Databases 2.0

14th November 2024

Examination paper

Answer ALL questions.

Clearly cross out surplus answers.

Time: 3 hours

The maximum mark for this paper is 100.

Any reference material brought into the examination room must be handed to the invigilator before the start of the examination.

Answer ALL questions

Marks

Question 1

A university database tracks information about students, modules, professors and the departments to which they belong.
Each student is enrolled in multiple modules and each module is taught by one or more professors. Professors are assigned to specific departments and each department offers multiple modules.

a) Identify FOUR (4) entities in the university database system based on the scenario provided. **4**

b) Identify an example of a primary key that could be used in one of the entities you've identified in a). Explain how a primary key can be used to uniquely identify records. **3**

c) Identify an example of a foreign key that could be used in the given scenario. Explain how it would ensure referential integrity. **3**

Total 10 Marks

Question 2

A small online shopping platform uses a relational database to manage user accounts, transactions and product listings. Each day, the system handles several transactions and the platform must ensure that all operations run smoothly and consistently.

a) Identify each property in ACID. Provide ONE (1) practical example of how each property would help ensure smooth operations for the online shopping platform. **8**

b) Explain the purpose of the ROLLBACK command in SQL. Identify a situation where it would be used. **2**

Total 10 marks

Marks

Question 3

Scenario: **10**

A restaurant wants to create a database to manage its customers, menu items and the orders placed by customers.

Customers can place multiple orders and each order can contain ONE (1) or more menu items. Menu items can be part of many orders.

Draw an Entity Relationship Diagram for the restaurant database that includes FOUR (4) entities: menu item, order detail, order and customer.

You need to identify relationships, cardinalities and label all the primary and foreign keys. Clearly state which entity the keys belong to.

Total 10 marks

Question 4

a) A smart parking system uses a database to manage parking spots, cars and parking reservations. **4**

Entities:

- Parking spot
- Car
- Reservation

Create a CRUD matrix to show the following transactions:

Transaction 1 – Add a new parking spot to the system

Transaction 2 – Create a new parking reservation for an existing car

Transaction 3 – Update car information for an existing reservation

Transaction 4 – Remove a parking spot that is no longer available

b) Explain data integrity. **1**

c) Identify **and** explain TWO (2) potential issues that could arise if data integrity is not enforced when removing a parking spot that is currently reserved or occupied. **4**

Marks

d) Identify ONE (1) database mechanism that can be used to maintain data integrity in the situation described in c). **1**

Total Marks 10

Question 5

a) A local gym maintains a spreadsheet to track memberships and training sessions. The spreadsheet records each member's ID and full name, along with the names of the trainers and the dates for training sessions. **8**

Each member can have multiple training sessions, but they can only work with one trainer per session.

The current structure of the data does not conform to the First Normal Form. Convert the provided data into 1NF. Make sure you clearly identify keys.

Provided data:

member_id	member_name	training_sessions
201	Tom Johnson	“Strength training” with Luke “Kick boxing” with Daniel
202	Alice Smith	“Weightlifting” with Ben
203	Chris Lee	“Cardio” with Luke “Pilates” with Sarah “Core training” with Daniel

b) The gym is considering switching from a spreadsheet to a database system for managing memberships and training sessions. Identify TWO (2) advantages of using a database system compared to the current spreadsheet. **2**

Total 10 marks

Marks

Question 6

Review the scenario in Question 4. It is shown below for your convenience:

A smart parking system uses a database to manage parking spots, cars and parking reservations.

Entities:

- Parking spot
- Car
- Reservation

Write the appropriate SQL command to perform each of the following tasks to the parking_spot data provided below.

parking_spot

spot_id	location	charge_per_hour (£)	spot_type
1	AB1	2.00	Electric
2	BG2	1.50	Regular
3	EN8	2.99	Regular

a) Create the `parking_spot` table. **5**

b) The `parking_spot` table needs to be updated to include a new column named is`_reserved` to track whether a spot is reserved or not. **2**

c) The `charge_per_hour` for the parking slot with spot_id 3 needs to be updated to £3.50. **3**

Total 10 marks

Marks

Question 7

Review the scenario described in Question 4. The database contains the following tables.

parking_spot

spot_id(PK)	location	charge_per_hour (£)	spot_type
1	AB1	2	Electric
2	BG2	1.5	Regular
3	EN8	2.99	Regular

car

licence_plate(PK)	owner_name
XYZ1234	Chris Lee
ABD1234	Alice Smith
BDF1234	John Brown

reservation

reservation_id(PK)	start_time	end_time	licence_plate(FK)	spot_id(FK)
301	2024-12-23 09:00:00	2024-12-23 10:00:00	XYZ1234	1
302	2024-11-02 12:00:00	2024-11-02 14:10:00	ABD1234	2
303	2024-10-14 08:00:00	2024-10-14 11:30:00	BDF1234	2
304	2024-09-20 19:00:00	2024-09-20 22:00:00	ABD1234	3
305	2024-09-16 11:00:00	2024-09-16 13:00:00	BDF1234	1

a) Write an SQL command to display all the reservations that take place on parking spots with the spot_type ‘Regular’. **3**

b) Write an SQL command to display each car’s licence_plate, owner_name and the location of the parking spot it was reserved in. **3**

c) Write an SQL command to list each car’s licence_plate, owner_name and the total number of reservations it has made. **4**

Total 10 marks

Marks

Question 8

A national wildlife research organisation has been using paper-based records to track animal sightings, habitats and population counts for several endangered species. **10**

Field researchers manually record this information during fieldwork and later submit the data to a central office, where it is stored in physical filing cabinets.

The organisation is considering moving to a database system to improve the efficiency of its data collection and management.

Identify FIVE (5) advantages of using a database system over the current manual system. Provide ONE (1) specific example to illustrate each advantage.

Total 10 marks

Question 9

a) A national healthcare provider has recently faced issues related to the mismanagement of their patient database. **8**

Identify FOUR (4) possible consequences of failing to properly manage their database backup and recovery processes. Provide an explanation of each consequence.

b) A small e-commerce startup company is considering moving their database to the cloud. The company has limited technical staff and wants to focus on developing their product rather than managing IT infrastructure. **2**

Identify a suitable cloud database model for them. Provide ONE (1) reason to support your answer.

Total 10 marks

Marks

Question 10

A new social media platform is developing a scalable backend to store a wide variety of data, including user profiles, real-time messages, social connections and user activity logs. The platform is considering using a NoSQL database to manage its data efficiently.

a) Define what NoSQL stands for. **1**

b) Identify and explain THREE (3) NoSQL data models that could be used to store different types of data for the platform. Provide ONE (1) example of data that each model would handle best. **6**

c) Consider the 3V model: Volume, Variety and Velocity and how it applies to the data management challenges the social media platform might face when handling large-scale data. **3**

Provide an explanation of each V in this context.

Total 10 marks

End of Paper