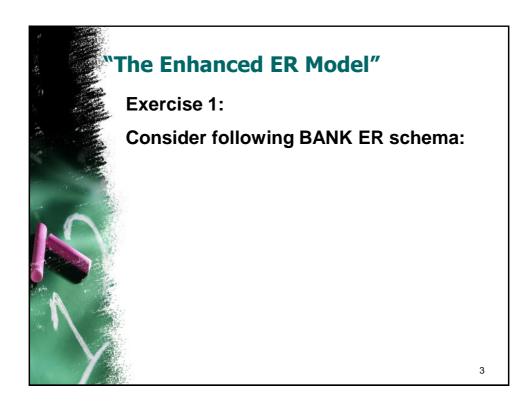
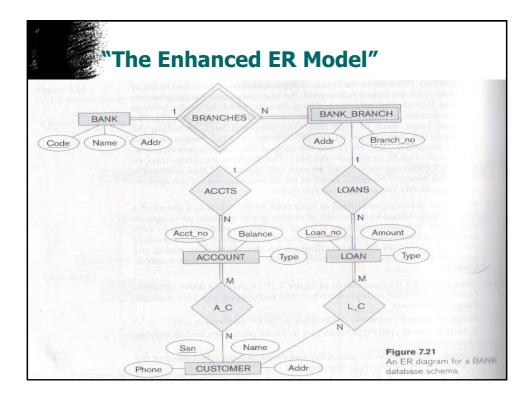




EER Model

- Extension to ER model that improves its representational capabilities.
- Subclasses and Superclasses
- Specialization and Generalization
 - > Top-down refinement
 - Bottom-up synthesis
- Attribute and Relationship Inheritance





"The Enhanced ER Model"

Exercise 1:

Suppose that it is necessary to keep track of different types of accounts (SAVINGS, CHECKING, ...) and LOANS (CAR_LOANS, HOME_LOANS, ...).

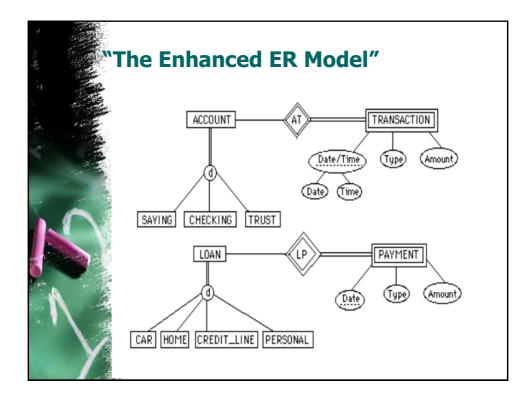
The Enhanced ER Model"

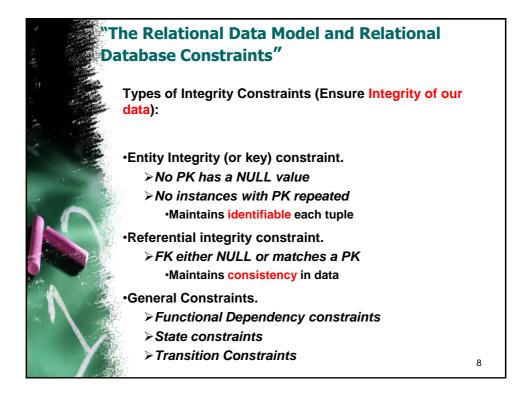
Exercise 1:

Suppose that it is also desirable to keep track of each account's transactions (deposits, withdrawals, checks, ...) and each loan's payment; both of these include the amount, date, time, ...

Modify the BANK schema, using ER and EER concepts of specialization and generalization. State any assumptions you make about the additional requirements.

6





"The Relational Data Model and Relational Database Constraints"

Exercise 2:

Suppose each of the following Update operations is applied directly to the following database. Discuss *all* integrity constraints violated by each operation, if any, and the different ways of enforcing these constraints.

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4534534 3334455 3334455	555 555				1	Bay	Relate	Palationable	
453453/ 3334455 3334455 3334455	555 555 555	10 20	10.0 D	Esen	Dependent_name 5	Sex	Bdate	Relationship	(iii) Insert a new DEPARTMENT
4534534 3334455 3334455 3334455 3334455	555 555 555 555 777	10 20	10.0 D 10.0 30.0		Dependent_name : Alice	F	1986-04-05	5 Daughter	
453453 3334450 3334450 3334450 3334450 9998877	555 555 555 777 777	10 20 30	10.0 D 10.0 30.0 10.0 D	Eson 333445555	Dependent_name : Alice Theodore	100000	1986-04-05 1983-10-25	5 Daughter 5 Son	(iii) Insert a new DEPARTMENT
4534534 3334450 3334450 3334450 3334450 9998877 9998877	555 555 555 777 777 987	10 20 30 10	10.0 D 10.0 30.0 10.0 35.0 D	Esen 333445555 333445555	Dependent_name : Alice Theodore Joy	F M	1986-04-05 1983-10-25 1958-05-03	5 Daughter 5 Son 3 Spouse	(iii) Insert a new DEPARTMENT
453453 3334459 3334459 3334459 3334459 9998877 9998877 9879879	555 555 555 777 777 987 987	10 20 30 10 10 30	10.0 D 10.0 30.0 10.0 95.0 5.0 5.0 5.0 D	Esen 333445555 333445555 333445555	Dependent_name : Alice Theodore Joy Abner	F M F	1986-04-05 1983-10-25 1958-05-03 1942-02-26	5 Daughter 5 Son 3 Spouse 3 Spouse	(iii) Insert a new DEPARTMENT
453453 3334450 3334450 3334450 9998877 9998877 9879879 9879879	555 555 555 555 555 777 777 987 987 987 321	10 20 30 10 10 30	10.0 D 10.0 30.0 10.0 35.0 5.0 20.0	Esen 333445555 333445555 333445555 333445555 987654321	Dependent_name : Alice : Theodore : Joy : Abner : Michael :	F M F M	1986-04-05 1983-10-25 1958-05-03	5 Daughter 5 Son 3 Spouse 1 Spouse 4 Son	(iii) Insert a new DEPARTMENT

