Overview of Database Design

陆伟

College of Software and Microelectronics

Database Systems-Design and Application

April 9, 2021

Northwestern Polytechnical University

Outline

- Background of Software Engineering
- Overview of the Information Systems Lifecycle
- The Database Systems Lifecycle
- The main stages of the Database Systems Lifecycle
- The benefits of Computer-Aided Software Engineering (CASE) tools
- Fact-finding Techniques
- About Documents for each Stage

Background of Software Engineering

- 软件不同于硬件或其它产品
- 计算机软件是一种复杂、抽象的逻辑实体，它所固有的一些特点有：
    - 抽象性：没有形体，自然没有一般制造业产品所具有的几何尺寸、物理性质（如重量、体积等）、化学性质。
    - 复杂性：软件内部结构复杂，有人说软件是人类创造的最为复杂的实体。

Background of Software Engineering

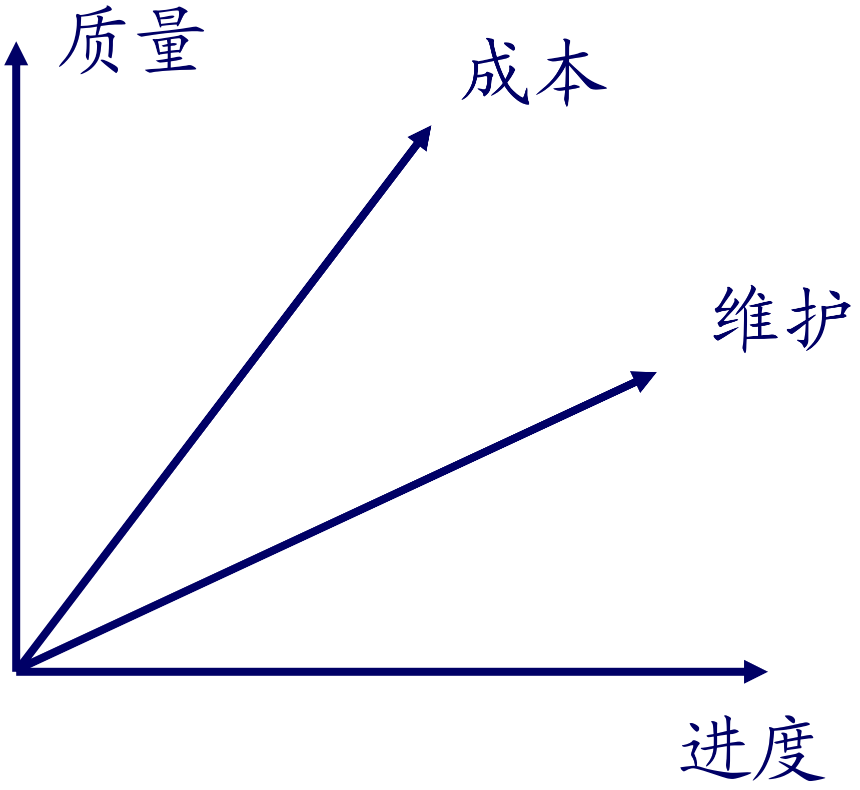
  - 多样性：没有完全相同的软件。
  - 易变性：软件在开发过程以及交付使用后常常会出于各种原因而修改。
  - 软件需求难于把握：软件开发常常会出现用户弄不清自己的需求、用户讲不清自己的需求、开发人员理解不透用户的需求，用户提出了需求以后，在开发的过程中再三要求变更需求等等情况。
- 所有这些软件独具的特点都增加了软件开发的困难，造成了许多其他行业没有出现过的特殊问题。

Background of Software Engineering

- Although the term ‘software crisis’ was first used in the late 1960s, the crisis is still with us.

Background of Software Engineering

- 软件危机的表现



软件的错误一出再出－－质量
软件的进度一拖再拖－－进度
软件的成本一增再增－－成本
软件的维护越来越困难- -维护

Background of Software Engineering

- 70年代，开始探索用工程的方法进行软件生产的可能性，即用现代工程的概念、原理、技术和方法进行计算机软件的开发、管理、维护和更新。于是，计算机科学技术的一个新领域—“软件工程”诞生了。

Background of Software Engineering

- 软件工程的定义
  - IEEE 1993年给出的定义：Software Engineering

    (I) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software.

    (II) The study of approaches as in （I）.

