Database systems
Simulation of Written exam
June 9, 2022

Draft solution

TQ1 - Theory question - Select the correct answer	**Points 1**
The primary key of a table A. none of the answers is correct B. must be unique but it might be equal to NULL C. must include only one attribute D. must include at least two attributes E. must be referenced by a foreign key	
Solution: **Answer: A**	

TQ2: Theory question - Motivate the answer **Points 1**

The following relational table is given (primary keys are underlined, optional attributes are denoted as '*'):

LESSON (CourseCode, Date, Hour, Classroom, TeacherID*)

Check whether the following instance is consistent with the table schema. Justify the answer.

CourseCode	Date	Hour	Classroom	TeacherID*
01_TA	17/10/2021	10:00	12A	TID1
02_XA	22/1/2022	17:00	NULL	TID2
011_TO	30/9/2021	NULL	11	TID3
07_XB	18/12/2021	15:00	2P	TID3
07_XB	18/12/2021	15:00	21A	TID4
20_7TT	2/2/2022	21:00	12B	NULL

The following records are incorrect

CourseCode	Date	Hour	Classroom	TeacherID*
01_TA	17/10/2021	10:00	12A	TID1
02_XA	22/1/2022	17:00	**NULL Note: Attribute Classroom cannot assume the NULL value**	TID2
011_TO	30/9/2021	**NULL Note: Attribute Hour cannot assume the NULL value**	11	TID3
07_XB	18/12/2021	15:00	2P	TID3
~~**07_XB**~~	~~**18/12/2021**~~	~~**15:00**~~	~~**21A**~~	~~**TID4**~~
The two records have the same primary key value				
20_7TT	2/2/2022	21:00	12B	NULL

TQ3: Theory question - Select the correct answer **Points 1**

The SQL instruction

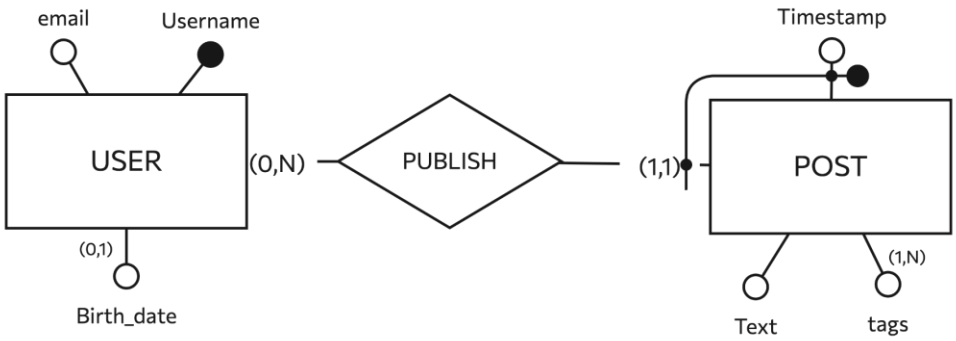
```
CREATE TABLE T1
(A1 CHAR(5) NOT NULL,
A2 INTEGER NOT NULL DEFAULT 0,
A3 CHAR(5),
PRIMARY KEY (A1),
FOREIGN KEY (A2) REFERENCES T2(A2),
ON DELETE SET DEFAULT);
```

A. It creates the table T1 in which any delete operation on T1 violating the referential integrity constraint causes the insertion of default values in the corresponding attributes of T2
B. It creates the table T1 in which any delete operation on T2 violating the referential integrity constraint causes the insertion of default values in the corresponding T1 attributes
C. It creates the table T1 in which any delete operation on either T1 or T2 violating the referential integrity constraint causes the insertion of default values in the corresponding attributes of the other table
D. none of the answers are correct

Answer: B

TQ4: Theory question - Select the correct answer **Point 1**

Given the following conceptual schema represented using the Entity-Relationship diagram



Select the corresponding logical schema (primary keys are underlined, optional attributes are denoted as '*'):

A. USER (Username, email, Birth_date)
PUBLISH (Username, Timestamp)
POST (Timestamp, Text, tags)

B. USER (Username, email, Birth_date*)
POST (Timestamp, Text)
TAGS (Timestamp, tags)

C. USER (Username, email, Birth_date*)
POST (Timestamp, Username, Text)
TAGS (Timestamp, Username, tags)

D. USER (Username, email, Birth_date)
POST (Timestamp, Username, Text)
TAGS (Timestamp, tags)

Answer: C

SQL1: Writing queries using the SQL language **Points 3**

Given the following relational tables (primary keys are underlined, optional attributes are denoted as '*'):

PERSON (SSN, Name, Surname, DateOfBirth, Gender)
SERIOLOGICAL-TEST (STCode, CommercialName, Brand, Reliability)
BUILDING (BCode, City, Province Region, MaxCapacity)
UNDERGO-TEST (SSN, STCode, Date, BCode, Outcome)

Write the following query in the SQL language:
Find the name and surname of the male persons (Gender = "Male") who have never undergone serological tests with a positive outcome (Outcome = "Positive") in a building located in the city of Turin.

