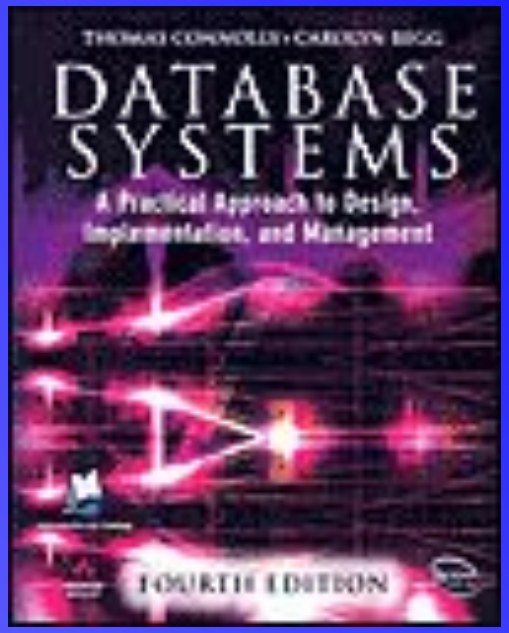
Lecture Two
Database Environment

Based on Chapter Two of this book:



Database Systems: A Practical Approach to Design, Implementation and Management

International Computer Science S.

Carolyn Begg, Thomas Connolly

Lecture 2 - Objectives

- Purpose of three-level database architecture.
- Contents of external, conceptual, and internal levels.
- Purpose of external/conceptual and conceptual/internal mappings.
- Meaning of logical and physical data independence.
- Distinction between DDL and DML.
- A classification of data models.

Lecture 2 - Objectives

- Purpose/importance of conceptual modeling.
- Typical functions and services a DBMS should provide.
- Software components of a DBMS.
- Meaning of client–server architecture and advantages of this type of architecture for a DBMS.
- Function and importance of the system catalog.

