NATIONAL UNIVERSITY
COLLEGE OF COMPUTING AND
INFORMATION TECHNOLOGIES

VER 1.0

# Course MANUAL

## INFORMATION MANAGEMENT

This course provides students with the theoretical knowledge and practical skills in the utilization of databases and database management systems in the ICT applications. The logical design, physical design and implementation of relational databases are all covered in this course.

INFORMATION TECHNOLOGY

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# INFORMATION MANAGEMENT

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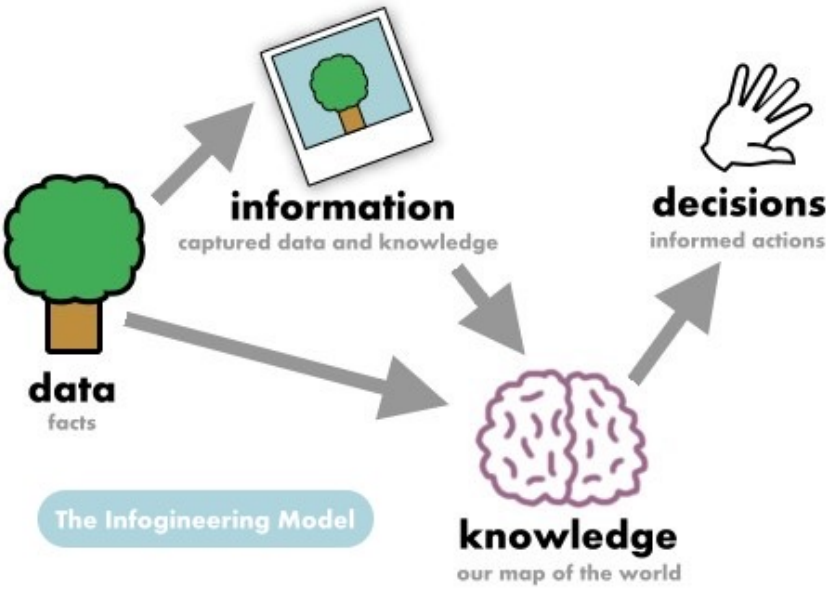
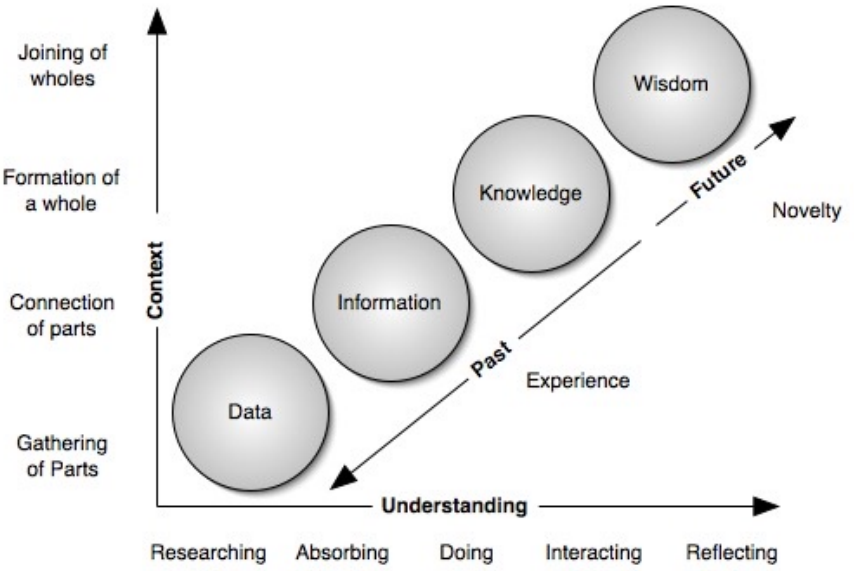
1.1

# Data vs. Information

- Good Decisions require good information derived from raw facts/data.
- Data is managed most efficiently when stored in a database.
- Databases evolved from file systems.
- Understanding file systems characteristics is important.



