Basics of DBMS

Course Overview

Objective:

To understand the importance of DBMS in the modern day applications

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Outline:

- Why Database
- Know your course
- Course Outline
- Course Textbox

Why Database Management System?

Data base management systems (DBMS) contains information about a particular enterprise

- Collection of interrelated data
- Set of programs to access/process the data
- An environment that is both *convenient and efficient* to use

Database Applications

- **Banking**: transactions
- **Airline**: reservations, schedules
- **University**: registration, grades
- **Sales**: customer, products, purchases
- **Online retailer**: order tracking, customized recommendations, maintenance of product evaluations
- **Manufacturing**: production in factories, inventory, order supply chain
- **Human Resources**: employee, records, salary, tax deductions

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- DB can be very large/small
- It touches all the aspects of our daily life

University Database Example

- **Application program examples**:
  - Add new students, instructor, departments, courses
  - Register students for courses and generate class roster/timetable
  - Assign grades to students, compute grades point GPA and generate a transcript.

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In early days, DB applications were built directly on top of the file system

Drawbacks of using File System to Store Data

- Data Redundancy and inconsistency
  - Multiple file formats, duplications of information in different files

- Difficulty in accessing data in a convenient and efficient manner
  - Need to write a new program to carry out each new task

- Data Isolation
  - Multiple files and formats
  - Writing new application programs to retrieve the appropriate data is difficult

Drawbacks of using File System to Store Data

- Integrity Problem
  - Integrity constraints; e.g. minimum balance
  - Hard to add new constraints or change existing one
- Security Problem
  - Hard to provide user access to some but not all, data
- Concurrency Access by multiple users, which is needed for the performance
- Atomicity of updates
  - Failures may leave DB in an inconsistent state with partial updates carried out

Data Management: Physical

- **Physical Data or Record Management,** more formally known as Book Keeping, has been using physical ledgers and journals for centuries

- The most significant development happened when Henry Brown, an American inventor, patented a “receptacle for storing and preserving papers” in 1886

- Herman Hollerith adapted the punch cards used for weaving looms to act as a memory for the mechanical tabulating machines, in 1890

Data Management: Electronic

- **Electronic Data or Record Management,** moves with the advances in technology – especially in memory, computing, and networking

History of Database Systems

- 1950s:
  - Computer Programming started

- 1960s:
  - Data Processing using magnetic tapes for storage
  - Tapes provide only sequential order
  - punch card for input

- 1970s:
  - Hard disks became prevalent that allowed direct access
  - Network and hierarchical data models in widespread use
  - Todd Codd defined a relational data model
  - Won the Association of Computing Machinery Turing Award

History of Database Systems

- 1980s:
  - Research relational prototypes evolve into commercial systems – SQL becomes industry standard
  - Parallel and distributed database systems
  - Object-oriented database systems

- 1990s:
  - Large decision support and data-mining applications
  - Large multi-terabytes data warehouse
  - Emergence of Web commerce

- Early 2000s: XML and XQuery standards

- Later 2000s: Giant data storage systems: Google BigTable, Amazon

Syllabus

Introduction: Data, data processing requirement, desirable characteristics of an ideal data processing system, traditional file based system, its drawback, concept of data dependency, Definition of database, database management system, 3-schema architecture, database terminology, benefits of DBMS, Database development process - conceptual data modeling, logical database design, physical database design, database implementation, database maintenance.

Database Analysis: Conceptual data modeling using E-R data model -entities, attributes, relationships, generalization, specialization, specifying constraints. 5 – 6 practical problems based on E-R data model.

Relational Database: Relational data model: Introduction to relational database theory: definition of relation, relational model integrity rules, relational algebra and relational calculus.

Relational Database Design: Normalization- 1NF, 2NF, 3NF, BCNF, 4NF and 5NF. Concept of De-normalization and practical problems based on these forms.

Syllabus

Indexing of Data: Impact of indices on query performance, basic structure of an index, creating indexes with SQL, Types of Indexing and its data structures.

Database Implementation: Introduction to SQL, DDL aspect of SQL, DML aspect of SQL – update, insert, delete & various form of SELECT-simple, using special operators, aggregate functions, group by clause, sub query, joins, co-related sub query, union clause, exist operator. PL/SQL - cursor, stored function, stored procedure, triggers, error handling, and package

Text Books

1. Silverschatz A., Korth F. H. and Sudarshan S., Database System Concepts, Tata McGraw Hill (2010) 6th ed.

2. Elmasri R. and Navathe B. S., Fundamentals of Database Systems, Pearson (2016) 7th ed.

Reference Books:

1. Bayross I., SQL, PL/SQL the Programming Language of Oracle, BPB Publications (2009) 4th ed.

2. Hoffer J., Venkataraman, R. and Topi, H., Modern Database Management, Pearson (2016) 12th ed.

3. Parteek Bhatia and Gurvinder Singh, Simplified Approach to DBMS.