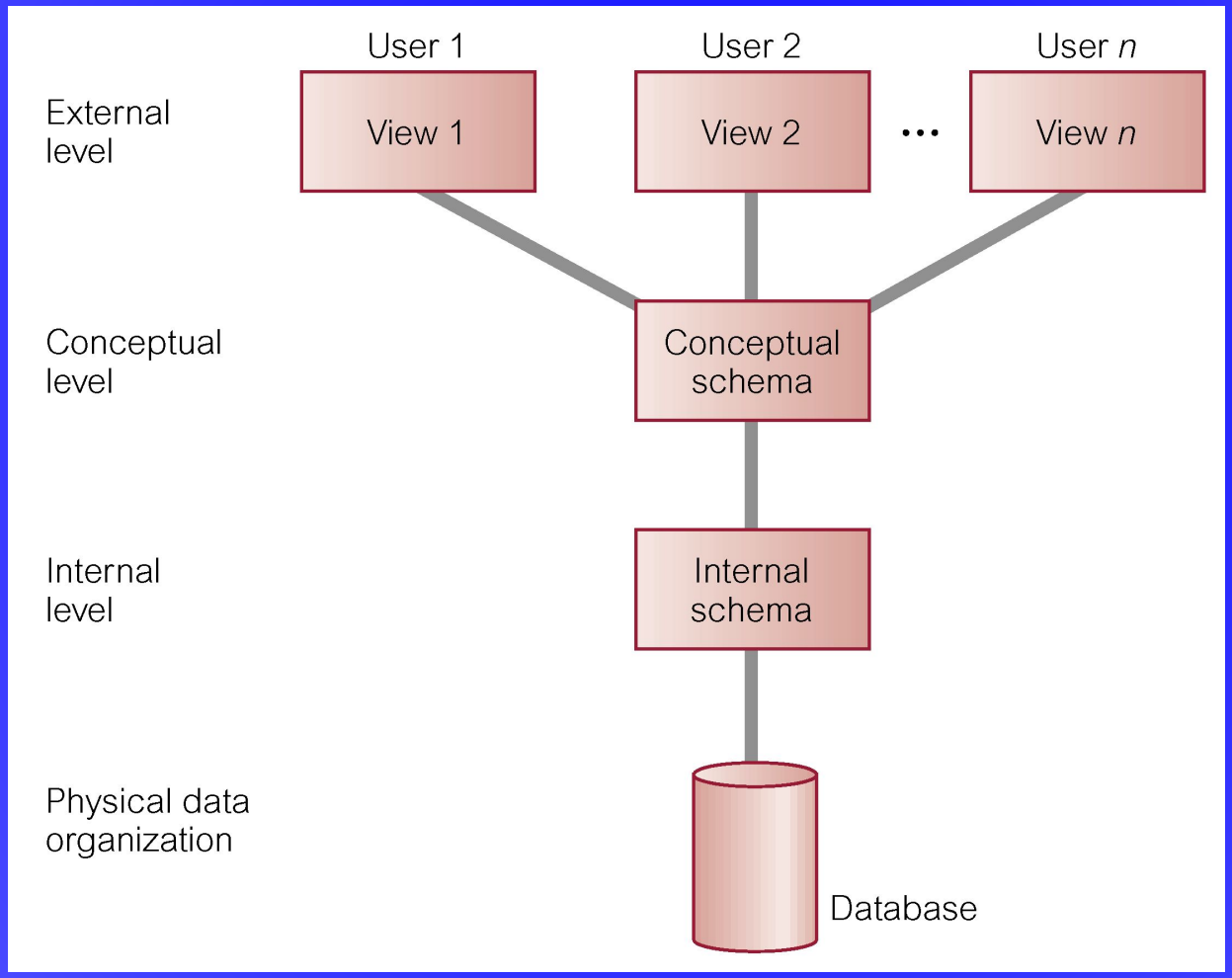
Objectives of Three-Level Architecture

- All users should be able to access same data.
- A user's view is immune to changes made in other views.
- Users should not need to know physical database storage details.

Objectives of Three-Level Architecture

- DBA should be able to change database storage structures without affecting the users' views.
- Internal structure of database should be unaffected by changes to physical aspects of storage.
- DBA should be able to change conceptual structure of database without affecting all users.