# Data vs. Information



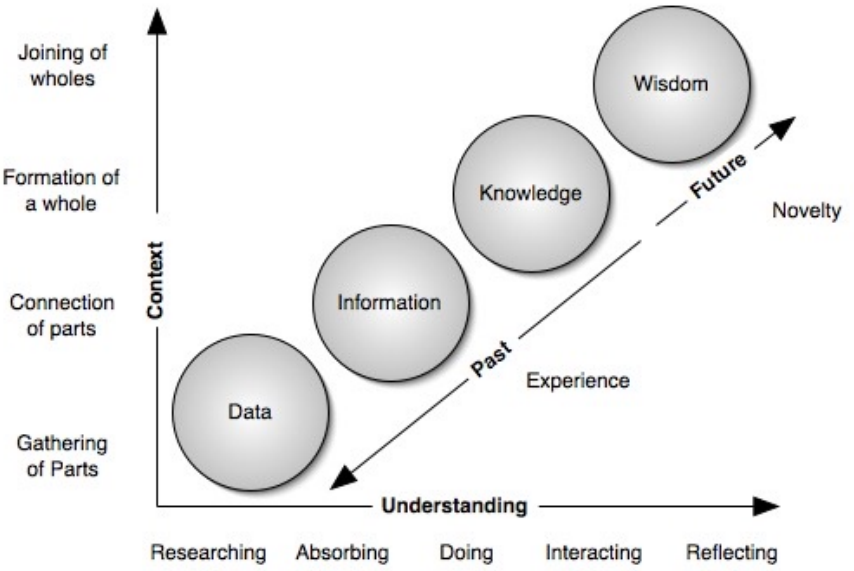

## DATA

- Data refers to raw facts, observations, or information that can be collected, stored, and analyzed.
- It can take various forms, including numbers, text, images, sound, and more.
- Data is the foundation for generating knowledge and making informed decisions.
- We can describe data as the smallest unit of factual information we can use for reasoning , calculations or discussion.

Data can be collected through various methods, including surveys, sensors, observations, and experiments. Once collected, data can be processed, analyzed, and interpreted to extract meaningful information and insights.

The field of data science involves using various techniques and tools to analyze and extract knowledge from data.

# Data vs. Information




## INFORMATION

- Information is data that has been processed or organized in a meaningful way, giving it context, relevance, and purpose.
- Information is data that has been interpreted, analyzed, and is now presented in a form that is useful for decision-making or understanding a particular context
- The processed data as a result is information after processing the raw data. Processing involves organizing, structuring, and analyzing data to extract meaningful patterns, relationships,  or insights.
- For example, consider a weather dataset containing temperature and precipitation data for a specific location over a month. Raw data might be a list of numbers. Processed data could include averages, highs, lows, and total precipitation. Information derived from this processed data could be a summary report stating whether it was a warm and dry month or a cold and wet one.
- In summary, information is the meaningful result of processing and interpreting data, providing insights and knowledge for decision-making and understanding.

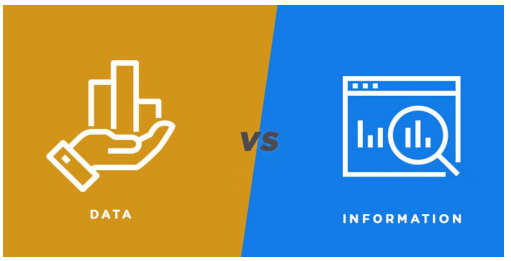
# Data vs. Information

## KEY DIFFERENCES OF DATA AND INFORMATION

| DATA | INFORMATION |
| --- | --- |
| Data is a collection of individual statistics, facts, or items of information | Information is data that is processed, organized, and structured |
| In raw form and unprocessed and unstructured | Processed and structured |
| Might be meaningless on its own | Always meaningful |
| Relies on data | Does not rely on information |
| Comes in forms like numbers, figures, and statistics | Comes as words, thoughts, and ideas |
| May be difficult to understand data | Relatively easy to understand information |

# Data vs. Information

## EXAMPLE:




Data may come in the form of observations, text, images, figures, symbols, graphs, or numbers. For instance, data may include:

- weights
- prices
- ages
- addresses
- dates
- temperatures
- tax codes
- the number of products sold
- registration marks
- product names

Some examples of information may include:

- time tables
- report cards
- merit lists
- printed documents
- receipts
- pay slip
- headed tables
- schedules
- account returns
- history of a person

# Data vs. Information

## EXAMPLE:

Let's consider a real-world example involving weather data:

**Data:**
•Raw weather observations for a particular location on a given day, including a list of temperature readings at different times, humidity levels, wind speeds, and precipitation amounts.
**Information:**
•Processed and interpreted data that provides meaningful insights.
• For example:

- **Average Temperature:** Calculating the average temperature for the day.
- **Weather Summary:** Describing the overall weather conditions (e.g., sunny, rainy, or cloudy).
- **Trend Analysis:** Identifying patterns such as temperature fluctuations throughout the day.
- **Forecast:** Predicting the likelihood of rain or snow based on historical data and current conditions.

