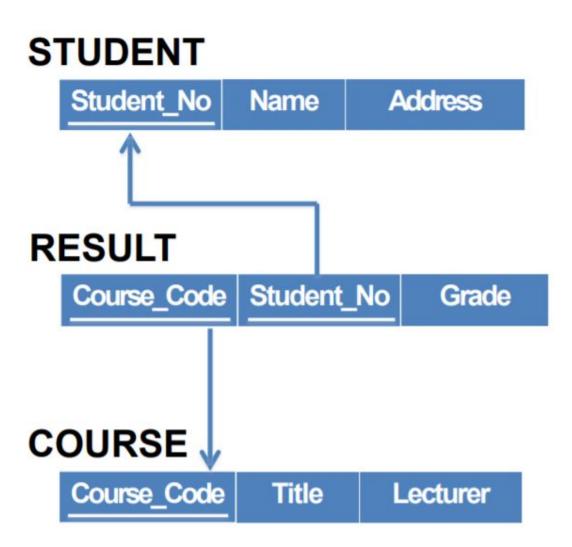


## Referential Integrity

- When defining an attribute as a Foreign Key
  - You must also specify whether or not the foreign key is allowed to contain NULLs
- In the case of a composite Foreign Key
  - if the Foreign Key is allowed to contain NULLs then either all the component attributes should be NULL or none of them NULL
    - in order to enforce referential integrity



# **NULL Keys**

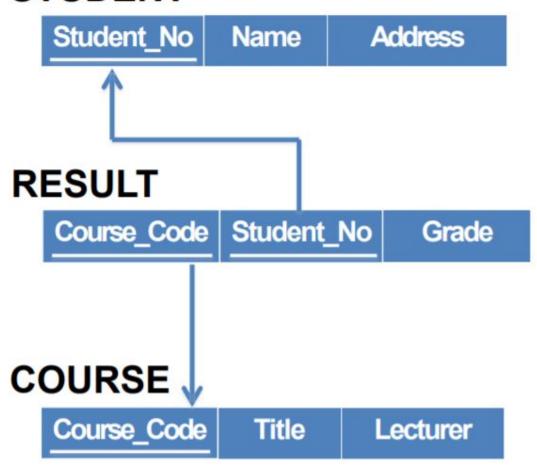




NULL Ke'

Question: should we allow student\_no in result table to be NULL?

### **STUDENT**

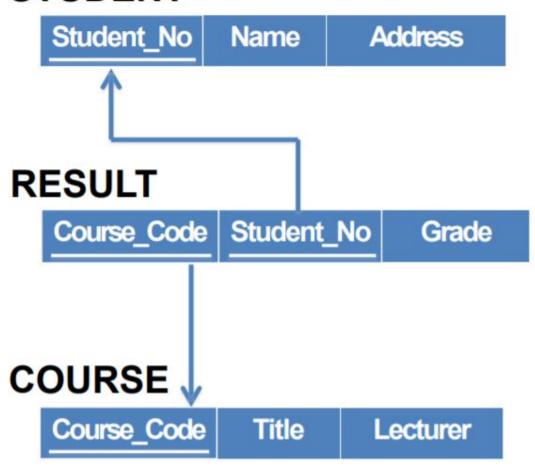




NULL Ke

No! this would defy logic
- a result should not be
able to exist without a
student

### STUDENT





### **Constraint Violation**

There are three basic operations that modify the state of relations in a DB

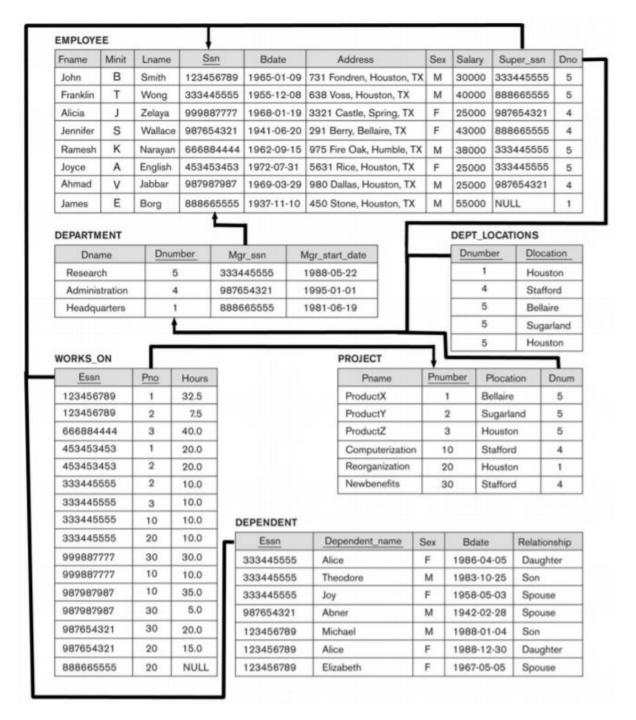
- Insert
- Update
- Delete

These operations should not violate the integrity constraints specified for the DB – Key, Entity, Referential



### Example

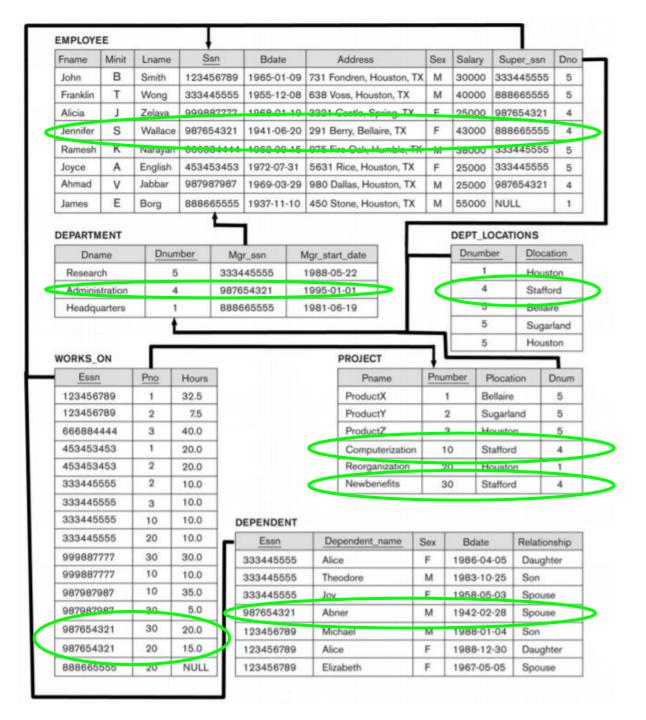
- Employee
- Department
- Dept Location
- Project
- Works on
- Dependent





### Example

- Employee
- Department
- Dept Location
- Project
- Works on
- Dependent





### **Insert Constraint Violation**

Insert provides a list of attribute values for a **new tuple t** that is to be added to relation R

- Inserts can violate all the integrity constraints that we have discussed
  - Key
  - Entity Integrity
  - Referential Integrity



### **Insert Constraint Violation**

Key constraints - may not be any duplicate entries in key attributes

tuple t that is to be

raints that we have

#### discusse

- Key
- Entity Integrity
- Referential Integrity



## Insert Constraint Violation

Key co

Entity constraints - may not be any NULL values in the primary Key attribute

tuple t that is to be

raints that we have

#### discusse

- Key
- Entity Integrity
- Referential Integrity





Fntitucons

Example: a Foreign Key

between two relations

referential integrity constraint

formally specifies a

Key co

discusse

- Key
- Entity Integrity
- Referential Integrity

uple t that is to be

we have



<'Cecilia', 'F', 'Kolonsky', NULL, '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, NULL, 4>

Fname	Minit	Lname	Ss	in	Bdate	Address	Sex	Salary	Sup	per_ssn	l
John	В	Smith	12345	6789	1965-01-09	731 Fondren, Houston, TX	M	30000	333	445555	Ī
Franklin	Т	Wong	33344	5555	1955-12-08	638 Voss, Houston, TX	M	40000	888	665555	Ī
Alicia	J	Zelaya	99988	37777	1968-01-19	3321 Castle, Spring, TX	F	25000	987	654321	Ī
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888	665555	Ī
Ramesh	K	Narayan	66688	34444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333	445555	Ī
Joyce	Α	English	45345	3453	1972-07-31	5631 Rice, Houston, TX	F	25000	333	445555	Ī
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Dallas, Houston, TX	M	25000	987	654321	Ī
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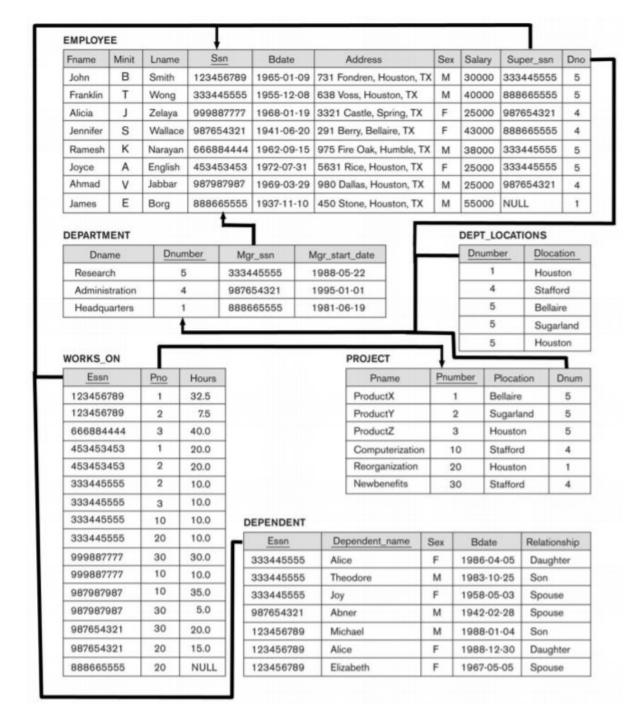
<'Cecilia', 'F', 'Kolonsky', NULL, '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, NULL, 4>

#### Answer:

- No, this insertion violates the Entity Integrity constraint
- NULL is provided for the Primary Key, Ssn, so the insertion is rejected.