Solution:

```
SELECT Name, Surname
FROM PERSON
WHERE SSN NOT IN (
    SELECT SSN
    FROM UNDERGO-TEST UT, BUILDING B
    WHERE UT.BCode = B. BCode AND Outcome = "Positive" AND City = "Turin")
AND Gender = "Male"
```

SQL2: Writing queries using the SQL language **Points 3**

Given the following relational tables (primary keys are underlined, optional attributes are denoted as '*'):

FOOTBALL-PLAYER (FPCode, Name, Surname, Address, CityOfBirth)
TEAM (TCode, Name, Category, ConstitutionDate)
AWARD (ACode, FPCode, DeliveryDate, DeliveryPlace, Type)
PLAYER-TEAM (FPCode, TCode, StartingDate, EndingDate, NumPlayedMatches, NumGoals)

Write the following query in SQL language:
Find name, surname of the football players who played in at least one team of category "Serie A" and who received at least two awards of type "Top scorer".

Solution:

```
SELECT Name, Surname
FROM FOOTBALL-PLAYER FP, AWARD A
WHERE FP.FPCode = A.FPCode AND Type='Top scorer'
AND FP.FPCode IN
    (SELECT FPCode
    FROM TEAM T, PLAYER-TEAM PT
    WHERE PT.TCode = T.TCode AND Category = 'Serie A')
GROUP BY FP. FPCode, Name, Surname
HAVING COUNT(*)>=2;
```

Alternative solution

```
SELECT Name, Surname
FROM FOOTBALL-PLAYER
WHERE FPCode IN
    (SELECT FPCode
    FROM TEAM T, PLAYER-TEAM PT
    WHERE PT.TCode = T.TCode AND Category = ‘Serie A’)
AND FPCode IN
     (SELECT FPCode
      FROM AWARD
      WHERE Type=’Top scorer’
      GROUP BY FPCode
      HAVING COUNT(*)>=2)
```

SQL3: Writing queries using the SQL language **Points 4**

Given the following relational tables (primary keys are underlined, optional attributes are denoted as '*'):

LOCATION (LCode, Name, City, Region, MaxCapacity)
EVENT (ECode, Title, Type)
EDITION (ECode, Date, LCode, NumberOfParticipants)

Write the following query in SQL language:
For each event of type "Theater Festival" for which more than two editions were (overall) held in 2021, show event title, number of editions and number of different locations.

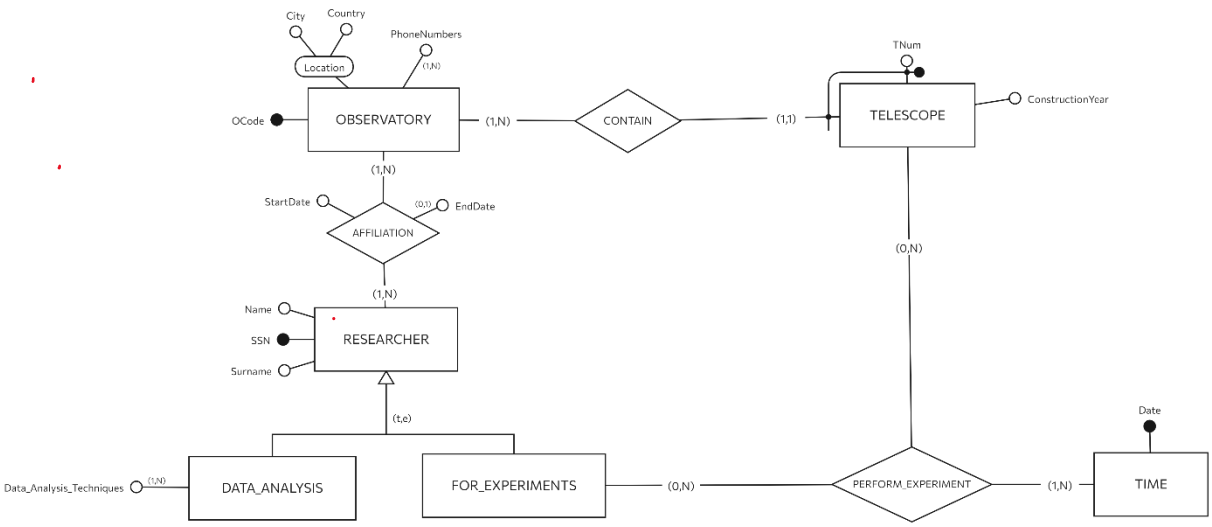
Solution

```
SELECT Title, COUNT(*), COUNT(DISTINCT LCode)
FROM EVENT E, EDITION ED
WHERE Type ='Theatre Festival'
AND E.ECode = ED.ECode
AND E.ECode IN (
      SELECT ECode
      FROM EDITION
      WHERE Date => 1/1/2021 and Date <= 31/12/2021
      GROUP BY ECode
      HAVING COUNT(*) > 2
      )
GROUP BY E.ECode, Title
```