In this example, the raw weather observations constitute the data. When this data is processed and organized, it becomes information that is more useful for making decisions or gaining insights into the weather conditions. The average temperature, weather summary, trend analysis, and forecast are all forms of information derived from the raw weather data.

In summary, data might be the individual temperature readings, humidity levels, etc., while information is the meaningful output derived from processing and analyzing that data, providing insights about the weather conditions for that day.

LESSON #

1.2

# Introducing the Database

- Database solved many problems encountered in data management.
- Used in almost all modern settings involving data management like business, research and administration.
- It is important to understand how databases work and interact with other applications.


# Database

## WHAT IS DATABASE?

- A database is a structured collection of data that is organized in a way to facilitate efficient storage, retrieval, and management of information.
- It serves as a centralized and organized repository for storing and managing data, making it easier to access, update, and analyze information.
- A database is a systematic collection of data. They support electronic storage and manipulation of data. Databases make data management easy.
- We can provide a countless number of examples for the usage of databases.
- Example:
  - An online telephone directory uses a database to store data of people, phone numbers, and other contact details.
  - Your electricity service provider uses a database to manage billing, client-related issues, handle fault data, etc.
  - Let us also consider Facebook. It needs to store, manipulate, and present data related to members, their friends, member activities, messages, advertisements, and a lot more.

## TYPES OF DATABASES:

**Distributed databases**
A distributed database is a type of database that has contributions from the common database and information captured by local computers. In this type of database system, the data is not in one place and is distributed at various organizations.

**Relational databases**
This type of database defines database relationships in the form of tables. It is also called Relational DBMS, which is the most popular DBMS type in the market. Database example of the RDBMS system include MySQL, Oracle, and Microsoft SQL Server database.

**Object-oriented databases**
This type of computers database supports the storage of all data types. The data is stored in the form of objects. The objects to be held in the database have attributes and methods that define what to do with the data. PostgreSQL is an example of an object-oriented relational DBMS.

**Centralized database**
It is a centralized location, and users from different backgrounds can access this data. This type of computers databases store application procedures that help users access the data even from a remote location.

**Open-source databases**
This kind of database stored information related to operations. It is mainly used in the field of marketing, employee relations, customer service, of databases.

**Cloud databases**
A cloud database is a database which is optimized or built for such a virtualized environment. There are so many advantages of a cloud database, some of which can pay for storage capacity and bandwidth. It also offers scalability on-demand, along with high availability.

## TYPES OF DATABASES:

**Data warehouses**
Data Warehouse is to facilitate a single version of truth for a company for decision making and forecasting. A Data warehouse is an information system that contains historical and commutative data from single or multiple sources. Data Warehouse concept simplifies the reporting and analysis process of the organization.

**NoSQL databases**
NoSQL database is used for large sets of distributed data. There are a few big data performance problems that are effectively handled by relational databases. This type of computers database is very efficient in analyzing large-size unstructured data.

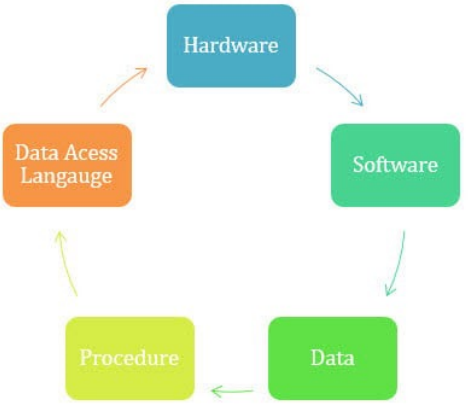
**Graph databases**
A graph-oriented database uses graph theory to store, map, and query relationships. These kinds of computers databases are mostly used for analyzing interconnections. For example, an organization can use a graph database to mine data about customers from social media.

**OLTP databases**
OLTP another database type which able to perform fast query processing and maintaining data integrity in multi-access environments.

**Personal database**
A personal database is used to store data stored on personal computers that are smaller and easily manageable. The data is mostly used by the same department of the company and is accessed by a small group of people.

**Multimodal database**
The multimodal database is a type of data processing platform that supports multiple data models that define how the certain knowledge and information in a database should be organized and arranged.

