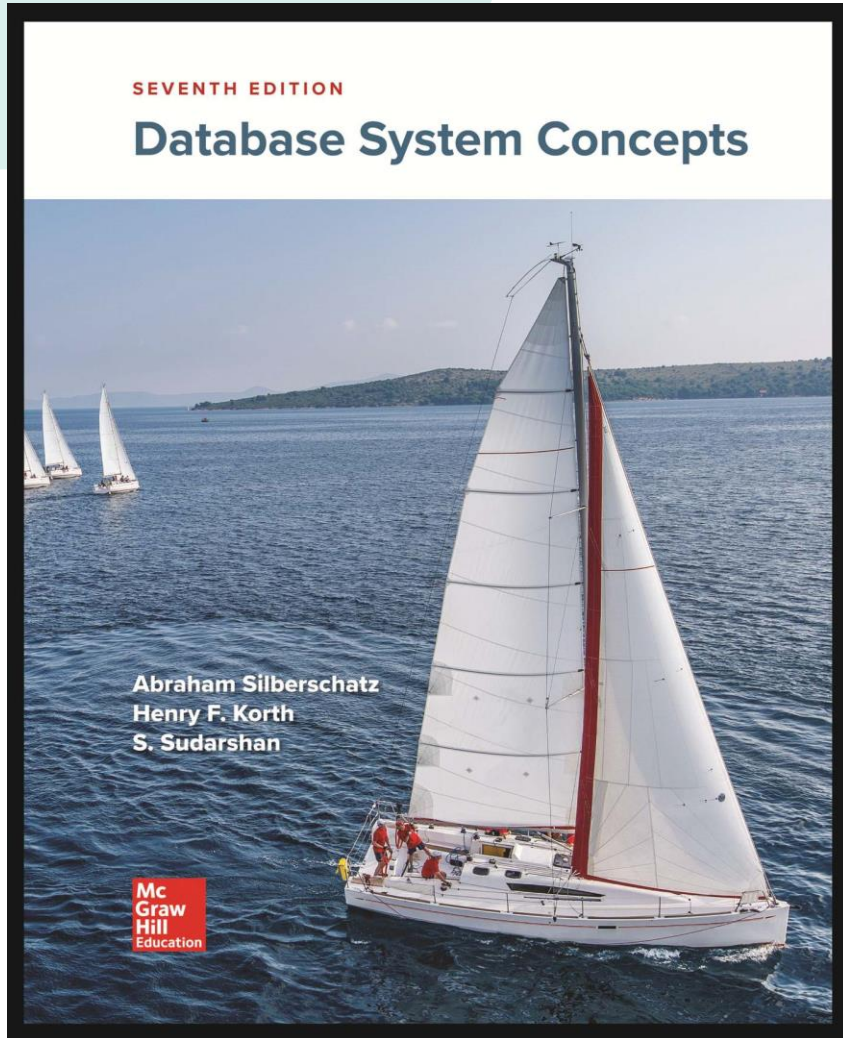IF3140 – Sistem Basis Data

Introduction to Database System

SEMESTER I TAHUN AJARAN 2025/2026

KNOWLEDGE & SOFTWARE ENGINEERING

References

Abraham Silberschatz, Henry F. Korth, S. Sudarshan : "**Database System Concepts**", 7th Edition

