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Database Systems

HW1

1.7 List four significant differences between a file-processing system and a DBMS.

Answer: The four significant differences between a file-processing system and a DBMS are as follows -:

a) In a file processing system, the information is stored in files and has different application programs to manipulate it. This causes the risk of data redundancy and inconsistencies as two files may contain the same information, however, when it is manipulated in one file, the other is not updated. The centralized nature of a DBMS solves this issue as there exists relationships between the different tables.
b) File processing systems usually have limited security which may be an issue as security must be ensured in each file and are usually unique to each. Due to the nature of a DBMS, security is addressed consistently for all the information stored within ensuring a safer system.
c) Retrieving and manipulating information in a file processing system can be tedious and time consuming as it usually involves writing custom code for each process. In a DBMS, due to SQL, the data becomes more accessible to the user and developer.
d) In a file processing system, concurrent access is unstable. Due to the lack of a relationship between the information, inconsistencies may occur when manipulating/accessing information in a file. For example, if a website lists only one item in stock and 2 users simultaneously purchase it, during payment the system will minus one from the inventory and allow both users to purchase. This leads to violation of business constraints as well as inventory discrepancies. A DBMS allows for concurrent processes by allowing multiple operations to be treated as a single unit.

1.8 Explain the concept of physical data independence and its importance in database systems.

Answer: the concept of physical data independence dictates a separation between the logical structure of a database and the physical. This means that any changes made to the physical structure of the data such as organization, storage etc. will not change/influence the logical aspect. This allows the database to be flexible and adaptable to future situations and updates. Any significant changes needed to be made to the way the data is stored or organized will not affect the logical relationships etc.

1.9 List five responsibilities of a database-management system. For each responsibility, explain the problems that would arise if the responsibility were not discharged.

The five main responsibilities of a DBMS include;

a. Data Storage and retrieval: A DMBS must efficiently store and retrieve data from the database. The problem without proper storage and retrieval is that data could be lost, unorganized and inaccessible. This could lead to further problems with consistency and time.

b. Enforce security: a DBMS needs to prevent unauthorized access to data. Without this feature, unauthorized persons could access, manipulate or remove sensitive information which could lead to dire consequences like a data leak.

c. Enforce integrity: A DBMS needs to satisfy a few constraints relevant to the information stored. For example, in a website when users try to buy an item, a constraint could be that the inventory of the item does not fall below 0. The problem with the lack of enforcing integrity is that it could lead to overselling products and allowing users to purchase items that are no longer in stock.

d. Backup and recovery: In a DBMS, Data should be backed up and be able to be retrieved in case of failure. Failure to do so could lead to loss of data and significant time spent trying to retrieve the lost data.

e. Concurrency control: A DBMS needs to be able to handle concurrent processes without leading to inconsistencies and mismanagement of data. By not implementing this rule, data could be incorrect, inconsistent and could violate the organizations constraints and policies.

1.11 Assume that two students are trying to register for a course in which there is only one open seat. What component of a database system prevents both students from being given that last seat?

Answer: The concurrent transactions control component of a database system prevents both students from being given that last seat. This property controls multiple users accessing the database and allows this without data inconsistencies and conflicts. In this scenario, this property will allow for only one student to register for the course while locking the other out of the database preventing over registration.

1.12 Explain the difference between two-tier and three-tier application architectures. Which is better suited for web applications? Why?

Answer: Database applications are separated into 2 parts, a front-end that runs the user interface and client processes and the backend server side that manages and stores and data and handles the business processes. In two-tier applications, the above is the structure. This structure may be good for simple systems. In three-tier applications, the backend part is further separated into the server side (the database) as well as the application side (business logic). This structure increases flexibility, security and performance of the database and is thus better for web applications.

1.1.4 Explain why NoSQL systems emerged in the 2000s, and briefly contrast their features with traditional database systems.

Answer: The changing needs of data storage in the 2000's led to the emergence of NoSQL. NoSQL was equipped to manage various types of data such as semi-structured and even unstructured. This allowed developers to work efficiently and fast with various data types and develop applications rather quickly without the constraints of previous SQL databases such as allowing some inconsistencies as long as they later converge.

NoSQL databases are different from traditional databases due to its flexibility, scalability and consistency. They use flexible data models, prioritize eventual consistency and scale horizontally instead of vertically, which makes them useful for a lot of unstructured data. In contrast traditional databases are rigid, very consistent and have vertical scalability(tables) and are very useful for structured data.

1.15 Describe at least three tables that might be used to store information in a social-networking system such as Facebook.

Answer: Some tables that might be used to store information in a social networking system are as follows-:

a) The user information table: This table may store all personal information about the user such as name, DOB, email address, Phone number, username, profile picture etc. Most information in this table is likely to be encrypted or hashed.
b) The friend table: This table may store information related to friends/connections that users have on the site. Some information would be day of friendship, status of friendship etc.
c) Personal messages table: This table may store information related to texts/ DM's sent between two users. Some examples of information here could be relation between user, individual message content, when they were sent, when they were received etc.