Introduction

陆伟

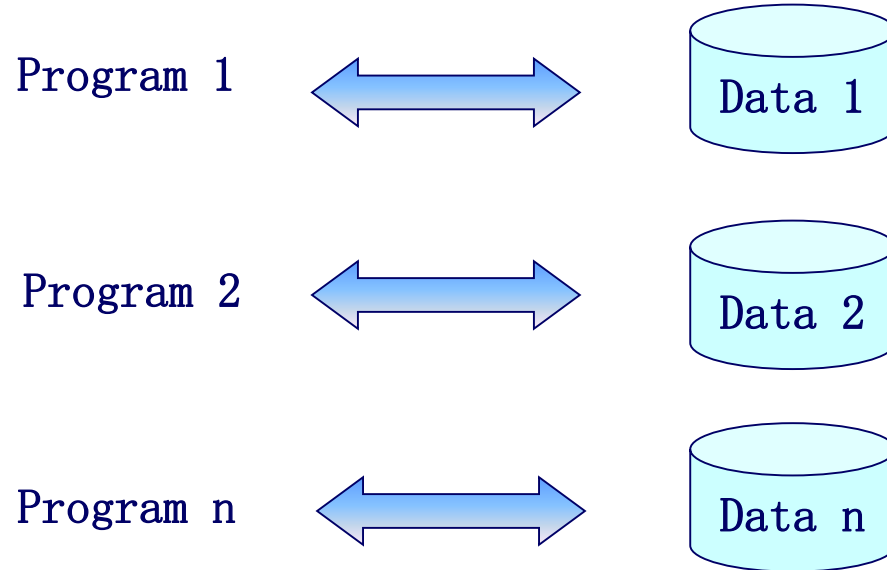**Database Systems**

January 7, 2022

目 录
CONTENTS

Origin and development of database

- Database approach is now the most effective approach for data management. It is necessary for us to review it's predecessors although these approaches are largely obsolete.

- The approach for data management has gone through three stages – manual management, file-based system, database system.

Origin and development of database

- Manual management
  - Used before 1950s
  - Application background: science computation
  - Hardware condition: punch tape, punch card, magnetic tape, no disk
  - Software condition: no OS, no software for data management, batch mode for data process
  - Limitations: data and program are dependent, data are managed by each application, no need to save data long time, no shared data

Origin and development of database

Program 1 ⟷ Data 1

Program 2 ⟷ Data 2

Program n ⟷ Data n

phase of manual management

Origin and development of database

- File-based System
    - Used between 1950s and 1960s
    - Application background: science computation, data management
    - Hardware condition: disk, drum
    - Software condition: have special data management software - file systems in OS, real time process data online (besides batch)
    - Limitations: data are separate and isolated, uncontrolled duplication of data, data and program are dependent, incompatible file formats

Origin and development of database
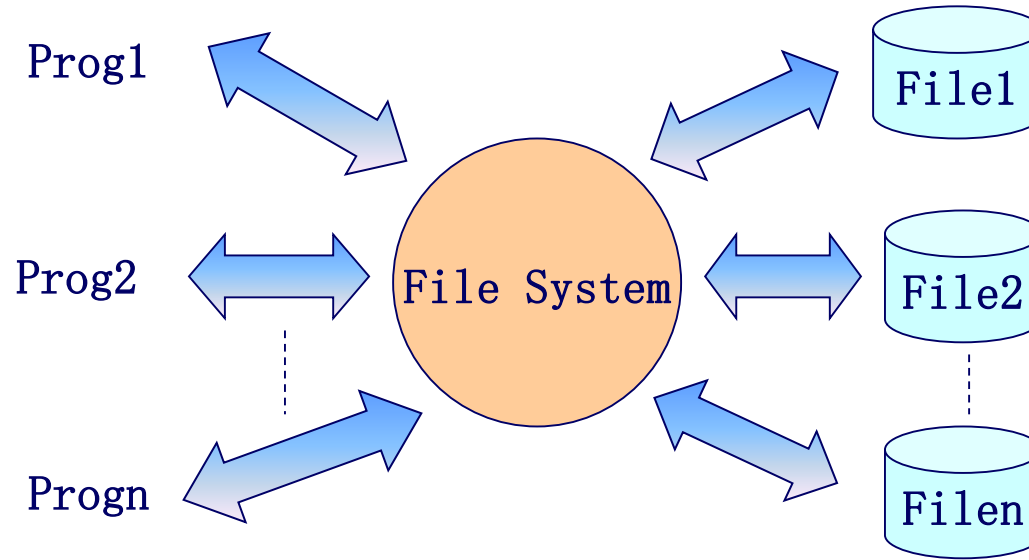
phase of file system

