Course Overview

Course Title: Database Systems (CS-207)

Instructor: Engr. Muhammad Younis

Credit Hours: 3+1

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Course Guidelines

Marks Distribution

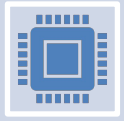
Nature of Examination (Theory)	**Max. marks**
Sessional marks (quiz, assignment, Presentation, Practical)	30
Midterm Examinations	30
Final Examinations	40
Total marks	**100**
Nature of Examination (Practical)	**Max. marks**
Practical Exam	20
Viva, Discussion, Presentation	15
Manuals, Project File etc	15
Total marks	**50**

Course Objectives

Understand fundamental database concepts.

Design database schemas using conceptual, logical, and physical models.

Apply normalization techniques to resolve database anomalies.



Use SQL for database manipulation and queries.

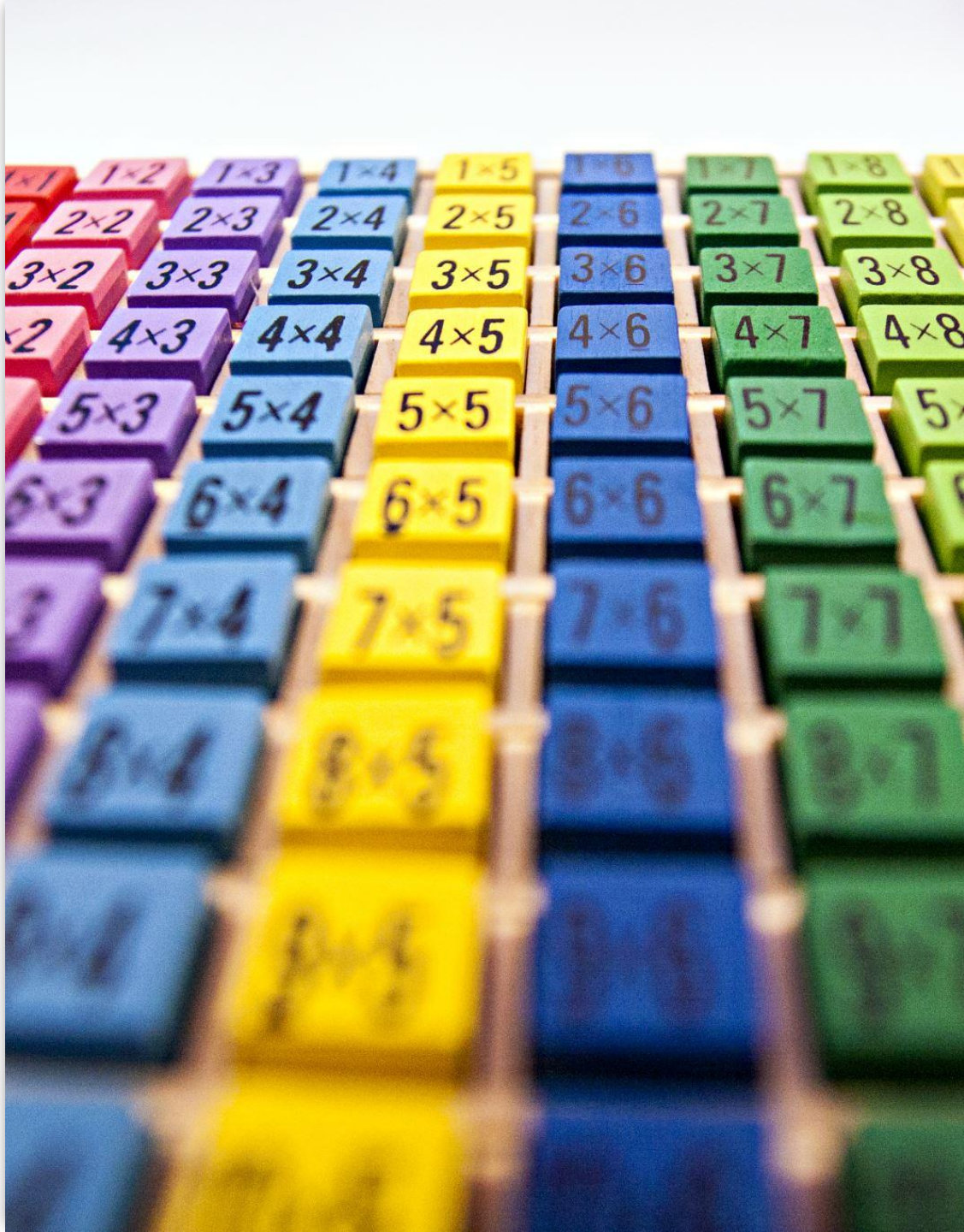
Data, Information, Knowledge & Wisdom

1. Data: Raw, unprocessed facts or figures without any context or meaning. It is the foundation of information.

- **Example**: Numbers, words, or measurements, such as 10, Blue, 100°C.
- **Analogy:** Imagine individual LEGO pieces scattered on the floor. Each piece is like data: it has no specific meaning until you assemble it into something meaningful.

2. Information: Processed or organized data that provides context and meaning. It answers the "who," "what," "where," and "when" questions.

- **Example:** "The temperature today is 10°C, and it is cloudy.“
- **Analogy:** When you organize LEGO pieces to build a small house, it becomes information. The pieces now form a recognizable structure with meaning.



Data, Information, Knowledge & Wisdom

3. Knowledge: Gained by analyzing and applying information to understand patterns, relationships, or principles. It answers the "how" question.

- **Example:** "When the temperature drops to 10°C, people usually wear jackets to stay warm."
- **Analogy:**
  - Using your LEGO house as a part of a bigger city plan, you recognize how it fits into the overall design. You now understand the relationship between the pieces and the structure.

4. Wisdom: The ability to use knowledge and experience to make sound judgments and decisions. It answers the "why" question.

- **Example:** "Since the temperature is 10°C and people wear jackets in such weather, I should bring a jacket to stay comfortable."