e	14 M		"T	he R	elation	a	l Da	ta M	odel and Relational
- 11 AL	A. S. S. S.		Da	taba	ase Con	S	traiı	nts″	
EMPLOYE	E							¥.	
Fname	Minit	Lname	San	Bdate	Address	Sex	Salary Su	per_ssn Dno	
John	В	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	(M	and the second second second	3445555 5	Exercise 2
Franklin	Т	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000 888	8665555 5	
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000 987	7654321 4	
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000 888	8665555 4	(C) Insert
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000 335	8445555 5	
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000 333	3445555 5	< 'Production', 4.
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	М	25000 987	7654321 4	,,,
James	E	Borg	888665555	5 1937-11-10	450 Stone, Houston, TX	м	55000 NU	և 1	'943775543', '01-OCT-88' >
DEPARTM	ENT		J [_	DEPT LOCA		
Dnan	COLUMN TWO IS NOT	Dnun	abor N						
Research		5	Contraction (Second		Agr_start_date	-	Dnumber	Diocation	into DEPARTMENT
Administ		4			1988-05-22 1995-01-01		4	Houston	
Headqua					1981-06-19		5	Bellaire	
. ionoqui			000	000000	1901-00-19		5	Sugarland	Violates key constraint because there
		_					5	Houston	
WORKS_O	DN	1			PROJECT	1		1 IOUSION	already exists DNUMBER=4.
Essn		Pno	Hours		Pname	Pau	mber Ploca	tion Dnum	(i) Reject the insertion
1234567	789	1	32.5		ProductX		1 Bellain	e 5	(ii) Change the DNUMBER
1234567	789	2	7.5		ProductY	:	2 Sugari	and 5	
6668844	444	3	40.0		ProductZ	:	3 Houste	on 5	
4534534	453	1	20.0		Computerization	1	0 Staffor	d 4	Violates referential integrity
4534534		2	20.0		Reorganization	2	0 Houste	on 1	
3334455		2	10.0		Newbenefits	3	0 Staffor	d 4	Because there is no tuple in the
3334455		3	10.0						EMPLOYEE
3334455				DEPENDENT					relation with SSN = '943775543'.
3334455		20	10.0	Essn	Dependent_name §	Sex	Bdate	Relationship	
9998877			30.0	333445555		F	1986-04-05	Daughter	(i) Reject the insertion
9998877		10	10.0	3334455555		м	1983-10-25	Son	(ii) Change the value of MGRSSN
9879879			35.0	333445555		F	1958-05-03	Spouse	
98798798		30	5.0	987654321		м	1942-02-28	Spouse	(iii) Insert a new EMPLOYEE with
9876543			20.0	123456789		м	1988-01-04	Son	SSN='943775543'
		20	15.0	123456789	-	F	1988-12-30	Daughter	55N= 943775543 14
8886655	655	20	NULL	123456789	Elizabeth	F	1967-05-05	Spouse	

			`T '	he R	elation	a	D	ata	M	lodel and Relational
	141	2	Da	taha	ase Con	C	tra	int	c″	
EMPLOYE	F	1.11. 44		Labe					5	-
Fname	Minit	Lname	San	Bdate	Address	Sex	Salary	Super ss	n Dno	a l
John	В	Smith	123456789		731 Fondren, Houston, TX	1000000	100000000000000000000000000000000000000	33344555	10111 10000010	Exercise 2
Franklin	T	Wong	333445555		638 Voss, Houston, TX	M		8886655	-	
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	98765432		
Jennifer	s	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	88866555		(D) Insert
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	м	38000	33344555	15 5	
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	33344556	5 5	< '677678989', null, '40.0' >
Ahmad	٧	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	м	25000	98765432	1 4	 Corrorosos, nun, 40.0 >
James	Е	Borg	888665555	1937-11-10	450 Stone, Houston, TX	м	55000	NULL	1	-
	100 a 100		J							into WORKS ON
EPARTM	COLUMN TWO IS NOT		¥	The local data in the local data				CATIONS		
Dnar		Dnum	Contraction of the second second	Contraction of the second	lgr_start_date	->	Dnumbe		cation	
Researc		5			988-05-22		1		uston	
Headqu		4			995-01-01		5		fford	Violates entity integrity
riestoqu	aerora		000	000000	391-00-13		5		laire	
							5		uston	because PNO, which is part of the
WORKS_C	DN	1			PROJECT			110	V	primary key of WORKS_ON, is null.
Essn		Pno	Hours		Pname	Paun	nber P	location	Dnum	
1234565	789	1	32.5		ProductX	1	Be	llaire	5	
1234565	789	2	7.5		ProductY	2	2 Su	garland	5	(ii) Change the value of PNO.
666884	2.5.6	3	40.0		ProductZ	3	B Ho	uston	5	
4534534		1	20.0		Computerization	10	0 Sta	afford	4	No. 1. A second se
4534534		2	20.0		Reorganization	20		uston	1	Violates referential integrity because
3334455		2	10.0		Newbenefits	30	0 Sta	afford	4	there is no tuple in the EMPLOYEE
3334458		3	10.0					_		relation with SSN='677678989'.
3334455		10		DEPENDENT						
3334456		20	10.0	Esen	Dependent_name S	Sex	Bdate	Relat	ionship	(i) Reject the insertion
9998877		_	30.0	333445555	Alice	F	1986-04-	05 Dau	ghter	(ii) Change the value of ESSN
9998877		10	10.0	333445555		м	1983-10-	25 Son		
9879879			35.0	333445555		F	1958-05-	03 Spo	JSE	(iii) Inserting a new EMPLOYEE tuple
9879879		30 30	5.0	987654321		М	1942-02-	28 Spo	186	with SSN='677678989'
			20.0	123456789		м	1988-01-	0.000		
9876543		20	15.0	123456789		F	1988-12-	30 Dau	ghter	15
8886655		20	NULL	123456789	Elizabeth	F	1967-05-0	05 Spor		

	1000	Chilling and the		ie K	егатіоп	d			lodel and Relational
	14 / 14 / P -	1.18	Da	taha	ise Cor	۱G	trai	nts	7
MPLOYE	E							4	
name	Minit	Lname	San	Bdate	Address	Se	Salary S	uper ssn	
lohn	В	Smith	123456789	1965-01-09	731 Fondren, Houston, T	ХМ	30000 33	3445655	Exercise 2
ranklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000 88	8665556	5
Alicia	1	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000 98	7654321	(E) Incort
ennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000 88	8665555	E) .Insert
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, T	K M	38000 33	3445555	5
cyce	Α	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000 33	3445555	< '453453453', 'John', M,
Ahmad	٧	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	М	25000 98	7654321	
ames	Е	Borg	888665555	1937-11-10	450 Stone, Houston, TX	м	55000 NU	л	
PARTM			J			_			12-DEC-60', 'SPOUSE' >
	COLUMN TWO IS NOT		¥ .	The local data in the local data	Contractor in the local division of the loca		DEPT_LOCA		
Dnan		Dnur	Contraction of the second	and the second se	gr_start_date	-	Dnumber	Diocatie	
Research		5			988-05-22		1	Housto	into DEPENDENT
Administ		4			995-01-01		4	Stafford	_
Headqua	arters		888	665555 1	981-06-19		5	Bellaire	_
							5	Sugarla	4
ORKS O	N	J.			PROJECT	11	5	Housto	
Essn		Pno	Hours		Pname	Pa	mber Plop	ation Dr	No constraint violations
234567	89	1	32.5		ProductX	-	1 Bellai		
234567	89	2	7.5		ProductY	-	2 Sugar	-	
668844	44	3	40.0		ProductZ	-	3 Houst		-
534534	-53	1	20.0		Computerization		10 Staffo	and 4	-
534534	53	2	20.0		Reorganization		20 Houst		-
334455	55	2	10.0		Newbenefits	1	30 Staffo	ard 4	
334455	55	3	10.0			-			
334455	55	10	10.0 0						
334455	55	20	10.0	Esen	Dependent_name	Sex	Bdate	Relations	
998877	77	30	30.0	333445555	Alice	F	1986-04-05	and a second s	
998877	77	10	10.0	3334455555	Theodore	M	1983-10-25	Son	-
879879	87	10	35.0	333445555	Joy	F	1958-05-03		-
879879	87	30	5.0	987654321	Abner	M	1942-02-28		-
	21	30	20.0	123456789	Michael	м	1988-01-04		
876543		20	15.0	123456789	Alice	F	1988-12-30		16
	21	~~							