Origin and development of database

- Database system
  - Used since 1960s
  - Application background: large scale data management
  - Hardware condition: disk with large capacity, the price of hardware falls down
  - Software condition: a unified special data management software – database management system appeared

Origin and development of database

Prog1

Prog2

Progn

DBMS

Database

phase of database system
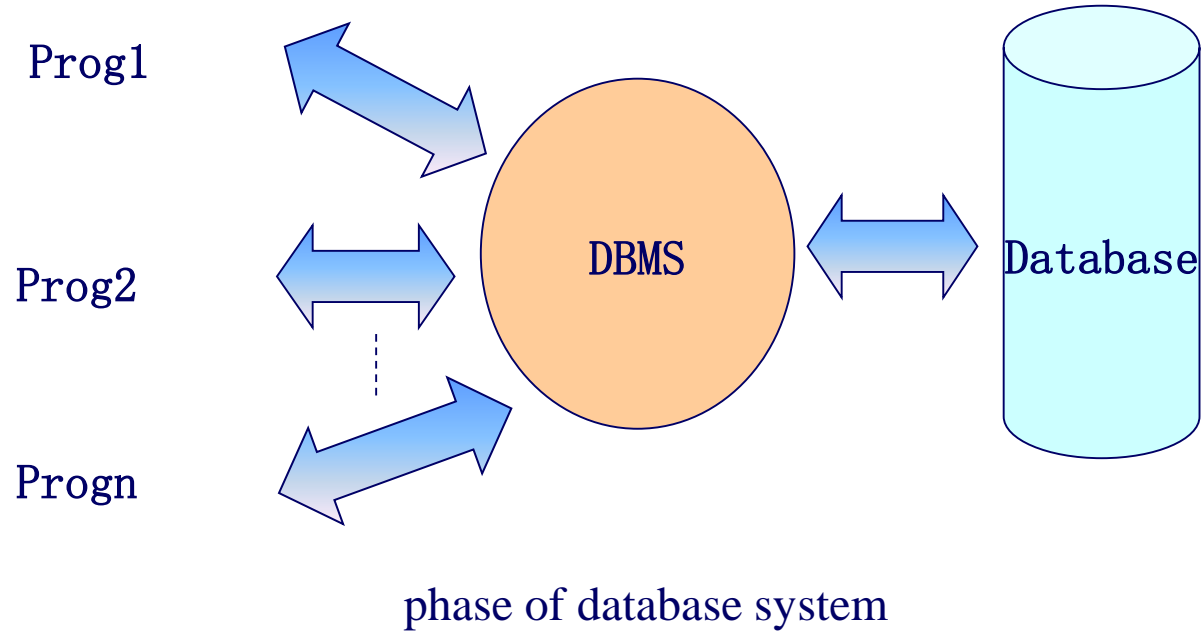
Key concepts in database systems

- Data
  - Data are raw facts that describe people, objects, and events.
- Information
  - Information are images that denote the status of objects and its' evolvement.

