CS1555 Recitation 5 - Video Solution

Objective: To practice more relational model concepts and relational algebra, especially aggregations, joins, and division.

Consider the following relation schemas and states:

Student (SID, Name, Class, Major)

Student\_Dir (SID, Address, Phone)

FK: (SID) → Student (SID)

Course (Course\_No, Name, Level)

Courses\_taken (Course\_No, Term, SID, Grade)

FK: (Course\_No) → Course (Course\_No)

FK: (SID) → Student (SID)

**Student**

|  |  |  |  |
| --- | --- | --- | --- |
| SID | Name | Class | Major |
| 123 | John | 3 | CS |
| 124 | Mary | 3 | CS |
| 126 | Sam | 2 | CS |
| 129 | Julie | 2 | Math |

**Student\_Dir**

|  |  |  |
| --- | --- | --- |
| SID | Address | Phone |
| 123 | 333 Library St | 555-535-5263 |
| 124 | 219 Library St | 555-963-9635 |
| 129 | 555 Library St | 555-123-4567 |

**Course**

|  |  |  |
| --- | --- | --- |
| Course\_No | Course\_Name | Course\_level |
| CS1520 | Web Programming | UGrad |
| CS1555 | Database Management Systems | UGrad |
| CS1550 | Operating Systems | UGrad |
| CS 1655 | Secure Data Management and Web Applications | UGrad |
| CS2550 | Database Management Systems | Grad |

**Course\_taken**

|  |  |  |  |
| --- | --- | --- | --- |
| Course\_No | Term | SID | Grade |
| CS1520 | Fall 19 | 123 | 3.75 |
| CS1520 | Fall 19 | 124 | 4 |
| CS1520 | Fall 19 | 126 | 3 |
| CS1555 | Fall 19 | 123 | 4 |
| CS1555 | Fall 19 | 124 | NULL |
| CS1550 | Spring 20 | 123 | NULL |
| CS1550 | Spring 20 | 124 | NULL |
| CS1550 | Spring 20 | 126 | NULL |
| CS1550 | Spring 20 | 129 | NULL |
| CS2550 | Spring 20 | 124 | NULL |
| CS1520 | Spring 20 | 126 | NULL |

**Part 1: Relational Model**

1. For each of the relational algebra queries below:
   1. Identify the expected arity, schema, and min/max cardinality of the relation resulted from the below queries, without actually evaluating the query and based only on the schemas and cardinalities of the 4 given relations.
   2. Find the resulted relation given the above states of the relations.

(Note: we are using |T| notation to denote the Arity of relation T and |r(T)| notation to denote the cardinality of relation T)

a. Course\_No ( Term = 'Spring 20' (Courses\_taken ))

|T2| =1

T2(Course\_No)

Min|r(T2)| =0; Max|r(T2)| =|r(Course)|

**T2**

|  |
| --- |
| Course\_No |
| CS1550 |
| CS2550 |
| CS1520 |

b. T3 Courses\_taken \* Course

|T3| =6

T3(Course\_No, Term, SID, Grade, Course\_name, Course\_level)

|r(T3)| = |r(Course\_taken)|

**T3**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Course\_No | Term | SID | Grade | Course\_Name | Course\_Level |
| CS1520 | Fall 19 | 123 | 3.75 | Web Programming | UGrad |
| CS1520 | Fall 19 | 124 | 4 | Web Programming | UGrad |
| CS1520 | Fall 19 | 126 | 3 | Web Programming | UGrad |
| CS1555 | Fall 19 | 123 | 4 | Database management System | UGrad |
| CS1555 | Fall 19 | 124 | NULL | Database management System | UGrad |
| CS1550 | Spring 20 | 123 | NULL | Operating Systems | UGrad |
| CS1550 | Spring 20 | 124 | NULL | Operating Systems | UGrad |
| CS1550 | Spring 20 | 126 | NULL | Operating Systems | UGrad |
| CS1550 | Spring 20 | 129 | NULL | Operating Systems | UGrad |
| CS2550 | Spring 20 | 124 | NULL | Database Management System | Grad |
| CS1520 | Spring 20 | 126 | NULL | Web Programming | UGrad |

c. T4 Courses\_taken ▷◁Courses\_taken.Course\_No = Course.Course\_No Course

|T4| =7

T4(Course\_Taken.Course\_No, Term, SID, Grade, Course.Course\_No, Course\_Name, Course\_Level)

|r(t4)| =|r(Course\_Taken)|

**T4**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Course\_Taken.Course\_No | Term | SID | Grade | Course.Course\_No | Course\_Name | Course\_Level |
| CS1520 | Fall 19 | 123 | 3.75 | CS1520 | Web Programming | UGrad |
| CS1520 | Fall 17 | 124 | 4 | CS1520 | Web Programming | UGrad |
| CS1520 | Fall 19 | 126 | 3 | CS1520 | Web Programming | UGrad |
| CS1555 | Fall 19 | 123 | 4 | CS1555 | Database management System | UGrad |
| CS1555 | Fall 19 | 124 | NULL | CS1555 | Database management System | UGrad |
| CS1550 | Spring 20 | 123 | NULL | CS1550 | Operating Systems | UGrad |
| CS1550 | Spring 20 | 124 | NULL | CS1550 | Operating Systems | UGrad |
| CS1550 | Spring 20 | 126 | NULL | CS1550 | Operating Systems | UGrad |
| CS1550 | Spring 20 | 129 | NULL | CS1550 | Operating Systems | UGrad |
| CS2550 | Spring 20 | 124 | NULL | CS2550 | Database Management System | Grad |
| CS1520 | Spring 20 | 126 | NULL | CS1520 | Web Programming | UGrad |

**Part 2: Relational Algebra**

Write a relational algebra query for each of the queries below:

1. List the SID of the students who did not enroll in any course in Fall 19.

SID\_enroll\_fall19 SID( Term = 'Fall 19' (Courses\_Taken))

SID\_all SID(Student)

RSLT SID\_all - SID\_enroll\_fall19

If we were interested in all of the student attributes then :

 Student.SID, Student.name, Student.class, Student.major (Student ▷◁Student.SID = RSLT.SID RSLT)

1. Find the total number of students.

FCOUNT SID (Student)

1. Find the total number of students who have enrolled in the course “Operating Systems”*.*

OS\_Taking SID(Course.Name = 'Operating Systems' (Course\_Taken \* Course))

RSLT FCOUNT SID ( OS\_Taking)

*(or you can combine the two steps into one expression (nested operations))*

1. List the SID, name, and address (if available) of all students.

SID, name, address(Student ]▷◁Student.SID=StudentDir. ID Student\_Dir)

*(note the left outer join)*