											and Relational
		1.16	Da	taba	ase Cor	S	tra	int	s"		
MPLOYE	E							Ý			
name	Minit	Lname	San	Bdate	Address	See	Salary	Super_s	sn Dno	_	
John	В	Smith	123456789	1965-01-09	731 Fondren, Houston, T	(M	30000	33:34455	55 5	Exe	rcise 2
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	м	40000	8886655	56 5		
Alicia.	1	Zelaya	999887777		3321 Castle, Spring, TX	F	25000	9876543	21 4		Delete the WORKS ON
lennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	8886655	56 4	(F)	.Delete the WORKS_ON
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, T	M	38000	3334455	55 5		tuples with
loyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	3334455	55 5		
Ahmad	V	Jabbar	987987987		980 Dallas, Houston, TX	м	25000	9876543	21 4		
lames	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	м	55000	NULL	1		
EPARTM	ENT		J 1.			_					
	COLUMN TWO IS NOT	Dnum	¥				-	OCATIONS			
Dna		COLO DE TRANSPORTE	and the second second second		lgr_start_date	-	Dnumb		ocation		ESSN= '333445555'
Adminis		5			1988-05-22		1		ouston		
Headqu		- 4			1995-01-01		4	0.	afford		
nerodo	aners	_	8880	65555 1	1981-06-19		-		sllaire		
							5	-	igarland		
ORKS (DN					11	5	He	uston		
					PROJECT				14		constraint violations
Essn		Pao	House		PROJECT	Pou	mbor r		· · · ·	No	constraint violations
Essn 123456		Pno	Hours		Pname	-		Nocation	Dnum	No	constraint violations
123456	789	1	32.5		Pname ProductX		1 Br	ellaire	Dnum 5	No d	constraint violations
123456 123456	789 789		Contraction of the		ProductX ProductY		1 Be 2 Se	ellaire ugarland	Dnum 5 5	No d	constraint violations
123456 123456 366884	789 789 444	1 2	32.5 7.5		ProductX ProductY ProductZ		1 Br 2 Sc 3 H	ellaine ugarland ouston	Dnum 5 5 5	No d	constraint violations
123456 123456 366884 1534534	789 789 444 453	1 2 3	32.5 7.5 40.0		ProductX ProductY	1	1 Br 2 Sr 3 Hr 10 St	ellaire ugarland	Dnum 5 5 5 4	No d	constraint violations
123456 123456 366884 153453 153453	789 789 444 453 453	1 2 3 1	32.5 7.5 40.0 20.0		Prame ProductX ProductY ProductZ Computerization	1	1 Br 2 St 3 Hr 10 St 20 Hr	ellaire ugariland ouston tafford	Dnum 5 5 5 4 1	No d	constraint violations
123456 123456 366884 153453 153453 333445	789 789 444 453 153 555	1 2 3 1 2	32.5 7.5 40.0 20.0 20.0		ProductX ProductY ProductZ Computerization Reorganization	1	1 Br 2 St 3 Hr 10 St 20 Hr	ellaire ugariland ouston lafford ouston	Dnum 5 5 5 4	No	constraint violations
123456 123456 666884 453453 453453 3334458 3334458	789 789 444 453 453 355 555	1 2 3 1 2 2 3	32.5 7.5 40.0 20.0 20.0 10.0 10.0	EPENDENT	Phame ProductX ProductY ProductY Computerization Reorganization Newbenefits	1	1 Br 2 St 3 Hr 10 St 20 Hr	ellaire ugariland ouston lafford ouston	Dnum 5 5 5 4 1	No d	constraint violations
123456 123456 123456 153453 153453 153453 153453 153453 153453 153453 153453 153455 153555 153555 153555 153555 1535555 1535555 1535555 1535555 15355555 15355555555	789 789 444 453 453 555 555 555	1 2 3 1 2 2 3	32.5 7.5 40.0 20.0 20.0 10.0 10.0	EPENDENT	Phame ProductX ProductY ProductZ Computerization Reorganization Newbenefits	1 2 3	1 Br 2 St 3 Hr 10 St 20 Hr 30 St	ellaire ugarland ouston tafford ouston tafford	Dnum 5 5 4 1 4	No d	constraint violations
1234567 1234567 666084 453453 453453 3334450 3334450 3334450 3334450	789 789 444 453 555 555 555 555	1 2 3 1 2 2 3 10 20	32.5 7.5 40.0 20.0 10.0 10.0 10.0 10.0 0.0	Esen	Phame ProductX ProductY ProductZ Computerization Reorganization Newbanefits	1 2 3 Sex	1 Brian Brian Belate	ellaire ugarland ouston tafford cafford Rela	Dnum 5 5 4 1 4 1 4	No d	constraint violations
1234567 1234567 666884 453453 453453 3334450 3334450 3334450 3334450 3334450	789 789 444 453 355 355 355 355 355 355	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 10.0 10.0 10.0 10.0 0 0.0 10.0 0 0.0	<u>Essn</u> 333445555	Phame ProductX ProductY ProductZ Computerization Reorganization Newbanefits Dependent_name Alice	1 2 3 Sex F	1 Br 2 Su 3 Hr 10 Su 20 Hr 300 Su Bdate 1986-04	ellaine ugarland ouston tafford ouston tafford Rela -05 Dau	Dnum 5 5 4 1 4 tionship ggiter	No d	constraint violations
1234567 1234567 866884 453453 453453 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458 3334458	789 789 444 453 355 355 355 355 355 777 777	1 2 3 1 2 2 3 10 20 30	32.5 7.5 40.0 20.0 10.0 10.0 10.0 10.0 10.0 30.0 10.0	Eson 333445555 333445555	Phame ProductX ProductX ProductY Computerization Reorganization Newbanefits Dependent_name Alice Theodore	1 2 3 Sex	1 Br 2 Sr 3 Hr 10 Sr 20 Hr 30 Sr Bdate 1986-04 1983-10	ellaire ugarland ouston tafford ouston tafford Rala -05 Dau -25 Sor	Dnum 5 5 4 1 4 1 4	No d	constraint violations
1234567 366884 453453 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459 3334459	789 789 4444 453 555 555 555 555 555 777 777 777 887	1 2 3 1 2 2 3 10 20 30 10	32.5 7.5 40.0 20.0 10.0 10.0 10.0 10.0 10.0 30.0 10.0 30.0 10.0	Esen 333445555 333445555 333445555	Pharme ProductX ProductX ProductZ Computerization Reorganization Newbenefits Dependent_name Alice Theodore Joy	1 2 3 Bex F M F	1 Br 2 Sr 3 Hr 10 Sr 20 Hr 30 Sr 986-04 1988-05	ellaire ugarland ouston tafford ouston tafford Rela -05 Dau -25 Son -03 Spc	Dhum 5 5 4 1 4 1 4 5 5 5 4 1 4 1 4 5 5 5 5 4 1 4 1	No d	constraint violations
1234567 1234567 666884 453453 453453 3334458 338458 338458 338458 338458 338458 3387 33878 33879879	789 789 444 453 555 555 555 555 777 777 777 887 887	1 2 3 1 2 2 3 10 20 30 10 10 10 10 30	32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0 10.0 10.0 30.0 5.0	Esen 333445555 333445555 333445555 987654321	Phane ProductX ProductY ProductZ Computerization Recoganization Newbenefits Ne	1 2 3 Sex F M F M	1 Bd 2 St 3 Hi 10 St 20 Hi 30 St Bdate 1988-05 1942-02 1942-02	ellaire ugarland ouston lafford ouston lafford Rela -05 Dau -25 Sor -03 Spc -28 Spc	Dnum 5 5 5 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4	No d	constraint violations
Esen 1234565 1234565 666884 453453 3334455 3334455 3334455 3334455 999887 999887 999887 999887 999887 999887 999887 999887 999887 999887 999887 999887 999887 987987 987987 987987 9876543	789 789 444 453 555 555 555 555 555 777 777 777 887 887	1 2 3 1 2 2 2 3 10 20 30 10 10 10 10 30 30	32.5 75 40.0 20.0 20.0 10.0 10.0 10.0 10.0 30.0 10.0 30.0 10.0 20.0 20.0	Esen 333445555 333445555 333445555	Pharme ProductX ProductX ProductZ Computerization Reorganization Newbenefits Dependent_name Alice Theodore Joy	1 2 3 Bex F M F	1 Br 2 Sr 3 Hr 10 Sr 20 Hr 30 Sr 986-04 1988-05	ellaire ugarland ouston lafford ouston lafford -05 Dau -25 Sor -03 Spc -28 Spc -04 Sor	Dnum 5 5 5 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4	No	constraint violations