Fname	Minit	Lname	Ss	n	Bdate	1	Address	Sex	Salar	ry :	Super_s	sn Dn
John	В	Smith	12345	6789	1965-01-09	731 For	ndren, Houston, T	M	3000	00 3	3334455	55 5
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Alicia	J	Zelaya	99988	7777	1968-01-19	3321 0	Castle, Spring, TX	F	2500	00 9	9876543	21 4
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Be	erry, Bellaire, TX	F	4300	00 8	3886655	55 4
Ramesh	K	Narayan	66688	4444	1962-09-15	975 Fin	e Oak, Humble, TX	M	3800	00 3	3334455	55 5
Joyce	Α	English	45345	3453	1972-07-31	5631 R	Rice, Houston, TX	F	2500	00 3	3334455	55 5
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Da	allas, Houston, TX	M	2500	00 9	9876543	21 4
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<'Alicia', 'J', 'Zelaya', '999887777', '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, '987654321', 4>



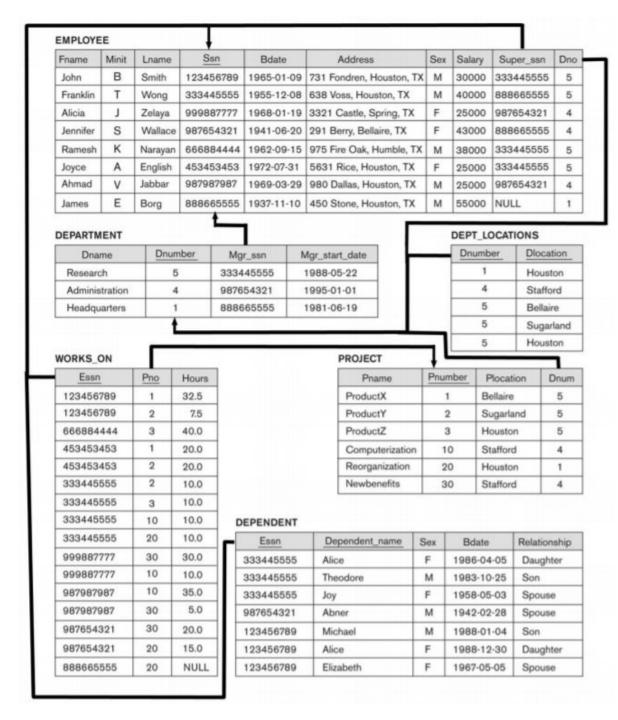
<'Alicia', 'J', 'Zelaya', (999887777), '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, '987654321', 4>

#### Answer:

- No, this insertion violates the Key constraint
- Another tuple with the same Ssn value already exists in the EMPLOYEE relation, so it is rejected

Fname	Minit	Lname	Ss	n	Bdate		Address	Sex	Salar	y S	uper_ssn	Dr
John	В	Smith	12345	6789	1965-01-0	731	Fondren, Houston, T.	X M	3000	0 33	3445555	5 5
Franklin	Т	Wong	33344	5555	1955-12-0	638	Voss, Houston, TX	М	4000	0 88	8665555	5 5
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Jennifer	S	Wallace	98765	4321	1941-06-2	291	Berry, Bellaire, TX	F	4300	0 88	8665555	5 4
Ramesh	K	Narayan	66688	4444	1962-09-1	975	Fire Oak, Humble, T	М	3800	0 33	3445555	5 5
Joyce	Α	English	45345	3453	1972-07-31	5631	Rice, Houston, TX	F	2500	0 33	3445555	5 5
Ahmad	٧	Jabbar	98798	7987	1969-03-2	980	Dallas, Houston, TX	M	2500	0 98	7654321	4
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Essn 123456' 123456' 666884' 453453' 453453' 333445' 333445' 333445' 333445' 999887'	789 789 444 453 453 555 555 555 555 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	<u>Essn</u> 333445555	Al Th	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 1 1 2 2 3 3 1 5 Sex F	9 0 0 0 8da 1986-	Ploca Bellairi Sugar Houst Staffo Houst Staffo	House action ree Infland Idon Infland Idon Infland Idon Infland Idon Infland Idon Infland Idon Infland Idon Infland Idon Idon Idon Idon Idon Idon Idon Id	Dnur 5 5 5 4 1 4
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Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887 999887 999887	789 789 444 453 453 555 555 555 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0		Essn 333445555 333445555 333445555 987654321	Al Th	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Pependent_name lice neodore	1 2 3 3 10 20 3 6 Sex F M F	Bda 1986- 1983- 1958- 1942-	Plocal Bellain Sugar Houst Staffo Houst Staffo 10-25 05-03 02-28	House station free fland from	Dnur 5 5 5 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Essn 123456' 123456' 666884' 453453' 453453' 333445' 333445' 333445' 999887' 9879876' 9879876'	789 789 444 453 453 555 555 555 777 777 987 987	1 2 3 1 2 2 3 10 20 30 10 10 10 30	32.5 7.5 40.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0		Essn 333445555 333445555 333445555	All The Jo	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Pependent_name lice neodore Py bner	1 2 3 3 1 1 ( 2 ( 3 ( ) ) 5 ( ) 5 ( ) 5 ( ) 7 (	Bda 1986- 1983- 1958-	Ploca Bellairi Sugar Houst Staffo Houst Staffo 10-25 05-03 02-28 01-04	House action are all and all a	Dnur 5 5 5 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4

<'Cecilia', 'F', 'Kolonsky', '677678989', '1960-04-05', '6357 Windswept, Katy, TX', F, 28000, '987654321', 7>



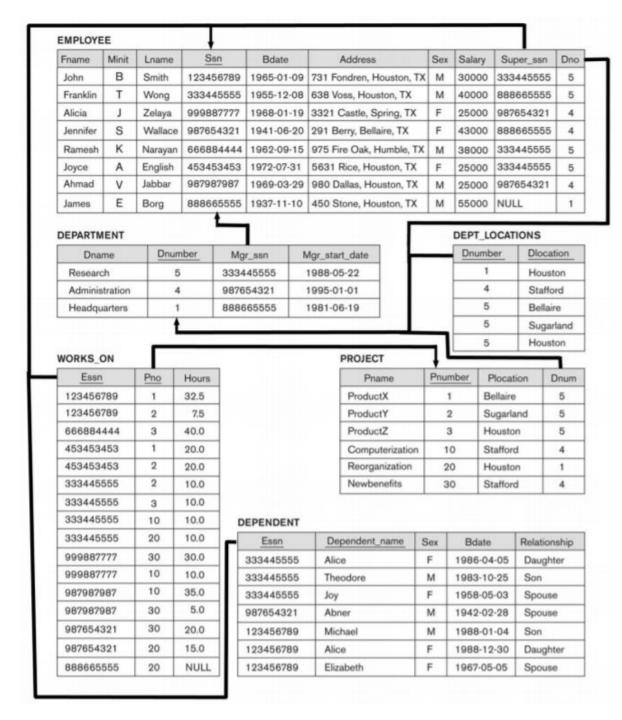
<'Cecilia', 'F', 'Kolonsky', '677678989', '1960-04-05', '6357 Windswept, Katy, TX', F, 28000, '987654321', 7>

#### Answer:

- No, this insertion violates the referential integrity constraint specified on Dno in EMPLOYEE
- No corresponding tuple exists in DEPARTMENT with Dnumber = 7

