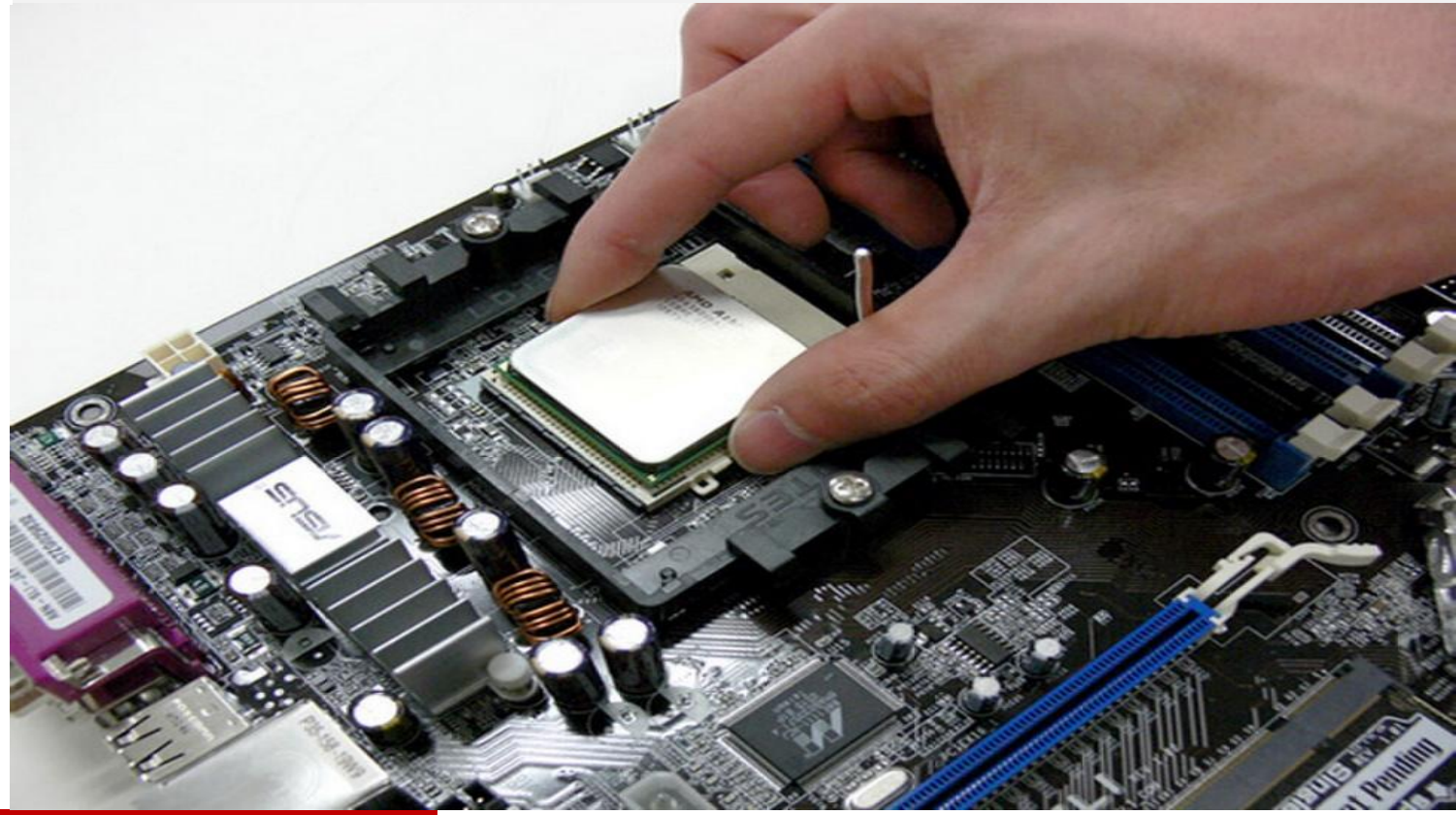
Database Programming

Lecture 1



By. Mohamed Elshabka

Introduction to Databases & Relational Model

LECTURE 1

Outline

- Data, File System, Database
- Database Management System (DBMS)
- Main Types of Databases
- Relational Database Management System (RDBMS)
- Microsoft SQL Server
- Tips for Installation of MS SQL Server & SSMS

Data

Data: Raw facts, numbers, text, symbols, or observations that describe real-world entities.