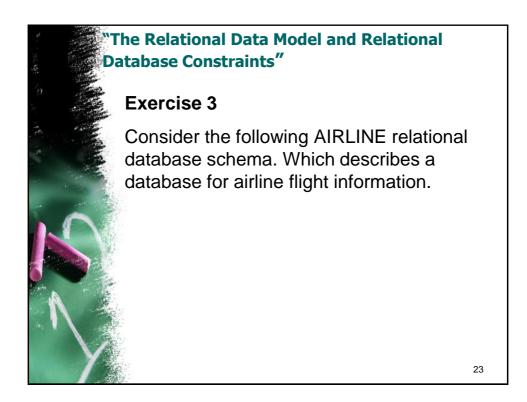
		0.0	T "	he R	elatio	าล	l Da	ta Mo	odel and Relational
	1	23 1 56 23	Da	taha	ase Co	nc	trai	nte"	
EMPLOYEE		1.16.144		Lava	ise cu				
	Minit	Lname	San	Bdate	Address	Se	a Salary Sa	uper ssn Dno	
John	в	Smith	123456789		731 Fondren, Houston,	100	and an	3445655 5	Exercise 2
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M		8665556 5	
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000 985	7654321 4	
	s	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000 888	8665555 4	(G) .Delete the EMPLOYEE tuple
	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble,	TX M	38000 333	3445555 5	with
	A	English	453453453		5631 Rice, Houston, T)	-	Construction of the local division of the lo	3445555 5	VVICII
	V E	Jabbar	987987987	1969-03-29	980 Dallas, Houston, T			7654321 4	
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, T	(M	55000 NU	u 1	SSN= '987654321'
DEPARTME	NT		- 1				DEPT LOCA	TIONS	
Dname	0	Dnun	nber M	grasn A	for start date	Ι.	Dnumber	Diocation	
Research		5	333	445555	1988-05-22		1	Houston	
Administra	ation	4	987	654321	1995-01-01	I 1	4	Stafford	Violates referential integrity
Headquart	ters	1	888	665555	1981-06-19	I 1	5	Bellaire	because there are tuples existing
							5	Sugarland	
WORKS ON					PROJECT	٦.	5	Houston	in the WORKS ON,
Esso		Pno	Hours		Phame	Po	umber Ploca		DEPENDENT, DEPARTMENT, and
12345678	9	1	32.5		ProductX	1.00	1 Bellain	and a standard the	
12345678	9	2	7.5		ProductY	-	2 Sugari		EMPLOYEE that reference the
66688444	14	3	40.0		ProductZ		3 Houste		volue heing
45345345	3	1	20.0		Computerizatio	n	10 Staffor	rd 4	value being
45345345		2	20.0		Reorganization		20 Houste	on 1	deleted from EMPLOYEE.
33344555	· · ·	2	10.0		Newbenefits		30 Staffor	rd 4	(i) Deject the deletion
33344555 33344555	2.1	3	10.0						(i) Reject the deletion
33344555	-	10 20	10.0	DEPENDENT					(ii) Delete all tuples in the
99988777	-	30	30.0	Esen	Dependent_name	Sex	Bdate	Relationship	
99988777	-	10	10.0	333445555	Alice	F	1986-04-05	Daughter	WORKS_ON, DEPENDENT,
987987987	-	10	35.0	333445555 333445555	Theodore Joy	M	1983-10-25 1958-05-03	Son	DEPARTMENT, and
987987987	7	30	5.0	987654321	Abner	M	1958-05-03	Spouse Spouse	· · · · · · · · · · · · · · · · · · ·
98765432	1	30	20.0	123456789	Michael	M	1988-01-04	Son	EMPLOYEE whose values for
987654321	1	20	15.0	123456789	Alice	F	1988-12-30	Daughter	ESSN, ESSN, MGRSSN, and
		20	NULL	123456789					