Fname	Minit	Lname	Ssr	1	Bdate		Address	Sex	Salary	S	uper_ssn	Dn
John	В	Smith	123456	6789	1965-01-0	731	Fondren, Houston, T.	K M	30000	33	3445555	5
Franklin	Т	Wong	333445	5555	1955-12-0	638	Voss, Houston, TX	М	40000	88	8665555	5
Alicia	J	Zelaya	999887	7777	1968-01-1	3321	Castle, Spring, TX	F	25000	98	7654321	4
Jennifer	S	Wallace	987654	1321	1941-06-2	291	Berry, Bellaire, TX	F	43000	88	8665555	4
Ramesh	K	Narayan	666884	4444	1962-09-1	975	Fire Oak, Humble, T	M	38000	33	3445555	5
Joyce	Α	English	453453	3453	1972-07-31	5631	Rice, Houston, TX	F	25000	33	3445555	
Ahmad	٧	Jabbar	987987	7987	1969-03-2	980	Dallas, Houston, TX	M	25000	98	7654321	4
James	E	Borg	888665	5555	1937-11-10	450	Stone, Houston, TX	М	55000	) NU	ILL	1
DEPARTM	IENT		1		1		г		DEPT	LOCA	TIONS	
Dna	me	Dnum	ber	Mg	r_ssn	Mgr_st	art_date		Dnun	nber	Dloca	ation
Researc	ch	5			45555		05-22			1	Hous	ton
Adminis	tration	4		9876	54321	1995-	01-01			4	Staff	ord
Headqu	arters	1		8886	65555	1981-	06-19			5	Bella	ire
										-	-	
		t								5	Suga	irland
		_t						$\neg$	-	5	Hous	_
VORKS_C	ON	Ļ					PROJECT	Ţ	-	-	-	ston
WORKS_C		Pno	Hours				PROJECT Pname	Pnun		-	Hous	_
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Essn 123456 123456	789 789 444	1 2	32.5 7.5				Pname ProductX ProductY	1 2	nber	5 Ploca Bellair Sugar	House stion re fand on	Dnur 5
Essn 123456 123456 666884	789 789 444 453	1 2 3	32.5 7.5 40.0				ProductX ProductY ProductZ	1 2 3	nber	Ploca Bellair Sugar Houst	House ation lee fand on rd	Dnur 5 5
Essn 123456 123456 666884 453453	789 789 444 453 453	1 2 3	32.5 7.5 40.0 20.0				ProductX ProductY ProductZ Computerization	1 2 3	nber 2	Ploca Bellair Sugar Houst Staffo	House ation re land on rd	Dnur 5 5 5
Essn 123456 123456 666884 453453 453453	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0 20.0				ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber 2	Ploca Bellair Sugar Houst Staffo	House ation re land on rd	Dnur 5 5 5 4
Essn 123456 123456 666884 4534534 4534534 333445	789 789 444 453 453 555	1 2 3 1 2 2	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT		ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber 2	Ploca Bellair Sugar Houst Staffo	House ation re land on rd	Dnur 5 5 5 4
Essn 123456 123456 666884 453453 453453 333445 333445	789 789 444 453 453 555 555	1 2 3 1 2 2 2	32.5 7.5 40.0 20.0 20.0 10.0		EPENDENT Essn	D	ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber 2	Ploca Bellair Sugar Houst Staffo Houst Staffo	House ation re land on rd	Dnur 5 5 5 4 1 4
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Essn 123456' 123456' 666884' 453453' 453453' 333445' 333445' 333445' 333445' 999887'	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 10.0 30.0		<u>Essn</u> 333445555	A	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Pependent_name lice neodore	1 2 3 10 20 3 6 Sex F	nber	Ploca Bellair Sugar Houst Staffo Houst Staffo	House station lee stand on lee	Dnur 5 5 5 4 1 4
Essn 123456' 123456' 666884' 453453' 453453' 333445' 333445' 333445' 999887' 999887'	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 10.0 30.0		Essn 333445555 333445555	Al Th	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Pependent_name lice neodore	1 2 3 3 10 20 3 3 10 Sex F	Bdat 1986-0	Pioca Bellair Sugar Houst Staffo Houst Staffo	House ation lee land on rd land land on rd land Son land land land land land land land lan	Dnur 5 5 5 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887 999887 999887	789 789 444 453 453 555 555 555 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0		Essn 333445555 333445555 333445555	Al Th	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name lice neodore	1 2 3 3 10 20 3 3 6 Sex F M F	Bdat 1986-(1983-	Ploca Bellair Sugar Houst Staffo Houst Staffo	House station lee stand on lee	Dnur 5 5 5 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Essn 123456' 123456' 666884' 453453' 453453' 333445' 333445' 333445' 999887' 9879876' 9879876'	789 789 444 453 453 555 555 555 777 777 987 987	1 2 3 1 2 2 3 10 20 30 10 10 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0		Essn 333445555 333445555 333445555 987654321	Al Th Jo Al	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name lice neodore by bner	1 2 3 3 10 20 3 6 Sex F M F M	Bdal- 1986- 1988- 1958- 1942-	Ploca Bellairi Sugar Houst Staffo Houst Staffo 10-25 05-03 02-28 01-04	House ation lee land on rd land Son Spour Spour Son	Dnur 5 5 5 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4

<'Cecilia', 'F', 'Kolonsky', '677678989', '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, NULL, 4>



<'Cecilia', 'F', 'Kolonsky', '677678989', '1960-04-05', '6357 Windy Lane, Katy, TX', F, 28000, NULL, 4>



#### Answer:

 Yes, this insertion satisfies all constraints, so it is acceptable

Fname	Minit	Lname	Ss	n	Bdate		Address	Sex	Salar	ry S	Super_ssn	Dn
John	В	Smith	12345	6789	1965-01-09	731 Fo	ondren, Houston, T	M	3000	00 3	3344555	5 5
Franklin	Т	Wong	33344	5555	1955-12-08	638 Vo	oss, Houston, TX	M	4000	00 8	8866555	5 5
Alicia	J	Zelaya	99988	7777	1968-01-19	3321 (	Castle, Spring, TX	F	2500	00 9	8765432	1 4
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Be	erry, Bellaire, TX	F	4300	00 8	8866555	5 4
Ramesh	K	Narayan	66688	4444	1962-09-15	975 Fir	re Oak, Humble, TX	M	3800	00 3	3344555	5 5
Joyce	Α	English	45345	3453	1972-07-31	5631 F	Rice, Houston, TX	F	2500	00 3	3344555	5 5
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Da	allas, Houston, TX	M	2500	00 9	8765432	1 4
James	E	Borg	88866	5555	1937-11-10	450 St	tone, Houston, TX	М	5500	00 N	IULL	1
DEPARTM	IENT		1	_	1		Г		DEPT	LOC	ATIONS	
Dna	me	Dnum	ber	Mg	r_ssn	Mgr_star	t_date		Dnu	mber	Dloc	ation
Researc	ch	5		3334	45555	1988-05	5-22			1	Hou	ston
Adminis	tration	4		9876	54321	1995-01	1-01			4	Staf	ford
Headqu	arters	1		8886	65555	1981-06	6-19			5	Bell	aire
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		t								5	Sug	arland
		_t						_		5	-	arland
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WORKS_C		Pno	Hours	1			PROJECT Pname	Pnun	nber	5	-	ston
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Essn	789						Pname	-		5 Ploc Bella	Hou	Dnur
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Essn 123456 123456	789 789 444	1 2	32.5 7.5				ProductX ProductY	1 2	: :	Ploc Bella Suga	Hou cation aire arland	Dnur 5
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Essn 123456 123456 666884 453453	789 789 444 453 453	1 2 3	32.5 7.5 40.0 20.0				Pname ProductX ProductY ProductZ Computerization	1 2 3	0	Ploc Bella Suga Hous Staff	House cation aire arland ston ford ston	Dnun 5 5 5 4
Essn 123456 123456 666884 453453 453453	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0 20.0				Pname ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	0	Ploc Bella Suga Hous Staff Hous	House cation aire arland ston ford ston	Dnun 5 5 5 4
Essn 123456 123456 666884 453453 453453 333445	789 789 444 453 453 555	1 2 3 1 2 2 2 2	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT		Pname ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	0	Ploc Bella Suga Hous Staff Hous	House cation aire arland ston ford ston	Dnun 5 5 5 4
Essn 123456 123456 666884 453453 453453 333445	789 789 444 453 453 555 555	1 2 3 1 2 2 2 3 3	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT Essn		Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 10 20	0	Ploc Bella Suga Hous Staff Hous Staff	House cation aire arland ston ford ston	Dnun 5 5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445	789 789 444 453 453 555 555 555	1 2 3 1 2 2 2 3 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0	Г			Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 10 20 3	0 0 0 0	Ploc Bella Suga Hous Staff Hous Staff	House cation aire arland ston ford ston ford Relation	Dnun 5 5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445	789 789 444 453 453 555 555 555 555	1 2 3 1 2 2 3 10 20	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0	٢	Essn	<u>De</u>	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 1 (c) 2 (c) 3 (c) Sex	9 0 0 0 0 1986	Ploc Bella Suga Hous Staff Hous Staff	House cation aire arland ston ford ston ford Relation 5 Daug	Dnun 5 5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 555 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555	<u>De</u>	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e	1 2 3 1 ( 2 ( 3 ( ) ) Sex F	8 0 0 0 0 0 1986 1983	Ploce Bella Suga Hous Staff Hous Staff	House cation aire arland ston ford ston ford Relation 5 Daug 5 Son	Dnun 5 5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555 333445555	Dep Alico	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e odore	1 2 3 10 20 Sex F M	Bdi 1986 1983	Ploc Bella Suga Hous Staff Hous Staff	Acation aire arland ston ford ston ford Ston 5 Daug 5 Son 3 Spou	Dnun 5 5 5 4 1 4 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887 999887	789 789 444 453 453 555 555 555 555 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0		Essn 333445555 333445555 333445555	Dej Alici Theo Joy Abn	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e odore	1 2 3 1 ( 2 ( 3 ( ) ) Sex F M F	Bdi 1986 1983 1958	Plox Bella Suga Hous Staff Hous Staff -04-08-	cation aire arland ston ford ston ford  Relation 5 Daug 5 Son 3 Spoul 8 Spoul	Dnun 5 5 5 4 1 4 4
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### **Constraint Violation - Delete**

