Q1 Academic Honesty

0 Points

It is a violation of the Academic Integrity Code to look at any reference material other than your textbook and lecture notes, or to give inappropriate help to someone or to receive unauthorized aid by someone in person or electronically via messaging apps such as WhatsApp. Academic Integrity is expected of all students of Hacettepe University at all times, whether in the presence or absence of members of the faculty. Do NOT sign nor take this exam if you do not agree with the honor code.

Understanding this, I declare I shall not give, use or receive unauthorized aid in this examination.

Signature (Specify your name and surname as your signature)

İbrahim Burak Tanrıkulu

While answering the following questions, please consider the implementations that we discussed in our lectures unless stated otherwise.

Q2

15 Points

Q2.1

3 Points

Which of the following is not a task of a relational database management system (RDBMS)?

- ○ Providing mechanisms to help protect the integrity of the data
- ◉ Ensuring that relational schemas do not contain any redundancy
- ○ Allowing for concurrent transactions against the database
- ○ Facilitating crash recovery of the database in case of hardware failure
- ○ Optimizing query evaluation for arbitrary SQL queries

Q2.2

3 Points

Consider a relation with five attributes R(A,B,C,D,E). How many possibilities are there for its primary key (e.g., ACE)?

- ○ 5
- ○ 24
- ◉ 31
- ○ 120
- ○ ∞

Q2.3

3 Points

Which of the following is impossible to represent in a relational schema?

- ○ any mandatory participation constraint in a many-to-one relationship
- ○ any mandatory participation constraint in a many-to-many relationship
- ○ a one-to-one relationship
- ○ a many-to-one relationship
- ◉ a ternary relationship

Q2.4
3 Points

Why are NULL values needed in the relational model? NULL values can be used for all but which one of the following?

- ○ To allow duplicate tuples in the table by filling the primary key column(s) with NULL
- ◉ To avoid confusion with actual legitimate data values like 0 for integer columns and '' (the empty string) for string columns
- ○ To leave columns in a tuple marked as “unknown” when the actual value is unknown
- ○ To fill a column in tuple when that column does not really “exist” for that particular tuple
- ○ To opt a tuple out of enforcement of a foreign key

Q2.5
3 Points

An E-R diagram can be viewed as a graph. What does the cycle in the graph mean in terms of the structure of a schema?

Q3 ER
30 Points

Consider the following requirements for a **library database**

- The library has many books, for each book we have its ISBN (unique), title, the number of copies, number of pages in this book, and the price.
- The library has two types of customers, either registered customers or un-registered customers. For all customers, we keep the ID (unique), name, DoB. For registered customers we keep additional information such as Registration ID, Tel. number, and the discount offer(s) available for that customer (can have several offers).
- Customers (either registered or not) can buy books; each customer can buy many books and can buy the same book on different dates. We want to capture the purchase

date, the number of copies purchased, and the credit card (CC) info used in the transaction (CC number, expiry date, and 3-digit security number).

- Only registered customers can borrow books, where each borrow transaction has a borrow date and it can contain at most 3 books. Each borrowed book can be returned on a different date that we want to capture.
- The library maintains storage areas only for registered customers. Each area has an ID (unique), size, and rented price. Each area belongs to at most one customer and each customer can have at most one storage area.

Q3.1

15 Points

Create the ER Diagram for the application mentioned above.

▾ 2020_12_03 11_37 Office Lens.pdf Download

Q3.2

15 Points

Convert your ER Diagram to its corresponding relational model. For each relation, write it in the form of R(A1, A2,....An),

- state primary keys in the form of `R.PK(A1,..Ai)` where $1 \leq i \leq n$
- and also state the foreign keys in the form of `R.Ai (FK) References S.Aj (PK)` where $1 \leq i, j \leq n$ and S denotes another relation.

book(ISBN,title,price,numOfCopies,numOfPages,borrowedBy)
book.PK(ISBN)
book.A3(borrowedBy) References Customer.A1(ID)
Customer(ID,DoB,name)
Customer.PK(ID)
UnregisteredCustomer(ID,DoB,name)
UnregisteredCustomer.PK(ID)
RegisteredCustomer(ID,DoB,name,regID,TelNum,offersOf,ownerOf)
RegisteredCustomer.PK(ID)
RegisteredCustomer.A1(offers) References Discount.A1(ID)
RegisteredCustomer.A1(ownerOf) References Storage.A1(ID)
Discount(ID)
Discount.PK(ID)
Storage(ID,Size,Price)
Storage.PK(ID)
buy(ID,ISBN,numOfCopiesPurchased,CC)
buy.PK(ID,ISBN)
CreditCard(CCnum,expDate,3dNum)

Q4 SQL

7 Points

Consider the SQL statements given below.

```
Create Table t (c int);
Insert into t Values (1), (2), (3), (4), (5);

Select SUM(________) From t;
```

Q4.1

3 Points

What should come to the empty place so that the output of the select statement is 5?