- Chapter 1.6 : Database Engine
- Chapter 15 : Query Processing
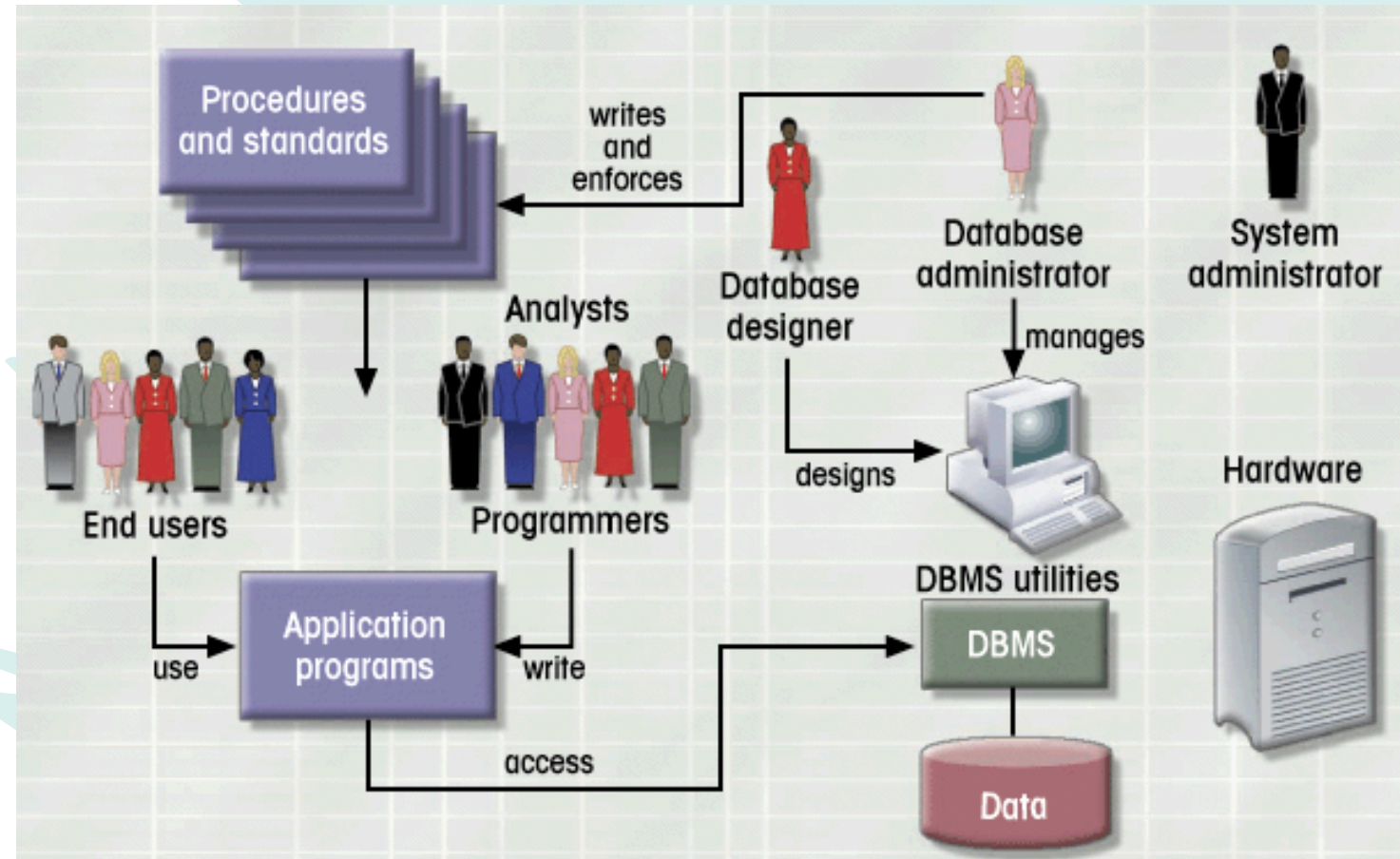
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Database Systems