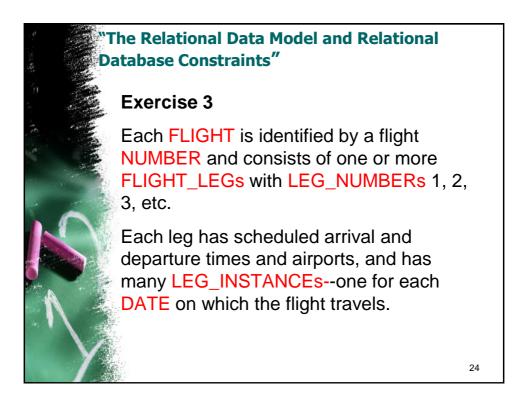
		106.04		taba	se Cor	۱S	traii	nts"	
EMPLOYE	EE							V	
Fname	Minit	Lname	San	Bdate	Address	See	Salary Su	per_ssn Dno	
John	В	Smith	123456789	1965-01-09 7	731 Fondren, Houston, T	ХМ	30000 335	445555 5	Exercise 2
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	м	40000 888	8665555 5	
Alicia	1	Zelaya	999887777	1968-01-19 3	3321 Castle, Spring, TX	F	25000 987	654321 4	(LI) Delete the DDO IFOT tuble
Jennifer	S	Wallace	987654321	1941-06-20 2	291 Berry, Bellaire, TX	F	43000 888	8665555 4	(H) .Delete the PROJECT tuple
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, T	K M	38000 333	8445555 5	with
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000 333	445555 5	VVILI I
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	м	25000 987	654321 4	
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	м	55000 NU	u	PNAME= 'ProductX'
EPARTN	MENT		- 1			_	DEPT_LOCA	TIONS	
Dna	me	Dnur	nber Mc	r ssn Mc	gr_start_date		Dnumber	Diocation	
Researc	ch	5	3334	and the second se	988-05-22		1	Houston	
Adminis	stration	4	9876	54321 19	995-01-01		4	Stafford	Violates referential integrity because
Headqu	uarters	1	8886	65555 19	981-06-19		5	Bellaire	two tuples exist in the WORKS_ON the
		-					5	Sugarland	
							5	Houston	reference the tuple being deleted
VORKS_	ON	*			PROJECT	1.		V	
Essn	1	Pno	Hours		Pname	Pnu	mber Ploca	tion Dnum	
123456	789	1	32.5		ProductX		1 Bellain	5	(i) Reject the deletion
123456		2	7.5		ProductY	1	2 Sugari	and 5	(ii) Delete the tuples in the WORKS Of
666884		3	40.0		ProductZ		3 Housto	on 5	
453453		1	20.0		Computerization	1	0 Staffor	d 4	where value for PNO=1.
		2	20.0		Reorganization	2	20 Houste	on 1	
453453		2	10.0		Newbenefits	3	30 Staffor	d 4	
453453 333445		3	10.0	_					
453453 333445 333445		10	10.0 D	EPENDENT					
453453 333445 333445 333445			10.0	Esen	Dependent_name	Sex	Bdate	Relationship	
453453 333445 333445	555	20		333445555	Alice	F	1986-04-05	Daughter	
453453 333445 333445 333445 333445 999887	555 555 777	20 30	30.0			M	1983-10-25	Son	
453453 333445 333445 333445 333445 333445	555 555 777		-	333445555	Theodore				
453453 333445 333445 333445 333445 999887	555 555 777 777	30	10.0	333445555 333445555	Theodore Joy	F	1958-05-03	Spouse	
453453 333445 333445 333445 333445 999887 999887	555 555 777 777 987	30 10	10.0			F	1958-05-03 1942-02-28	Spouse Spouse	
453453 3334450 3334450 3334450 3334450 3334450 3334450 9998877 9998877 9879876 9879876	555 555 777 777 987 987	30 10 10 30	10.0 95.0 5.0	333445555	Joy			Spouse	
453453 333445 333445 333445 333445 999887 999887 9879870	555 555 777 777 987 987 321	30 10 10 30	10.0 35.0 5.0 20.0	333445555 987654321	Joy Abner	M	1942-02-28		19

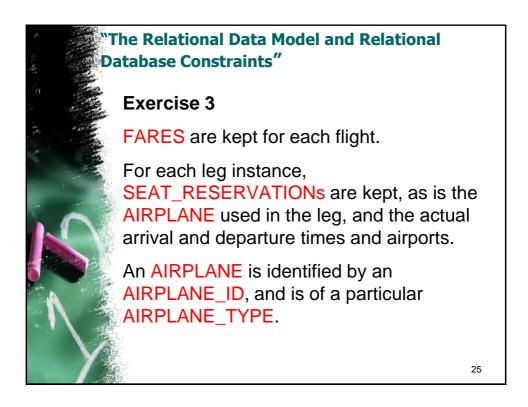
đ	1.22 A 1.42			_	elation ase Cor	-	-			odel and Relational
EMPLOYE	E							J.		
Fname	Minit	Lname	San	Bdate	Address	Sex	Salary S	super ss	n Dno	
John	в	Smith	123456789	1965-01-09	731 Fondren, Houston, T	100000000	and the second second second	344555	10111 1000000	Exercise 2
Franklin	т	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M		866555		
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000 98	3765432		
Jennifer	s	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000 88	866555		(I) .Modify the MGRSSN and
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, T	M	38000 33	344555	55 5	
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F		344555	-	MGRSTARTDATE of the
Ahmad	v	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M		3765432	-	DEDARTMENIT tuplo with
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M		JLL	1	DEPARTMENT tuple with
					_	1	1			DNUMBER=5 to '123456789'
DEPARTM	ENT		- 🗸				DEPT_LOC	ATIONS		
Dnan	ne	Dnum	iber Mg	r_ssn M	lgr_start_date		Dnumber	Dlo	cation	and '01-OCT-88', respectively
Research	h	5	3334	45555 1	988-05-22	-	1	Ho	uston	
Administ	tration	4	9876	54321 1	995-01-01		4	Sta	ford	
Headqua	arters	1	8886	65555 1	981-06-19		5	Bel	laire	
VORKS_O	ON	Pno	Hours		PROJECT	Pour	5 5	-	garland uston Dnum	No constraint violations
1234567	89		32.5		ProductX	Paul			11111000200000	
1234567		2	7.5		ProductX				5	
6668844	144		40.0		ProductZ	1			5	
4534534	2.5.6		20.0		Computerization	1			4	
4534534	53		20.0		Reorganization	2	-		4	
3334455	55		10.0		Newbenefits	3			4	
3334455	55	3	10.0			-	- Orang		-	
3334455	55	10	10.0 D		,					
3334455	55	20	10.0	Esso	Dependent name		0.0		and a second	
9998877	77	30	30.0	333445555	Alice	Sex	Bdate		ionship	
9998877	77			333445555	Theodore	M	1986-04-05			
9879879	87	10	A2 4	333445555	Joy	F	1958-05-03			
9879879	87	30	-	987654321	Abner	M	1938-05-03			
9876543	21	30	-	123456789	Michael	M	1942-02-28	oper	use	
9876543	21		-	123456789	Alice	F	1988-01-04			20
								Daug		

