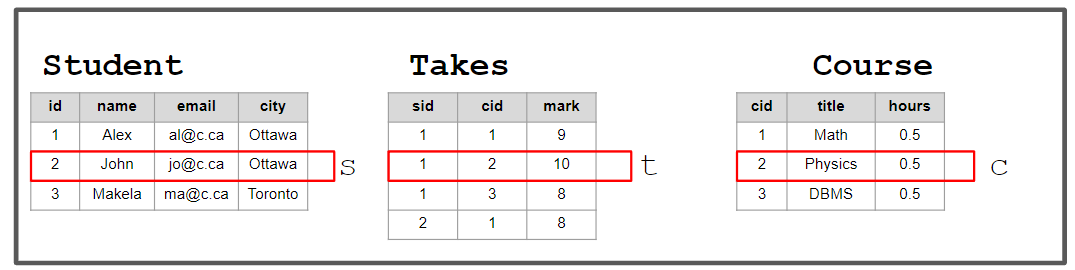
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| --- | --- | --- |
| **Course ID:** COMP 3005A  **Course Name:** DBMS  **Assignment #:** 1 | **Due:** 05-Oct-2023 at 11:59 PM  **Instructor:** Abdelghny Orogat |  |
| **Name: Vidun Jayakody**  **ID: 101224988** | | |

**Instructions:**

• The accepted format for your submission is pdf only and .txt for SQL queries.

**Question (1):**

Consider the following relational database. Show the output result of the following queries



1. **πemail (𝞂name=’John’ (Student))** **[1 mark]**

|  |  |  |
| --- | --- | --- |
| |  | | --- | | **email** | | jo@c.ca | |

1. **Student ⨝Student.id=Takes.sid Takes** **[1 mark]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **id** | **name** | **email** | **city** | **sid** | **cid** | **Mark** | | 1 | Alex | al@c.ca | Ottawa | 1 | 1 | 9 | | 1 | Alex | al@c.ca | Ottawa | 1 | 2 | 10 | | 1 | Alex | al@c.ca | Ottawa | 1 | 3 | 8 | | 2 | John | jo@c.ca | Ottawa | 2 | 1 | 8 | |

1. **Student ⟕Student.id=Takes.sid Takes** **[1 mark]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **id** | **name** | **email** | **city** | **sid** | **cid** | **Mark** | | 1 | Alex | al@c.ca | Ottawa | 1 | 1 | 9 | | 1 | Alex | al@c.ca | Ottawa | 1 | 2 | 10 | | 1 | Alex | al@c.ca | Ottawa | 1 | 3 | 8 | | 2 | John | jo@c.ca | Ottawa | 2 | 1 | 8 | | 3 | Makela | [ma@c.ca](mailto:ma@c.ca) | Toronto |  |  |  | |

1. (**π**sid,cid Takes) / (**π**cid Course) **[1 mark]**

|  |  |  |
| --- | --- | --- |
| |  | | --- | | **sid** | | 1 | |

**Question (2):**

Consider the following relational database instance where

* For the “Employee” relation,
  + the “EManager” column refers to the EID of the manager of the current employee. For example, the employee (22222, Einstein) is the manager of (12121, Wu), (32343, El Said), (45565, Katz), and (98345, Kim), and so on.
  + the “EDepart” column refers to a department in the “Department” relation. For example, the department’s id of (12121, Wu) is 2. This id=2 refers to the “Accounting” department in the “Department” relation.

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| Employee   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **EID** | **EName** | **ESalary** | **EManager** | **EDepart** | | 22222 | Einstein | 95000 | Null | 1 | | 12121 | Wu | 90000 | 22222 | 2 | | 32343 | El Said | 60000 | 22222 | 3 | | 45565 | Katz | 75000 | 22222 | 4 | | 98345 | Kim | 80000 | 22222 | 5 | | 76766 | Crick | 72000 | 98345 | 5 | | 10101 | Srinivasan | 65000 | 98345 | 5 | | 58583 | Califieri | 62000 | 98345 | 5 | | 83821 | Brandt | 92000 | 98345 | 5 | | 15151 | Mozart | 40000 | 98345 | 5 | | 33456 | Gold | 87000 | 12121 | 2 | | 76543 | Singh | 80000 | 12121 | 2 | | Department   |  |  |  |  | | --- | --- | --- | --- | | **DID** | **DName** | **DLocation** | **DBudget** | | 1 | CEO | Toronto | 10,000 | | 2 | Accounting | Ottawa | 100,000 | | 3 | Media | Ottawa | 30,000 | | 4 | Research | Ottawa | 20,000 | | 5 | Production | Ottawa | 500,000 | |

Write relational algebra and tuple-relational-calculus expressions to solve the following questions, and show the resulting table for each example. The first example is solved to show you how to answer each question

**(a)**Return the employees whose salaries are less than $80,000. **[0 marks]**

**Answer**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relational Algebra Expression:**  𝞂ESalary<80000(Employee)  **Tuple Relational Calculus Expression:**  {e.\*| e ∈ Employee AND  e.ESalary<80000}  **Returned Result:**  Employee   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **EID** | **EName** | **ESalary** | **EManager** | **EDepart** | | 32343 | El Said | 60000 | 22222 | 3 | | 45565 | Katz | 75000 | 22222 | 4 | | 76766 | Crick | 72000 | 98345 | 5 | | 10101 | Srinivasan | 65000 | 98345 | 5 | | 58583 | Califieri | 62000 | 98345 | 5 | | 15151 | Mozart | 40000 | 98345 | 5 | |

