Database Systems 2

Lecture 9

Database Design Methodology

Overview

Modelling methodologies

Two main approaches to data modeling: top-down and bottom-up.

Bottom-up models

- They usually start with existing data structures, forms, fields on application screens, or reports.
- Often the result of a reengineering effort.
- These models are usually physical, application-specific, and incomplete from an enterprise perspective.
- They may not promote data sharing, if the existing organisation does not favour it.

Top-down models

- Created in an abstract way by getting information from people who know the subject area.
- A system may not implement all the entities in a logical model, but the model serves as a reference point or template.

Sometimes models are created in a mixture of the two methods:

Unfortunately, in many environments the distinction between a logical data model and a physical data model is blurred. In addition, some CASE tools don’t make a distinction between logical and physical data models.

Critical Success Factors in Database Design

- Work interactively with users as much as possible.
- Follow a structured methodology throughout the data modelling process.
- Employ a data-driven approach.
- Use diagrams to represent as much of the data models as possible.
- Incorporate conceptualisation, normalisation and transaction validation techniques into the data modeling methodology
- Use a database design language to represent additional data semantics.
- Build a data dictionary to supplement the data model diagrams.
- Be willing to repeat steps.

Database Design Methodology

"A structured approach that uses procedures, techniques, tools and documentation aids to support and facilitate the process of design."

Connolly & Begg

Broken down into three phases:

- Conceptual database design
- Logical database design
- Physical database design

Unfortunately, in many environments the distinction between a logical data model and a physical data model is blurred. In addition, some CASE tools don't make a clear distinction between conceptual, logical and physical data models.

Three phases

Conceptual Database Design

- "The process of constructing a model of the information used by an enterprise, independent of all physical considerations."

Logical Database Design

- "The process of constructing a model of the information used in an enterprise based on a specfic data model, but independent of a particular DBMS and other physical considerations"

Physical Database Design

- "The process of producing a description of the implementation of the database on secondary storage; it describes the storage structures and access methods used to achieve efficient access to the data."

American National Standards Institute. 1975.
ANSI/X3/SPARC Study Group on Data Base Management Systems;
Interim Report. FDT (Bulletin of ACM SIGMOD) 7:2.

Overview of the Methodology

Conceptual Database Design

1 Build local conceptual data model for each user view.

Logical Database Design

2 Build and validate local logical data model for each user view

3 Build and validate global logical data model

Physical Database Design

4 Translate global logical data model for target DBMS

5 Design physical representation

6 Design security mechanisms

7 Monitor and tune operational system

Conceptual Database Design

1 Build local conceptual data model for each user view.

1.1 Identify entities

1.2 Identify relationships

1.3 Identify and associate attributes with entities or relationships

1.4 Determine attribute domains

1.5 Determine candidate and primary key attributes

1.6 Specialise/generalise entities (optional)

1.7 Draw Entity-Relationship diagram

1.8 Review local conceptual data model with user

Logical Database Design

2 Build and validate local logical data model for each user view

2.1 Map local conceptual data model to local logical data model

2.2 Derive relations from local logical data model

2.3 Validate model using normalisation

2.4 Validate model against user transactions

2.5 Draw Entity-Relationship diagram

2.6 Derive integrity constraints

2.7 Review local logical data model with user

Logical Database Design

3 Build and validate global logical data model

3.1 Merge local logical data models into global model

3.2 Validate global logical data model (normalisation & transactions)

3.3 Check for future growth

3.4 Draw final Entity-Relationship diagram

3.5 Review global logical data model with users

Physical Database Design

4 Translate global logical data model for target DBMS

4.1 Design base relations for target DBMS

4.2 Design enterprise constraints for target DBMS

5 Design physical representation

5.1 Analyse transactions

5.2 Choose file organisations

5.3 Choose secondary indexes

5.4 Consider the introduction of controlled redundancy

5.5 Estimate disk space requirements

Physical Database Design

6 Design security mechanisms

6.1 Design user views

6.2 Design access rules

7 Monitor and tune operational system