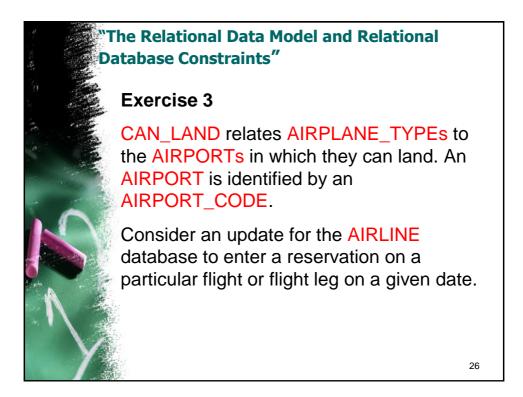
	33	1.21		LaDa	ase Cor	12	LI AII	nts	
EMPLOYE	EE							¥]
Fname	Minit	Lname	San	Bdate	Address	Sex	Salary Si	uper ssn Dno	
John	В	Smith	123456789	1965-01-09	731 Fondren, Houston, T.	KM	30000 33	3445555 5	Exercise 2
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	м	40000 88	8665556 5	
Alicia	1	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000 98	7654321 4	
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000 88	18665555 4	(J) .Modify the SUPERSSN
Ramesh	к	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, T	M	38000 333	3445555 5	attribute of the EMPLOYEE
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	Construction of the local division of the lo	3445555 5	
Ahmad	V	Jabbar	987987987		980 Dallas, Houston, TX	М		17654321 4	tuple with SSN= '999887777
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	м	55000 NU	л. 1	· ·
EPARTN	IENT		- L				DEPT LOCA	TIONE	to '943775543'
Dna	Contraction of the	Dnur	abor Ma	rsan N	lgr_start_date		Dnumber	Diocation	
Researc	the second s	5	and the second second second	Contraction of the second s	988-05-22	->	1	Houston	
Adminis		4			995-01-01		4	Stafford	
Headqu		1			981-06-19		5	Bellaire	Violates referential integrity
		_					5	Sugarland	violates referential integrity
		_					5	Houston	because there is no tuple in th
ORKS_	ON	Ł			PROJECT	רו	5	-	because there is no tuple in th
WORKS_		Pno	Hours		PROJECT	Pnur		Houston	because there is no tuple in th EMPLOYEE relation with that
Essn 123456	789	Pno 1	Hours 32.5			Pau	mber Ploca	Houston	EMPLOYEE relation with that
Essn 123456 123456	1 789 789	1 2	Contraction of the local division of the loc		Pname	-	mber Ploce	Houston ation Dnum re 5	
Essn 123456 123456 666884	789 789 789 444	1 2 3	32.5 7.5 40.0		Pname ProductX	-	mber Ploca 1 Bellair 2 Sugar	Houston ation Dnum re 5 rland 5	EMPLOYEE relation with that SSN ='943775543'
Essn 123456 123456 666884 453453	789 789 444 453	1 2 3 1	32.5 7.5 40.0 20.0		ProductX ProductY ProductZ Computerization	1	mber Ploca 1 Bellair 2 Sugar 3 Houst 0 Staffor	Houston ation Dnum re 5 riland 5 ton 5	EMPLOYEE relation with that SSN ='943775543' (i) Reject the deletion
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Essn 123456 123456 666884 453453 453453 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		ProductX ProductY ProductZ Computerization	1	mber Ploca 1 Bellair 2 Sugar 3 Houst 0 Staffor 0 Houst	Houston sation Dnum re 5 rliand 5 ton 5 ord 4 ton 1	EMPLOYEE relation with that SSN ='943775543' (i) Reject the deletion (ii) Insert a new EMPLOYEE
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EMPLOYEE		1015-246		Lave			LIAI			•	
a black the later of the	Minit	Lname	San	Bdate		-10	la i	¥	in the second		
John	B	Smith	123456789		Address	Sei		Super_se	COLUMN TWO IS NOT	Exercise 2	
Franklin	T	Wong	333445555		731 Fondren, Houston, T			334455			
Alicia	1	Zelaya	999887777		638 Voss, Houston, TX	F		886655			
Jennifer	S	Wallace	999687777		3321 Castle, Spring, TX 291 Berry, Bellaire, TX	F		8765433		(K) .Modify the HOURS attribu	te
Ramesh	ĸ	Narayan	987654321			-	-				
Joyce	A	English	453453453		975 Fire Oak, Humble, T. 5631 Rice, Houston, TX	X M		334455		of the WORKS_ON tuple v	vit
Ahmad	v	Jabbar	987987987	19/2-07-31	980 Dallas, Houston, TX	-		8765433			
James	E	Borg	888665555		450 Stone, Houston, TX		-			ESSN= '999887777' and	
201105	16	Doug	0000055555	1837-11-10	400 Stone, Houston, TX	м	55000 N	ULL	1		
EPARTME	ENT		- 1				DEPT LOC	ATIONS	S	PNO= 10 to '5.0'	
Dnam		Dnur	nber M	gr ssn 🛛 🕅	for start date		Dnumber		location		
Research		5	the second s	Contraction of the second	1988-05-22		1	01110	ouston		
Administration		4			1995-01-01		4		tafford		
Headquarters		-	201		51 91			36			
meadqua	inters	1	888	665555 1	1981-06-19		5		ellaire	No constraint violations	
VORKS_O		Ł		665556 1	PROJECT	Paul	5	Su Ho	ugarland ouston	No constraint violations	
	N	Pno	Hours	665555 1	PROJECT Phame	-	5 5 mber Plo	Su Ho	ugarland ouston Dnum	No constraint violations	
WORKS_OI	N 89	Pno		665555 1	PROJECT Pname ProductX	-	5 5 1 Bella	Su Ho cation	ugarland ouston Dnum 5	No constraint violations	
VORKS_OI Essn 12345678 12345678	N 89 89	Pno 1	Hours 32.5	665555 1	PROJECT Phame		mber Pto 1 Bella 2 Suga	Su Ho cation sine ariland	Ugarland ouston Dnum 5 5	No constraint violations	
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WORKS_OI Essn 12345678 12345678 6668844 45345345	N 89 44 53 53 55 55 55 55	Pno 1 2 3 1 2 2 3 10	Hours 32.5 7.5 40.0 20.0 20.0 10.0 10.0 10.0		PROJECT ProductX ProductX ProductY ProductY Computerization Reorganization Newbanefits	Sex	5 5 1 Belli 2 Sug 3 Hou 10 Staff 20 Hou 30 Staff	Su Ho cation wire ariand ston ford ston ford Relat	ugarland ouston Dnum 5 5 5 4 1 4 1 4 1 4	No constraint violations	
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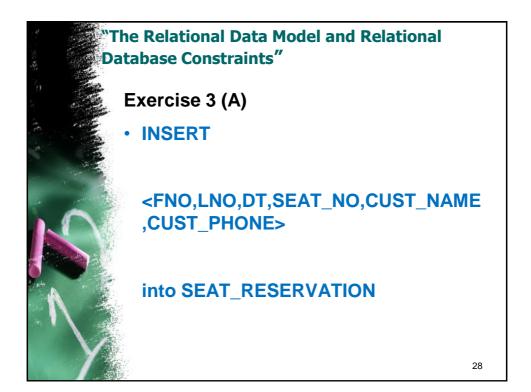