ANSI-SPARC Three-level Architecture



ANSI-SPARC Three-level Architecture

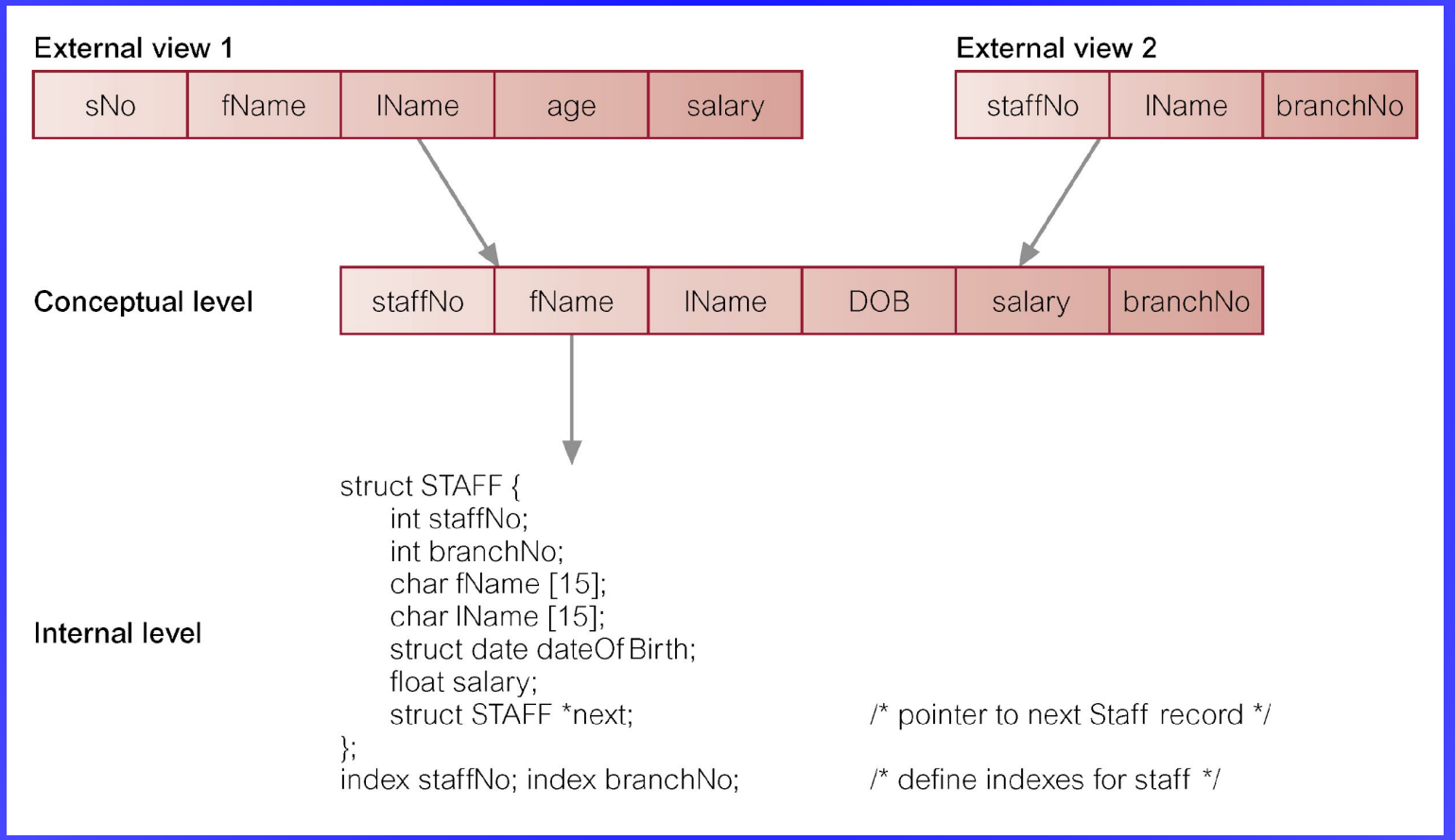
- External Level
  - Users' view of the database.
  - Describes that part of database that is relevant to a particular user.

- Conceptual Level
  - Community view of the database.
  - Describes what data is stored in database and relationships among the data.

ANSI-SPARC Three-level Architecture

- **Internal Level**
  - **Physical representation of the database on the computer.**
  - **Describes how the data is stored in the database.**