Key concepts in database systems

- Database
  - A shared collection of logically related data, and a description of this data, designed to meet the information needs of an organization.
  - Related
  - Integrated or shared
  - Structured
  - Keep data long time
  - Large quantities of data

Key concepts in database systems

- Database Management System (DBMS)
  - A software system that enables users to define, create, maintain, and control access to the database.
  - DBMS is the interface between the user's application programs and the database
  - Oracle, DB2, SQLServer, MySQL, Sybase, PostgreSQL,…

Key concepts in database systems

- History of Database Management Systems
    - DBMS has its roots in the 1960s Appllo moon-landing project.
    - NAA(美国北美航空公司), the prime contractor for the project, developed software known as GUAM (Generalized Update Access Method). It is a hierarchical structure.
    - 1960s, IBM joined NAA to develop GUAM into IMS (Information Management System)

Key concepts in database systems

- History of Database Management Systems
  - Mid-1960s,IDS (Integrated Data Store) emerge from General Electric. It is a network DBMS.
  - 1970, E.F,Codd of IBM Research Laboratory produced his high influential paper on the relational data model.
  - System R project at IBM San Jose Research Laboratory in California
    - Structured Query Language (SQL) become standard language for relational DBMSs;
    - DB2, SQL/DS, Oracle, …

Key concepts in database systems

- Database system
  - A database system is developed to support the operations of a specific organization or a specific set of applications.
  - A Database System consists of :
    - an application specific database
    - the DBMS that maintains that database
    - the application software that manipulates the database
  - Figure illustrates a simplified database-system architecture.
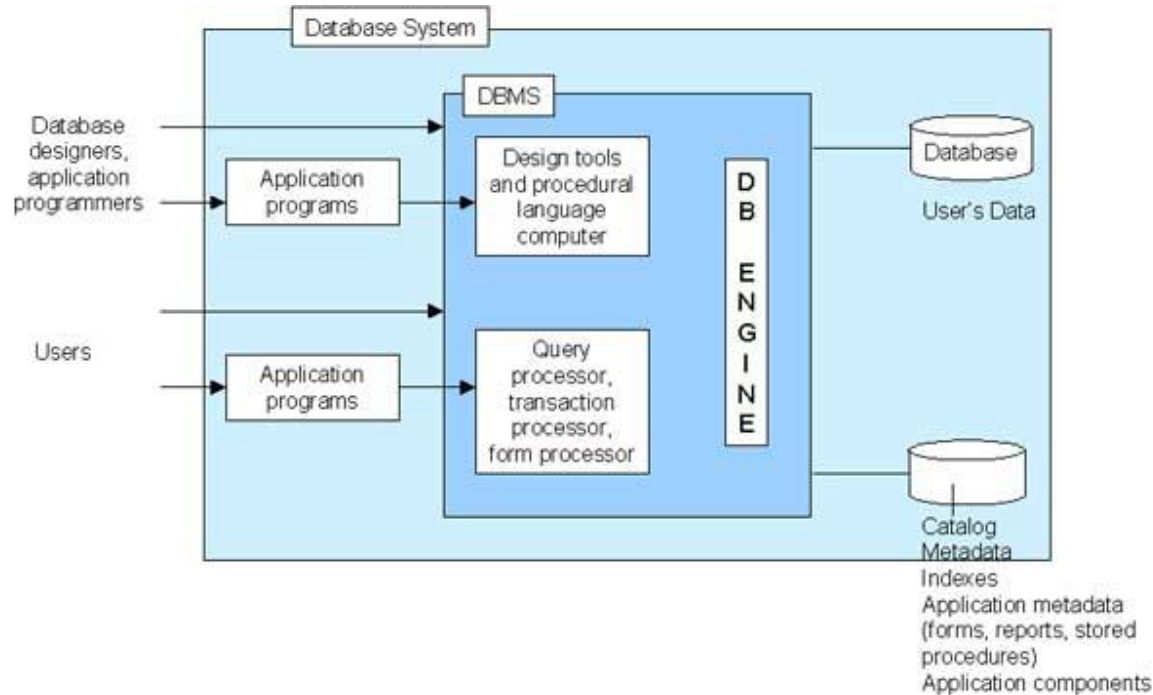
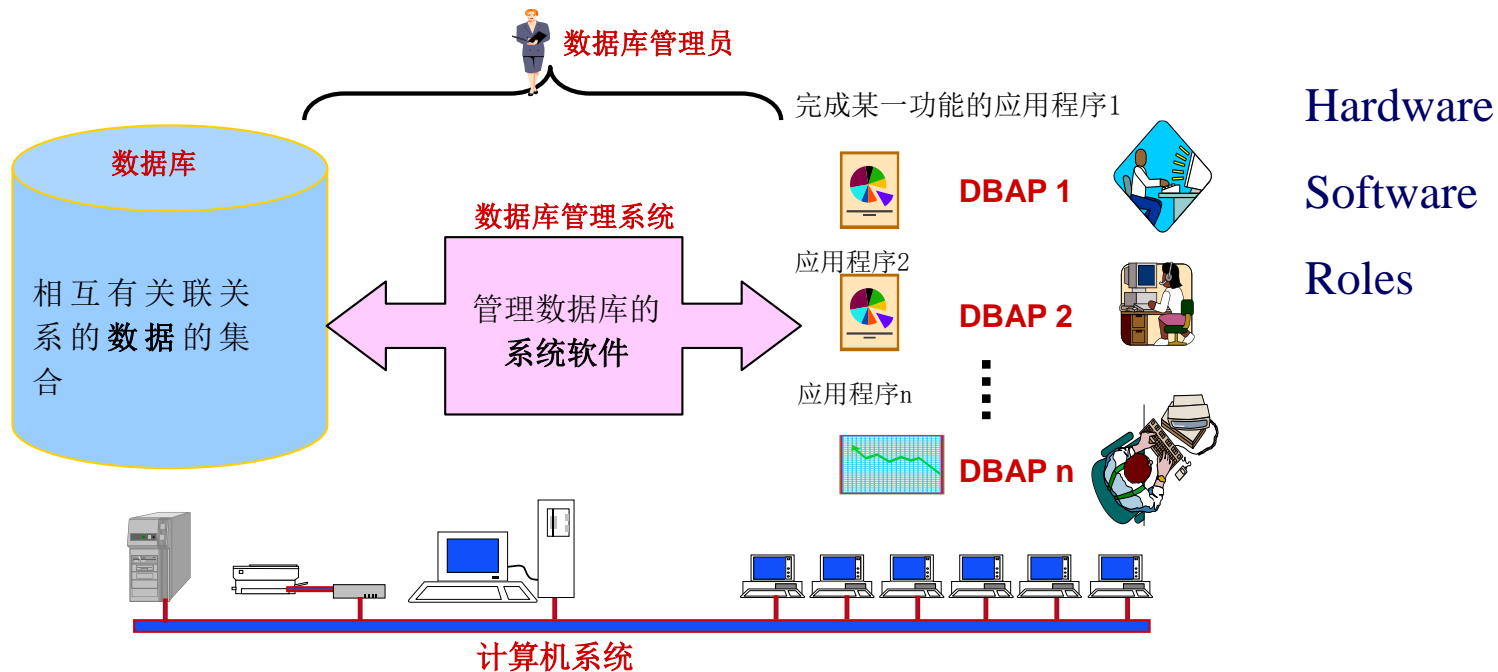# Key concepts in database systems

