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-Relationship 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 (pot-
tentially) 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 information?
    * 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 information 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?

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Database Design

Requirements Collection/Analysis

Conceptual Design

Logical Design

Tuning

Physical Design

Security Design

Database Application Design

Requirements Collection/Analysis

Application Program Design

Application Code
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use cases

expected workloads

use cases

user categories

SQL