

Databases Intermediate Exercise

1) Describe three advantages of databases over the traditional file processing systems.

Solution: (three of the following)

- Elimination of data redundancy
- Elimination of data inconsistency
- Greater data integrity
- Independence from application programs
- Improved data access to users through use of query languages
- Improved data security

2) Explain the following terms: candidate key, primary key and foreign key.

Solution:

Candidate key is a key (field) that is unique.

Primary key is one (and only one) of the candidate keys that is chosen to represent the records.

A foreign key is a field that is added to a table to create a relationship.

3) Name three database models.

Solution: (three of the following)

- Flat model
- Hierarchical model
- Network model
- Relational model
- Object-oriented model

4) Mention three responsibilities of a DBA.

Solution: (three of the following)

- Establishing the needs of users
- Mapping out the conceptual design
- Monitoring user access
- Security
- Monitoring performance and managing parameters to provide fast query responses
- Maintaining adherence to the Data Protection Act
- Creating and modifying the database through the use of the DDL.
- Controlling access privileges.
- Developing, managing and testing back-up and recovery plans.

5) Describe the three levels (schemas) of a database.

Solution: A schema is a description of the database.

The three schemas are:

- External schema (**user**)
 - A high-level description of the database
 - For the database users
 - Each user will have a different description (e.g. not all users can see all files) i.e. we have multiple external schemas
- Conceptual schema (**designer**)
 - An intermediate-level description of the database
 - Used by the designer of the database to specify how the data will be stored inside the DBMS (e.g. how the tables are organized, the fields in each table etc.)
 - There is only ONE conceptual schema for each database
 - The conceptual schema must encompass all the external schemas in the database
- Physical schema (**database administrator**)
 - A low-level description of the database
 - Used by the database administrator to specify how the files used in the conceptual schema will be stored e.g. will file be sequential or random, what media should be used (e.g. hard-disk or flash memory), how is the file going to be accessed (e.g. use an index etc.)
 - There is also only ONE physical schema for each database

6) Define the terms: referential integrity, validation, SQL.

Solution

Referential Integrity is a condition whereby the DBMS allows only valid relationships in the database.

Validation is a technique where the DBMS checks input data before being saved in the database e.g. it would not allow 3/36/2012 to be entered as a date.

SQL (Structured Query Language) is a query language devised for relational databases. It is a language by means of which a user can request data from a database.

7) Describe three safeguards that are taken to guarantee security on a database.

Solution:

Data security means protecting data, such as a database, from destructive forces and from the unwanted actions of unauthorized users. Measures include:

- Passwords & two-factor authentication

- Biometric technology
- Encryption
- Backups
- Data recovery methods

8) What is the difference between a Database and a DBMS?

Solution: A database is a collection of data. A DBMS is a program that manages the database. The main features of a DBMS are the following:

- Data Security: The DBMS can prevent unauthorized users from viewing or updating the database.
- Data Integrity: The DBMS can ensure that the data it holds will not be corrupted.
- Interactive Query: A DBMS provides a query language that lets users interactively interrogate the database.
- Interactive Data Entry and Updating: A DBMS typically provides a way to interactively enter and edit data.
- Data Independence: The data inside the database is independent of the programs that use them or the users that access them. The structure of data can change (e.g. a column added to a table, a value's range changed, a string field length increased, etc.) without affecting the programs and the users' operations.

9) Referring to a relational database give another term for each of the following words: relation, attribute, tuple.

Solution:

Relation: table, entity

Attribute: field

Tuple: record

10) Give one example of a one-one, one-many and many-many relationship.

Solution:

One-one e.g. countries – capital cities

One-many e.g. artists – paintings

Many-many e.g. authors – books

11) Explain the terms: data dictionary, DML, DDL.

Solution:

Data dictionary: a file that defines the basic organization of a database. It contains a list of all files in the database, the number of records in each file, and the names and types of each field. Data dictionaries do not contain any actual data from the database, only bookkeeping information for managing it.

12) Consider the table below, called "Parts". What is the output of the following SQL statement:

```
SELECT id FROM Parts WHERE price<40 ORDER BY product ASC
```

id	product	price	shelf
001	Hard disk 250 GB	32	A3
002	DDR2 1G	45	A1
003	Hard disk 300 GB	20	A3
004	CPU fan	21	A2

Solution:

id
004
001
003

13) Consider the following tables. For each one say whether it is in 1NF, 2NF and 3NF.

- a) SHOP_OWNERS (ID, Name, Account No, Bank Code No, Bank Name)
- b) STUDENTS (ID, Name, DOB, Address, Phone1, Phone2, Phone3)
- c) OPERATIONS (Patient ID, Surgeon ID, Patient Name, Surgery)

Solution:

- a) No repeated attributes, therefore it is in 1NF
Primary key is not composite therefore it is in 2NF
However there is a dependency that is not coming from the primary key (Bank Name is dependent on Bank Code No), thus the table is not in 3NF.
This table is in 2NF.
- b) This table has repeated attributes (Phone1, Phone2, Phone3) therefore it is not in 1NF.
This table is in neither of the normal forms.
- c) No repeated attributes, therefore it is in 1NF.
The table has a partial dependency since Patient Name is dependent on Patient ID. Therefore the table is not in 2NF.
This table is in 1NF.

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Solution:

- a) Primary key for Employees: employeeID

Primary key for Stock: itemNo
Primary key for Orders: orderID
Primary key for Customers: customerID

- b) Orders and Customers: relationship is many-one
- c) 1 sector = 2 records
2048 records = 1024 sectors
Size of file = 1024x512 bytes = 512kilobytes

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Solution:

- a.
 - i. A record is made up of a number of fields that can have different types e.g. number, text, date etc. A field is one of the values that constitute the record. Both the record and the field have a name.
 - ii. A primary key is unique. It represents the record e.g. a field called “identity card number” can be a primary key to a table called Persons. An entity may have one or more choices for the primary key. Collectively these are known as candidate keys. One is selected as the primary key. Those not selected are known as secondary keys. A foreign key is a key that is added to a table for the purpose of creating a relationship.
- b. .
 - i. In the Clients Table it is ClientID because it is the only field that is unique. CarID for Cars Table for the same reason.
 - ii. Client ID card number.
 - iii. The primary keys i.e. ClientID and CarID.
 - iv. So that searches can be made, say, on the town.
 - v. It is not suitable because it changes as time passes. A more suitable field could be Date of Birth.
 - vi. The record with ClientID 4.
- c. DML is used to access the database i.e. read information from the database, enter information, update and delete information. DDL is used to define the database and modify its structure i.e. give a name to tables, give a name to the fields and declare their type, insert or delete a field or even a table and even delete a whole database.
- d. .
 - i. Backups and Recovery Strategy (recovery is done using files that contain all the transactions)
 - ii. Mapping out the conceptual design and Maintaining adherence to the Data Protection Act