- Database consists of logically related data stored in a single repository

- Provides advantages over file system management approach
  - Eliminates inconsistency, data anomalies, data dependency, and structural dependency problems
  - Stores data structures, relationships, and access paths
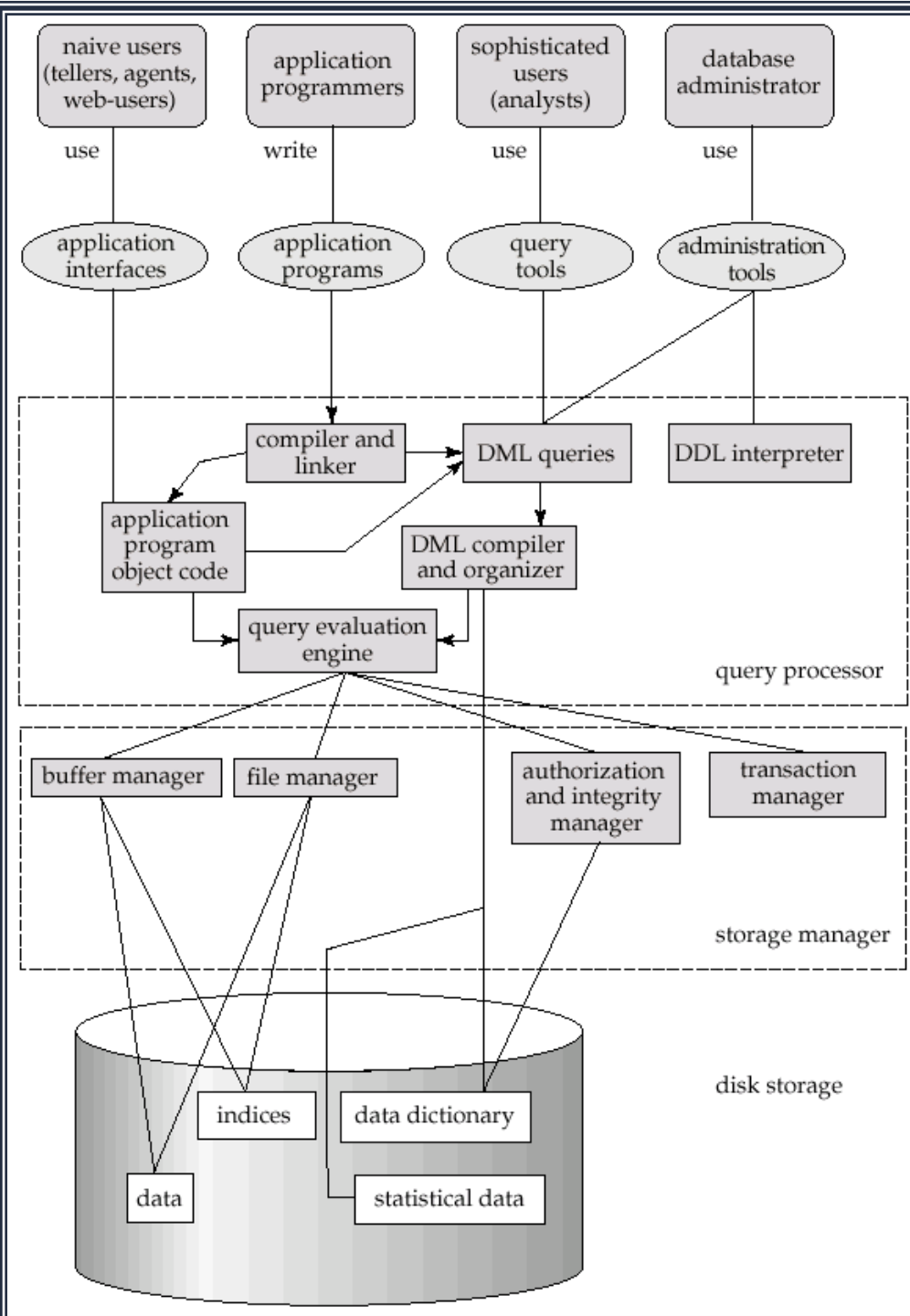
Database System Environment

- Hardware
- Software
- People/Users
- Procedures → governance
- Data

Database Systems: Design, Implementation, & Management, 5th Edition, Rob & Coronel

What Is a DBMS?

- A Database Management System (DBMS) is a software package designed to store and manage databases

- DBMS provides an environment that is both *convenient* and *efficient* to use.
  - Data independence and efficient access
  - Reduced application development time
  - Data integrity and security
  - Uniform data administration
  - Concurrent access, recovery from crashes

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Overall System Structure

Database Engine

- A database system is partitioned into modules that deal with each of the responsibilities of the overall system.