Properties:

- Unprocessed
- May be unstructured
- By itself, it has little meaning

Examples:

Student Number: 25

Student Name: Ahmed

Student GPA: 3.5

File System

File System: A method of storing data in separate files, managed by the operating system, where each application accesses its own files independently.

Examples:

Excel Files for Employees

Word Files For Customers

Image Files

Properties:

- Unstructured
- No relationships between data
- High redundancy
- No centralized control,

Data Storage

Data storage is the physical or logical place where data is saved.

Properties:

- Stores data **as files or blocks**
- No intelligence about relationships between data
- No built-in querying or rules

Examples:

Hard disks (HDD, SSD)

USB drives

Cloud storage (AWS S3, Google Drive)

Flat files (CSV, TXT, JSON, XML)

Database

Database: An organized, electronically stored collection of data that allows easy retrieval, management, and updating.

Properties:

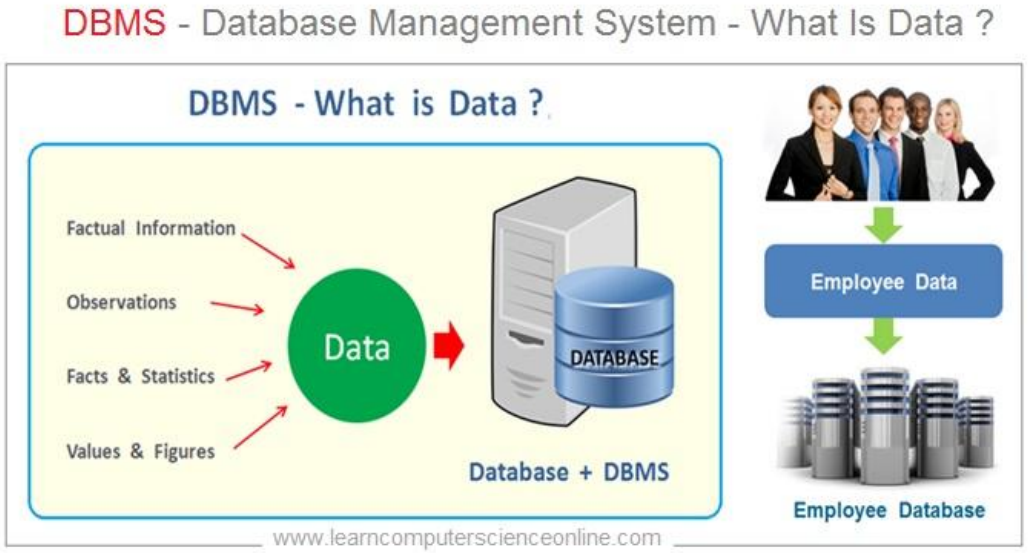
- Data is structured (tables, rows, columns)
- Easy to search, update, and relate data
- Stores data efficiently
- Reduce redundancy

Examples:

Student database

Customer database

Product database



DBMS (Database Management System)

Software that manages databases, handling storage, retrieval, updates, security, and concurrency.