Differences between Three Levels of ANSI-SPARC Architecture



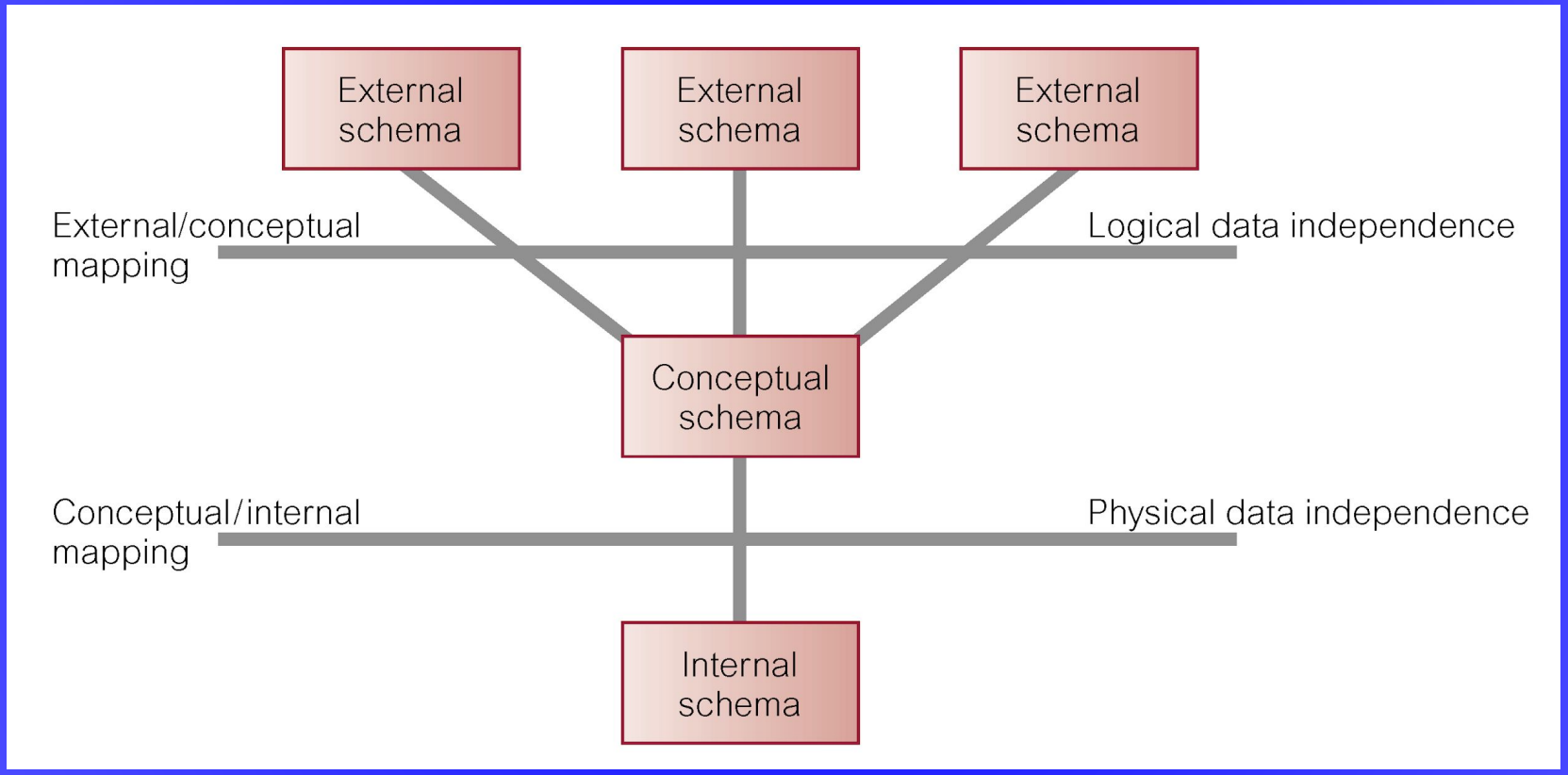
Data Independence

- Logical Data Independence
  - Refers to immunity of external schemas to changes in conceptual schema.
  - Conceptual schema changes (e.g. addition/removal of entities).
  - Should not require changes to external schema or rewrites of application programs.

Data Independence

- **Physical Data Independence**
  - **Refers to immunity of conceptual schema to changes in the internal schema.**
  - **Internal schema changes (e.g. using different file organizations, storage structures/devices).**
  - **Should not require change to conceptual or external schemas.**

Data Independence and the ANSI-SPARC Three-level Architecture



Database Languages

- Data Definition Language (DDL)
  - Allows the DBA or user to describe and name entities, attributes, and relationships required for the application
  - plus any associated integrity and security constraints.

Database Languages

- Data Manipulation Language (DML)
  - Provides basic data manipulation operations on data held in the database.
- Procedural DML
  - allows user to tell system exactly how to manipulate data.
- Non-Procedural DML
  - allows user to state what data is needed rather than how it is to be retrieved.