- The **functional components** of a database system can be divided into

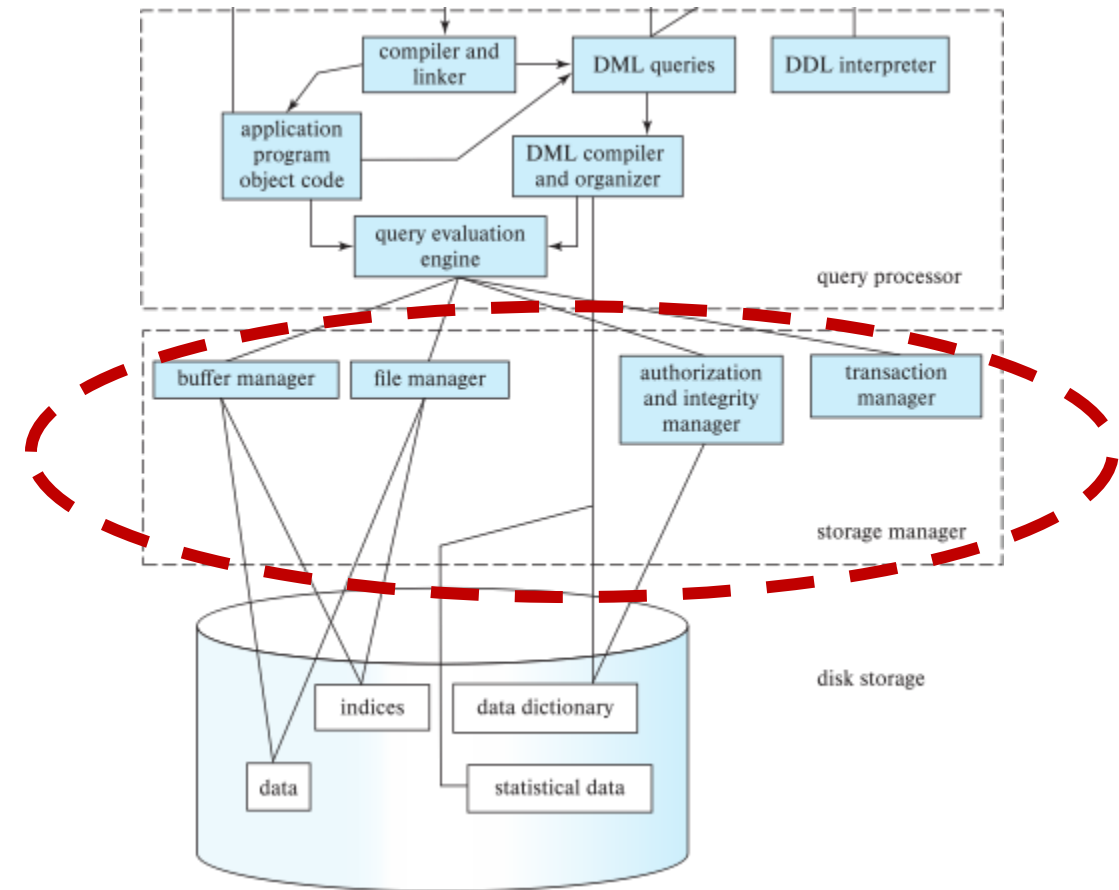|		
The storage manager	The query processor component	The transaction management component

Database Engine

The storage manager

The query processor component

The transaction management component

Storage Manager (1/2)

- A program module that provides the **interface between the low-level data stored in the database and the application programs** and queries submitted to the system.

- The storage manager is **responsible** to the following tasks:
  - Interaction with the OS file manager
  - Efficient storing, retrieving and updating of data

- The storage manager **components** include:
  - Authorization and integrity manager
  - Transaction manager
  - File manager
  - Buffer manager

Storage Manager (2/2)

The storage manager implements several data structures as part of the physical system implementation.

Data files	Data dictionary	Indices
• store the database itself	• stores metadata about the structure of the database, in particular the schema of the database.	• can provide fast access to data items. A database index provides pointers to those data items that hold a particular value.

Database Engine

The storage manager

The query processor component

The transaction management component

Query Processor (1/2)

