POLITEKNIK BRUNEI

FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS

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What is a Database?

- "A set of information held in a computer"

  Oxford English Dictionary

- "One or more large structured sets of persistent data, usually associated with software to update and query the data"

  Free On-Line Dictionary of Computing

- "A collection of data arranged for ease and speed of search and retrieval"

  Dictionary.com

Why Study Database?

Databases are widely used.

Many computing applications deal with large amounts of information.

Database systems give a set of tools for storing, searching and managing this information.

Basic concepts and skills with database systems are part of the skill set you will be assumed to have once you graduate.

Databases Everywhere

Why Database?

Imagine you are running a business. What do you need to know?

- Who your customers are?
- Your products details
- Who is working for you
- Who owes you money
- To whom you owe money

Those data has to be available for decision makers when necessary.

What Can a Database Do?

It allow users to perform variety of operations involving files such as:

- **Adding new files to the database**

- **Inserting data into existing files**

- **Retrieving data from existing files**

- **Deleting data from existing files**

- **Changing data in existing files**

- **Removing existing files from the database.**

Data VS Information

What is data? What is information?

Name	Mathematics	Science
Ali	80	70
Siti	75	90
Abu	65	50

Data are raw facts.

Information is the result of processing raw data to reveal its meaning.

Advantages of Database

- it represents complex relationships among different data items.

- Keeps a tight control on data redundancy.

- Enforces user defined rules to ensure the integrity of data in a table form.

- Maintains data dictionary for the storage of information pertaining to data fields and data manipulation.

Cont. Advantages of Database

- Ensures that data can be shared across all applications.

- Enforces data access authorization.

- Has an automatic intelligent backup and recovery procedure of data.

- Has different interfaces through which users can manipulate data.

Database Systems Applications

More example on representative applications:

- **Enterprise Information**
  - Sales : For customer, product, and purchase information.

  - Accounting: For payments, receipts, account balances, assets, and other accounting information.

  - Human resources : For information about employees, salaries, payroll taxes, and benefits, and for generation of paychecks.

Cont. Database Systems Applications

- Manufacturing : For management of the supply chain and for tracking production of items in factories, inventories of items in warehouses and stores, and orders for items.

- Online retailers : For sales data, online order tracking, generation of recommendation lists, and maintenance of online product evaluations.

Cont. Database Systems Applications

- **Banking and Finance**

  - Banking : For customer information, accounts, loans, and banking transactions.

  - Credit card transactions: For purchases on credit cards and generation of monthly statements.

  - Finance : For storing information about holdings, sales, and purchases of financial instruments such as stocks, also for storing real-time market data to enable online trading by customers.

Cont. Database Systems Applications

- **Universities** : for students information, course registrations and materials, and grades.

- **Airlines** : for reservations and schedule information.

- **Telecommunication** : for keeping records of call made, generating monthly bills, maintaining balances on prepaid calling cards, and storing information about the communication networks.

Size of Database

Depending on the type of information system and business characteristics of the business, these data can vary from a few megabytes to terabytes.

Telecommunication such as AT&T are known to have system that keep data on trillions of phone calls, with new data being added to the system at speeds up to 70,000 calls per second!

Google are estimated with **91 million** searches **per day** across a collection of data that is several in terabytes in size.

Google

Database Systems

A database system consists of

- **Data (the database)**

- **Software**

- **Hardware**

- **Users**

Database systems allow users to **Store, Update, Retrieve, Organize** and **Protect** their data.

Database's Data

Database is shared, integrated computer structure housing:

- **End user data**
  - Different users will require different views
  - Different users will have different access

- **Metadata**

Metadata – Data Dictionary

Metadata is a dictionary or catalog stores information about the database itself.

This is data about the data itself (metadata).

Almost every aspect of the DBMS uses the dictionary.

The dictionary holds the descriptions of database objects (tables, users, rules, views, indexes)

It also hold the information about who is using which data (locks), Schemas and mappings.

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Database Software

Database Management Systems (DBMS) is the software used in database system.

DBMS is a collection of components that support data acquisition, dissemination, maintenance, retrieval and formatting.

DBMS typically operates on a database server or mainframe system to manage structured data, accept queries from users, and respond to those queries.

DBMS Common Features

Following are the some of common features found in most DBMS.

- Provides a way to structure data as records, tables, or objects.

- Accepts data input from operators and stores that data for later retrieval.

- Provides query languages for searching, sorting, reporting, and other "decision support" activities that help users correlate and make sense of collected data.

Cont. DBMS Common Features

- Provides multiuser access to data, along with security features that prevent some users from viewing and/or changing certain types of information.

- Provide data integrity features that prevent more than one user from accessing and changing the same information simultaneously.