## DATABASE COMPONENTS




There are five main components of a database:

**Hardware**

The hardware consists of physical, electronic devices like computers, I/O devices, storage devices, etc. This offers the interface between computers and real-world systems.

**Software**

This is a set of programs used to manage and control the overall database. This includes the database software itself, the Operating System, the network software used to share the data among users, and the application programs for accessing data in the database.

**Data**

Data is a raw and unorganized fact that is required to be processed to make it meaningful. Data can be simple at the same time unorganized unless it is organized. Generally, data comprises facts, observations, perceptions, numbers, characters, symbols, images, etc.

**Procedure**

Procedure are a set of instructions and rules that help you to use the DBMS. It is designing and running the database using documented methods, which allows you to guide the users who operate and manage it.

**Database Access Language**

Database Access language is used to access the data to and from the database, enter new data, update already existing data, or retrieve required data from DBMS. The user writes some specific commands in a database access language and submits these to the database

LESSON #

1.3

# Purpose of the Database Systems

Database systems are designed to manage large bodies of information.

Management of data involves both defining structures for storage of information and providing mechanisms for the manipulation of information.

Databases provide a centralized location for storing data, which makes it easier to manage and access. This is especially important for organizations that have a large amount of data or that need to store data for an extended period of time.

**Database Management System (DBMS)** is a collection of programs that enable its users to access databases, manipulate data, report, and represent data. It also helps to control access to the database.

## DATABASE MANAGEMENT SYSTEMS

- A database management system (DBMS) is a software application that enables users to quickly construct, design, and edit databases in order to store, process, and analyze data.
- A database management system (DBMS) provides an interface or a tool for doing various tasks, such as creating databases, putting data in them, updating data, creating database tables, and so on.
- The DBMS also ensures the privacy and security of databases. It also maintains data consistency when there are multiple users.

**Some Example of DBMS :**

- MySql
- Oracle
- SQL Server
- IBM DB2

**Purpose of database system**

- It is a collection of tools that enable users to create and manage databases. In other words, it is general-purpose software that allows users to create, manipulate, and design databases for a number of purposes.
- Database systems are design to deal with large volumes of data. Data management comprises both the construction of data storage systems and the provision of data manipulation methods.
- Database system must maintain the security of the information held despite system crashes or attempts at unauthorized access. The system must avoid any unexpected effects if data is to be shared across multiple users.

**The goal of a database management system (DBMS) is to transform the following:**

1. Data into information.
2. Information into knowledge.
3. Knowledge of the action.

## CHARACTERISTICS OF DBMS

### Characteristics of DBMS

•Firstly, It manages and stores information in a server-based digital repository.

•Secondly, It can logically and visibly represent the data transformation process.

•Automatic backup and recovery techniques are built into the database management system.

•It has ACID features, which ensure that data is safe even if the system fails.

•It has the ability to make complex data connections more understandable.

•It's utilize to help with data manipulation and processing.

•It is utilize to keep information safe.

•Lastly, It can examine the database from a variety of perspectives, depending on the needs of the user.

## ADVANTAGES & DISADVANTAGES OF DBMS

### Advantages of DBMS

•Firstly, Because it saves all of the data in a single database file and that record data is saves in the database, it can control database redundancy.
•Data sharing: Authorized users of a database management system can share data with a large number of other users.
•The database system is relatively easy to maintain due to its centralized architecture.
•It saves time by lowering the time it takes to create a product as well as the time it takes to maintain it.
•Backup: It consists of backup and recovery subsystems that create automatic data backups in the case of hardware or software failures and restore the data if necessary.
•Lastly, It offers graphical user interfaces and application programme interfaces, among other options.

### Disadvantages of DBMS

•Hardware and software costs: To operate DBMS software, you'll need a fast data processor and a lot of memory.
•Size: To run them efficiently, it takes up a lot of disc space and RAM.
•Complexity: The database system adds to the complexity and demands.
•Failure has a greater impact on the database since most organizations keep all of their data in a single database, and if the database is damage due to an electric outage or database corruption, the data might lost permanently.

LESSON #

1.4

# Database Architecture

A **Database Architecture** is a representation of DBMS design. It helps to design, develop, implement, and maintain the database management system.

A DBMS architecture allows dividing the database system into individual components that can be independently modified, changed, replaced, and altered. It also helps to understand the components of a database.

