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CS44800 Homework 1

Question 1. (0.25 pts)  
Discuss the main characteristics of the database approach and how it differs from traditional file Systems.

* A traditional file system typically provides files to store data
* Most provide a privilege scheme to control who can access files
* Often they include features such as keyed access and partitioning and encryption
* A database management system does everything a traditional file system does
* A database management system provides a query language that one can use to query and maintain tables.

Question 2. (0.25 pts)  
Discuss the capabilities that should be provided by a DBMS.

* create objects to hold data
* insert data into an object
* update data elements in an object
* delete data elements from an object
* retrieve data elements from an object
* prevent loss of data

Question 3. (0.25 pts)  
Cite some examples of integrity constraints (e.g. unique constraints, referential integrity  
constraints) that you think can apply to the database shown in Figure 1.2 in the textbook.

* The StudentNumber should be unique for each STUDENT record (key constraint).
* The CourseNumber should be unique for each COURSE record (key constraint).
* A value of CourseNumber in a SECTION record must also exist in some COURSE record(referential integrity constraint).
* A value of StudentNumber in a GRADE\_REPORT record must also exist in some  
  STUDENT record (referential integrity constraint).
* The value of Grade in a GRADE\_REPORT record must be one of the values in the set {A, B,C, D, F, I, U, S} (domain constraint).

Question 4. (0.25 pts)  
What is the difference between a database schema and a database state? Please, use examples to support your answer.

* Database Schema is the overall Design of the Database. It is the skeleton structure that represents the logical view of the entire database. It tells how the data is organized and how the relations among them are associated.
* Database State: Refers to the content of a database at a moment in time

Question 5. (0.50 pts)  
What is the difference between logical data independence and physical data independence? Which one is harder to achieve? Why?

* logical data independence: change in metadata structure(logical representation of data) should not affect how application interacts to database
* physical data independence: change in storage structure (physical representation of data, ex: change database from row oriented database to columnar database ) should not effect metadata structure of database
* applications are heavily dependent on logical structure of data than physical structure of the data. so it's hard to achieve logical DI than physical DI

Question 6. (0.50 pts)  
What are the different components of a DBMS? Discuss the importance and need of each  
Component.

* Query Processor - Machine only understand low level language, so it is the task of query processor to convert user’s queries in the series of low level instruction. Then after, it sends these instructions to database manager for execution. There are various component of query processor.
  + DDL Complier: it records the ddl statements into set of tables containing data dictionary. It coverts ddl statement into object form from source form.
  + DML Complier: It converts DML statements into low level instructions that are more easy to understand by query evaluation engine.
  + Query Evaluation Engine: Queries generated by DML compiler are executed in Query evaluation Engine.
* Database Manager - Database manager components issue the interface between low level data, application program and queries. It is responsible for the backup and recovery operations of database.
* Authority and integrity manager: Authority manager is responsible for checking the authority of users to access and use information in database. Integrity manager check the integrity constraints like various keys (Primary, unique etc.)
* Transaction manager: It ensures that transaction occurring currently completes without any problem.
* File manager: The task of file manager is to ensure that file space is managed correctly. Also the allocation of disk space is managed by file manager.
* Buffer Manager: It manages the data fetched from disk storage into main memory. Its task is to send blocks from disk to main memory.
* Data Files: These are the files that stored data base.
* Data Dictionary: Data dictionary carries the data about data means it stores the metadata of data structure.
* Access Acids: Acid properties are used to improve the performance of database management system. They make the search operations very fast.
* Statistical Data: It stores some information that are used by query processor to choose the best way to execute queries.

Question 7. (0.50 pts)  
What are the main phases of database design? What needs to be done by the user and what needs to be done by the database administrator? What is involved in physical database design?

* Conceptual Design
* Logical Design
* Normalization
* Physical Design

Question 8. (0.25 pts)  
What is a user transaction? What properties must be maintained for a transaction by the database system?

* The methods that allow an application to explicitly manage transaction boundaries
* The five needed to maintain it are
  + Atomicity
  + Consistency
  + Isolation
  + Durability
  + Serialization

Question 9. (0.25 pts)  
Why is accessing a disk block expensive? Discuss the time components involved in accessing a  
disk block.

* Seek time (s): the time needed to mechanically position theread/write head on the correct track for movable-head disks.
* Rotational delay (rd): when the user must wait for the beginning of the required block to rotate into position under the read/write head (p - revolutions per minute - rpm)
  + rd = (½) \* (1/p) min = 30000/p msec
* Block transfer time (btt): some time is needed to transfer the data in the block, which is based on the block size, track size and rotational speed (measured in bytes/msec)
  + btt = b/tr msec