Figure database-system architecture

Components of the DBMS environment

数据库管理员

完成某一功能的应用程序1

数据库

相互有关联关系的**数据**的集合

数据库管理系统

管理数据库的**系统软件**

DBAP 1

应用程序2

DBAP 2

应用程序n

DBAP n

Hardware

Software

Roles

计算机系统

Characteristics of database approach

- Data Abstraction
  - DBMSs allow data to be structured in ways that make it more understandable and meaningful to the applications than the ways data are physically stored on disks.
  - The DBMS stores the structure of the data as part of the description of the database in the system catalog, separately from the application programs.

Characteristics of database approach

- Reliability
  - Enforcing integrity constraints
    - Integrity constraints reflect the meaning (or, the semantics) of the data and of the application.
    - Data type of each data item - An alphanumeric character string of maximum length 10
  - Ensuring data consistency
    - When the system fails, DBMSs guarantee data consistency; that is, interrupted update operations do not corrupt the database with values that violate the integrity constraints and no data in the database is lost.

Characteristics of database approach

- Efficiency
  - DBMSs support both efficient space utilization and efficient access to data.
  - By making use of the data description in the catalog, DBMSs are able to minimize data redundancy, which in turn saves both space and processing time.
  - DBMSs enhance the performance of queries by means of optimizations and the use of access methods to data based on their values.
  - DBMSs decrease response time of transactions by allowing multiple users to access the database concurrently.
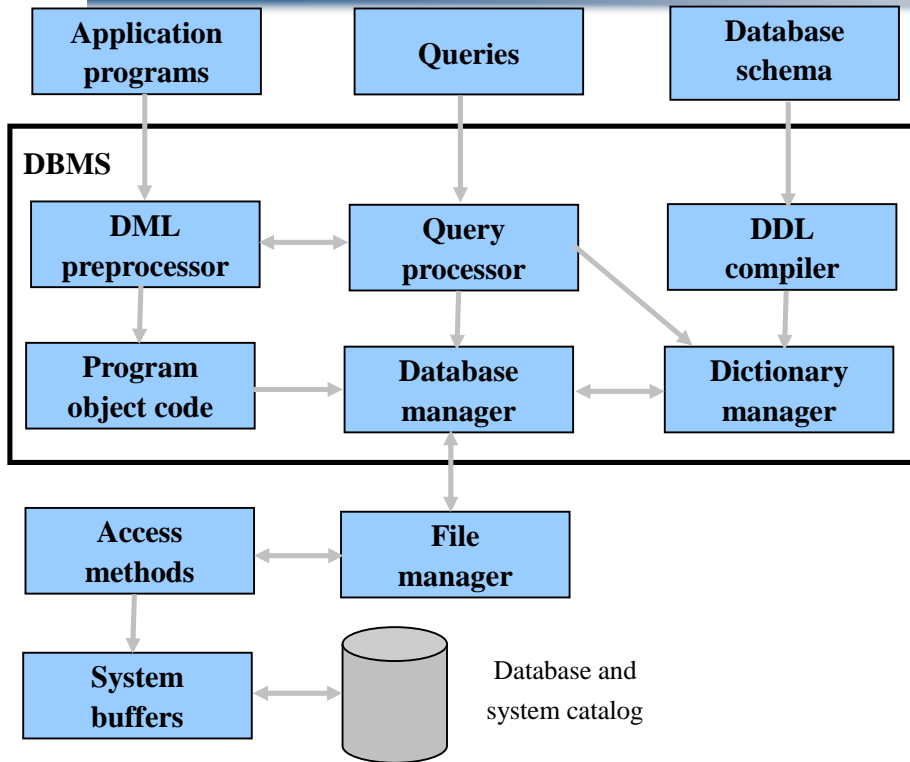
Characteristics of database approach

- When Is a Database Management System Needed?
  - Large quantities of related data need to be stored
  - Require efficient data sharing among many users
  - Security and access control is crucial
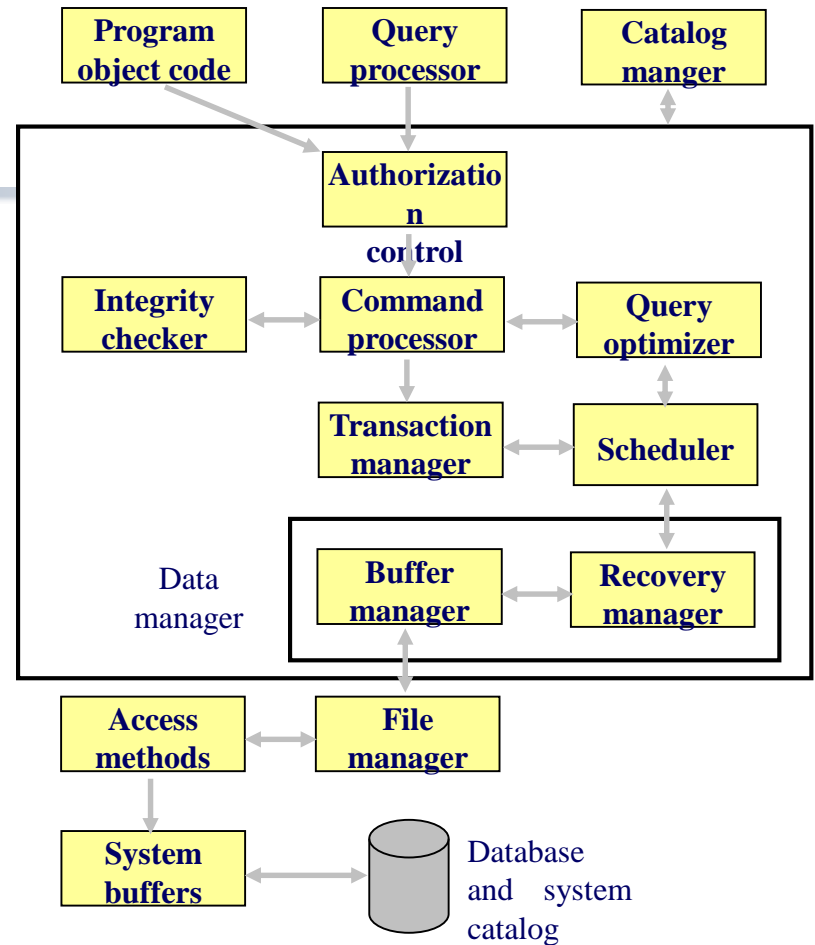 - Require a real quality of service to be a part
  - …