CD1: Conceptual design of a relational database **Points 4**

The National Institute of Astrophysics is required to design a database collecting information relating to the experimental sessions executed at the Italian astronomical observatories. Describe the Entity-Relationship diagram addressing the following specifications:

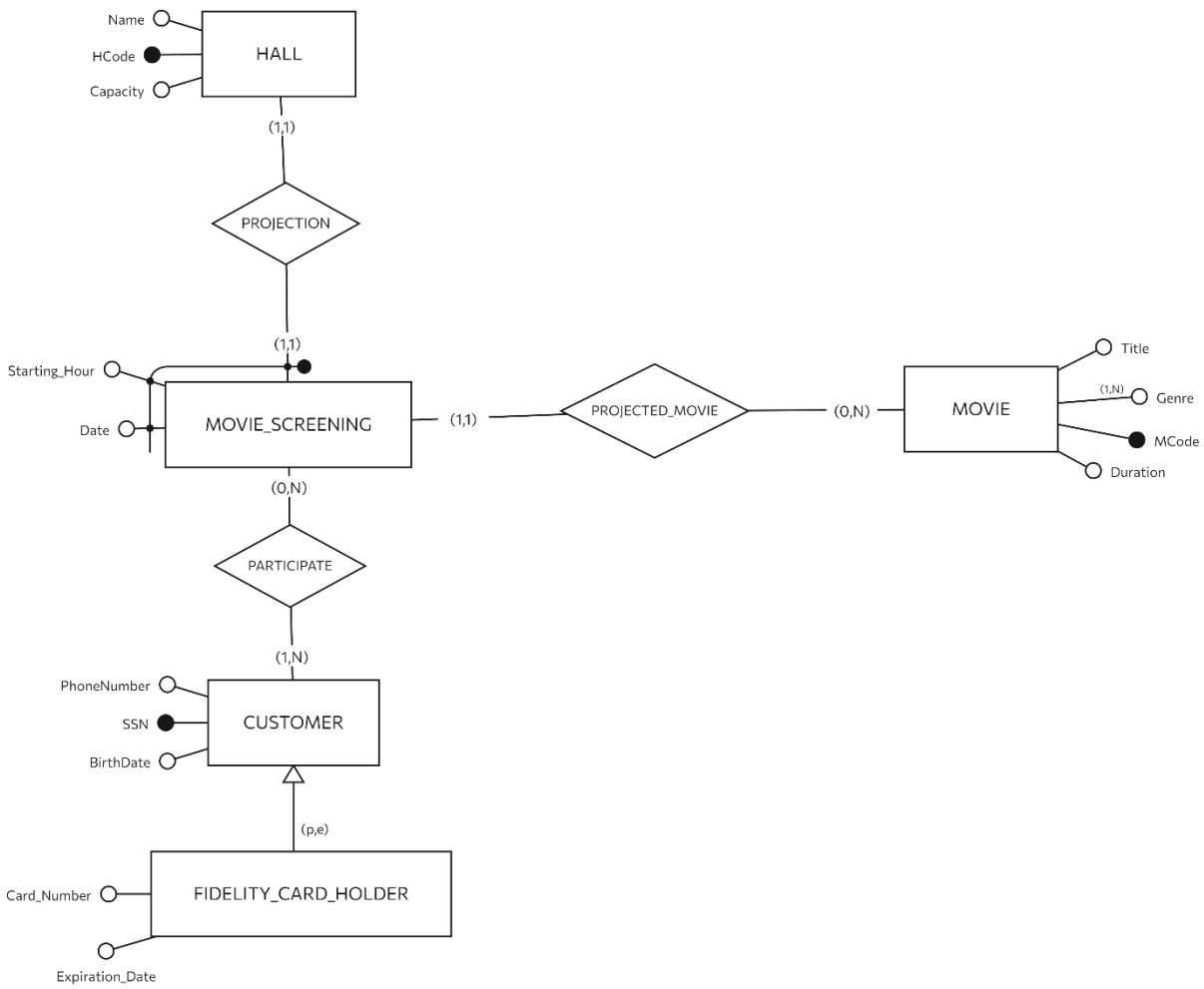
- Astronomical observatories are identified by a unique code. They are characterized by their location (i.e., the city and the country where they are located), a list of telephone numbers, and the list of telescopes they include.
- Each telescope is identified by a number, unique within the observatory to which it belongs, and it is characterized by the year of construction.
- The researchers, whose name, surname, and social security number are known, are affiliated with one or more observatories. The last period of affiliation (start date, end date) in each observatory is known for each researcher. Please note that the affiliation can still be ongoing, hence the end date could be unknown. An observatory can have many affiliated researchers.
- Researchers are divided into researchers who perform the telescope experiments and those who perform the analysis of the collected data.
- For each of the researchers belonging to the latter category, the list of data analysis techniques known to the researcher are known.
- For each of the researchers belonging to the first category, the database must record the different experimental sessions executed at the telescopes by researchers. For each experimental session, the date, the telescope used, and the researcher who conducts it are known. Consider that (1) a researcher can carry out an experimental session with the same telescope on different days; (2) a researcher can carry out several experimental sessions with different telescopes on the same day; (3) a telescope can be on the same day for more than one experimental session.