*

Q4.2
2 Points

What should come to the empty place so that the output of the select statement is 10?

c-1

Q4.3
2 Points

What should come to the empty place so that the output of the select statement is 30?

c*2

Q5 Relational Schemas
12 Points

Implement the relational schema below by using the least number of SQL statements.

```
Department (id, name, headId);
Person (id, name, deptId);
```

Hint 1: *headId* and *deptId* attributes are references to the keys of *Person* an *Department* tables, respectively.

Hint 2: You can use *int* and *varchar* for the types of *id* and *name* attributes, respectively.

```
create table Department(
id int,
name varchar(20),
headId int,
primary key (id)
foreign key (headId) references Person);
create table Person(
```

```
id int,
name varchar(20),
deptId int,
primary key (id)
foreign key (deptId) references Department);
```

Q6
20 Points

Consider the **Employee (name, salary)** relation, which holds names and salaries of employees in a company.
hint: You can assume that the name attribute is unique.

Q6.1
10 Points

Write an SQL query that will return the name of the employee(s) who has(have) secured the third highest salary.

```
select max(salary) from Employee where in ()
```

Q6.2
10 Points

Write an SQL query to find the second highest salary among the employees?

```
select max(salary) from Employee where not in (select
max(salary) from Employee)
```

Q7 Relational Algebra
7 Points

Let R and S be two relations with the following schema:

R (P, Q, R1, R2, R3)
S (P, Q, S1, S2)

Where {P, Q} is the key for both schemas. Which of the following queries are equivalent?

I. $\Pi_P (R \bowtie S)$
II. $\Pi_P (R) \bowtie \Pi_P (S)$
III. $\Pi_P (\Pi_{P,Q} (R) \cap \Pi_{P,Q} (S))$
IV. $\Pi_P (\Pi_{P,Q} (R) - (\Pi_{P,Q} (R) - \Pi_{P,Q} (S)))$

- ○ I, III
- ◉ III, IV
- ○ II, III, IV
- ○ I, III, IV

Q8

9 Points

A database schema containing two tables *A* and *B* are created by using the *create.sql* script given below. To populate records in tables *A* and *B*, the *populate.sql* script is wanted to be used.

Can you use the *populate.sql* script as it is to populate records in tables? If no, propose three alternative (and different) ways to populate tables.

Hint 1: You can make modifications in scripts without changing the data.

Hint 2: Please explain your alternative solutions verbally with two sentences at most. You are **NOT** supposed to provide any SQL statement as your answer.

create.sql	populate.sql

`Create Table A (`
`  c1 integer Primary Key Not Null,`
`  c2 char(2) Not Null,`
`);`
`Create Table B (`
`  c1 integer Primary Key Not Null,`
`  c2 char(2) Not Null,`
`  c3 integer,`
`  Constraint B_FK`
`  Foreign Key`
`  c3 References A(c1)`
`);`
	`Insert into B Values (1, "A1", 1);`
	`Insert into A Values (1, "B1");`
	`Insert into B Values (2, "A2", 3);`
	`Insert into A Values (2, "B2");`
	`Insert into B Values (3, "A3", 2);`
	`Insert into A Values (3, "B3");`
	`Insert into B Values (4, "A4", 1);`

Alternative #1

Alternative #2

Alternative #3

Midterm Exam

GRADED

STUDENT

IBRAHIM BURAK TANRIKULU

TOTAL POINTS

42 / 100 pts

QUESTION 1

Academic Honesty **0** / 0 pts

QUESTION 2

(no title) **6** / 15 pts

2.1 (no title) **3** / 3 pts

2.2 (no title) **3** / 3 pts

2.3 (no title) **0** / 3 pts

2.4 (no title) **0** / 3 pts

2.5 (no title) **0** / 3 pts

QUESTION 3

ER **18** / 30 pts

3.1 (no title) **9** / 15 pts

3.2 (no title) **9** / 15 pts

QUESTION 4

SQL **4** / 7 pts

4.1 (no title) **0** / 3 pts

4.2 (no title) R **2** / 2 pts

4.3 (no title) R **2** / 2 pts

QUESTION 5

Relational Schemas **4** / 12 pts

QUESTION 6

(no title) **10** / 20 pts

6.1 (no title) **0** / 10 pts

6.2 (no title) **10** / 10 pts

QUESTION 7

Relational Algebra **0** / 7 pts

QUESTION 8

(no title) **0** / 9 pts