Examples:

MySQL

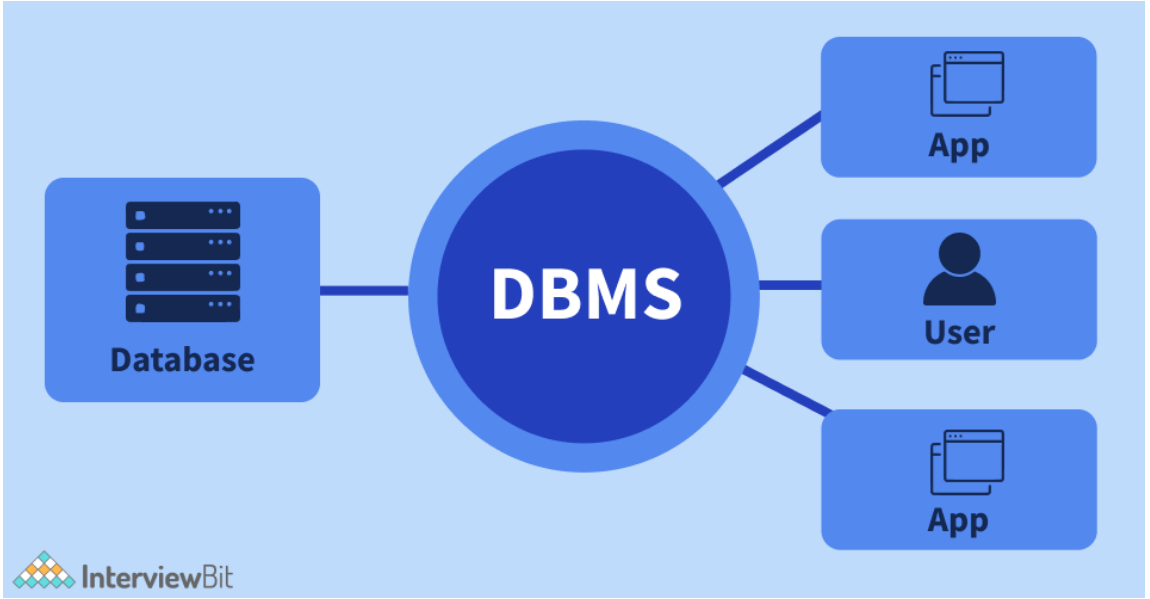
PostgreSQL

Oracle

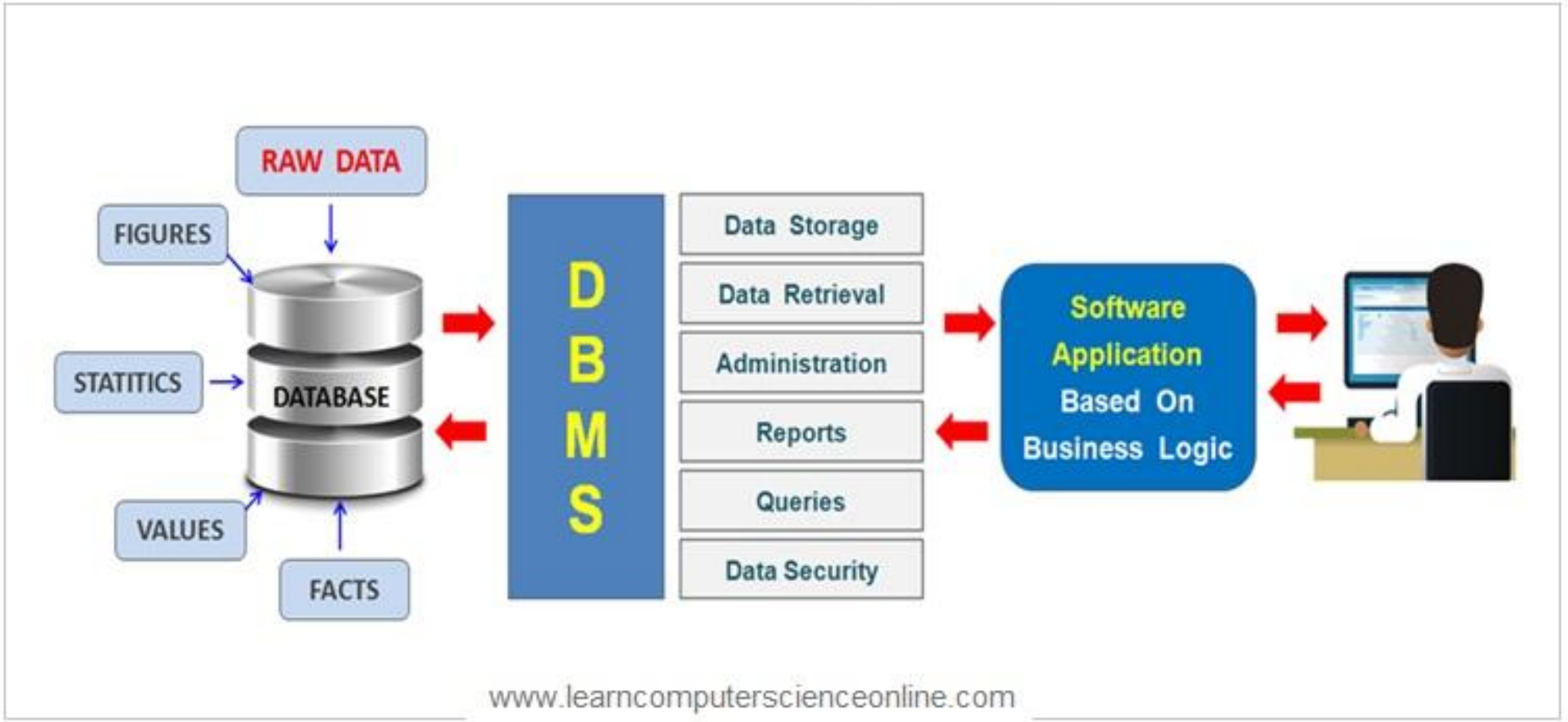
SQL Server

Properties:

- Creates databases
- Organizes data into tables or collections
- Inserts, updates, and deletes data
- Controls access and security
- Executes queries (SQL)



DBMS - Database Management System



Short Comparison

	What it is	Example	Key Feature
Data	Raw facts	90, Ahmed, image	Unorganized, raw
File System	A method of storing data in separate files	Excel and Word Files	Unstructured, no centralized control.
Data Storage	Physical/logical storage	HDD, Cloud, CSV	Stores data, no management
Database	Organized collection of data	Student table	Structured, searchable
DBMS	Software managing databases	MySQL, Oracle	Querying, security, integrity

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For more such information!

Don't forget to
Save for later

Types of Databases

Relational/SQL Database

- MySQL
- Oracle
- Microsoft SQL Server
- PostgreSQL

- Relationship & referential integrity
- Structured Data
- SQL Support
- Transactions & ACID properties
- Indexing & Optimization
- Security Features

Time-Series Database

- InfluxDB
- Timescale DB
- ClickHouse
- Prometheus

- High-write & read performance
- Data Compression
- Time-based data retention policies
- Built-in time-series functions
- Scalability

NoSQL Database

- InfluxDB
- Timescale DB
- Graphite
- Prometheus

- Document-based
- Column-based
- Key-value
- Graph Database
- Distributed Arch.
- Concurrency Ctrl.
- SQL Compatibility