- The query processor **components** include:
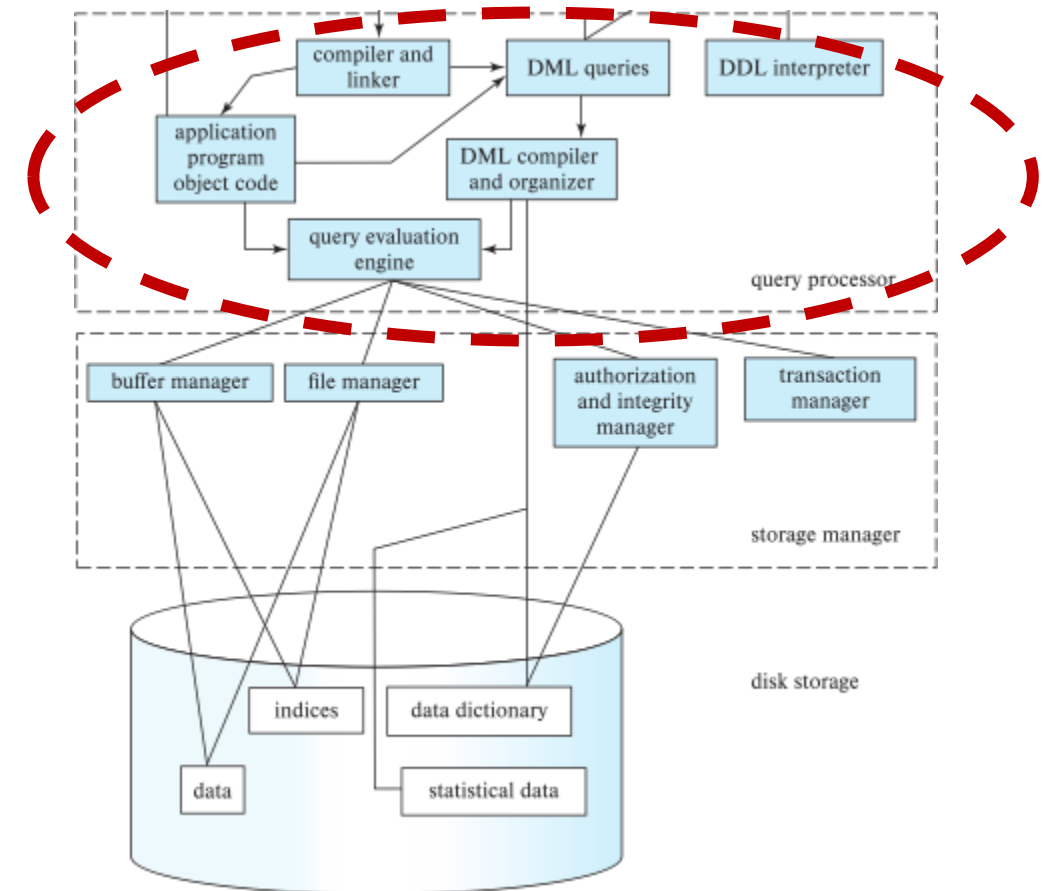
DDL interpreter

- interprets DDL statements and records the definitions in the data dictionary.

DML compiler

- translates DML statements in a query language into an evaluation plan consisting of low-level instructions that the query evaluation engine understands.
- the DML compiler performs query optimization; that is, it picks the lowest cost evaluation plan from among the various alternatives.

Query evaluation engine

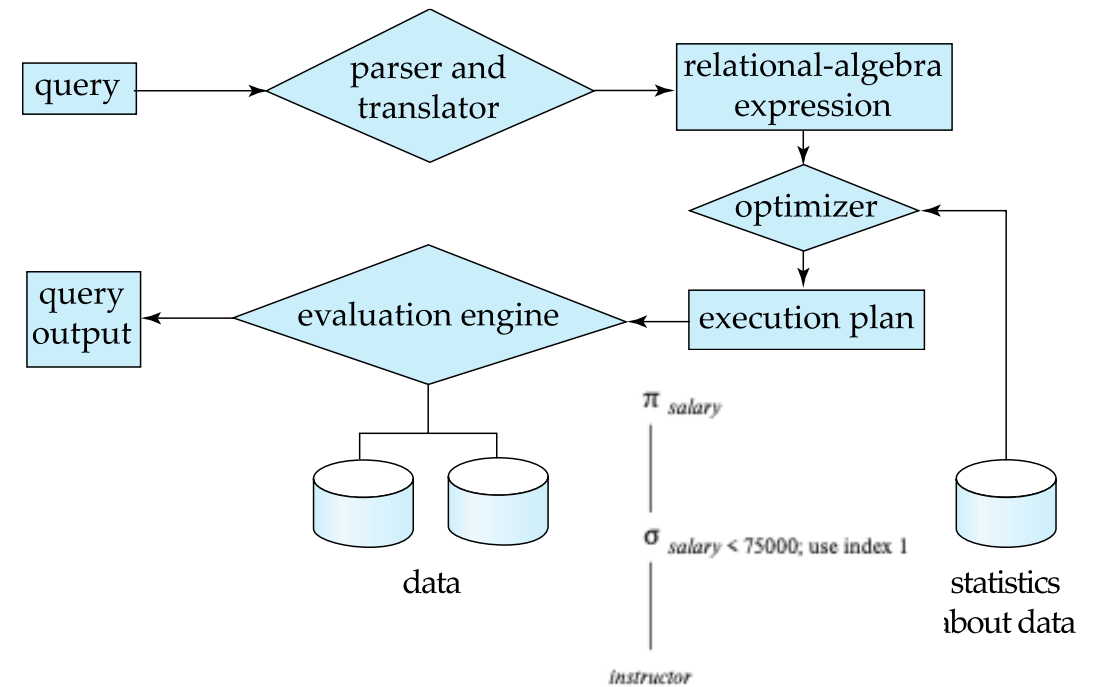- executes low-level instructions generated by the DML compiler.