To specify a deletion, a condition on the attributes of a relation is created which selects <u>one or more tuples</u> to be deleted

The Delete operation can only violate the Referential Integrity constraint



### Can we delete the following?

Any tuples in WORKS\_ON with Essn = '99988777' and Pno = 10

Fname	Minit	Lname	Ss	n	Bdate		Address	Sex	Salary	Su	per_ssn	D
John	В	Smith	12345	6789	1965-01-0	9 731 Fo	endren, Houston, T	M	30000	333	3445555	
Franklin	Т	Wong	33344	5555	1955-12-0	8 638 Vo	oss, Houston, TX	М	40000	888	8665555	
Alicia	J	Zelaya	99988	37777	1968-01-1	9 3321 (	Castle, Spring, TX	F	25000	987	7654321	
Jennifer	S	Wallace	98765	4321	1941-06-2	0 291 Be	erry, Bellaire, TX	F	43000	888	8665555	
Ramesh	K	Narayan	66688	34444	1962-09-1	5 975 Fir	re Oak, Humble, TX	M	38000	333	3445555	
Joyce	Α	English	45345	3453	1972-07-3	1 5631 F	Rice, Houston, TX	F	25000	333	3445555	
Ahmad	٧	Jabbar	98798	7987	1969-03-2	9 980 D	allas, Houston, TX	M	25000	987	7654321	
James	E	Borg	88866	5555	1937-11-1	0 450 St	tone, Houston, TX	М	55000	NU	LL	
DEPARTM	IENT			_	1		Г	31/2	DEPT	LOCA	TIONS	
Dnar	me	Dnum	ber	Mg	r_ssn	Mgr_star	t_date		Dnun	ber	Dloca	ation
Researc		5			45555	1988-08				1	Hous	ton
Adminis	tration	4		9876	54321	1995-01	1-01			4	Staff	ord
Headqu	arters	1		8886	65555	1981-06	6-19			5	Bella	ire
		t								5	Suga	rlan
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WORKS_C	_	Pno	Hours	]			PROJECT Pname	Pnur		Ploca	Hous	_
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Essn 1234567	789 789	1	32.5				Pname ProductX	1	mber	Ploca	Hous tion e and	Dnu 5
Essn 1234567 1234567	789 789 444	1 2	32.5 7.5				Pname ProductX ProductY	1	mber	Ploca Bellaire Sugarl	House tion e and on	Dnu 5
Essn 1234567 1234567 666884	789 789 444 453	1 2 3	32.5 7.5 40.0				Pname ProductX ProductY ProductZ	3	mber 1 2 3 0	Ploca Bellaire Sugarl Houste	House tion e and on	Dnu 5 5
Essn 1234567 1234567 6668844 4534534	789 789 444 453 453	1 2 3	32.5 7.5 40.0 20.0				ProductX ProductY ProductZ Computerization	3 3	nber	Ploca Bellaire Sugarl Houste Staffor	House tion e and on rd	Dnu 5 5 5
Essn 1234567 1234567 666884 4534534	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0 20.0				Pname ProductX ProductY ProductZ Computerization Reorganization	1 3 1 2	nber	Ploca Bellaire Sugarl Houste Staffor Houste	House tion e and on rd	Dnu 5 5 4
Essn 1234567 1234567 666884 4534534 4534534 3334458	789 789 444 453 453 555	1 2 3 1 2 2	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT		Pname ProductX ProductY ProductZ Computerization Reorganization	1 3 1 2	nber	Ploca Bellaire Sugarl Houste Staffor Houste	House tion e and on rd	Dnu 5 5 4
Essn 1234567 1234567 666884 4534534 4534534 3334458	789 789 444 453 453 555 555	1 2 3 1 2 2 2 3 3	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDEN1 Essn		Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 3 1 2	nber	Ploca Bellaire Sugarl Housto Staffor Housto Staffor	House tion e and on rd	Dnu 5 5 5 4 1 4
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Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 3334458 9998877	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0		Essn 333445555 333445555	Der Alico The Joy	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e odore	1 2 3 Sex F M	mber   1   2   3   3   0   0   0   0   1986-0   1983-0	Ploca Bellairi Housto Housto Staffor	House tion e and on rd on rd Relatio	Dnu 5 5 4 1 4
Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 9998877 9998877	789 789 444 453 453 555 555 555 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0		Essn 333445555 333445555 333445555	De Alici The Joy Abn	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e odore	1 2 3 3 Sex F M F	mber   1   2   3   3   0   0   0   0   1986-(1983-1958-(1958	Ploca Bellairus Housto Staffor Housto	House tion e and on rd on rd on Spous	Dnu 5 5 5 4 1 4
Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 9998877 9998877 9879878	789 789 444 453 453 555 555 555 777 777 987 987	1 2 3 1 2 2 3 10 20 30 10 10 30 30	32.5 7.5 40.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0		Essn 333445555 333445555 333445555 987654321	Dei Alici Thei Joy Abn Mici	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  pendent_name e odore  eer hael	1 2 3 3 Sex F M F M	mber   1   2   3   3   0   0   0   0   1986-(1983-1958-(1942-(1942-(1983-1983-1983-1983-1983-1983-1983-1983-	Ploca Bellairus Sugarl Housto Staffor Housto Staffor 0-25 0-25 0-20 0-25 0-20 0-20 0-20 0-20	House tition le land on la land on le land o	Dnu 5 5 4 1 4 unship

### Can we delete the following?

Any tuples in WORKS\_ON with Essn = '99988777' and Pno = 10

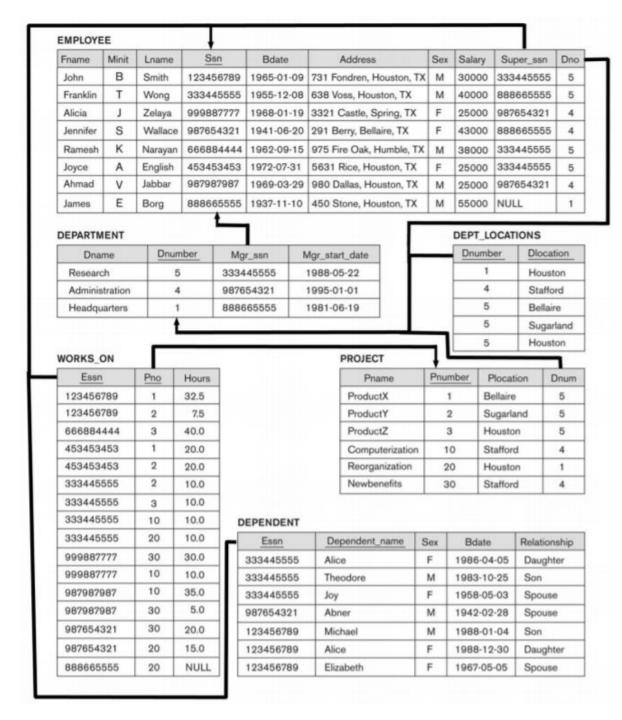


#### Answer:

 Yes, this deletion is acceptable and deletes exactly one tuple

Fname	Minit	Lname	Ss	n	Bdate	Ad	idress	Sex	Salar	y S	uper_ssr	Dn
John	В	Smith	12345	6789	1965-01-09	731 Fond	dren, Houston, TX	M	3000	00 33	344555	5 5
Franklin	Т	Wong	33344	5555	1955-12-08	638 Voss	s, Houston, TX	M	4000	00 88	866555	5 5
Alicia	J	Zelaya	99988	7777	1968-01-19	3321 Ca	stle, Spring, TX	F	2500	00 98	3765432	1 4
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Berry	y, Bellaire, TX	F	4300	00 88	866555	5 4
Ramesh	K	Narayan	66688	4444	1962-09-15	975 Fire	Oak, Humble, TX	M	3800	0 33	344555	5 5
Joyce	Α	English	45345	3453	1972-07-31	5631 Ric	ce, Houston, TX	F	2500	00 33	344555	5 5
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Dalla	as, Houston, TX	M	2500	00 98	3765432	1 4
James	E	Borg	88866	5555	1937-11-10	450 Stor	ne, Houston, TX	М	5500	00 NI	ULL	1
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Dna		Dnum	ber	Mg	r_ssn	Mgr_start_c	date			mber		ation
Researc	ch	5		3334	45555	1988-05-2	22			1	Hou	ston
Adminis	tration	4		9876	54321	1995-01-0	01			4	Staf	ford
Headqu	arters	1		8886	65555	1981-06-1	19			5	Bell	aire
										5	0	
		t								0	Sug	arland
		t						$\neg$		5	-	arland
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Essn 123456 123456 666884 453453	789 789 444 453 453	1 2 3	32.5 7.5 40.0 20.0			F F	ProductX ProductY ProductZ Computerization	1 2 3	0	Ploc Bellai Suga Hous Staffo	ation fre fland ton ford ton	Dnun 5 5 5
Essn 123456 123456 666884 453453 453453	789 789 444 453 453 555	1 2 3 1	32.5 7.5 40.0 20.0 20.0			F F	ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	0	Ploc Bellai Suga Hous Staffo Hous	ation fre fland ton ford ton	Dnun 5 5 5 4
Essn 123456 123456 666884 453453 453453 333445	789 789 444 453 453 555	1 2 3 1 2 2 2 2	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT	F F	ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	0	Ploc Bellai Suga Hous Staffo Hous	ation fre fland ton ford ton	Dnun 5 5 5 4
Essn 123456 123456 666884 453453 453453 333445 333445	789 789 444 453 453 555 555	1 2 3 1 2 2 2	32.5 7.5 40.0 20.0 20.0 10.0		EPENDENT Essn	F	Prame ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 10 20	0	Ploc Bellai Suga Hous Staffo Hous Staffo	House ation ire rland ton ord	Dnun 5 5 5 4 1 4
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Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555 333445555	F F C C F N N N N N N N N N N N N N N N	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 10 20 Sex F M	Bdi 1986 1983	Ploc Bellai Suga Hous Staffe Hous Staffe -04-05-10-25	House ation free reland ton ford free free free free free free free fr	Dnun 5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887 999887	789 789 444 453 453 555 555 555 555 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0	ſ	Essn 333445555 333445555 333445555	Deper Alice Theod	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 1 ( 2 ( 3 ( ) ) Sex F M F	Bdi 1986 1983 1958	Ploc Bellai Suga Hous Staffo Hous Staffo	Action action ord ton ord so Son Spoul	Dnun 5 5 4 1 4
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Any tuples in EMPLOYEE with Ssn = '999887777'



