COMP-3150 CHAPTER 5: LECTURE NOTES (Ch 5)

Chapter 5: The Relational Data Model and Relational Database Constraints

Winter 2021 Comp 3150 online recordings can be downloaded from the black board virtual classroom for the class of the day. The links below are the recordings of similar classes in Fall 2020 that I uploaded to one drive in case you prefer to review these.

Links to any posted recorded in-class lectures for Chapter 5 Oct. 1, 2020 or Sept. 28, 2021 and possibly Oct. 6, 2020 or Sept. 30, 2021 will be found below:

1. Links on one drive to recorded lecture of Tuesday, Oct. 1, 2020 (similar to Sept. 28, 2021 lecture) (saved in two recorded sessions to break down the files) is provided below in sequences 1, 2:

Frist Recording 1 of 2:

https://uwin365-my.sharepoint.com/:v:/g/personal/cezeife_uwindsor_ca/EVrAf0_g1g1Mp-5hQHiK0DkBuMXXRqQRRSQ2Keet8Zh4gg

Second Recording 2 of 2:

https://uwin365-my.sharepoint.com/:v:/g/personal/cezeife_uwindsor_ca/EWYixJGd4SdJl5ERz_8PWmQBQhuWWu3cKP-tVMKFVYT1jw

Links on one drive to recorded lecture of Thursday, Oct. 6, 2020 (similar to Sept. 30, 2021 lecture) (saved in two recorded sessions to break down the files) is provided below in sequences 1, 2:

Frist Recording 1 of 2:

https://uwin365-my.sharepoint.com/:v:/g/personal/cezeife_uwindsor_ca/Ebmj9s1B5gpJv88g2pD3qRUBApRocu9N627AWUsTYrEU1w

Second Recording 2 of 2:

https://uwin365-my.sharepoint.com/:v:/g/personal/cezeife_uwindsor_ca/EbdGh4o0U3FNuTNe4hW1lF8BxM3hf-mGCmfCtEwuPd_NMg

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The following questions on The Relational Data Model and Relational Database Constraints discussed in Chapter 5 of Comp 3150 text book, Chapter 5, Comp 3150 posted course slide notes, are in-class questions for students to ponder and answer as I teach.

- The answers to the questions are found also by reviewing the Comp 3150, posted power point slide notes for Chapter 5 and being in class.

- Students are advised to review Chapters 5 and 14 of course book and Comp 3150 posted slide notes before and after each class.

- I will also go over the Slide notes in class with examples and integrate them into the class lectures, which are also posted in the More course material link on black board with any links to recorded live lectures.

1. WHAT IS RELATIONAL DATA MODEL AND WHAT IS AN EXAMPLE RELATIONAL DBMS?

2. WHAT ARE THESE RELATIONAL DATABASE CONCEPTS – RELATION/TABLE ?

3. WHAT IS A TUPLE AND AN ATTRIBUTE?

4. WHAT IS DOMAIN OF AN ATTRIBUTE?

5. WHAT IS A KEY (E.G., PRIMARY, CANDIDATE, FOREIGN KEY, SUPERKEY?)

6. WHAT IS SCHEMA OF A RELATION?

7. WHAT IS STATE OF A RELATION?

8. WHAT ARE NULL VALUES?

9. WHAT IS A RELATIONAL DATABASE SCHEMA?

10. WHAT ARE RELATIONAL MODEL CONSTRAINTS?
(a) Implicit constraints based on the data model. E.g., attributes are single valued and a list cannot be stored as the value of one attribute (domain constraint).
(b) Schema based or explicit constraints. (e.g., key

constraint, entity and referential integrity (foreign key) constraint) enforced during database relation creation. (c) Application based constraint (e.g., student cumulative grade point average should not be less than 60%) enforced with Triggers (a type of active query that is triggered by some changes in the database).

10. WHAT IS A VALID DATABASE STATE?
- a Valid Database state should not have any integrity constraints (ICs) violated.

- What are possible conditions that can violate the ICs and how can these violations be handled or avoided? Eg.

i. How can INSERT operation violate any of the Domain, key, referential and entity ICs?

ii. How can DELETE instruction violate ICs?

iii. How can UPDATE instruction violate ICs?

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Try to answer the 10 questions above with an example with reference to a simple 3-table database of student-takes-course given in Chapter 1 lecture in class.

An example relational database schema is given next.

Student (Studid, Name, Class, Major)
Course (Cid, Ctitle, Credithr, Dept)
Takes (Studid, Cid, grade)

An instance or state of the database showing the contents of the database at a particular point in time is:

Student

Studid	Name	Class	Major
1	John Smith	1	CS
2	Patty Moore	2	Math

Course

Cid	Ctitle	Credithr	Dept
Comp1400	Intro to C	3	CS
Comp3150	Database	3	CS
Math1720	Calculus	3	Math

Takes

Studid	Cid	Grade
1	Comp1400	80
1	Math1720	70
2	Comp1400	60

Problem:
Given the above state of the simple Student-Takes-Course database we built in Chapter 1,

i. Show the primary key, candidate key, superkey, foreign keys in the database.

ii. Also, answer the following questions regarding this database. What constraints if any are violated if you do the following transactions on this DB?

1. INSERT INTO TAKES
a. <5, 'Comp3150', NULL>
b. <1, 'Comp3150', NULL>
c. <2, 'Comp2140', NULL>

Solution
a. Foreign key violation because no studid 5 in the database.
b. no violation.
c. Foreign key violation because non-existent course Comp2140 in the database.

2. INSERT INTO THE STUDENT table as follows:
   a. <2, ‘Mary Goods’, 3, ‘CS’>
   b. <NULL, ‘Mark Oto’, 2, ‘Math’>

   Solution:
   a. Primary key constraint violation
   b. Entity IC violation.

3. UPDATE COURSE table to change some attribute values as:
   a. Update the grade of the TAKES tuple with Studid=1 and Cid = ‘Comp1400’ to 85.
   Solution: accepted.

4. DELETE the STUDENT tuple with Studid = 1.
   Solution: Violates referential IC because SID is enrolled in a class and operation fails.
   Handling this operation failure: Cascade the delete so tuples of the Relation STUDENT are deleted only after all their enrolment or references to them from other tables are deleted first.

   E.g., delete the enrolment of student 1 from all courses before you delete the student. This (deleting them from all references to a table first) you can also do manually (instead of cascade option) first before asking to delete the student from the student table.

On Slide 25 of Chapter 5 Slide Notes, you have a populated state of the COMPANY DB schema (Fig. 5.6). Use it to practice more on identifying all the foreign key (FK) attributes in Fig. 5.6 and checking operations that are valid or will violate ICs. Fig. 5.6 is

copied down next. Fig 5.7. Showing the schema diagram of this database with foreign key referential IC shown is also given next.

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

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

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

DEPT_LOCATIONS

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

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

Figure 5.7
Referential integrity constraints displayed on the COMPANY relational database schema.