

Database Management Systems

(COP 5725)

Fall 2019

Instructor: Dr. Markus Schneider

TA: Kyuseo Park

Homework 2

Name:	
UFID:	
Email Address:	

Pledge (Must be signed according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

Signature

For scoring use only:

	Maximum	Received
Exercise 1	25	
Exercise 2	25	
Exercise 3	22	
Exercise 4	28	
Total	100	

Exercise 1 (Relational Algebra) [25 points]

Consider the following relations. The primary keys are underlined. All attributes are of type string if not indicated otherwise.

- Student (s_ID, s_name, s_degree: integer, advisorID, d_ID)
- Lecture (l_ID, l_name, l_degree: integer, p_ID, d_ID)
- Register (s_ID, l_ID, score: integer, Semester)
- Professor (p_ID, p_name, d_ID)
- Department (d_ID, d_name, address)

1. [5 points] Find the names of professors who have taught in every semester.
2. [5 points] List the names of lectures that the CISE department offers but that are taught by a professor whose department is not CISE.
3. [5 points] Find the names of students who got the highest score in the lecture 'Databases'.
4. [5 points] Find the names of students who have registered every lecture of the CISE department.
5. [5 points] Find the names of students who got more than 90 in the 'DB' lecture and less than 70 in the 'Algorithm' lecture.

Exercise 2 (Relational Algebra) [25 points]

Consider the following relations for an online bookstore. The primary keys are underlined. All attributes are of type string if not indicated otherwise.

- Book(bID, title, author, publisher, year, price)
 - Customer(cID, name, ssn, gender, age: integer, email, street, city, state, zipcode)
 - Credit_Card(ccID, cID, cardNumber, exprDate)
 - cID is a foreign key to Customer relation.
 - Book_Order(bID, ccID, quantity: integer, time)
 - bID is a foreign key to Book relation.
 - ccID is a foreign key to Credit_Card relation.
1. [4 points] Find the titles of books that were purchased by the customers Ahn or Berr.
 2. [6 points] Find the names of customers who ordered the book “DB” the most.
 3. [4 points] Find the names of publishers whose books are not sold yet.
 4. [3 points] Find the genders of customers who ordered the “Machine Learning” book authored by Chris Bishop.
 5. [4 points] List the titles of books that were purchased by customers whose credit cards are expiring in 2018.
 6. [4 points] List the emails of customers who have not purchased any book.

Exercise 3 (Relational Algebra) [22 points]

Consider the following relations. The primary key is underlined. All attributes are of type string if not indicated otherwise.

- branch (branch_name, branch_city, assets: integer)
 - customer (customer_id, customer_name, customer_street, customer_city)
 - account (account_number, branch_name, balance)
 - depositor (customer_id, account_number)
1. [6 points] Find the names of customers who have an account in the branch with highest assets.
 2. [4 points] Find the names of customers who live in the same city where the branches are located that the customers use.
 3. [4 points] Find the names of customers whose account balance is less than \$1,000 and the branch that has the account is located in Gainesville.
 4. [4 points] Find the names of customers that have accounts in every branch in Gainesville.
 5. [4 points] Find the names of customers who do not have an account. (assume the bank keeps the customer information even if the account is closed.).

Exercise 4 (Relational Algebra) [28 points]

The following questions let you think deeper about the concepts of the Relational Algebra.

1. [6 points] Let R be the schema of a relation R , and let $A_1, A_2, \dots, A_n \subseteq R$. Is the term $\pi_{A_1}(\pi_{A_2}(\dots(\pi_{A_n}(R))\dots)) = \pi_{A_1}(R)$ correct, in general? If yes, argue why. If not, argue why not. If your answer is no, are there any restrictions that could make the statement true? If so, what are these restrictions in mathematical notation?
2. [6 points] Let R be the schema of a relation R , and let $A \subseteq R$. What is the condition in mathematical notation such that $\pi_A(\sigma_F(R)) = \sigma_F(\pi_A(R))$ holds where F is assumed to be a correct predicate on R ?
3. [16 points] Let $R(A, B)$ be a relation with $r > 0$ tuples, and let $S(B, C)$ be a relation with $s > 0$ tuples. We assume that A , B , and C have the *same data type*. For each of the following Relational Algebra expressions, in terms of r and s , determine the *minimum* and *maximum number of tuples* that the result relation can have. In other words, we are interested in the number of tuples the following Relational Algebra expressions can have *at least* and *at most*. The numbers have to be given by using the two variables r and s . Please note that you have to give precise explanations for your answers.
 - a. [4 points] $R \cup \rho_{T(A,B)}(S)$
 - b. [3 points] $(R \bowtie R) \bowtie R$
 - c. [4 points] $\pi_{A,C}(R \bowtie S)$
 - d. [5 points] $\sigma_{A=C}(R \bowtie S)$