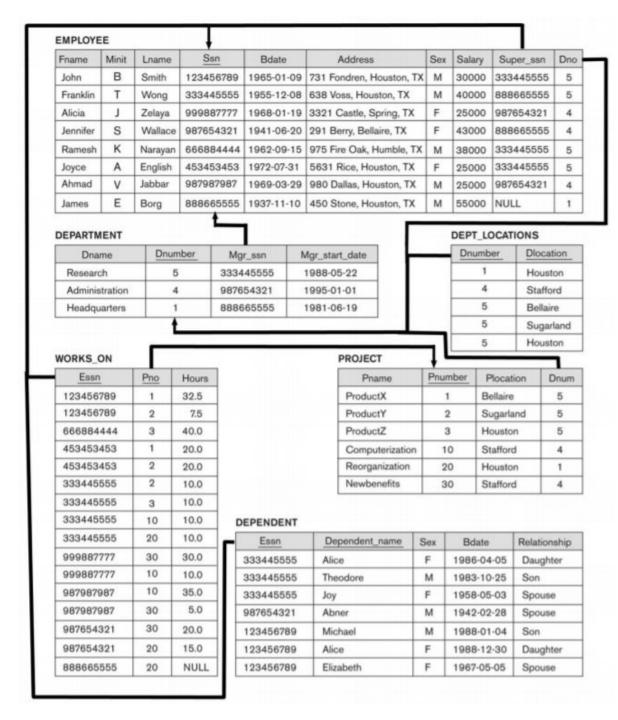
Any tuples in EMPLOYEE with Ssn = '999887777'

#### Answer:

- No, this deletion is not acceptable, because there are tuples in WORKS\_ON that refer to this tuple
- Hence, if the tuple in EMPLOYEE is deleted, Referential Integrity violations will result

Fname	Minit	Lname	Se	in	Bdate	Address	Sex	Salary	Su	per_ssn	1
John	В	Smith	12345	6789	1965-01-09	731 Fondren, Houston, T	M	30000	333	445555	
Franklin	Т	Wong	33344	15555	1955-12-08	638 Voss, Houston, TX	М	40000	888	8665555	
Alicia	J	Zelaya	99988	37777	1968-01-19	3321 Castle, Spring, TX	F	25000	987	654321	T
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888	665555	Т
Ramesh	K	Narayan	66688	34444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333	445555	T
Joyce	Α	English	45345	3453	1972-07-31	5631 Rice, Houston, TX	F	25000	333	445555	T
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Dallas, Houston, TX	M	25000	987	654321	T
James	E	Borg	88866	55555	1937-11-10	450 Stone, Houston, TX	М	55000	NU	LL	I
DEPARTM	IENT			_	1	г		DEPT_	LOCAT	IONS	
Dna	me	Dnum	ber	Mg	r_ssn	Mgr_start_date		Dnum	ber	Dloca	itio
Researc	ch	5			45555	1988-05-22			1	Hous	tor
Adminis	tration	4		9876	54321	1995-01-01			4	Staffo	ord
Headqu	arters	1		8886	65555	1981-06-19			5	Bellai	ire
		t							5	Suga	rla
		_					$\neg$		5	Hous	tor
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Essn	789					Pname	-	-	10110025110	9	5
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123456 123456	789 789 444	1 2	32.5 7.5			ProductX ProductY	1	:	Bellaire Sugarl	and	co co co
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Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name Alice	1 2 3 1 2 3 3 Sex F	8 1 1 0 1 1 0 0 1 1 0 0 1 1 1 1 1 1 1 1	Bellaire Sugarla Housto Staffor Housto Staffor e 04-05 0-25	and on d on d on d on Daugh	5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555 333445555	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name Alice Theodore	1 2 3 1 2 3 Sex F	Bdat 1986-0 1958-0	Bellaire Sugarla Housto Staffor Housto Staffor e 04-05 0-25	and on d d nn d Relation Daugh	5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 999887 999887	789 789 444 453 453 555 555 555 777 777 777	1 2 3 1 2 2 3 10 20 30 10 10 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0	ſ	Essn 333445555 333445555 333445555	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name Alice Theodore Joy	1 2 3 1 2 3 Sex F M F	Bdat 1986-0	Sellaire Sugarla Housto Staffor Housto Staffor 0-25 0-25 0-25	Relation Daugh Son Spous	5 5 4 1 4
Essn 123456 123456 666884 453453 453453 333445 333445 999887 999887 9879876	789 789 444 453 453 555 555 555 777 777 777 987	1 2 3 1 2 2 3 10 20 30 10 10 30 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0		Essn 333445555 333445555 333445555 987654321	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name Alice Theodore Joy Abner	1 2 3 1 1 2 3 3 Sex F M F M	Bdat 1986-C 1983-1 1958-C	Bellaire Housto	Relation Daugh Son Spous	5 5 4 1 1 4 4 msh teresee

Any tuples in EMPLOYEE with Ssn = '333445555'



Any tuples in EMPLOYEE with Ssn = '333445555'

#### Answer:

- No, this deletion will result in even worse
   Referential Integrity violations
- The tuple involved is referenced by tuples from the EMPLOYEE, DEPARTMENT, WORKS\_ON, and DEPENDENT relations

Fname	Minit	Lname	Se	n	Bdate	A	ddress	Sex	Salary	Su	per_ssn	D
John	В	Smith	12345	6789	1965-01-0	9 731 For	ndren, Houston, T.	K M	30000	333	3445555	5
Franklin	Т	Wong	33344	5555	1955-12-0	8 638 Vos	ss, Houston, TX	М	40000	888	3665555	5
Alicia	J	Zelaya	99988	37777	1968-01-1	9 3321 C	astle, Spring, TX	F	25000	987	654321	
Jennifer	S	Wallace	98765	4321	1941-06-2	0 291 Ber	rry, Bellaire, TX	F	43000	888	8665555	5
Ramesh	K	Narayan	66688	34444	1962-09-1	5 975 Fire	Oak, Humble, T	M	38000	333	3445555	5
Joyce	Α	English	45345	3453	1972-07-3	1 5631 R	ice, Houston, TX	F	25000	333	3445555	5
Ahmad	٧	Jabbar	98798	7987	1969-03-2	9 980 Da	llas, Houston, TX	M	25000	987	654321	
James	E	Borg	88866	5555	1937-11-1	0 450 Sto	one, Houston, TX	М	55000	NU	LL	
DEPARTM	IENT		- 3	<u> </u>	1		Г	STA	DEPT	LOCAT	TIONS	
Dnar		Dnum	ber	Mg	r_ssn	Mgr_start	_date		Dnum		Dloc	ation
Researc	:h	5		3334	45555	1988-05-	-22			1	Hous	ston
Adminis	tration	4		9876	54321	1995-01-	-01			4	Staff	ford
Headqu	arters	1		8886	65555	1981-06	-19			5	Bella	ire
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		Pno 1	Hours 32.5	1		P	1/22/2017	Pnun	nber	5	Hous	ston
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Essn 1234567	789 789	1	32.5			P	Pname ProductX	1	nber	Ploca Bellaire	House tion e and	Dnu 5
Essn 1234567 1234567	789 789 444	1 2	32.5 7.5			P	Pname ProductX ProductY	1 2	nber	Ploca Bellain Sugarl	House tion e and	Dnu 5
Essn 1234567 1234567 666884	789 789 444 453	1 2 3	32.5 7.5 40.0			P	Pname ProductX ProductY ProductZ	1 2 3	nber	Ploca Bellain Sugarl Housto	House tion e and on	Dnu 5 5
Essn 1234567 1234567 6668844 4534534	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0			P	ProductX ProductY ProductZ Computerization	3	nber	Ploca Bellaire Sugarl Housto	House tion e and on d	Dnu 5 5 5
Essn 1234567 1234567 666884 4534534	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0 20.0			P	ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber	Ploca Bellaire Sugarla Housto Staffor Housto	House tion e and on d	Dnu 5 5 4
Essn 1234567 1234567 666884 4534534 4534534 3334458	789 789 444 453 453 555	1 2 3 1 2 2	32.5 7.5 40.0 20.0 20.0 10.0	D	EPENDENT		ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber	Ploca Bellaire Sugarla Housto Staffor Housto	House tion e and on d	Dnu 5 5 4
Essn 1234567 1234567 666884 4534534 4534534 3334458	789 789 444 453 453 555 555	1 2 3 1 2 2 2	32.5 7.5 40.0 20.0 20.0 10.0		EPENDENT Essn		ProductX ProductY ProductZ Computerization Reorganization	1 2 3 10 20	nber	Ploca Bellaine Sugarla Housto Staffor Housto Staffor	House tion e and on d	Dnu 5 5 5 4 1
Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458	789 789 444 453 453 555 555 555	1 2 3 1 2 2 2 3 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0	Г		<b>Д</b>	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 10 20 3	mber	Ploca Bellaire Sugarl Housto Staffor Housto Staffor	House tion e and on d	Dnu 5 5 5 4 1 4
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Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 3334458 9998877	789 789 444 453 453 555 555 555 555 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0		Essn 333445555	Depris Alice	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 1 1 2 2 3 3 5 Sex F	nber	Ploca Bellaire Bellaire Houstc Staffor Houstc Staffor	House tion e and on dd	Dnu 5 5 4 1 4
Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 3334458 9998877	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555 333445555	Dep i Alice i Theo	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3 1 ( 2 4 3 ) Sex F M	mber   1   2   3   3   4   4   4   4   4   4   4   4	Ploca Bellaine Sugarli Housto Staffor Housto Staffor 0-25 0-25	House tion e and on d d on d d Relatio	Dnu 5 5 5 4 1 4
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Essn 1234567 1234567 666884 4534534 4534534 3334458 3334458 9998877 9998877 9879878	789 789 444 453 453 555 555 555 777 777 987 987	1 2 3 1 2 2 3 10 20 30 10 10 10 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0		Essn 333445555 333445555 333445555 987654321	Dep Alice Theo Joy Abne	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits endent_name	1 2 3 3 10 20 3 3 5 5 5 K F M F M	Bdat- 1986-C 1983-1 1958-C 1942-C	Ploca Bellaire Houstc Staffor Houstc Staffor 0-25 0-25 0-2-28 01-04	House tion and on dd Relatio Daugi Son Spour	Dnu 5 5 5 4 1 4