- Provides a data dictionary (metadata) that describes the structure of the database, related files, and record information.
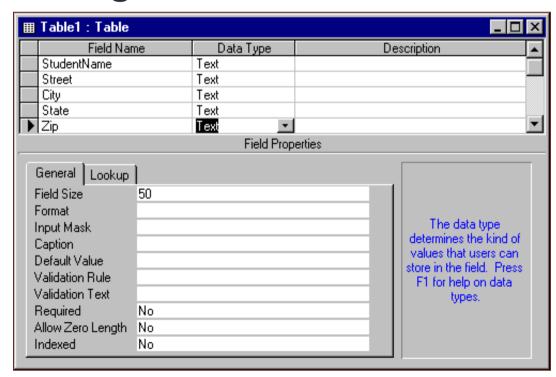
DBMS Common Functions

Following are the some of common function found in most DBMS.

1. **Data Definition**

2. **Non-Procedural Access**

3. **Application Development**

4. **Procedural Language Interface**

5. **Transaction Processing**

6. **Database Tunning**

Cont. DBMS Common Functions

1. Data Definition

Language and graphical tools to define entities relationships, integrity constraints and authorization rights.

Cont. DBMS Common Functions

2. Non-procedural access

- Language and graphical tools to access data without complicated coding.

- Allows users with limited computing skills to submit queries.

- The user specifies the parts of a database to retrieve, not implementation details of how retrieval occurs.

Cont. DBMS Common Functions

- Can reduce the number of lines of code by a factor of 100 as compared to procedural access.

- Because a large part of business software involves data access, non-procedural access can provide a dramatic improvement in software productivity.

- Allow language such as SQL to specify the parts of a database to access rather than to code a complex procedure.

Cont. DBMS Common Functions

3. Application Development

Graphical tools to develop menus, data entry forms, and reports, data requirement for forms and reports are specified using non-procedural access.

4. Procedure Language Interface

Allows the combination of non-procedural access with full capabilities of a programming language.

Cont. DBMS Common Functions

5. Transaction Processing

- Contains control mechanism to prevent interference from simultaneous users and recover lost data after failure.

- Reliable and efficient processing of large volumes of repetitive work.

Cont. DBMS Common Functions

6. Database Tuning

- Tools to monitor and improve database performance.

- It consist of a group of activities used to optimize and regulate the performance of a database which includes the DBMS, hardware and operating system on which the database is hosted.

- Database are design with efficiency in mind, however, it is possible to enhance it's performance via custom settings and configuration.

Category of DBMS

There are two categories of DBMS.

- **Desktop database**
  - Microsoft Access, FoxPro, FileMaker Pro, Paradox, Lotus

- **Server database**
  - Oracle, Microsoft SQL Server (MYSQL), IBM, DB2, Ingres

Cont. Category of DBMS

Desktop database

- Support database used by work teams and small business.

- Are designed to run on personal computers and small servers.

- Have limited function but is much more user friendly.

Cont. Category of DBMS

Server database

- Provides database services to other computer programs or computers, defined as client-server model.

- May also refer to a computer dedicated to run such program.

- Most DBMS provide database server functionality, and some DBMS rely exclusively on the client-server model for database access.

Advantage of Desktop Database

- **Low cost**
  - less equipment
  - lower maintenance cost

- **Easy to use**

- **Save time**
  - Processing time is shorter than server database

- **Data Security**
  - Data can be secured

Advantage of Server Database

- **Flexible data access**
  - Provides data access via native relational SQL or direct navigational commands.

- **Optimized**
  - Offers optimized data access for Delphi, Visual Studio, Visual Objects, Visual Basic and more.

- **Easy to manage**
  - Zero administration is needed, as it is easy to install and manage.

Cont. Advantage of Server Database

- **Referential integrity support**
  - Provides complete referential integrity support, including primary/foreign key definition and cascaded updates and deletes.

- **Avoids Database Corruption**
  - Server-based transaction processing eliminates database corruption.

- **Data security**
  - Offers complete security and encryption support.

Cont. Advantage of Server Database

- **Highly scalable**
  - Fully scalable from local to peer-to-peer to client-server environments – with one set of source code.

- **Availability**
  - Operation will always be available with proper set up such as backup storage plan using RAID (Redundant array of inexpensive disks) if disk fail and UPS (Uninterrupted Power Supply) if there is a power shortage, etc.

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Data Center Video Documentary

Refer to [Innovative Video] Facebook Data Center on
Youtube

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Database Users

Who are the user of the database?

- **End users** – use the database system to achieve some goal.

- **Database Administrator (DBA)** – Designs & manages the database system.

- **Application developers** – Write software to allow end users to interface with the database system.

- **Database systems programmer** – Writes the database software itself.

Importance of Database Systems

Database technology provides the following benefits to organizations:

- **Data integration** – combining larger pool of data

- **Data Sharing** – more available

- **Reporting flexibility** – easy to obtain and generated.

- **Minimal data redundancy and inconsistencies**

Cont. Importance of Database Systems

- **Data independence** – data can be changed without changing the program and vice versa.

- **Central management of data** – database administrator can coordinate, control and managing data from one place.

- **Cross-functional analysis** – relationships can be explicitly defined and used in the preparation of management reports.