DATABASE MANAGEMENT SYSTEM

Chapter 5

Conceptual Design

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System Development Life Cycle

- Planning
  - Define general objectives
- Analysis
  - Identify problems
  - Specify conceptual data model
- Detailed system design
  - Detail system specification
- Implementation
  - Coding, installation, fine-tuning
- Maintenance
  - Evaluation, maintenance, enhancement

Database design

- The formal process of analyzing facts about the real world into a structured database model
- Divided into three stages: conceptual design, logical design and physical design

Conceptual database

- Conceptual database design is the initial phase of creating a database.
- It involves identifying the essential data elements, their relationships, and constraints within a specific domain.
- This stage is crucial as it lays the groundwork for subsequent design phases, ensuring the database effectively meets the organization's needs.

Conceptual database

- Identify entities: Determine the main objects or concepts within the system.
- Define attributes: Specify the properties or characteristics of each entity.
- Establish relationships: Determine how entities are connected or related.
- Specify constraints: Define rules and restrictions on data integrity.

Stages in DB Design

- **CONCEPTUAL**
  - Software & hardware independent
  - Describes & defines included entities
  - Identifies how entities will be represented in the database
  - Requires decisions about how real-world dimensionality & relationships will be represented
- **LOGICAL**
  - Software specific but hardware independent
  - Sets out the logical structure of the database elements, determined by the database management system used by the software
- **PHYSICAL**
  - Both hardware & software specific
  - Requires consideration of how files will be structured for access

Conceptual design

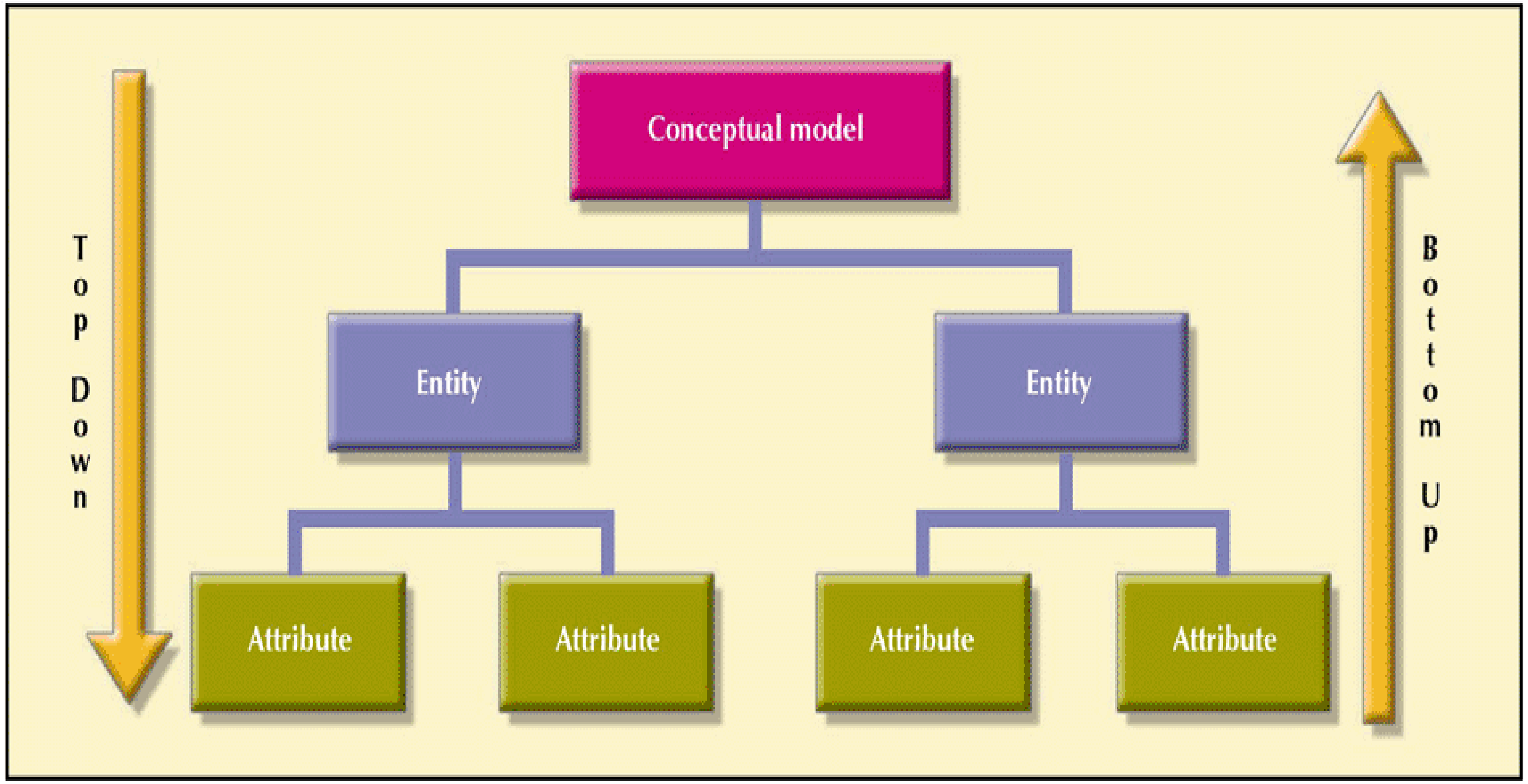
- Identify data content and describe data at an *abstract*, or conceptual level (so it can be implemented in any system)
- Should represent real-world objects in the most *realistic* way possible
- Should reflect *what* can be done with this database with a clear understanding of business rules or constraints
- Ensure that all data *needed* are in the model, and that all data in the model are needed