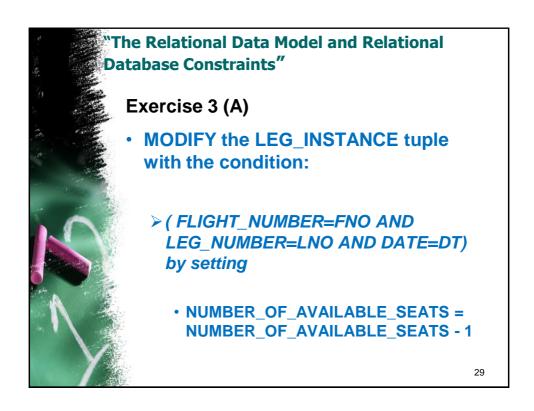


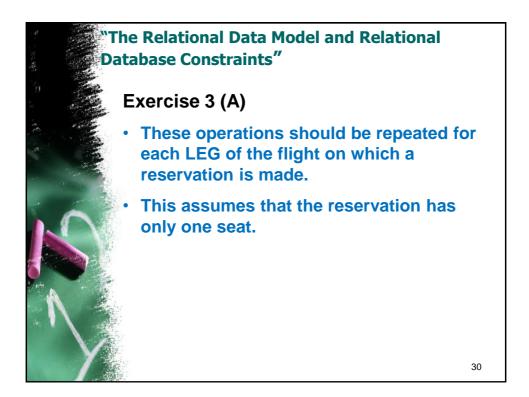




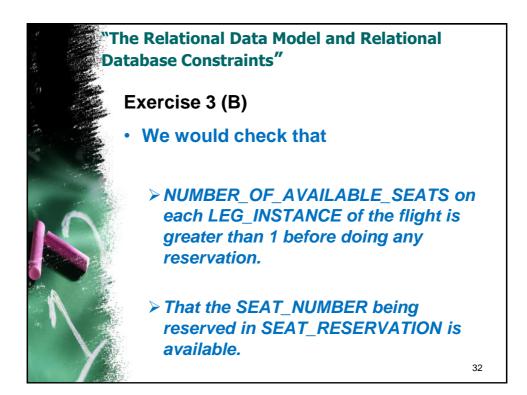
"The Relational Data Model a Database Constraints"	nd Relational
AIRPORT Airport_code Name City State	Exercise 3
FLIGHT Flight_number Airline Weekdays	 (A) Give the operations for this update.
FLIGHT_LEG Flight_number Leg_number Departure_airport_code Scheduled_departure_time	
Arrival_airport_code Scheduled_arrival_time LEG_INSTANCE Flight_number Leg_number Date Number_of_available_seats Airplane_jd Departure_airport_code Departure_time Arrival_airport_code Arrival_time	Enter a reservation on a particular flight on a given date
FARE Flight_number Fare_code Amount Restrictions	
AIRPLANE_TYPE Airplane_type_name Max_seats Company CAN_LAND Airplane_type_name Airport_code	
AIRPLANE Airplane_id Total_number_of_seats Airplane_type	
SEAT_RESERVATION Flight_number Leg_number Date Seat_number Customer_name Customer_phone	27



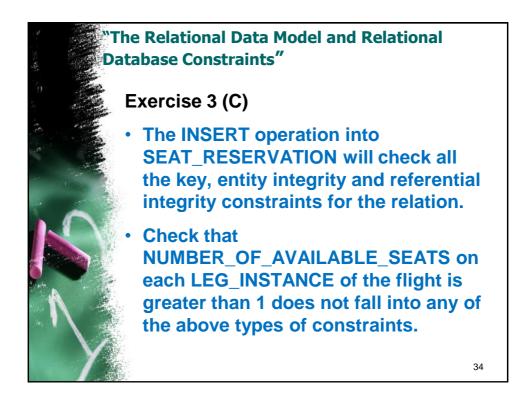




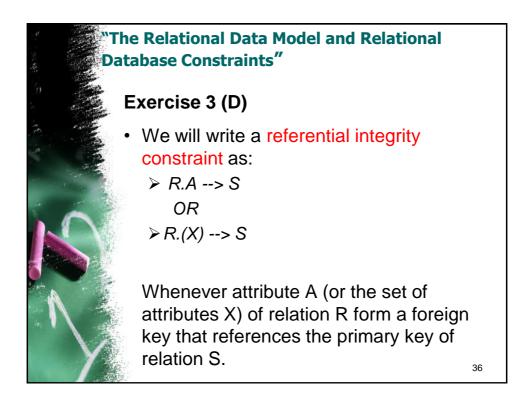
"The Relational Data Model a	nd Relational
AIRPORT Database Constraints"	
Airport_code Name City State	Exercise 3
FLIGHT Flight_number Airline Weekdays	(B) What types of constraints would
Flight_number Leg_number Departure_airport_code Scheduled_departure_time	you expect to check?.
Arrival_airport_code Scheduled_arrival_time	010000
Flight_number Leg_number Date Number_of_available_seats Airplane_id Departure_airport_code Departure_time Arrival_airport_code Arrival_time	
Flight_number Fare_code Amount Restrictions	
Airplane_type_name Max_seats Company CAN LAND	
Airplane_type_name Airport_code	
AIRPLANE Airplane_id Total_number_of_seats Airplane_type	
Flight_number Leg_number Date Seat_number Customer_name Customer_phone	31

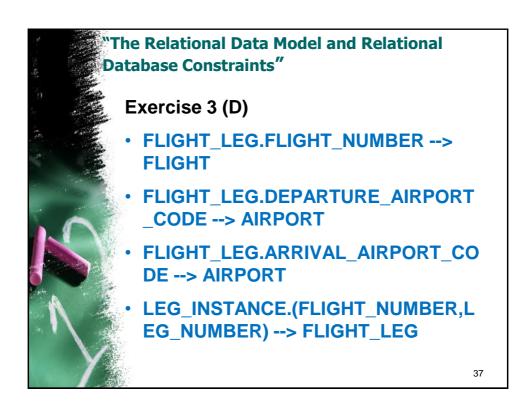


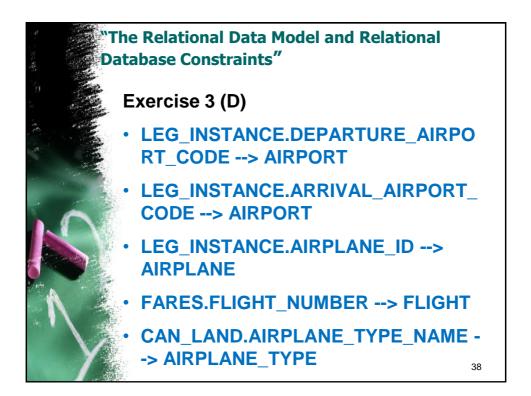
"The Relational Data Model Database Constraints"	and Relational
AIRPORT Airport_code Name City State	Exercise 3
FLIGHT Flight_number Airline Weekdays FLIGHT_LEG Flight_number Leg_number Departure airport code Scheduled_departure_time	(C) Which of these constraints are key, entity integrity, and
Arrival_airport_code Scheduled_arrival_time	referential integrity constraints and which are not?
Flight_number Leg_number Date Number_of_available_seats Airplane_id Departure_airport_code Departure_time Arrival_airport_code Arrival_time	which are not :.
Flight_number Fare_code Amount Restrictions	
Airplane_type_name Max_seats Company Can Land Company Company	
Airplane_type_name Airport_code	
Airplane_id Total_number_of_seats Airplane_type	
SEAT RESERVATION	33
Flight_number Leg_number Date Seat_number Customer_name Customer_phon	e