- **Analogy:**
  - Deciding to use your LEGO pieces creatively to design a sustainable city based on lessons learned from past builds. Wisdom involves applying knowledge to create value and solve problems effectively.

Introduction to Databases

- **What is a Database?**
  - Structured collection of data stored electronically for easy access and management.
  - A database is an organized collection of data that is stored electronically in a structured format. It allows for efficient storage, retrieval, and management of data for various purposes.
  - Think of a database as a digital filing cabinet where information (files) is stored in labeled folders for quick retrieval and efficient organization.
  - Examples: Library catalogs, online shopping platforms, social media platforms.

Introduction to Databases

1. Library

- **Analogy:** A library contains thousands of books on different subjects. Without a catalog system, finding a book would be chaotic.
- **Database Concept:** The catalog system is a database that organizes books by title, author, and subject to make retrieval easy.

2. Supermarket Inventory

- **Analogy:** A supermarket tracks the products it sells, their quantities, and prices. Without organization, they wouldn’t know when to restock or update prices.
- **Database Concept:** Inventory systems are databases that store and manage product data to ensure smooth operations.

Introduction to Databases

3. Online Shopping Websites

- **Analogy:** Platforms like Amazon store data about millions of products, customers, orders, and payments.
- **Database Concept:** These platforms use databases to manage and retrieve product information, customer details, and order histories.

4. Banking System

- **Analogy:** Banks store customer details, account balances, and transaction histories. Without a database, tracking these details would be impossible.
- **Database Concept:** Banking systems use databases to manage account data securely and efficiently.

Introduction to Databases

5. Hospital Patient Records

- **Analogy:** A hospital keeps track of patient details, medical history, and prescriptions.
- **Database Concept:** The hospital's database organizes this data to ensure accurate treatment and easy access for doctors.

