CSc 484
Database Management Systems

Ken Gamradt

Spring 2024

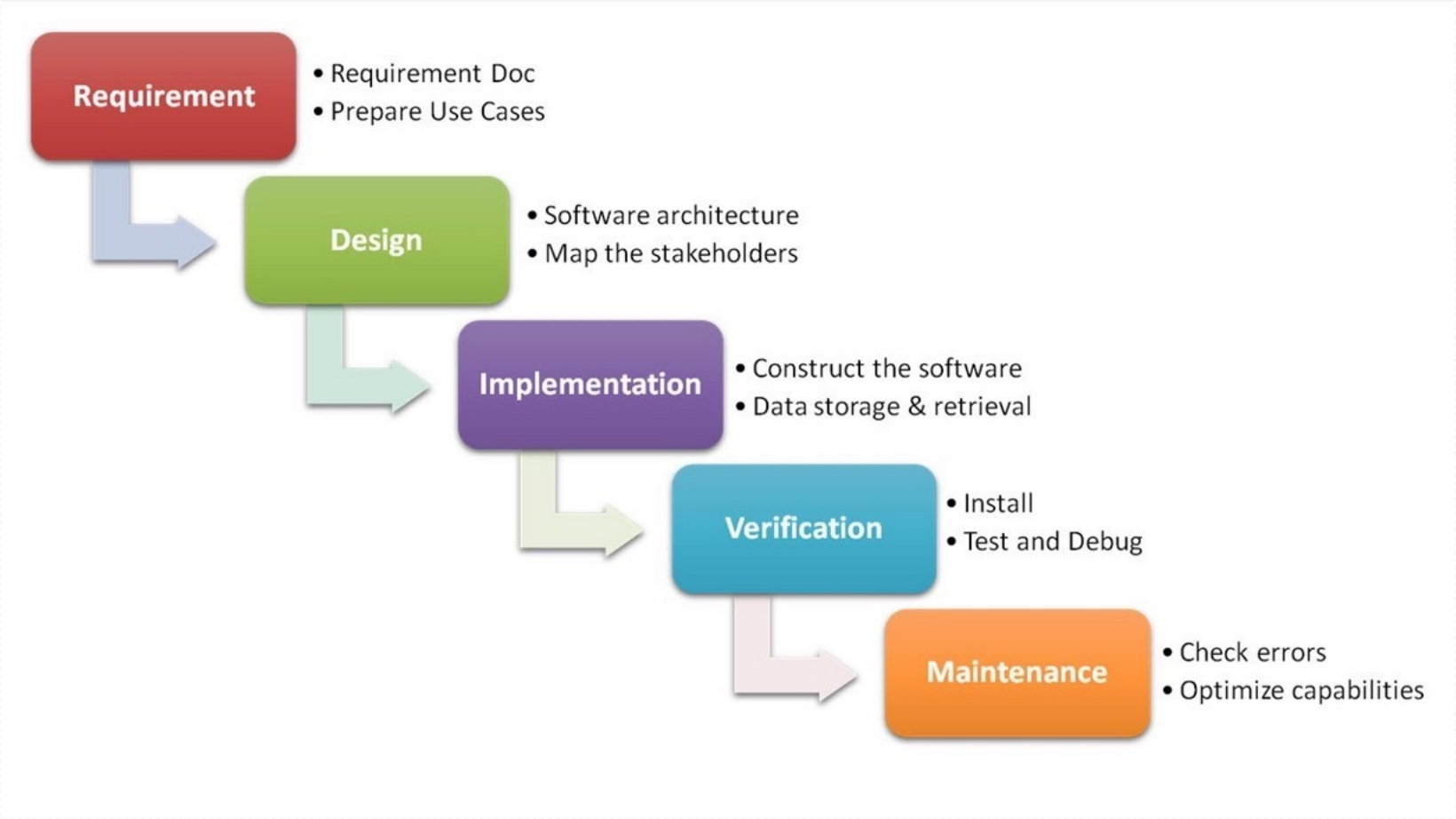
Database Design using ER (I)

Information System

- Resources that enable the
  - Collection
  - Management
  - Control
  - Dissemination

  of information throughout an organization
- A computer-based information system includes
  - A database
  - Database software
  - Application software
  - Computer hardware
  - Personnel using and developing the system

Software Development Lifecycle



Database Design Process – Requirements

- **Requirements**: Collection and Analysis
  - Preliminary stage to database design
  - **Purpose**:
    - Fully characterize the data needs of the prospective database users
  - **How to operate**:
    - Database designers need to interact extensively with domain experts and users
      - Interviewing, questionnaires, observing the enterprise in operation, research, …
  - **Outcome**:
    - A specification of user requirements
    - Represented by data-flow diagrams, UML, textual description, …

