

Database Management Systems

(COP 5725)

Fall 2019

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Exam 1 Part 1 Solutions

Name:	
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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
Question 1	20	
Question 2	30	
Total Part 1	50	

Question 1 (Relational Algebra) [20 points]

Provide brief answers to the following questions.

- (a) [5 points] Two relations $R(A_1: C_1, A_2: C_2, \dots, A_r: C_r)$ and $S(B_1: D_1, B_2: D_2, \dots, B_s: D_s)$ are given with arity r and s . Under what formal conditions are the two relations R and S schema compliant?

- The equality $r = s$ holds.
- There exists a permutation φ of the indices $\{1, \dots, r\}$ such that $\forall 1 \leq i \leq r : C_i = D_{\varphi(i)}$

- (b) [4 points] Determine whether the following statements are true or false, and explain why when a statement is false. (1 point for each)

- a. Given two relations with completely different attributes, the number of tuples of a natural join and the number of tuples of a Cartesian product between them are different.
 - This statement is false. When there are no common attributes, the natural join will be equal to a Cartesian product. Hence, the numbers of tuples will be the same.
- b. $\pi_A(R \cap S) = \pi_A(R) \cap \pi_A(S)$, where A is a common attribute of R and S .
 - This statement is false. Assume we have $R(A, B) = \{(1, 2)\}; S(A, B) = \{(1, 3)\}$.
 - $\pi_A(R \cap S) = \emptyset$
 - $\pi_A(R) \cap \pi_A(S) = \{(1)\}$
- c. $R \Delta S = (R - S) \cup (S - R)$
 - This statement is true.
- d. Given two relations: $R(a, b, c)$ and $L(b, c, d, e)$. The number of attributes of the following joins are the same for the expressions $R \bowtie L$ and $R \bowtie_F L$.
 - This statement is false. The natural join will have 5 attributes, and the theta join will have 7 attributes.

- (c) [6 points] Consider the following relation R :

R	X	Y
	5725	DBMS
	6610	ML
	7250	MDA

Determine a Relational Algebra expression that creates the following new relation S :

S	X1	Y	X2
	5725	DBMS	NULL

6610	ML	6610
NULL	MDA	7250

$$\rho_{R1(X1,Y)}(\sigma_{X<7000}(R))$$

$$\rho_{R2(X2,Y)}(\sigma_{X>6000}(R))$$

$$S \leftarrow R1 \bowtie R2$$

- (d) [5 points] Let us assume the relations $R(A_1: C_1, A_2: C_2, \dots, A_r: C_r)$ and $S(A_{i1}, A_{i2}, \dots, A_{in})$ where S is a projection on R with the attributes $A_{i1}, A_{i2}, \dots, A_{in} \in \{A_1, A_2, \dots, A_r\}$. Determine the *minimum* number and the *maximum* number of possible tuples that S can have, and explain under which conditions these numbers can arise.

Let $t = (v_1, \dots, v_r)$ be a tuple of R . We call $s = t|_{A_{i1}, \dots, A_{in}} = (v_{i1}, \dots, v_{in}) \in S$ the *projection tuple* of $t \in R$.

The minimum number of possible tuples in S is 1. This is the case if either R only contains a single tuple (the aspect of key attributes is unimportant in this case), or the key attributes do all or partially not belong to the projection attributes and the projection tuples formed from the tuples in R are all the same.

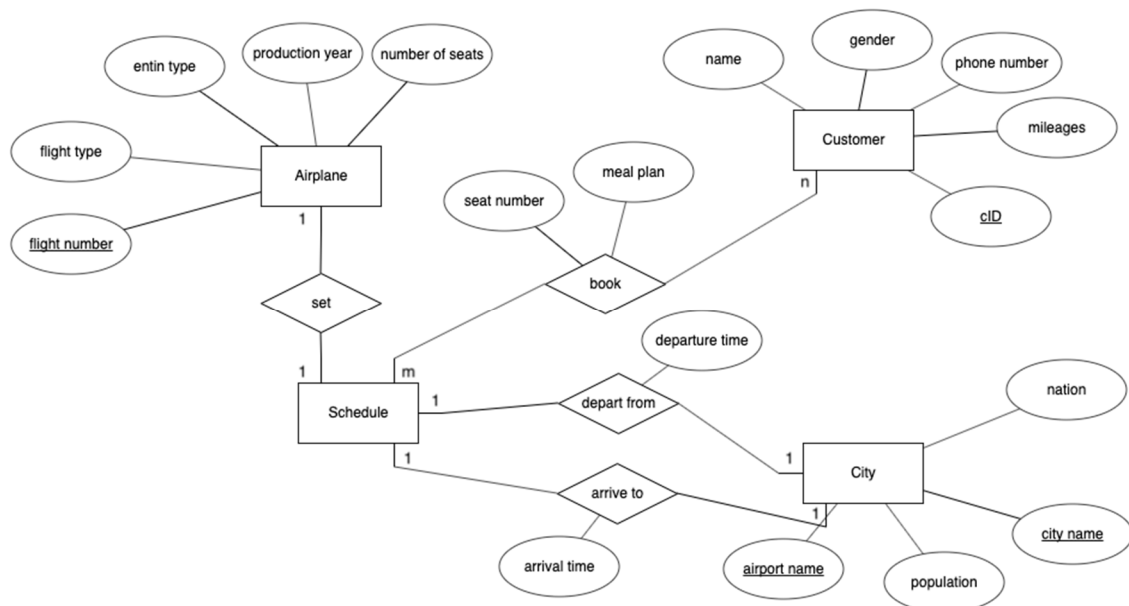
The maximum number of possible tuples in S is $|R|$. This is the case if either all key attributes belong to the projection attributes, or the key attributes do only partially or not at all belong to the projection attributes and the projection tuples formed from the tuples in R are all different.

Question 2 (ER Model) [30 points]

For the following ER design questions, identify the primary key of each entity set (if the primary key is not specified by requirement, use your best knowledge to add a key or use existing attributes). For each relationship, state the cardinalities (1:1, 1:m, m:n) between the entities participating in a relationship.

(a) [15 points] Design an ER diagram for ABC airlines' booking system.

- The system stores the data for airplanes, customers, flights schedules, and booking information.
- The airplanes have a flight type, an engine type, a production year, a number of seats, and a flight number.
- An available airplane is set a schedule.
- A schedule is associated with two cities where the airplanes depart from and travel to.
- The information of the departure and arrival which are the departure time and arrival time respectively are stored.
- A city has an airport name, nation, city name, and city population.
- A customer has a name, gender, phone number, and mileages.
- A customer can book schedules.
- When booking is done, a seat number and meal plan are stored.



(b) [15 points] Design an ER diagram for the following an Online Bookstore System.

- The system stores the customer's name, address, email which is considered as unique, and phone number.
- An author writes books and the author's name, address, and URL are stored.
- A publisher publishes books and name, address, phone number and URL are stored for the publisher.
- A book has year, title, price, and unique ISBN.
- Books are stocked in a warehouse which has an address, phone number, and warehouse code.
- Each customer can have a shopping cart that contains books and when a book is put into the cart a number is generated.
- Each shopping cart has a cartID.