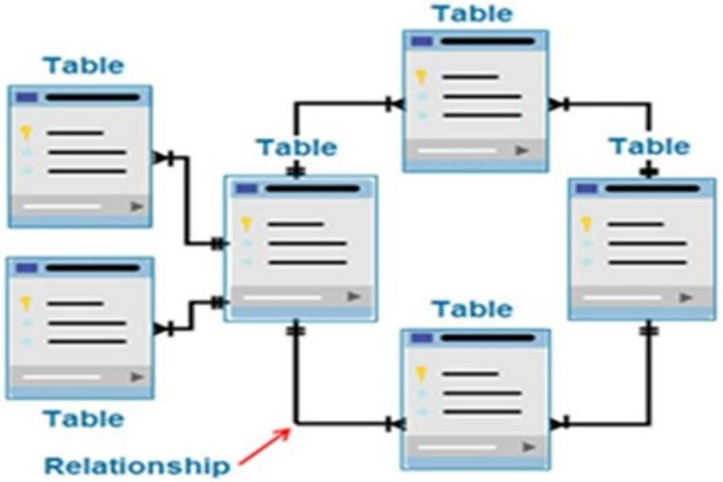
Advanced NoSQL ↓ NewSQL

Relational Database Management System (RDBMS)

RDBMS: is a software program used to **manage, store, retrieve, and update structured data**

organized into **tables (relations)** with **rows and columns**.

It ensures **data integrity and consistency** using **SQL**, **primary keys**, and **foreign keys**.



RDBMS

Relational Databases

Key Concepts of RDBMS

Tables (Relations):

Data is stored in **rows (records)** and **columns (attributes)**.

Structured Data:

Data is organized into **predefined schemas** with strict relationships.

SQL (Structured Query Language):

Standard language to interact with the database.

Common commands: SELECT, INSERT, UPDATE, DELETE.

Use Keys and Constraints:

- **Primary Key:** Uniquely identifies each row in a table.
- **Foreign Key:** Links and enforces relationships between tables.

Relationships

- **One-to-One (1–1)**
- **One-to-Many (1–M)**
- **Many-to-Many (M–M)**

Popular RDBMS Software

RDBMS	Description	Typical Use Case
MySQL	Open-source, widely used, fast	Web applications, small to medium systems
PostgreSQL	Open-source, advanced features, highly extensible	Enterprise systems, GIS, analytics
Oracle Database	Proprietary, enterprise-grade, robust	Large enterprises, banking, ERP
SQLite	Lightweight, file-based, serverless	Mobile apps, embedded systems
MariaDB	MySQL fork, open-source, high compatibility	Web apps, cloud systems
Microsoft SQL Server	**Proprietary, integrates well with Windows (Developer Version Free)**	**Corporate applications, business intelligence**

Microsoft SQL Server

Microsoft SQL Server has **two main groups of components**:

- **Server Components** (core functionality)
- **Client/Management Tools** (interaction and development).

Server Main Components

These are installed on the server and provide the core data services.

Component	Purpose
Database Engine	Core service for storing, processing, and securing relational data. Handles queries, storage, indexing, and replication.
SQL Server Analysis Services (SSAS)	Provides OLAP, data mining, and business intelligence capabilities.
SQL Server Reporting Services (SSRS)	Allows creation, management, and deployment of reports.
SQL Server Integration Services (SSIS)	Handles data integration and ETL (Extract, Transform, Load) operations.
SQL Server Agent	Automates administrative tasks like backups, jobs, and alerts.

Client / Management Main Components

Tools used to interact with, manage, and develop SQL Server solutions.

Component	Purpose
SQL Server Management Studio (SSMS)	GUI tool for managing SQL Server instances, databases, and server components.
Connectivity Components	Libraries (e.g., ODBC, OLE DB drivers) that enable communication between client applications and SQL Server instances.
SQL Server Data Tools (SSDT)	Development environment within Visual Studio for building databases, SSAS models, SSIS packages, and SSRS reports.

Tips for Installation of MS SQL Server & SSMS

To install SQL Server:

1. **Download the media** from the Microsoft SQL Server downloads page.

   https://www.microsoft.com/en-us/sql-server/sql-server-downloads?utm_source=chatgpt.com

2. Choose **Standard Developer edition** (free for development/testing).
3. **Run setup.exe** and follow the wizard.
4. After installation, separately download and install **SSMS** to manage your server.

https://learn.microsoft.com/en-us/ssms/install/install?utm_source=chatgpt.com


Thanks