3 steps in conceptual design

- Requirement analysis
  - Business rules► constraint, entity, relationship
  - Users' requirement► data, functionalities
- Develop conceptual model
  - Use design tool such as ERD or UML
  - Normalization techniques
- Data model verification
  - Run SQL

Two approaches in developing conceptual model

FIGURE 8.14 Top-Down vs. Bottom-Up Design Sequencing



Usually these two approaches are interactive/reiterative

Steps to create conceptual model

1. Identify entities
2. Identify the attributes that describe the entities
3. Validate the type of attributes
4. Identify the relationships between the entities
5. Analyze the relationships between the entities
6. Draw the complete diagram
7. Normalize the entities and relationships
8. Redraw the diagram if necessary

1. identifying entities

- Examine user/business requirements
- Examine the nouns? Are they items of significance?
- Name each entity
- Is there information of interest that the business needs to hold?
- Is each instance of the entity uniquely identifiable?
- Which attribute or attributes could serve as its unique identifier?

2. identifying attributes

- Ask the user questions (i.e. what information do you need to know about entity X?)
- Attributes may appear as descriptive words or phrases, nouns, prepositional phrases (e.g. salary amount for employee), possessive nouns (e.g. employee’s name)

3. validating attributes

- Are all attributes decomposed? (i.e. no composite attribute if needed)
- Are all attributes single valued? (i.e. no multi-valued attribute)
- Is each attribute dependent on the entire unique identifier?
- Is each attribute dependent on only one part of unique identifier?

4. identifying relationships

- Is the relationship implicit in the business rules or users' question?
- Does a significant relationship exist between entities?
- Use a relationship matrix to systematically examine each pair of entities
- Name each direction of the relationship
- Ask a relationships name – how are entity A and entity B related

5. analyzing a relationship

- Identify connectivity
- If M:N is found, transform it to 1:M using composite entity
- Read the relationship name from one to many side to validate it
- Determine cardinality
- Determine optionality

6. drawing diagram

- Make sure it conforms to standard notation whatever the form is (Chen, Crow’s foot model, UML class diagram, etc.)

7. normalization

- No attribute should have repeating values
- Draw dependency diagram
- Eliminate partial dependency if any
- Eliminate transitive dependency if any
- No multi-valued attribute should be included in the table (for relational database)

Why DB design?

- Conceive the outcome of your database project *with* DB design versus *without* DB design
- The design provides the comprehensive organization of the database.
- It allows the database to be viewed in its entirety and evaluate how the various aspects of the database need to interact.
- It allows for the early identification of major issues, potential problems, and design alternatives.