## **Cascading Deletes**

- An option to address Delete operations which violate Referential Integrity is to cascade, or propagate, the deletion
- For instance, in example 2:
  - Delete any tuples in EMPLOYEE with Ssn = '999887777'
- The DBMS could automatically delete the offending tuples from WORKS\_ON
  - in addition to the original tuple in EMPLOYEE
  - This must be implemented carefully, as it can lead to unintentional loss of data

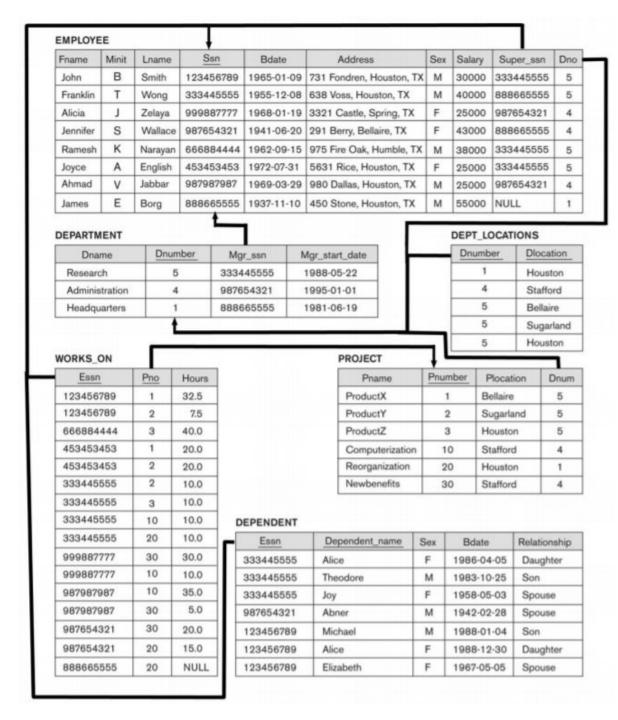


## **Constraint Violation - Update**

- An Update operation is used to <u>change the values of one or more</u> <u>attributes</u> of a relation
- To specify an update, a condition on the attributes of a relation is created which selects one or more tuples to be modified
- Updates can violate all the integrity constraints that we have discussed
  - Key
  - Entity Integrity
  - Referential Integrity



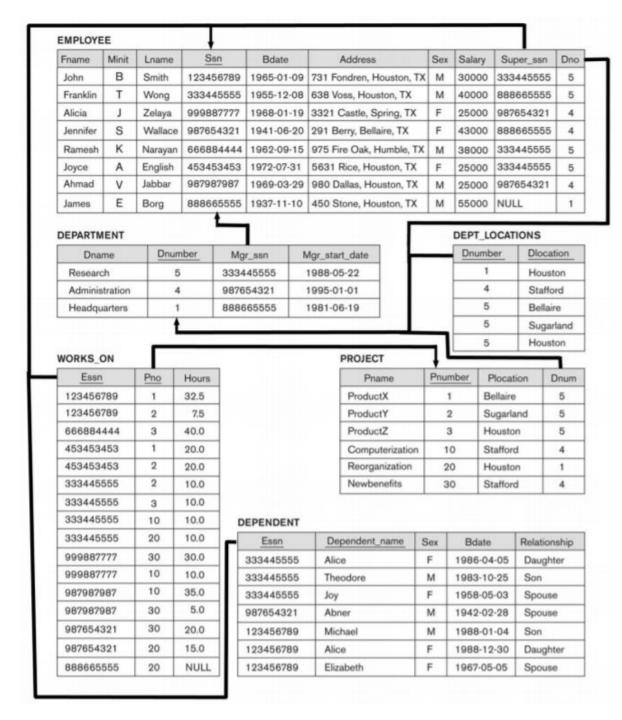
Update the salary of any EMPLOYEE tuples with Ssn = '999887777' to 28000



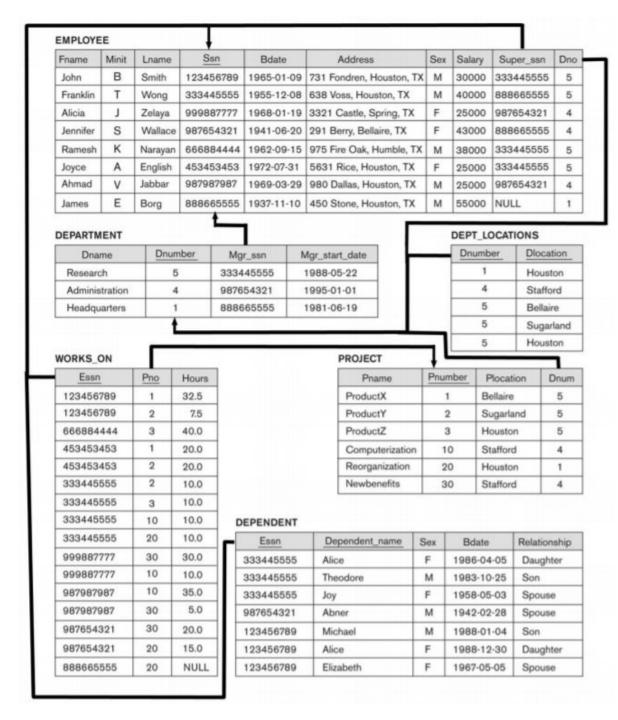
Update the salary of any EMPLOYEE tuples with Ssn = '999887777' to 28000

#### Answer:

 Yes, this modification is acceptable and updates exactly one tuple



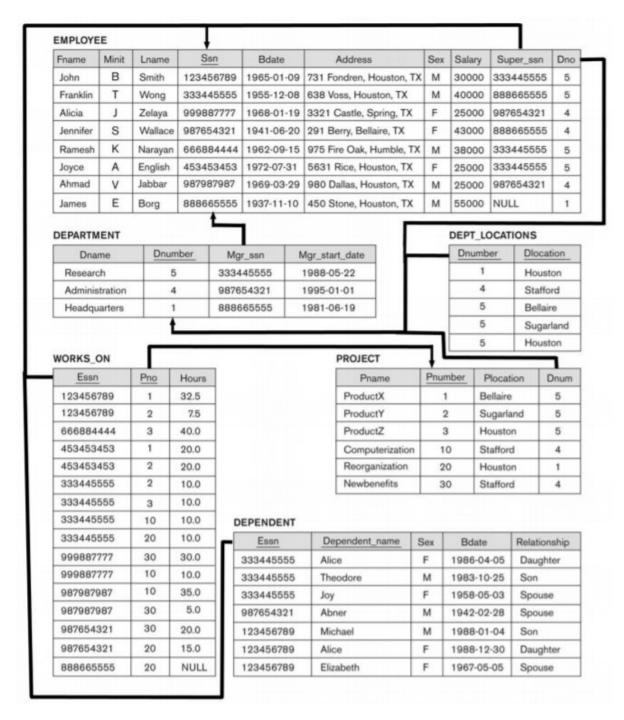
Update the Dno of any EMPLOYEE tuples with Ssn = '999887777' to 1