Query Processing (2/2)

1. Parsing and translation

2. Optimization

3. Evaluation

```
select salary
from instructor
where salary < 75000;
```

- $\sigma_{salary<75000} \ (\Pi_{salary} \ (instructor))$
- $\Pi_{salary} \ (\sigma_{salary<75000} \ (instructor))$

query → parser and translator → relational-algebra expression → optimizer → execution plan → evaluation engine → query output

data

statistics about data

π_{salary}

$\sigma_{salary < 75000; \text{ use index } 1}$

instructor

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Database Engine

The storage manager

The query processor component

The transaction management component

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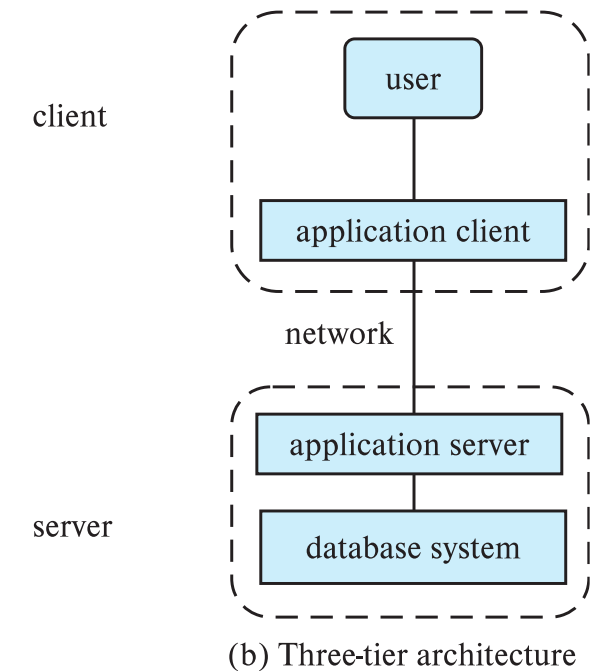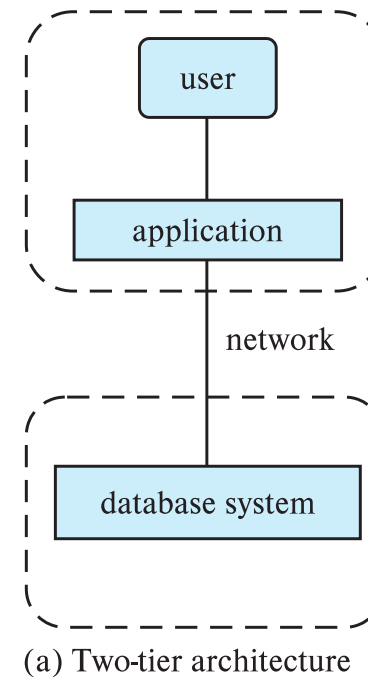
Transaction Management

- A **transaction** is a collection of operations that performs a single logical function in a database application

- **Transaction-management component** ensures that the database remains in a consistent (correct) state despite system failures (e.g., power failures and operating system crashes) and transaction failures.

- **Concurrency-control manager** controls the interaction among the concurrent transactions, to ensure the consistency of the database