Background of Software Engineering

- 软件工程的定义
  - 发展到今天，软件工程已是一门交叉性学科，它是解决软件工程问题的工程，对她的理解不应是静止的与孤立的。
- 软件工程是应用计算机科学、数学及管理科学等科学知识和技术原理，借鉴传统工程的原则、方法来创建软件，从而达到提高质量，降低成本的目的。

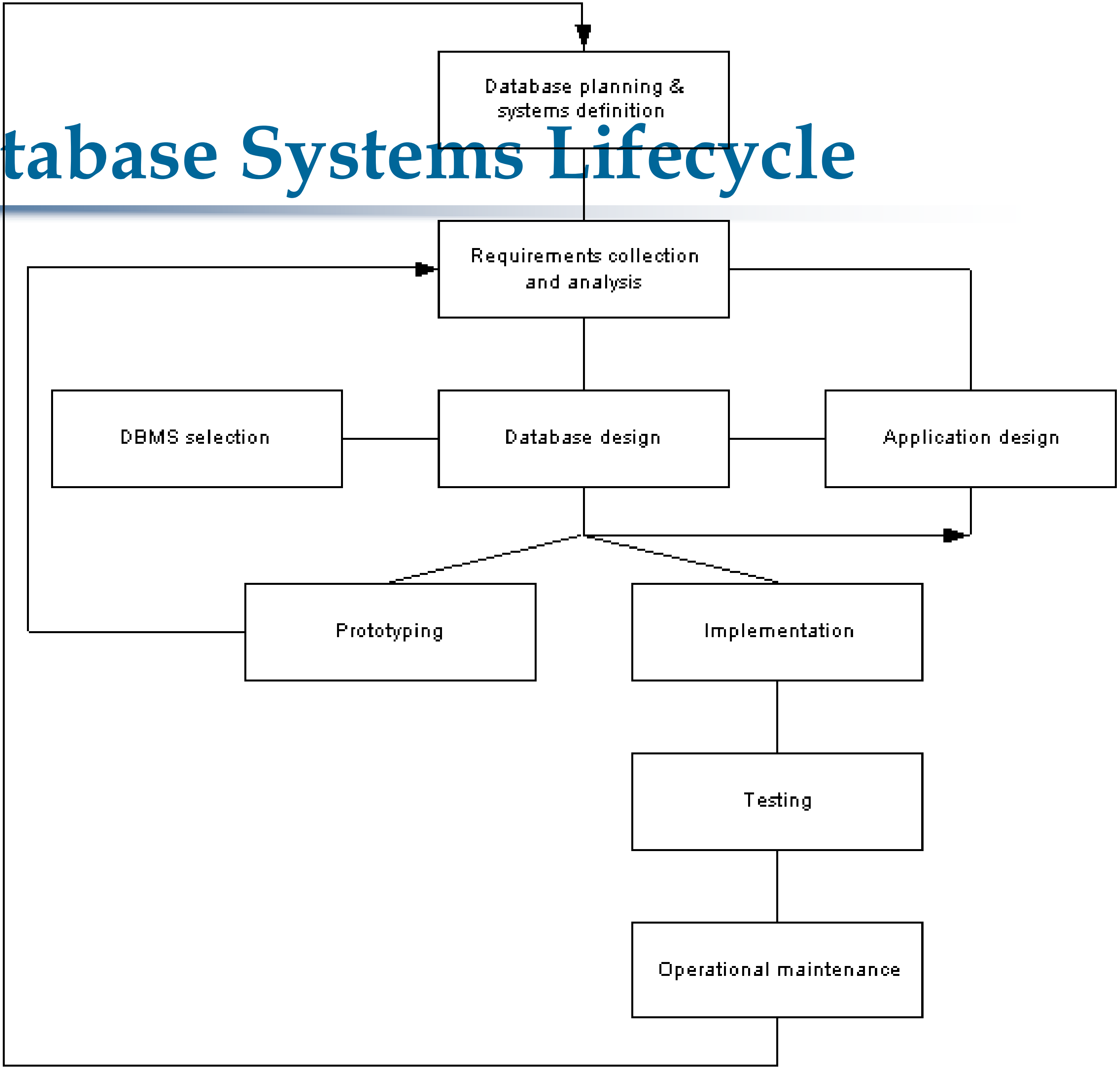
Overview of the Information Systems Lifecycle

- Information system
  - The resource that enable the collection, management, control, and dissemination of information throughout an organization.
- The database is a fundamental component of an information system.
- The lifecycle of an organization’s information system is inherently linked to the lifecycle of the database system that supports it.

Overview of the Information Systems Lifecycle

- Typically, the stages in the lifecycle of an information system include:
  - Planning
  - Requirements collection and analysis
  - Design
  - Prototyping
  - Implementation
  - Testing
  - Conversion
  - Operational maintenance

The Database Systems Lifecycle



Database Planning

- Database Planning
  - The management activities that allow the stages of the database application to be realized as efficiently and effectively as possible.
- Database planning must be integrated with the overall IS strategy of the organization.
- The most important objective of database plan is to clearly define the mission statement and mission objectives.

Database Planning

- There are three mian issues involved
  - Identification of enterprise plans and goals with subsequent determination of information systems needs;
  - Evaluation of current information systems to determine existing strengths and weaknesses;
  - Appraisal of IT opportunities that might yield competitive advantage.

Database Planning

- Database planning should also include the development of relative standards.
  - How data will be collected
  - How the format should be specified
  - What documentation will be needed
  - How design and implementation should proceed
  - …

System Definition

- System definition
  - Describes the scope and boundaries of the database application and the major user views.
- User view
  - Defines what is required of a database application from the perspective of a particular job role(such as Manager or Supervisor) or enterprise application area(such as marketing, personnel, or stock control).
- Identifying user views is an important aspect of developing a database application.

