جامعة بيرزيت

BIRZEIT UNIVERSITY
Computer Science Department
Database Systems 333

Midterm

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Circle your instructor:

- [x] Bassem Sayrafi (Section 1 – T R 11:25)
- [ ] Bassem Sayrafi (Section 2 M W 10:00)
- [ ] Mohammad Moreb (Section 3 – M W 12:50)
- [ ] Mohammad Moreb (Section 4 – S W 10:00)
- [ ] Wahbeh Mousa (Section 5 – M W 10:00)

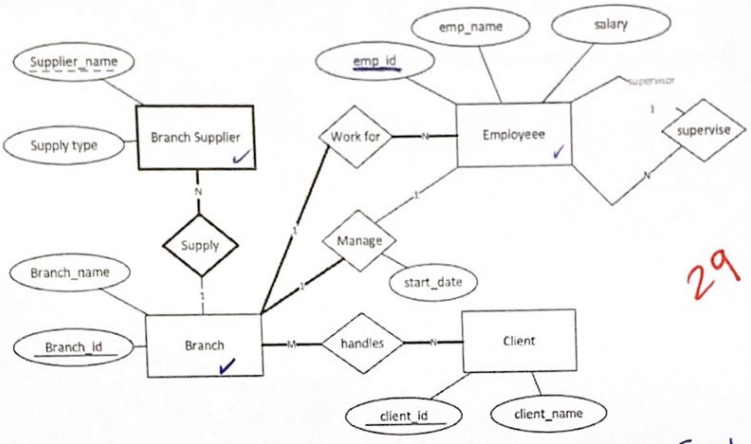
Question	Mark
Q1 Relational Model	29
Q2 Relational Algebra	20
Q3 SQL1	9
Q4 SQL2	11
Q5 ER Diagram	24
Total:	93

- Write your name and ID on each page.
- Use blue ink only.
- This exam is composed of 7 pages. The last page is blank.

(30%) Question 1 – Relational Model

The following is an ER diagram about a company organized into branches and each branch has a particular employee who manages it. The company makes its money by selling to clients. The foundation of the company is its Employees - An employee can work for one branch at a time and each branch will be managed by one of the employees that work there. At the branch an employee may also act as a supervisor for other employees. Each Branch has its own suppliers to buy inventory.

Write necessary create table statements with constraints and keys and after merging what is necessary. Any extra tables will lose points. Assume referential integrity constraints are deferred.



29

① create table Branch(
Branch-id int primary key,
Branch-name varchar(32),
emp-id int not null,
manager
start_date date,
);

② create table Employee(
emp-id int primary key,
emp_name varchar(32),
salary int,
Branch-id int,
supervisor_id int,
foreign key (Branch-id) references Branch (Branch-id)

④ Alter table Branch add foreign key(emp-id)
references Employee (emp-id);

⑤ create table Client(
client-id int primary key,
client-name varchar(32));

③ create table Branch-Supplier(
supplier_name varchar(32) not null,
Branch-id int not null,
supply-type varchar(32),
primary key (supplier_name, Branch-id),
foreign key (Branch-id) references Branch(Branch-id)
on delete cascade);

⑥ create table Branch2Client(
client-id int not null,
Branch-id int not null,
primary key (client-id, Branch-id)
foreign key (client-id) references
Client (client-id),
foreign key (Branch-id) referen
Branch (Branch-id));

(20%) Question 2 – Relational Algebra

Every day, students Ride on a trip from Ramallah to Birzeit University using public transportation known as "fords". A student pays a price for each trip that takes place on a specific day and time.

Consider the following relations

Student(sid:int, sname: string, birthdate: date, gender: string)

Ford(ford_id int, ford_name string, model string, model_year date, ford_color: string)

Trip (trip_id int, trip_year int, trip_month int, trip_day: int, trip_hour int, trip_minute int, trip_length int)

Ride(ford_id int, sid_id int, trip_id int, price double)

Write the following queries in Relational Algebra:

$\rho(S, Student), \rho(F, Ford), \rho(T, Trip), \rho(R, Ride)$

a. Find the student names who have ridden on a ford whose color was yellow and paid 5 shekels for the trip.

$$\Pi_{S.sname}\left[S \bowtie \left(\sigma_{R.price=5}(R) \bowtie \sigma_{F.ford\_color='yellow'}(F)\right)\right]$$

b. Find the student names and ids of students who did not ride in any ford in 2021.

$$\Pi_{S.sname, S.sid}(S) - \Pi_{S.sname, S.sid}\left[S \bowtie R \bowtie \left(\sigma_{T.trip\_year=2021}(T)\right)\right]$$

c. Find the female student names who rode on the same ford twice and in the same day, month and year.