Let T_i be transaction that transfers $50 form account A to account B:
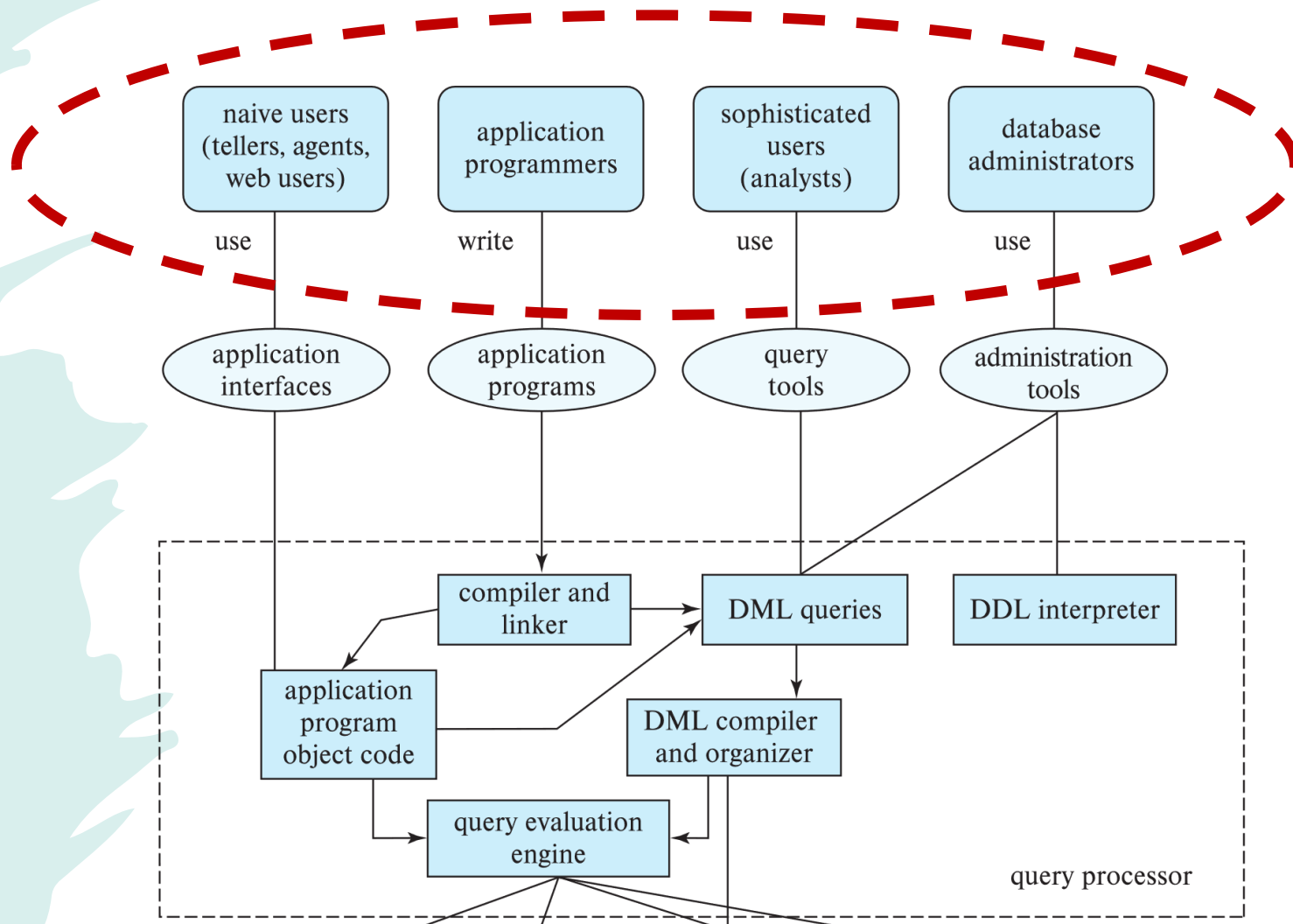
$$T_i: \text{read}(A);$$
$$A := A - 50;$$
$$\text{write}(A);$$
$$\text{read}(B);$$
$$B := B + 50;$$
$$\text{write}(B).$$

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Database Applications

- Two-tier architecture -- the application resides at the client machine, where it invokes database system functionality at the server machine

- Three-tier architecture -- the client machine acts as a front end and does not contain any direct database calls.
  - The client end communicates with an application server, usually through a forms interface.
  - The application server in turn communicates with a database system to access data.

user

application

network

database system

(a) Two-tier architecture

client

user

application client

network

application server

database system

server

(b) Three-tier architecture

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Database Users

Database Administrator

- A person who has central control over the system is called a **database administrator (DBA).**

- Functions of a DBA include:

Schema definition

Storage structure and access-method definition

Schema and physical-organization modification

Granting of authorization for data access

Routine maintenance

- Periodically backing up the database
- Ensuring that enough free disk space is available for normal operations, and upgrading disk space as required
- Monitoring jobs running on the database