Database Design Process – Requirements

- University Database System
  - Prospective database users
    - Instructors
    - Students
    - Departments
    - …
  - Possible requirements
    - **Instructors**
      - View and update their own personal information
        - ID, name, department name, and yearly salary
      - View the information of courses and sections
      - View the detailed information of student advisees

Database Design Process – Requirements

- University Database System
  - Possible requirements
    - **Students**
      - View and update their own personal information
      - View the courses offered by departments and register for courses
      - View their course history and check their grades
      - View their list of advisors

Database Design Process – Requirements

- University Database System
  - Possible requirements
    - **Department**
      - View and update the information of students and instructors
      - Update the course list, including
        - Adding
        - Deleting
        - Modifying

        courses
      - Update the prerequisites of the courses

Database Design Process – Data Model

- **Data model**: a collection of conceptual tools for describing
  - Data
  - Data relationships
  - Data semantics
  - Consistency constraints
- **Data models**:
  - Relational model
  - Entity-relationship model
  - Semi-structured data model
  - Object-oriented data model
  - …

- Each describe the data from a different perspective

Database Design Process – Data Model

- **Conceptual data model**
  - High-level description of data items with their attributes and relationships
  - Entity-Relationship model, Enhanced Entity-Relationship model, Object-Oriented model
- **Logical data model**
  - Translation or mapping of the conceptual schema onto the implementation data model of the database system that will be used
  - Relational model, semi-structured model, NoSQL model
- **Physical data model**
  - Mapped from a logical data model – DDL and DML – tables and constraints
  - Clearly describes which data are stored where, in what format, which indexes are provided to speed up retrieval, …
  - Set access methods, security protection for the system, …
  - Highly DBMS-specific

Database Design process – Data Model

- **Conceptual design**
  - **Purpose**
    - Provide a detailed view of the data requirements
      - Easy to understand for the business users
      - Formal enough for database designers for the next stage
  - **A high-level model**
    - DBMS-independent or implementation-independent
  - **How**
    - Choose a data model
      - Typically, entity-relationship model
    - Apply the concept of the chosen data model, translate the requirements into a conceptual schema of the database

Database Design process – Data Model

- **Conceptual design**
  - **Output**
    - An **entity-relationship diagram**, with essential documentation where needed
      - Provides a graphic representation of the schema
  - **Designers review the schema**
    - To confirm that all data requirements are satisfied, and that they do not conflict with one another
    - To remove any redundant features

Entity-Relationship Model

- Map the meanings and interactions of real world onto a conceptual schema
  - Represent the overall logical structure of a database

Instructors

Able to view and update their personal information:

ID, name, department name, and yearly salary

View the information of courses and sections

View the detailed information of students advised by them

Students

View and update their personal information

View the courses provided by departments and register courses

View the course history and check the grades

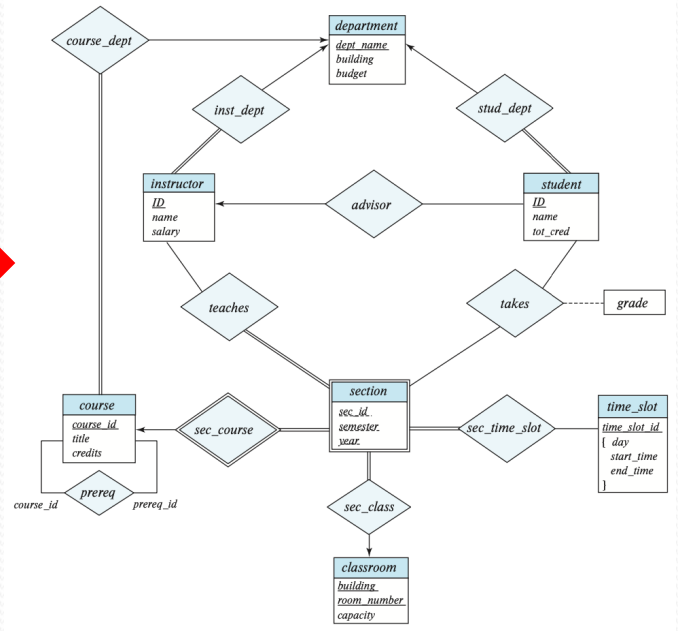
View the list of advisors

Department

View and update the information of students and instructors

Update the course list: including adding, deleting, and modifying courses

Update the prerequisites of the courses



Real world requirements

E-R diagram

Acknowledgements