~~$\rho(S1, \sigma_{S.gender="female"} Student) : S1.sid \rightarrow S1.sid1$~~

$\rho(R1, Ride) : R1.sid \rightarrow R1.sid1$

$\rho(R2, Ride) : R2.sid \rightarrow R2.sid2$

$$\sigma\left[T \bowtie \sigma_{\substack{R1.sid1=R2.sid2 \\ \wedge R1.ford\_id=R2.ford\_id \\ \wedge R1.tripid>R2.trip\_id}}(R1 \times R2)\right]$$

$$\sigma_{R1.sid1=R2.sid2 \wedge R1.ford\_id=R2.ford\_id \wedge R1.trip\_id>R2.trip\_id \wedge R1 \bowtie T.trip\_year=R2 \bowtie T.trip\_year}\left((R1 \bowtie T) \times (R2 \bowtie T)\right)$$

ظهر الورقة

Q2: ⓒ $\rho(C_1, R \bowtie T)$

$\rho(C_2, R \bowtie T)$

$$\Pi_{S.sname}\left(\sigma_{\substack{C_1.sid\_id = C_2.sid\_id \\ \wedge\ C_1.ford\_id = C_2.ford\_id \\ \wedge\ C_1.trip\_id > C_2.trip\_id \\ \wedge\ C_1.trip\_year = C_2.trip\_year \\ \wedge\ C_1.trip\_month = C_2.trip\_month \\ \wedge\ C_1.trip\_day = C_2.trip\_day}}(C_1 \times C_2) \bowtie \sigma_{S.gender = \text{"female"}}(S)\right)$$

(10%) Question 3 – Basic SQL1

Every day, students Ride on a trip from Ramallah to Birzeit University using public transportation known as "fords". A student pays a price for each trip that takes place on a specific day and time.

Consider the following relations

Student(sid:int, sname: string, birthdate: date, gender: string)
Ford(ford_id int, ford_name string, model string, model_year date, ford_color: string)
Trip (trip_id int, trip_year int, trip_month int, trip_day: int, trip_hour int, trip_minute int, trip_length int)
Ride(ford_id int, sid_id int, trip_id int, price double)

Gender: takes values "female" or "male". Model_year: is the year the ford was built (سنة التصنيع)
Write the following queries in SQL

1) The name of male students who have ridden on an orange ford built in 2022 and paid 4.5 shekels for the trip.

```
Select  S.Sname
from  Student S, Ford F, Ride R , Trip T
where  S.sid = R.sid_id
    and R.ford_id = F.ford_id
    and S.gender = "male"
    and F.ford_color = "orange"
    and F.model_year = 2022
    and R.trip_id = T.trip_id  and T.price = 4.5 ;
```

2) For each month, Print the count of how many trips were made by fords.

```
select  COUNT(*), T.trip_month
from  Trip T,
group by T.trip_month ;
```

(15%) Question 4 – Advanced SQL2

For the same schema found in the previous question, Write the following queries in SQL

1) Print the names of students born on or after 1/1/2002 who rode on all the yellow fords.

```
select S.sname
from Student S, Ford F, Ride R
where S.sid = R.sid_id
  and R.ford_id = F.ford_id
  and S.birthdate >= '1/1/2002'
  and F.ford_color
```

```
select S.sname
from student S where not exist
(select F.ford_id
 from Ford F
 where F.ford_id not
 (select Ff.ford_id
  from Ford Ff, Ride R
  where Ff.ford_color = "yellow"
    and R.ford_id = Ff.ford_id
    and R.sid_id = S.sid
    and S.birthdate >= '1/1/2002'))
```

2) For each student, print the student name and how many trips he/she made during 2021.

```
select S.sname, count(*)
from Student S, Ride R, Trip T
where S.sid = R.sid_id
  and R.trip_id = T.trip_id
  and T.trip_year = 2021
group by S.sid
```

3) For each ford, print the ford id and the average length of trips made by that ford. Only show fords that made at least 10 trips.

```
select F.ford_id, AVG(T.trip_lenght)
from Ford F, Trip T, Ride R
where F.ford_id = R.ford_id
  and R.ford_id = T.ford_id
  and T.trip_id = R.trip_id
have count(*) >= 10 ;
```

(25%) Question 5 – ER Diagram

Mahmoud Darwish Gallery is a renowned photo and painting exhibitor (معرض صور ورسومات مشهور). The gallery keeps information (معلومات) about artists such as their ids, names, address, age, and sex. All the artists fall into two categories: painter (رسام), and photographer (مصور). A painter has a favorite brush and a photographer has a favorite camera type. For each piece of artwork (عمل فني), its unique id, the artist, its name, description, and price is stored. Each artwork can be produced by only one artist. The time it took to produce it is recorded. Artworks are subdivided into two categories, paintings, and photos. Photos have information about the name of the area being photographed. Photos are photographed using disposable cameras (كاميرا قابلة للاستخدام لمرة واحدة فقط). Each photograph must be taken by one disposable camera only, and a disposable camera can only take one photograph. Information about the disposable camera used to capture the photo is recorded such as: camera's name, exposure time and focal length. A disposable camera is uniquely identified by the camera name and the photo/artwork id which was taken by that camera. The paintings have information about the type of paint used to paint the painting and its genre (نوع الرسمة).

Finally, the gallery keeps information about customers. For each customer, the gallery stores his/her customer id, name, address and the artists and the artworks the customer maybe interested in.

Design an ER diagram for the aircraft maintenance tracking system described above. Draw the ER diagram with all its components (entities, relationships, class hierarchies, weak entities, total participation and participation constraints (1-n, m-n, 1-1)).