## TYPES OF DBMS ARCHITECTURE

**Types of DBMS Architecture**

There are mainly three types of DBMS architecture:

- One Tier Architecture (Single Tier Architecture)
- Two Tier Architecture
- Three Tier Architecture

•An Architecture of DBMS helps in design, development, implementation, and maintenance of a database

•The simplest database system architecture is 1 tier where the Client, Server, and Database all reside on the same machine

•A two-tier architecture is a database architecture in DBMS where presentation layer runs on a client and data is stored on a server

•Three-tier client-server architecture consists of the Presentation layer (PC, Tablet, Mobile, etc.), Application layer (server) and Database Server

## 1-Tier Architecture

**1 Tier Architecture** in DBMS is the simplest architecture of Database in which the client, server, and Database all reside on the same machine.

A simple one tier architecture example would be anytime you install a Database in your system and access it to practice SQL queries. But such architecture is rarely used in production.

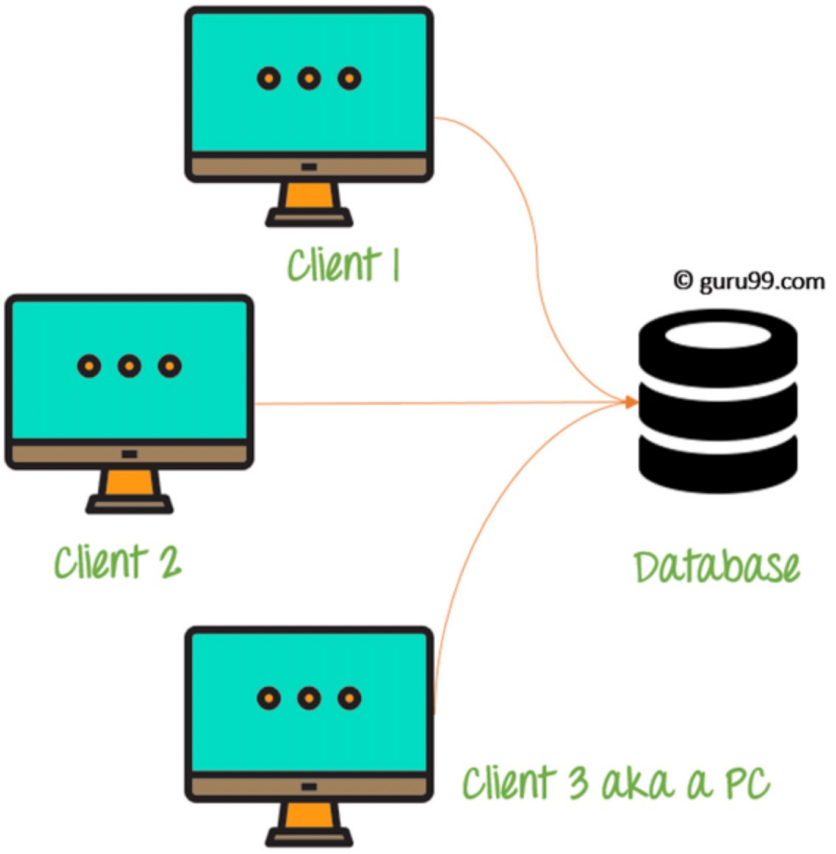
Single Tier Architecture

## 2-Tier Architecture

A **2 Tier Architecture** in DBMS is a Database architecture where the presentation layer runs on a client (PC, Mobile, Tablet, etc.), and data is stored on a server called the second tier.

Two tier architecture provides added security to the DBMS as it is not exposed to the end-user directly. It also provides direct and faster communication.

2 Tier client-server architecture of database management system, we can see that one server is connected with clients 1, 2, and 3.



## 3-Tier Architecture

A **3 Tier Architecture** in DBMS is the most popular client server architecture in DBMS in which the development and maintenance of functional processes, logic, data access, data storage, and user interface is done independently as separate modules.
Three Tier architecture contains a presentation layer, an application layer, and a database server.

3-Tier database Architecture design is an extension of the 2-tier client-server architecture. A 3-tier architecture has the following layers:

1.Presentation layer (your PC, Tablet, Mobile, etc.)
2.Application layer (server)
3.Database Server

The Application layer resides between the user and the DBMS, which is responsible for communicating the user's request to the DBMS system and send the response from the DBMS to the user. The application layer(business logic layer) also processes functional logic, constraint, and rules before passing data to the user or down to the DBMS.

**The goal of Three Tier client-server architecture is:**

- To separate the user applications and physical database
- To support DBMS characteristics
- Program-data independence
- Supporting multiple views of the data