CD2: Conceptual design of a relational database **Points 5**

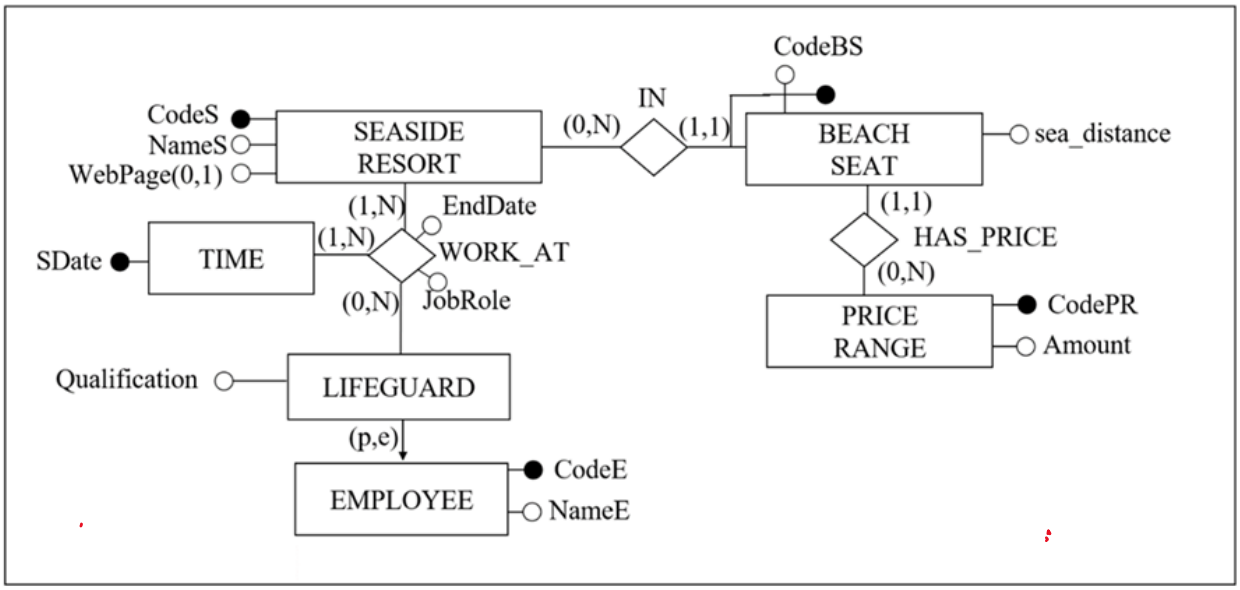
You are required to create a database for the management of the movie screenings in multiplex cinema. Describe the Entity-Relationship diagram addressing the following specifications:

