# Database Design in a Nutshell

## Six steps of Database Design

**Step 1: Requirements analysis.** Collect information from customer about

- data;
- desired features of the database;
- information needs.

**Step 2: Conceptual Database Design.** Develop high-level description of data, describe constraints.

- High-level design: often done using Entity-Relatioship diagrams (E-R diagrams).

**Step 3: Logical Database Design.** Select a DBMS, convert high-level design into (relational) database design (*database schema*) in Data Definition Language (DDL) of the DBMS.

- DDL for relational databases is a part of SQL.

**Steps 1–3** are main steps in database design. Thee more steps, *enhance* the Logical design.

**Step 4: Schema Refinement.** Logical database design is analyzed and (potentially) improved.

- Goal of schema refinement: have database schema in one of **normal forms**.

**Step 5: Physical Database Design.** Tailor the database schema to expected workloads (queries, information needs).

- Choose *indexes*.
- *Tune* database design.

**Step 6: Security Design.** Identify user groups, information (parts of the database) to be made available to different user groups. Represent security information in DDL.

- SQL has some mechanisms to maintain security of the data.

# Database Design vs. Application Design

Databases are rarely designed all by themselves. Typically, database design is accompanied by the database application design.

Important things to remember:

- Database design and database application design are **two different processes**. They may happen in parallel, but each has its own set of procedures to follow.
- Database design is studied in detail in this course. It concentrates on *determining the correct structure of the database* for a given application.
- Database application design is guided by the principles of software engineering. The design is broken into traditional stages:
  - Application requirements elicitation.
  - Application design.

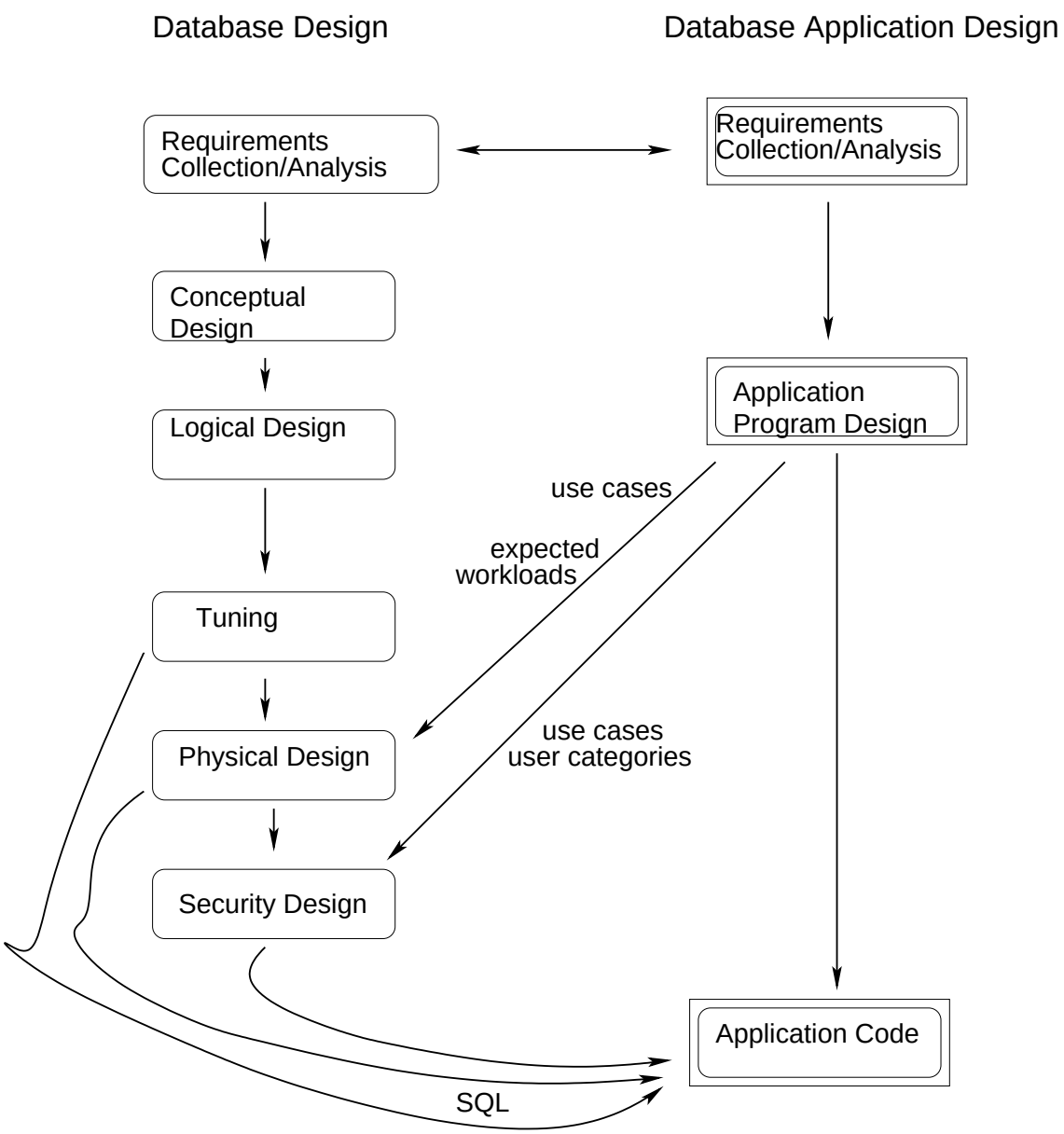
  Database application design concentrates on *uses of data from the database* and on *properties of software* which would satisfy those uses.
- Database design and database application design are usually performed in parallel.

## Requirements elicitation for database design

- Interaction with customers.
  - Who is the customer?
  - Who knows the structure of customer's data?
  - How can information about customer's data be obtained?
    - Interviews
    - Existing documentation
    - Specially prepared documentation
- Information collection.
  - How much domain expertise is needed?
  - What information is important? What information is NOT important?
  - How does one preserve elicited/discovered infromation?
    - Conceptual modeling.
    - Formalisms for conceptual modeling.
    - Entity-Relationship modeling framework.
    - Knowing the conceptual modeling mechanism that will be employed helps identify information to be elicited, the means of recording it.

## Requirements elicitation for database application design

- Interaction with customers.
  - Who are the intended users of the application?
    - Possibly different categories of intended users with different *transaction needs* and *information needs*.
  - Who can provide *transaction needs* and *information needs* for the application?

    - Possibly, more than one source of information.
    - Possibly, source of informarion different from the database requirements expert.
  - How can information about customer's application needs be obtained?
    - Interviews
    - Existing documentation
    - Specially prepared documentation

- Information collection.
  - How does data get into the database?
  - How is data managed in the database?
  - What information needs exist?
  - How should retrieved information be displayed?
  - What are expected workloads?