



Chapter 5

Physical Database Design



Introduction

- The Logical database design is concerned with the **what**;
- The Physical database design is concerned with the **how**.
- Physical database design is the process of producing a description of the implementation of the database on **secondary storage**.
- It describes the **base relations, file organization, and indexes** used to achieve effective access to the data along with any associated integrity constraints and security measures.

Cont...

- Physical design describes the base relation, file organization, and indexes used to achieve efficient access to the data, and any associated integrity constraints and security measures.
- Sources of information for the physical design process include global **logical data model and documentation** that describes model.
- Describes the storage structures and access methods used to achieve efficient access to the data
- Knowledge of the DBMS that is selected to host the database systems, with all its functionalities, is required since functionalities of current DBMS vary widely.

Steps in physical database design

I. Translate logical data model for target DBMS

- To determine the file organizations and access methods that will be used to store the base relations; i.e. the way in which relations and tuples will be held on secondary storage
- To decide how to represent the base relations we have identified in the **global logical data model** in the target DBMS.
- Design enterprise constraints for target DBMS
 - I.1. Design base relation
 - I.2. Design representation of derived data
 - I.3. Design enterprise constraint



Cont...

2. Design physical representation

2.1 Analyze transactions

- To understand the functionality of the transactions that will run on the database and to analyze the important transactions

2.2 Choose file organization

- To determine an efficient file organization for each base relation

2.3 Choose indexes

2.4 Estimate disk space and system requirement

- To estimate the amount of disk space that will be required by the database

Cont...

3. Design user view

- To design the user views that were identified in the conceptual database design methodology

4. Design security mechanisms

5. Consider controlled redundancy

- To determine whether introducing redundancy in a controlled manner by relaxing the normalization rules will improve the performance of the system.

6. Monitor and tune the operational system

Design access rules

- To design the access rules to the base relations and user views



I. Translate logical data model for target DBMS

- This phase is the translation of the global logical data model to produce a relational database schema in the target DBMS.
- This includes creating the **data dictionary** based on the logical model and information gathered.
- After the creation of the data dictionary, the next activity is to understand the functionality of the **target DBMS** so that all necessary requirements are fulfilled for the database intended to be developed.



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Knowledge of the DBMS includes:

- how to create base relations
- whether the system supports:
 - definition of Primary key
 - definition of Foreign key
 - definition of Alternate key
 - definition of Domains
 - Referential integrity constraints
 - definition of enterprise level constraints

1.1 Design base relation

- Designing base relation involves **identification of all necessary requirements** about a relation starting from the name up to the referential integrity constraints.
- The implementation of the physical model is dependent on the target **DBMS** since some has more facilities than the other in defining database definitions.
- The base relation design along with every justifiable reason should be fully documented.



1.2. Design representation of derived data

- While analyzing the requirement of users, we may encounter that there are some attributes holding data that will be derived from existing or other attributes.
- A decision on how to represent such data should be devised
- Most of the time **derived attributes** are not expressed in the logical model but will be included in the **data dictionary**.
- Whether to store stored attributes in a base relation or calculate them when required is a decision to be made by the **designer** considering the performance impact.
- The representation of derived attributes should be **fully documented**.

1.3. Design enterprise constraint

- Data in the database is not only subjected to constraints on the database and the data model used but also with some enterprise dependent constraints.
- This constraint definition is also dependent on the DBMS selected and enterprise level requirements.
- All the enterprise level constraints and the definition method in the target DBMS should be fully documented.



2. Design physical representation

- This phase is the level for determining the **optimal file organizations** to store the base relations and **indexes** that are required to achieve **acceptable performance**, that is, the way in which relations and tuples will be held on the secondary storage.



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- 2.1. Analyze transactions
- 2.2. Choose file organization
- 2.3. Choose indexes
- 2.4. Estimate disk space and system requirement
- 3. Design user view
- 4. Design security mechanisms
- 5. Consider controlled redundancy
- 6. Monitor and tune the operational system