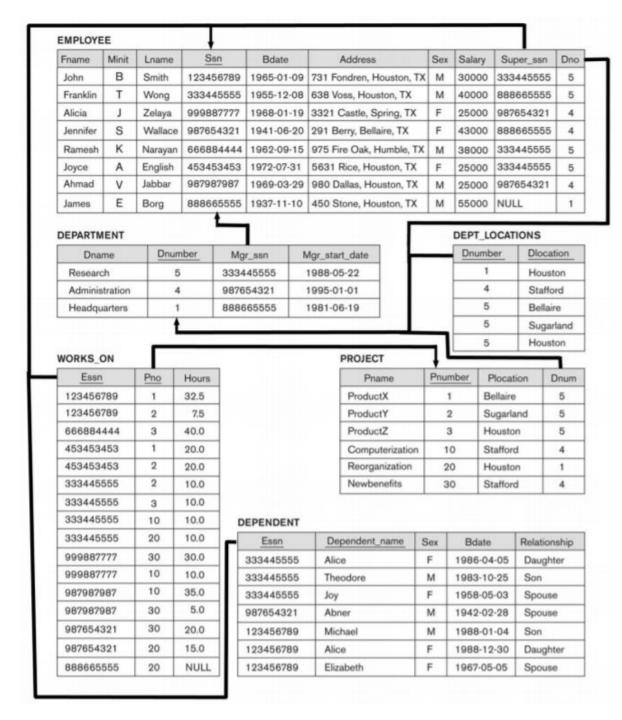
Update the Dno of any EMPLOYEE tuples with Ssn = '999887777' to 1

#### Answer:

 Yes, this modification is acceptable and updates exactly one tuple



Update the Dno of the EMPLOYEE tuple with Ssn = '999887777' to 7



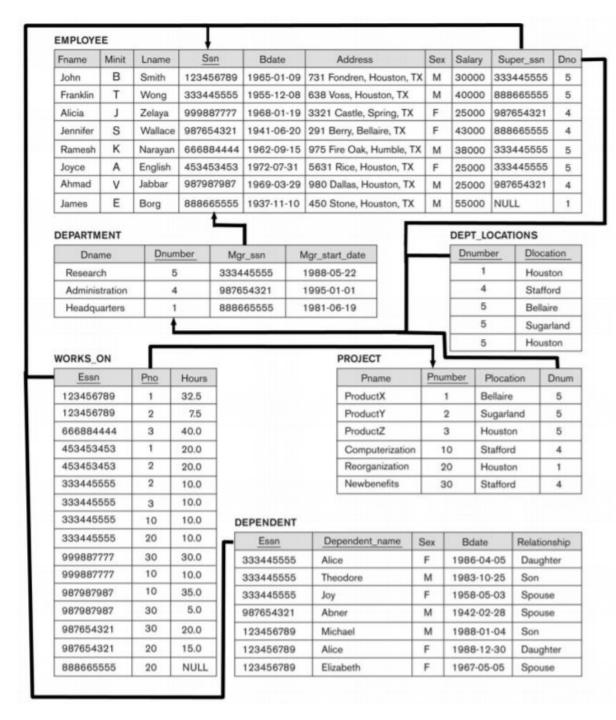
Update the Dno of the EMPLOYEE tuple with Ssn = '999887777' to 7

#### Answer:

- No, this update violates Referential Integrity
- There is no entry in the DEPARTMENT relation with a Dnumber of 7

Fname	Minit	Lname	Ss	n	Bdate		Address	Sex	Salar	ry S	Super_ss	n Dn
John	В	Smith	12345	6789	1965-01-0	9 731	731 Fondren, Houston, TX		3000	00 3	334455	55 5
Franklin	Т	Wong	33344	5555	1955-12-0	638	Voss, Houston, TX	M	4000	00 8	886655	55 5
Alicia	J	Zelaya	99988	7777	1968-01-1	9 332	1 Castle, Spring, TX	F	2500	00 9	8765432	21 4
Jennifer	S	Wallace	98765	4321	1941-06-2	0 291	Berry, Bellaire, TX	F	4300	00 8	886655	55 4
Ramesh	K	Narayan	66688	4444	1962-09-1	5 975	Fire Oak, Humble, T	M	3800	00 3	334455	55 5
Joyce	Α	English	45345	3453	1972-07-3	563	1 Rice, Houston, TX	F	2500	00 3	334455	55 5
Ahmad	٧	Jabbar	98798	7987	1969-03-2	9 980	Dallas, Houston, TX	M	2500	00 9	8765432	21 4
James	E	Borg	88866	5555	1937-11-1	450	Stone, Houston, TX	М	5500	00 N	IULL	1
DEPARTM	IENT		1	_	1		г		DEPT	LOC	ATIONS	
Dna		Dnum	ber	Mg	r_ssn	Mgr_st	tart_date			mber		cation
Researc	ch	5		3334	45555	1988	-05-22			1	Ho	uston
Adminis	tration	4		9876	54321	1995	-01-01			4	Sta	afford
Headqu	arters	1		8886	65555	1981	-06-19			5	Be	llaire
Headquarters			•								5 Suga	
		t								5	Su	garland
								$\neg$		5	_	garland uston
WORKS_C	ON	Ļ					PROJECT	Ţ			_	
WORKS_C		Pno	Hours	]			PROJECT Pname	Pnun	nber	5	_	uston
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Essn 123456 123456 666884 453453	789 789 444 453 453	1 2 3	32.5 7.5 40.0 20.0				ProductX ProductY ProductZ Computerization	3 10	0	Ploc Bella Suga Hous Staff	cation aire arland ston ford	Dnun 5 5 5
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Essn 123456 123456 666884 453453 453453 333445 333445 333445 999887	789 789 444 453 453 555 555 555 777 777	1 2 3 1 2 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 30.0	ſ	Essn 333445555 333445555	A TI	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name	1 2 3 1 ( 2 ( 3 ) 5 ( x ) F M	Bdi 1986 1983	Ploce Beila Suga Hous Staff Hous Staff -04-03	Ho cation aire arland ston ford ston ford Ston 3 Spo	Dnun 5 5 5 4 1 1 4 tionship ghter
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Essn 123456 123456 666884 453453 453453 3334456 3334456 999887 999887 9879878	789 789 444 453 453 555 555 555 777 777 987 987	1 2 3 1 2 2 3 10 20 30 10 10 30	32.5 7.5 40.0 20.0 10.0 10.0 10.0 30.0 10.0 35.0 5.0	ſ	Essn 333445555 333445555 333445555 987654321	A TI	Pname ProductX ProductY ProductZ Computerization Reorganization Newbenefits  Dependent_name lice heodore by bner	1 2 3 3 10 20 3 3 5 5 5 K F M F M	Bdi 1986 1983 1958 1942	Ploce Bella Suga Hous Staff Hous Staff -04-01-22 -05-03 -02-21	Relation  From Relation  From Son	Dnur 5 5 5 4 1 4 4 tionship ghter

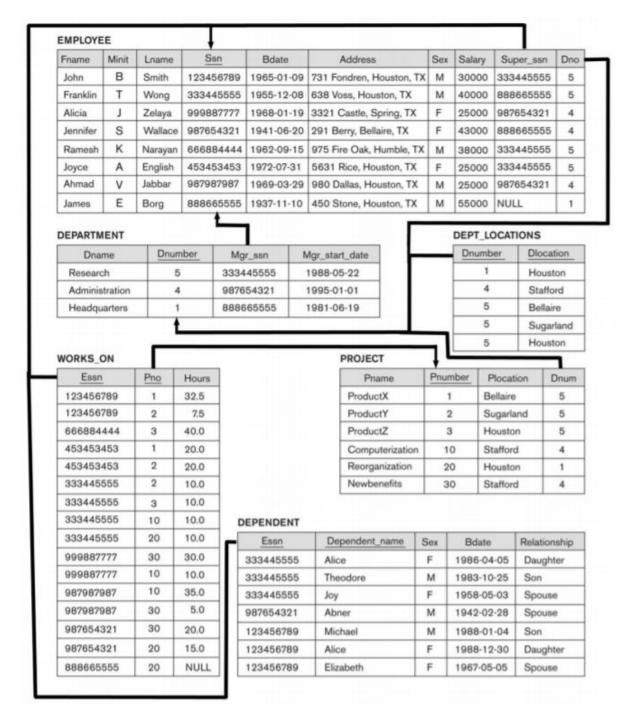
Update the Ssn of any EMPLOYEE tuples with Ssn = '999887777' to '987654321'



Update the Ssn of any EMPLOYEE tuples with Ssn = '999887777' to '987654321'

#### **Answer:**

- No, this update violates the Key constraint
  - It repeats a value that already exists as a Primary Key in another tuple
  - It also violates Referential Integrity constraints
  - There are other relations that refer to the existing value of Ssn



## **Cascading Updates**

As with Delete, an option to address Update operations which violate Referential Integrity is to cascade, or propagate, the update

- For instance: Update the Ssn of any EMPLOYEE tuples with Ssn = '333445555' to '123123123'
- The DBMS could automatically update the relations which have a Foreign Key to Ssn – WORKS\_ON, DEPARTMENT, DEPENDENT and EMPLOYEE itself