- The cinema has some halls, identified by a number. For each hall, its name and capacity are known. Movies shown at the cinema are identified by a unique code and they are characterized by their title, duration, and year of release. Movies are also characterized by the list of associated genres.
- Each hall hosts screenings of different movies. Each movie screening is identified by when it takes place (expressed as the date and starting hour) and the hall where it takes place. The movie screening is also characterized by the projected movie.
- For each movie screening, the database must record the list of customers watching it. For each customer, their name, social security number, telephone number and date of birth are known. Some customers have a loyalty card, which grants them some discounts. For such customers, the card number and the expiration date of the card are known.



LD1: Logical Design of a Relational database **Points 4**

Given the following Entity-Relationship diagram, you are required to provide a normalized relational logical schema for the same database.



SEASIDE_RESORT (CodeS, NameS, WebPage*)
TIME (SDate)
EMPLOYEE (CodE, NameE, Qualification*, TypeOfEmployee)
WORK_AT (CodeS, SDate, CodeE, JobRole, EndDate)
PRICE_RANGE (CodePR, Amount)
BEACH_SEAT (CodS, CodeBS, sea_distance, CodePR)

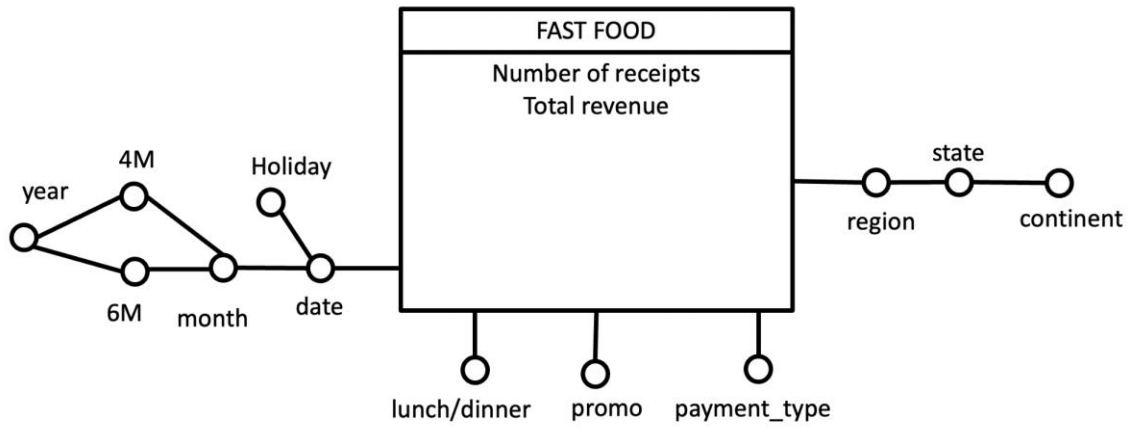
DWD: Data warehouse design **Points 4**

A worldwide fast-food company is interested in analyzing its revenues.
The fast-food services are divided into lunches (around noon) and dinners (in the evening). The company is interested in analyzing the purchases paid with different payment methods (each purchase can be paid only with a specific method). In particular, the company is interested in analyzing the purchases that used promotions. Promotions can be of different types: coupons, fidelity points, or menu discounts. Only one promotion can be used for the same purchase.

The company is interested in analyzing the total number of receipt and the average revenue per receipt according to:

- region, state, and continent
- date, holiday, month, 4 -month period, semester, year
- lunch or dinner
- payment type (e.g., credit card, cash)
- type of promotions used (e.g., coupon, discount, fidelity, points)

Write the conceptual and logical model of the data warehouse



Logical design

TIME (<u>TID</u>, data, holiday, month, 4M, 6M, year)
LOCATION (<u>LID</u>, region, state, continent)
LUNCH_DINNER (<u>LDID</u>, lunch_dinner)
PROMO (<u>PID</u>, promo)
PAYMENT (<u>PTID</u>, payment_type)
FAST_FOOD (<u>TID</u>, <u>LID</u>, <u>LDID</u>, <u>PID</u>, <u>PTID</u>, Number_of_receipts, Total_revenue)