Characteristics of database approach

- When Is a Database Management System Not Needed?
    - The data has a simple structure and its size is small.
    - The application, although simple and unchanging, has a special purpose.
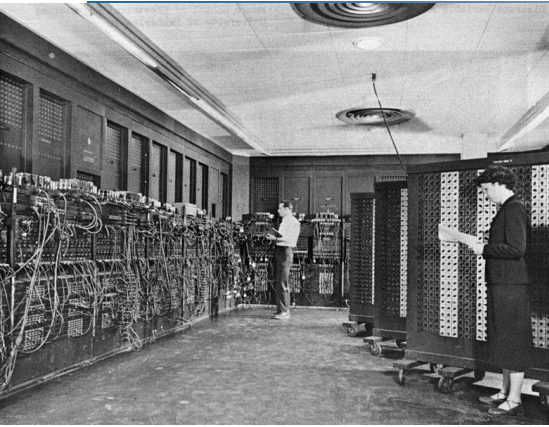   - Concurrent access to data by multiple users is not required.

About DBMS

Application programs	**Queries**	**Database schema**

DBMS

DML preprocessor	**Query processor**	**DDL compiler**
Program object code	**Database manager**	**Dictionary manager**

Access methods	**File manager**
System buffers	

Database and system catalog

Major components of a DBMS

Program object code	**Query processor**	**Catalog manger**

Authorization control

Integrity checker	**Command processor**	**Query optimizer**
	Transaction manager	**Scheduler**

Data manager

Buffer manager	**Recovery manager**

Access methods	**File manager**
System buffers	

Database and system catalog

Components of a database manager

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About DBMS

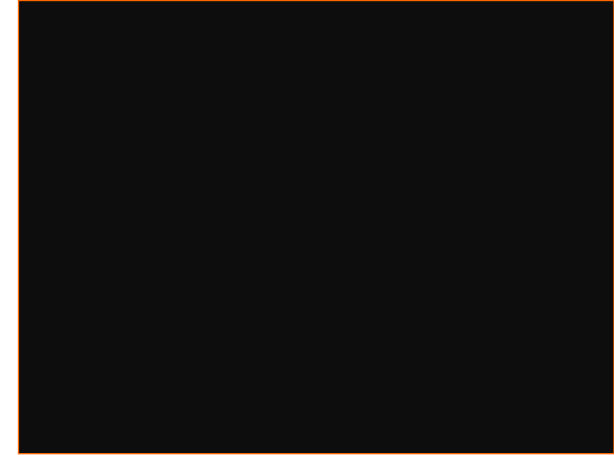The first general-purpose electronic computer, 1946.

…

Mostly used for big firm for commercial use, 1970.

…

World's first personal computer - APPLE I, 1976.

…

About DBMS

1st generation of Keyboard +
mouse input style., 1984.
Computer becomes more
personal
…

1990s-2010s: Computing
anywhere.
…

2020s
…

About DBMS

- The development of software architecture

祝各位学习愉快！