## Alternatives to Cascading



- The alternatives to the cascading of updates or deletes are:
  - Rejection of the update or delete as long as foreign key references exist
  - Update of the corresponding foreign key to NULL
  - Update of the corresponding foreign key to some default value



## Constraints in SQL



- Constraints specified as part of relation, or table, definition are called table constraints
- They are specified on each table individually
- They are typically specified during table creation in the CREATE TABLE statement
  - can be added later using ALTER TABLE
  - Constraints that affect more than one table are called Assertions



## **Primary Key Constraints**



The PRIMARY KEY constraint specifies the attribute(s) that forms the Primary Key

- For a single attribute, the constraint can directly follow the attribute specification
  - Dnumber INT PRIMARY KEY
- Composite keys can be specified at the end of the CREATE TABLE statement
  - PRIMARY KEY (Dnumber, Dlocation)



## UNIQUE



- As we have seen, there is often more than one candidate key in a relation
- Secondary keys can be specified using the UNIQUE constraint
  - For a single attribute, the constraint can directly follow the attribute specification
    - Engine\_num INT UNIQUE
  - Composite secondary keys can be specified at the end of the CREATE TABLE statement
    - UNIQUE (Licence\_Yr, Licence\_Mth, Licence\_Day)



## NOT NULL



- By default SQL allows NULLs as attribute values
  - a NOT NULL constraint may be specified if NULLs are not permitted for a specific attribute
  - this is always the case for any attribute that forms part of the Primary Key

**CREATE TABLE Person** 

(PPS char(8) NOT NULL PRIMARY KEY,

Fname varchar(255) NOT NULL,

Lname varchar(255),

Phone int);



## More Complex Constraints

- Can be specified using:
  - CHECK
  - ASSERTION
  - TRIGGER



## CHECK



- More complex constraints can be specified using the CHECK clause
  - used to restrict the values that can be entered for an attribute
- Each CHECK is specified on one or more attributes from a single table
- The CHECK is performed for every tuple that is inserted or modified



## **CHECK Clause**

- CHECK clauses are specified within the CREATE TABLE statement
- They can be specified on an individual attribute

Dnumber INT NOT NULL CHECK (Dnumber > 0 AND Dnumber < 21)

 or on multiple attributes from the same table CHECK (Dept\_create\_date <= Mgr\_start\_date)</li>



## Referential Integrity

- Referential Integrity is specified using the FOREIGN KEY clause
  - specified at the end of the CREATE TABLE statement FOREIGN KEY (Dno) REFERENCES DEPARTMENT(Dnumber)
  - can also have composite Foreign Keys
     FOREIGN KEY(artist, album)
     REFERENCES ALBUM(artist, name)



## Referential Integrity Violation

- As discussed earlier, Referential Integrity can be violated on update, insert or delete
  - Default action in SQL is to reject the operation
- it is possible to specify an alternate action by attaching a clause to each Foreign Key
  - SET NULL
  - CASCADE
  - SET DEFAULT



## Referential Integrity Violation

- Each action must be qualified with either
  - ON DELETE
  - ON UPDATE

```
CREATE TABLE EMPLOYEE (
Fname VARCHAR(15) NOT NULL,
Lname VARCHAR(15) NOT NULL,
Ssn CHAR(9) NOT NULL PRIMARY KEY,
Super_ssn CHAR(9),
Dno INT NOT NULL DEFAULT 1,
FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE(Ssn)
ON DELETE SET NULL ON UPDATE CASCADE,
FOREIGN KEY(Dno) REFERENCES DEPARTMENT(Dnumber)
ON DELETE SET DEFAULT ON UPDATE CASCADE);
```



## Naming Constraints

- Constraints can be named using CONSTRAINT
  - Names must be unique within the schema

```
CREATE TABLE movie

(movie_id INT NOT NULL PRIMARY KEY,
   title varchar(255) NOT NULL,
   genre CHAR(10),

CONSTRAINT check_movie_type CHECK
   (genre IN ('Horror', 'Action', 'Other')));
```



## **Assertions**

- An Assertion is a stand-alone constraint in a schema
  - used to specify a restriction that affects more than one table
- Table constraints (CHECK) are only evaluated if, and only if, the table to which it is attached has some data
  - Assertions are required to be true regardless of whether a table is empty or not



# **Assertion Syntax**

The general form of the ASSERTION command is:

```
CREATE ASSERTION <assertion-name>
CHECK ( <search-condition> )
```

### ASSERTIONs:

- are associated with the relations in question
- are evaluated before an operation can be performed on those relations
- are violated if false and the operation is not allowed
- define valid states of a DB
- are actually stored as rows in the ASSERTIONS table which is part of the system catalog



# **Evaluation of Assertions**

- Assertions are checked at the end of each SQL statement
  - a transaction can be more than one SQL statement
  - Assertion evaluation can be deferred until the end of a transaction, but is always evaluated prior to the completion of a transaction
- If an assertion fails, the DBMS returns an error message and the SQL statement is rejected



## Assertions

## MOVIE



### MUSIC



CREATE ASSERTION maximum\_inventory

CHECK((SELECT SUM(Cost\_Price) from MOVIE) +

(SELECT SUM(Cost\_Price) from MUSIC)

< 500000);

- Triggers are Event-Condition-Action rules
  - allow constraints to be checked on specified events and resulting actions to be invoked
- Triggers are only tested when certain events occur
  - e.g. insert, update etc.
- When triggered, a specified condition is tested
  - If the condition does not hold, then no further action is taken in response to the event
  - If the condition is satisfied, defined actions associated with the trigger are performed by the DBMS

General form:

```
CREATE TRIGGER <trigger name>
  ( AFTER | BEFORE ) <triggering events> ON
   [ FOR EACH ROW ]
  [ WHEN <condition> ]
  <trigger actions> ;
```

<trigger event>
 INSERT I DELETE I UPDATE [ OF <column name>
 {, <column name> } ]



**CREATE TRIGGER** Total Salary **AFTER** DELETE ON EMPLOYEE FOR EACH ROW WHEN (:OLD.Dno IS NOT NULL) UPDATE DEPARTMENT SET Total\_salary = Total\_salary - :OLD.Salary WHERE Dno = :OLD.Dno;



CREATE TRIGGER Inform\_Accounts

BEFORE INSERT OR UPDATE OF Salary, Supervisor\_ssn

ON EMPLOYEE

## **FOR EACH ROW**



## Assertions vs Triggers

- Assertions
  - do not modify the data, only check certain conditions
- Triggers
  - are more powerful because they can check conditions and also modify the data
  - are linked to specific tables and specific events
- All assertions can be implemented as triggers
- Not all triggers can be implemented as assertions
- Oracle does not have assertions



#### Task 5

- A) Insert into Project relation:< 'Awesome Project', NULL, 'London', 5 >
- B) Insert into Works\_on relation: <'999887777',20,NULL>
- C) Insert into Dependent relation: <'123456789','Elizabeth','F','1991-05-15,'Daughter'>
- D) Insert into Employee relation: <'Cecilia', 'F', 'Kolonsky', '677678989', '1960-04-05', '6357 Windswept, Katy, TX', F, 28000, '987654321', 8>
- E) Any Dependent with ESSN = '123456789'
- F) Any tuples in Department with Dno = 1
- G) Any tuples in Employee with SSN = '123456789'
- H) Set the Mgr\_ssn in Department relation to NULL for any Department with Dno = 5
- I) Update any Dependent with ESSN='333445555' and Name = 'Theodore' to '1983-09-25'
- J) Update the Pno to 25 of all rows with ESSN='123456789' in the Works on relation

Fname	Minit	Lname	Ss	n	Bdate	Add	dress	Sex	Salar	ry S	uper_ssi	n Dn	
John	В	Smith	12345	6789	1965-01-09	731 Fond	iren, Houston, T	M	3000	00 33	344555	5 5	
Franklin	Т	Wong	33344	5555	1955-12-08	638 Voss,	, Houston, TX	M	4000	00 88	866555	5 5	
Alicia	J	Zelaya	99988	7777	1968-01-19	3321 Cas	stle, Spring, TX	F	2500	00 98	765432	1 4	
Jennifer	S	Wallace	98765	4321	1941-06-20	291 Berry	y, Bellaire, TX	F	4300	00 88	866555	5 4	
Ramesh	K	Narayan	66688	4444	1962-09-15	975 Fire (	Oak, Humble, TX	M	3800	00 33	344555	5 5	
Joyce	Α	English	45345	3453	1972-07-31	5631 Rice	e, Houston, TX	F	2500	00 33	344555	5 5	
Ahmad	٧	Jabbar	98798	7987	1969-03-29	980 Dalla	s, Houston, TX	M	2500	00 98	765432	1 4	
James	E	Borg	88866	5555	1937-11-10	450 Stone	e, Houston, TX	М	5500	OO NU	JLL	1	
DEPARTN	MENT			_	1		Г		DEPT	LOCA	TIONS		
Dna		Dnum	ber	Ma	r_ssn 1	Mgr_start_d	date			mber		cation	
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Adminis	stration	4		9876	54321	1995-01-0				4	Sta	fford	
Headqu	uarters	1		8886	65555	1981-06-1	9			5	Bel	laire	
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Name:
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A) YES/NO, reason why
B) ...
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## CSU34041 / CSU44D01

## **Database Constraints**

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