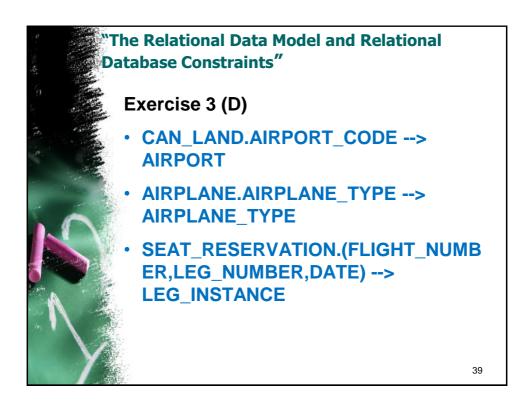


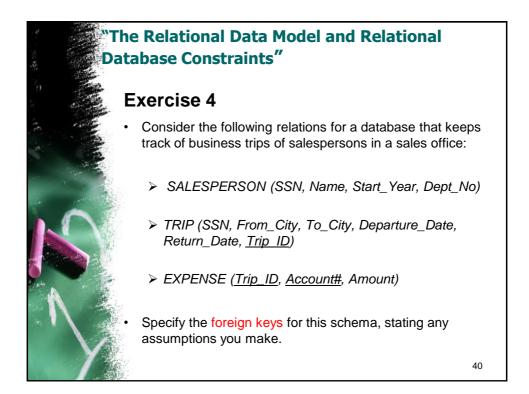
"The Relational Data Model a Database Constraints"	nd Relational
AIRPORT_code Name City State	Exercise 3
FLIGHT Airline Weekdays FLIGHT_LEG	(D) Specify all the referential integrity constraints.
Flight_number Leg_number Departure_airport_code Scheduled_departure_time Arrival_airport_code Scheduled_arrival_time	constraints.
LEG_INSTANCE Flight_number Leg_number Date Number_of_available_seats Airplane_id Departure_airport_code Departure_time Arrival_airport_code Arrival_time	
FARE Flight_number Fare_code Amount Restrictions	
AIRPLANE_TYPE Airplane_type_name Max_seats Company	
CAN_LAND Airplane_type_name Airport_code	
AIRPLANE Airplane_id Total_number_of_seats Airplane_type	
Flight_number Leg_number Date Seat_number Customer_name Customer_phone	35

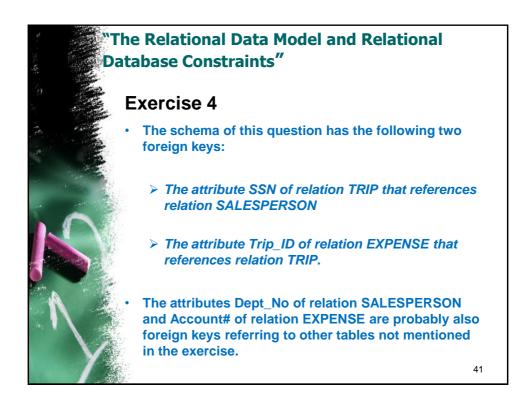


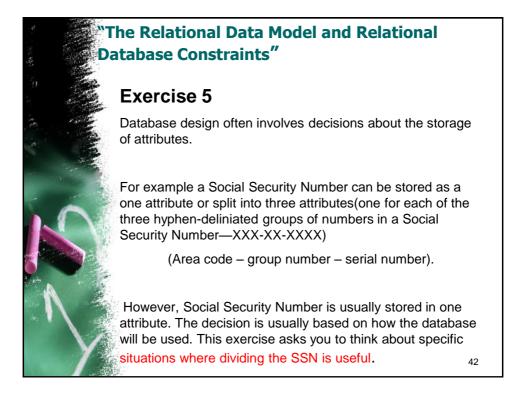


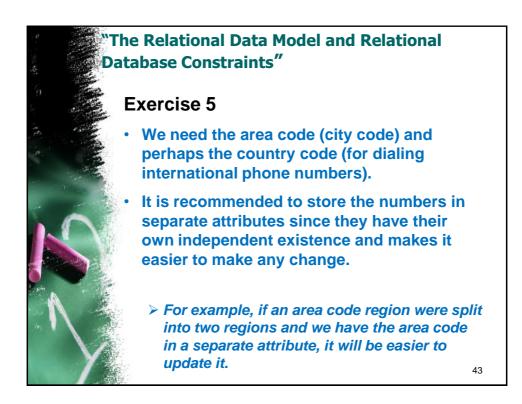


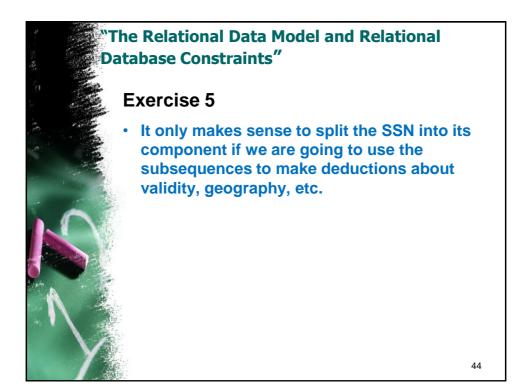




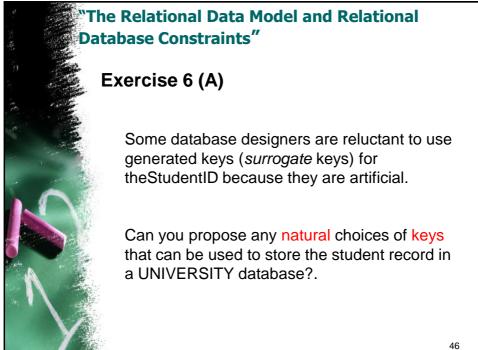








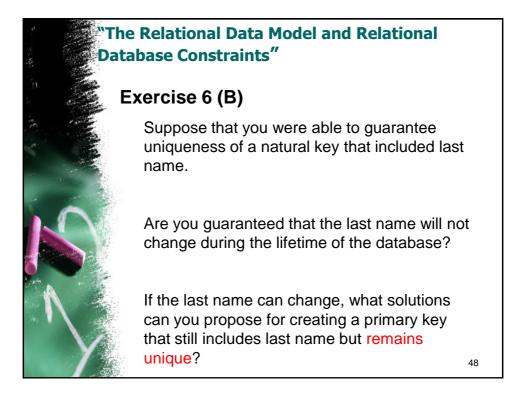
The Relational Data Model and Relational Database Constraints" **Exercise 6** Recent changes in privacy laws have disallowed organizations from using SSN to identify individuals unless certain restrictions are satisfied. As a result, most US universities cannot use SSNs as primary keys (except for financial data). In practice, StudentID, a unique ID identifier, assigned to every student, is likely to be used as the primary key rather than SSN Since StudentID is usable across all aspects of the system. 45



"The Relational Data Model and Relational Database Constraints" Exercise 6 (A) A combination of first name, last name, and home phone may address the issue assuming that there are no two students

with identical names sharing a home phone line. It also assumes that every student has a home phone number.

Another solution may be to use first name, last name, and home zip code. This again has a potential for duplicates, which would be very rare within one university.



"The Relational Data Model and Relational Database Constraints"

Exercise 6 (B)

If we are using the name as the primary key and the name changes (maybe because she gets married), then we need to accept changes in the primary key as well (this is an example of how our database must be able to model the natural world)

Changing the primary key is acceptable, however we must have in mind that this can be inefficient since any references to this key in the database need to be appropriately updated, and this can take a long time.