System Definition

- A user view defines what is required of a database application in terms of the data to be held and the transactions to be performed on the data.
- A database application may have one or more user views. A user view may be distinct to overlap with other views.

Requirements Collection and Analysis

- Requirements collection and analysis
  - The process of collecting and analyzing information about the part of the organization that is to be supported by the database application, and using this information to identify the user's requirements of the new system.
- There are many techniques for gathering this information, called fact-finding techniques.

Requirements Collection and Analysis

- Information is gathered for each major user view including:
  - A description of the data used or generated;
  - The details of how data is to be used or generated;
  - Any additional requirements for the new database application
- Requirements are described in documents refer to as requirements specifications.

Requirements Collection and Analysis

- The information collected at this stage may be poorly structured and include some informal requests, which must be converted into a more structured statement of requirements.
- Requirements specification techniques
  - Structured Analysis and Design (SAD)
  - Data Flow Diagrams (DFD)
  - Hierarchical Input Process Output (HIPO) charts
  - UML
  - Other CASE tools

Requirements Collection and Analysis

- Identifiying the required functionality for a database application is a critical activity.
  - Inadequate or incomplete functionality will..
  - Excessive functionality can also be problematic

Requirements Collection and Analysis

- Another important activity associated with this stage is deciding how to deal with the situation where there is more than one user view for database application.
  - The centralized approach
  - The view integration approach
  - A combination of both approach
- Anyway identifying the user's requirements is a difficult thing because…

Database Design

- Database Design
  - The process of creating a design for a database that will suport the enterprise's operations and objectives.
- Approaches to Database design
  - Bottom-up
  - Top-down
  - Inside-out
  - Mixed strategy

Database Design

- Data Modelling
  - Assist in the understanding of the meaning (semantics) of the data.
  - Facilitate communication about the information requirements.
- Building a data model requires answering questions about entities, relationships, and attributes.

Database Design

- Phases of Database Design
  - Conceptual database design
  - Logical database design
  - Physical database design

- Database design is an iterative process, which has a starting point and an almost endless procession of refinements.

Database Design

- Conceptual database design
  - The process of constructing a model of the information used in an enterprise, independent of all physical considerations.
  - It is entirely independent of implementation details such as the target DBMS software, application programs, programming languages, hardware platform, or any other physical considerations.
  - It is a source of information for the next phase, namely logical database design.

Database Design

- Logical database design
  - The process of constructing a model of the information used in an enterprise based on a special data model, but independent of a particular DBMS and other physical consideration.
  - A logical data model is derived knowing the underlying data model of the target DBMS.
  - It is a source of information for the next phase, namely physical database design.

Database Design

- Physical database design
  - The process of producing a description of the implementation of the database on secondary storage. It describes the base relations, file organizations, and indexes used to achieve efficient access to the data, and any associated integrity constraints and security measures.
  - It is tailored to a specific DBMS system.

DBMS Selection

Application Design

- Application Design
  - The design of the user interface and the application programs that use and process the database.
- Transaction Design
  - Data to be used by the transaction
  - Functional characteristics of the transaction
  - Output of the transaction
  - Importance to the users
  - Expected rate of usage

Application Design

- User Interface Design
  - Meaningful title
  - Comprehensible instructions
  - Logical grouping and sequencing of fields
  - Visually appealing layout of the form/report
  - Familiar field labels
  - Error correction, error messages
  - Color, space, convenient cursor movement
  - …

Prototyping

Implementation

Data Conversion and Loading

Testing

Operational Maintenance

The benefits of Computer-Aided Software Engineering (CASE) tools

Fact-finding Techniques

- Fact-finding
  - The formal process of using techniques such as interviews and questionnaires to collect facts about systems, requirements, and preferences.
- When are Fact-Finding Techniques Used?
  - Database planning
  - System definition
  - Requirements collection and analysis

About Documents for each Stage

数据库应用程序生存期阶段	**收集的数据**	**生成的文档**
数据库规划	数据库项目的目标和任务	数据库应用程序的任务陈述和任务目标
系统定义	描述主要用户视图	定义数据库应用程序的分为和边界；定义要支持的用户视图
需求收集和分析	用户视图和系统需求	用户和系统需求说明书
数据库设计	验证逻辑数据库设计的用户反映；目标 DBMS 提供的功能；	概念/逻辑数据库设计；物理数据库设计
应用程序设计	用户对界面设计的反映	应用程序设计
DBMS 选择	目标 DBMS 提供的功能	DBMS 的评估和推荐
建立原型	用户对系统原型的反响	改进的用户需求和系统需求说明书
实现	目标系统提供的功能	
数据转换和加载	当前数据的格式；目标 DBMS 的数据导入性能	
测试	测试结果	采用的测试策略；测试结果分析
运行维护	性能测试结果;用户和系统需求的增加和变化	用户手册；性能分析；改变的用户需求和系统说明书

Questions

Thanks