What is a database?
It is a collection of related data

Database System

Application Program

Database Management System (DBMS) Software

Logical Perspective
Runtime Mapping
Physical Perspective

High Level of Data Abstraction

Program-data independence
Allows to change the physical representation of data w/o making any changes to application programs.

Program-operation independence

Functions/methods
- interface/signature
- name of the method
- separation of parameters
- implementation of the method
- code segment

Allows to modify implementation w/o making any changes to the interface.
Database

Part I & II
- Traditional (Structured Data)
  - (Relational Database)
    - E.F. Codd - Bell Lab
    - A set of 2-D Flat Tables of text/numeric data
      - Based on Set Theory

Part III
- Non-Traditional (Unstructured)
  - Social Media: Facebook, Twitter
  - Big Data
  - NoSQL (not only SQL) Systems
  - Cloud Storage

Limitations of DB Systems:
- High overhead in storage, processing, learning
- Single user access of data
- Stringent real-time applications

Data Model
- A collection of concepts to store the structure of a database (meta-data)

Conceptual (High-level)

Physical (Low-level)

Relational Model (Data Model): Set Theory.
- A DB is a set of tables
  - Each table has a set of rows
  - Each row has a set of columns
Figure 1.1 A simplified database system environment.
Properties of a set
- Any number of elements
  - no element
  - one element
  - three elements
  - infinite elements
- All elements must be of the same type
- Each element must be unique
  (The set cannot have duplicate elements)
- No order among elements

Data Model: Conceptual
- Entities and attributes of entities
- Relationships among entity types
- Constraints (Rules that must be obeyed by the DB)

Conceptual Schema: Conceptual data model (Logical Schema) of the DB.

Data model: Physical
- Tables, Columns, datatype, size

Internal Schema (Physical Schema) Data Definition Lang (DDL)
- Storage and access paths...

External View: Subset of the conceptual schema for a specific group
- For each user group, a separate view is created.
Figure 2.2  The three-schema architecture.
Figure 2.3  Component modules of a DBMS and their interactions.