Database Languages

- Fourth Generation Language (4GL)
  - Query Languages
  - Forms Generators
  - Report Generators
  - Graphics Generators
  - Application Generators

Data Model

- Integrated collection of concepts for describing data, relationships between data, and constraints on the data in an organization.

- Data Model comprises:
  - A structural part
  - A manipulative part
  - Possibly a set of integrity rules

Data Model

- Purpose
  - To represent data in an understandable way.

- Categories of data models include:
  - Object-based
  - Record-based
  - Physical

Data Models

- Object-based Data Models
  - Entity-Relationship
  - Semantic
  - Functional
  - Object-Oriented
- Record-based Data Models
  - Relational Data Model
  - Network Data Model
  - Hierarchical Data Model
- Physical Data Models

Conceptual modeling

- Conceptual schema is the core of a system supporting all user views.
- Should be complete and accurate representation of an organization's data requirements.
- Conceptual modeling is process of developing a model of information use that is independent of implementation details.
- Result is a conceptual data model.

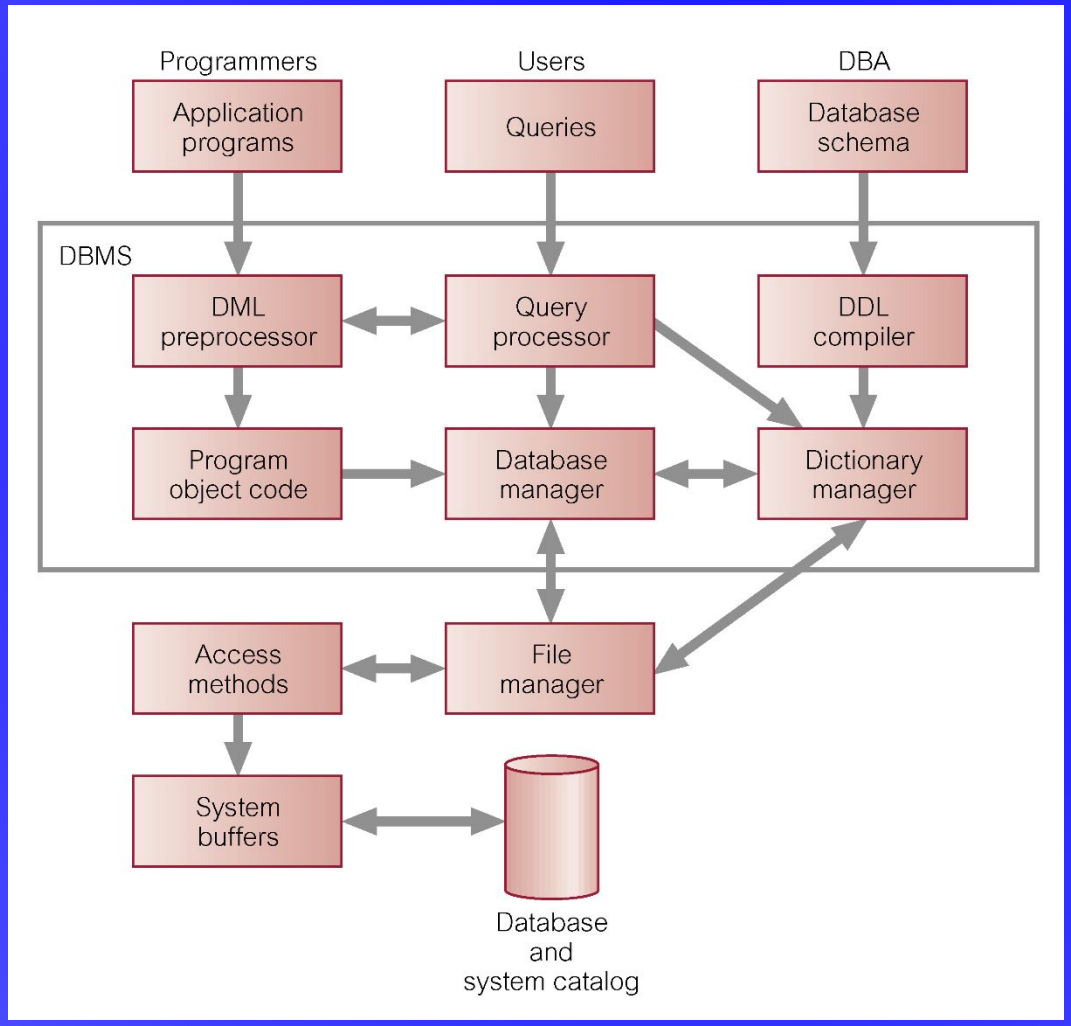
Functions of a DBMS

- Data Storage, Retrieval, and Update.
- A User-Accessible Catalog.
- Transaction Support.
- Concurrency Control Services.
- Recovery Services.

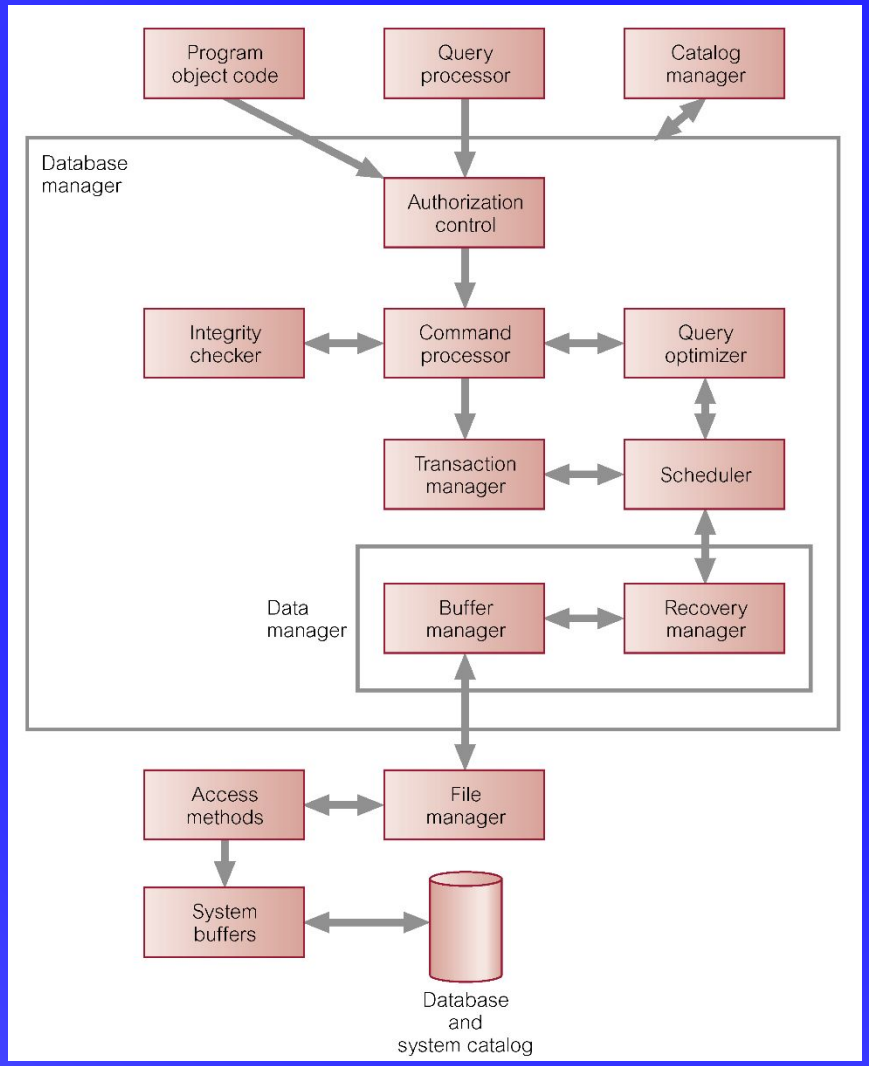
Functions of a DBMS

- Authorization Services.
- Support for Data Communication.
- Integrity Services.
- Services to Promote Data Independence.
- Utility Services.