6. Movie Streaming Services

- **Analogy:** Netflix recommends movies or shows based on what you've watched.
- **Database Concept:** A database stores data about movies, genres, and user preferences to personalize recommendations.

Types of Databases

- Relational Databases: Data stored in tables (e.g., MySQL, PostgreSQL).
- Object-Oriented Databases: Data as objects (e.g., db4o).
- NoSQL Databases: Flexible schema, designed for big data (e.g., MongoDB, Cassandra).
- Hierarchical Databases: Tree-like structures (e.g., IBM IMS).
- Network Databases: Graph-like structures (e.g., IDMS).

Applications of Databases

Banking: Account management and transactions.

Healthcare: Patient records, prescriptions.

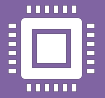
E-commerce: Product catalogs, orders.

Education: Student records, course management.

Database Management Systems (DBMS)

Definition: Software that interacts with users, applications, and the database itself to store, retrieve, and analyze data.

Functions of DBMS:



- Data storage, retrieval, and update.

- User and security management.

- Data integrity and transaction management.

Analogy for Database Management System (DBMS):

- A **DBMS** can be compared to a **library management system** that helps organize, manage, and access books efficiently. Here's how the analogy works:

1. **Database as a Library:** The **database** is like the collection of books in the library. It contains all the information (data) stored systematically.

2. **DBMS as the Librarian:** The **DBMS** acts like the **librarian**, who:
   - Organizes the books on shelves (stores data in tables).
   - Keeps track of which books are where (indexes and metadata).
   - Provides a system for borrowing or returning books (data retrieval and updates).
   - Ensures books are not misplaced or damaged (data integrity).

Analogy for Database Management System (DBMS):

3. **Users as Library Visitors:** The **users** are like the people visiting the library. They can:
   - Browse for specific books (query data).
   - Borrow books or return them (insert or update data).
   - Ask for help from the librarian to find what they need (use DBMS features).

4. **Query Language as the Library Catalog:** The **query language** (e.g., SQL) is like the **library catalog**:
   - Users can search by book title, author, or subject (filter data based on conditions).
   - The librarian uses this catalog to locate books quickly.

Analogy for Database Management System (DBMS):

5. **Security and Permissions:** Just as not everyone can enter certain parts of a library (e.g., staff-only areas or rare book collections), the **DBMS** enforces access controls and permissions to ensure only authorized users can access specific data.

6. **Backup as Book Duplicates:** In case of fire or loss, libraries often have backup copies of rare or important books. Similarly, the **DBMS** ensures data safety by maintaining backups.

7. **Scalability as Library Expansion:** As the library grows and needs more space, the librarian organizes the collection to make room for new books. Similarly, a **DBMS** scales to handle increasing amounts of data efficiently.

Types of DBMS

Relational DBMS: MySQL, Oracle, PostgreSQL.

Object-Oriented DBMS: db4o, ObjectDB.

NoSQL DBMS: MongoDB, DynamoDB.

Popular DBMS Examples

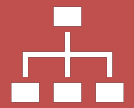
MySQL: Open-source RDBMS, commonly used for web applications.

PostgreSQL: Advanced RDBMS with strong community support.

MongoDB: A NoSQL database ideal for unstructured data.

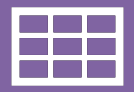
Data Models

A **data model** is a conceptual framework or blueprint that defines how data is organized, stored, and related within a database.



Hierarchical Model: Data organized in a tree-like structure.

Network Model: Data organized in a graph-like structure with nodes and edges.



Relational Model: Uses tables (relations) with rows and columns.

Object-Oriented Model: Integrates object-oriented programming and databases.

Summary

- Databases store and manage data for easy retrieval and manipulation.
- Types of databases include relational, hierarchical, and NoSQL.
- DBMS enables efficient interaction with databases.
- Data models define how data is structured and accessed.