**(b)**Return employees who are working in department number 5. **[3 marks]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relational Algebra Expression:**  **Tuple Relational Calculus Expression:**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **EID** | **EName** | **ESalary** | **EManager** | **EDepart** | | 98345 | Kim | 80000 | 22222 | 5 | | 76766 | Crick | 72000 | 98345 | 5 | | 10101 | Srinivasan | 65000 | 98345 | 5 | | 58583 | Califieri | 62000 | 98345 | 5 | | 83821 | Brandt | 92000 | 98345 | 5 | | 15151 | Mozart | 40000 | 98345 | 5 | |

**(c)** What is the salary of the employee “Kim”? **[3 marks]**

|  |  |  |
| --- | --- | --- |
| **Relational Algebra Expression:**  **Tuple Relational Calculus Expression:**   |  | | --- | | **ESalary** | | 80000 | |

**(d)** List pairs of employees’ names and their departments’ names. **[3 marks]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relational Algebra Expression:**  **Tuple Relational Calculus Expression:**   |  |  | | --- | --- | | **EName** | **DName** | | Einstein | CEO | | Wu | Accounting | | El Said | Media | | Katz | Research | | Kim | Production | | Crick | Production | | Srinivasan | Production | | Califieri | Production | | Brandt | Production | | Mozart | Production | | Gold | Production | | Singh | Production | |

**(e)** List employees’ names only for those who work in the Accounting department.**[3 marks]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Relational Algebra Expression:**  **Tuple Relational Calculus Expression:**   |  | | --- | | **EName** | | Gold | | Singh | | Wu | |

**(f)** In relational algebra, joining a relation with itself can lead to ambiguity about which table we're referencing. To address this, we can rename one of the relations before executing the join operation. If you have a relation R with two attributes a and b, which can be written as R(a,b), you can rename it and its columns using the expression ρS(a->c, b->d)(R) to generate a new relation with the same structure and the same content but with different name S(c,d).

Take the renaming operator into your consideration, solve the following query:

For employees only who have managers, list the employees’ names with their corresponding managers’ names. **[3 marks]**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Relational Algebra Expression:**  **Tuple Relational Calculus Expression:**   |  |  | | --- | --- | | **EmployeeName** | **ManagerName** | | Wu | Einstein | | El Said | Einstein | | Katz | Einstein | | Kim | Einstein | | Crick | Kim | | Srinivasan | Kim | | Califieri | Kim | | Brandt | Kim | | Mozart | Kim | | Gold | Wu | | Singh | Wu | |

**Question (3):**

Compared to Relational Algebra (RA), Tuple Relational Calculus (TRC) doesn't focus on operators or the sequence of operations. When crafting a query in TRC, it's essential to establish tuple variables (either free or bound) for the relations, which then help in defining the desired output relation. However, TRC allows one variable to be defined on multiple relations, and this helps us to write queries equivalent to the set operators (e.g., ∪, ∩, and -). For example, given two relations: R and S, the TRC query {t.\* | t ∈ R ∧ t ∈ S} is equivalent to the RA query R ∩ S, which returns the intersection between two relations.

1. Write the TRC query that is equivalent to the following RA queries
   1. R ∪ S **[1 mark]**

|  |
| --- |
|  |

* 1. R - S **[1 mark]**

|  |
| --- |
|  |

* 1. S - R **[1 mark]**

|  |
| --- |
|  |

**Question (4):**

*For this question, upload the SQL queries in a (.txt) file.*

Using the university database schema discussed in class, answer the following:

1. The primary key for the advisor relation is s\_id. Suppose a student can have more than one supervisor. Would s\_id still be a primary key in advisor? If yes, why? If not, what would be a suitable primary key? **[1 mark]**

|  |
| --- |
| No, **s\_id** can't be a primary key. We'd need a composite key of (**s\_id**, **i\_id**) for uniqueness. This allows each student to be linked to several instructors in the advisors table. |

1. The primary key for prereq is both attributes course\_id and prereq\_id. Why wouldn’t only course\_id work as the primary key? **[1 mark]**

|  |
| --- |
| Only using **course\_id** wouldn't work because a course can have multiple prerequisites. To uniquely identify each prerequisite for a course, both **course\_id** and **prereq\_id** are needed as the primary key. |

1. Given the existing schema of teaches, two or more instructors can teach the same section. How can the primary key be changed to restrict a section to one instructor only? **[1 mark]**

|  |
| --- |
| To restrict a section to only one instructor in the teaches relation, we’d need to make the combination of **course\_id**, **sec\_id**, and semester (which identifies a unique section) the primary key. This ensures each section can be associated with just one instructor. |

1. Create a new course ("Aces of Databases") with ID ("COMP5118") in the Computer Science department ("Comp. Sci.") with 0 credit hours. **[1 mark]**

|  |
| --- |
| **INSERT INTO course (course\_id, title, dept\_name, credits)**  **VALUES ('COMP5118', 'Aces of Databases', 'Comp. Sci.', Null);**  **Note**: 0 is not a valid credit hours because of the **check (credits > 0)** constraint in the provided database. |

1. Create a section 'A' for this course in the Winter of 2020 with no known location or time, yet.

**[1 mark]**

|  |
| --- |
| **INSERT INTO section**  **(course\_id, sec\_id, semester, year, building, room\_number, time\_slot\_id)**  **VALUES ('COMP5118', 'A', 'Winter', 2020, NULL, NULL, NULL);** |

1. One student with ID 12345 cannot take this course because of violating the prerequisite requirements (didn't pass COMP3005). Unregister this student from the new section **[1 mark]**

|  |
| --- |
| **DELETE FROM takes**  **WHERE ID = 12345 AND course\_id = 'COMP5118' AND sec\_id = 'A'**  **AND semester = 'Winter' AND year = 2020;** |