Components of a DBMS



Components of Database Manager (DM)



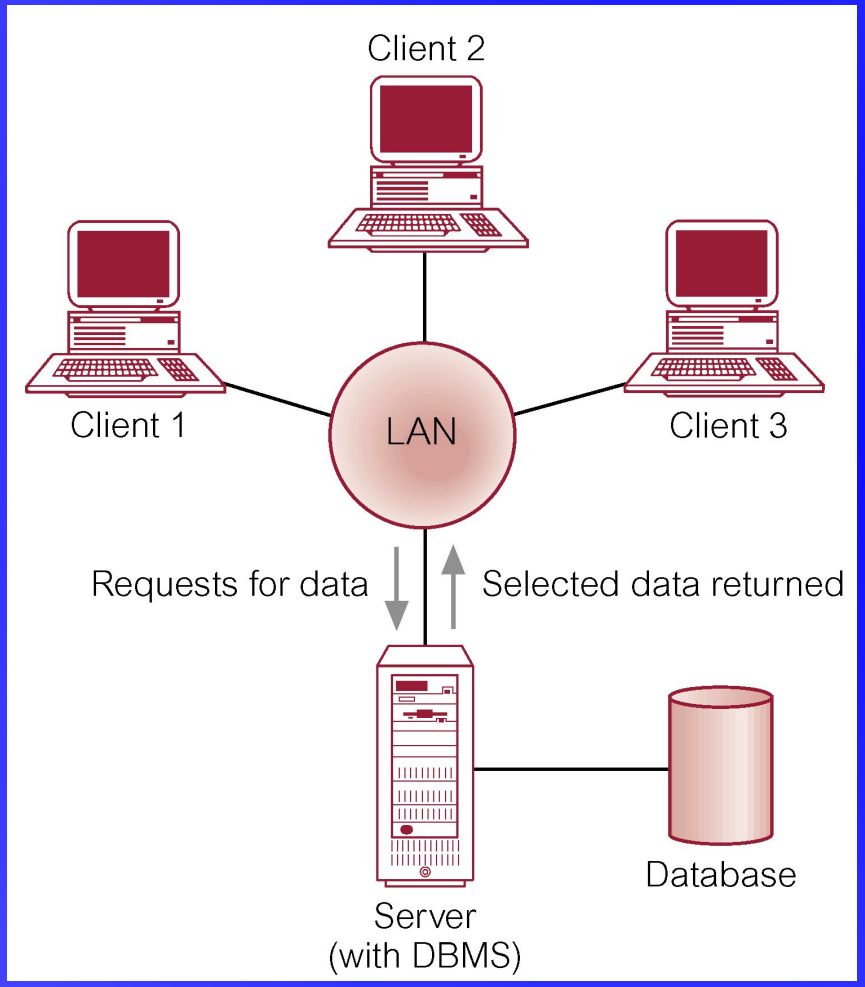
Multi-User DBMS Architectures

- Teleprocessing
- File-server
- Client-server

Client-server

- Server holds the database and the DBMS.
- Client manages user interface and runs applications.
- Advantages include:
  - wider access to existing databases
  - increased performance
  - possible reduction in hardware costs
  - reduction in communication costs
  - increased consistency.

Client-server Architecture



System Catalog

- Repository of information (metadata) describing the data in the database.
- Typically stores:
  - Names of authorized users.
  - Names of data items in the database.
  - Constraints on each data item.
  - Data items accessible by a user and the type of access.
- Used by modules such as Authorization Control and Integrity Checker.