IF3140 – Sistem Basis Data

Introduction to Database System

SEMESTER I TAHUN AJARAN 2024/2025

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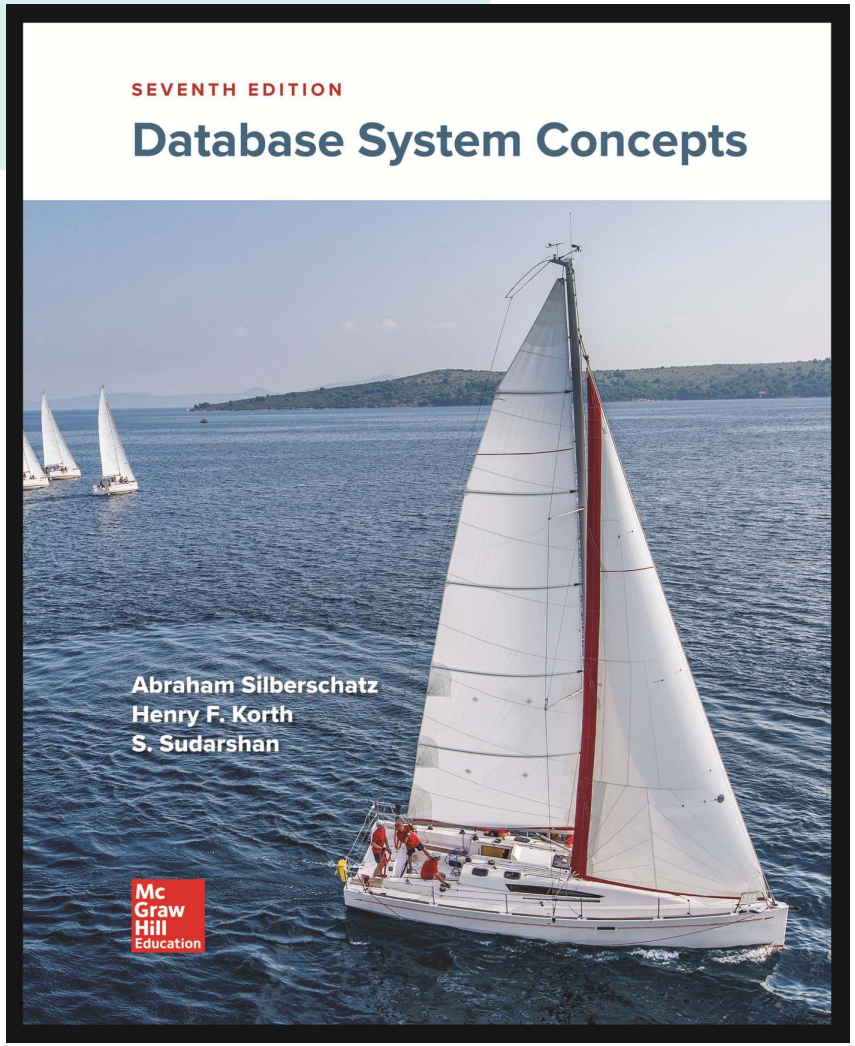

References

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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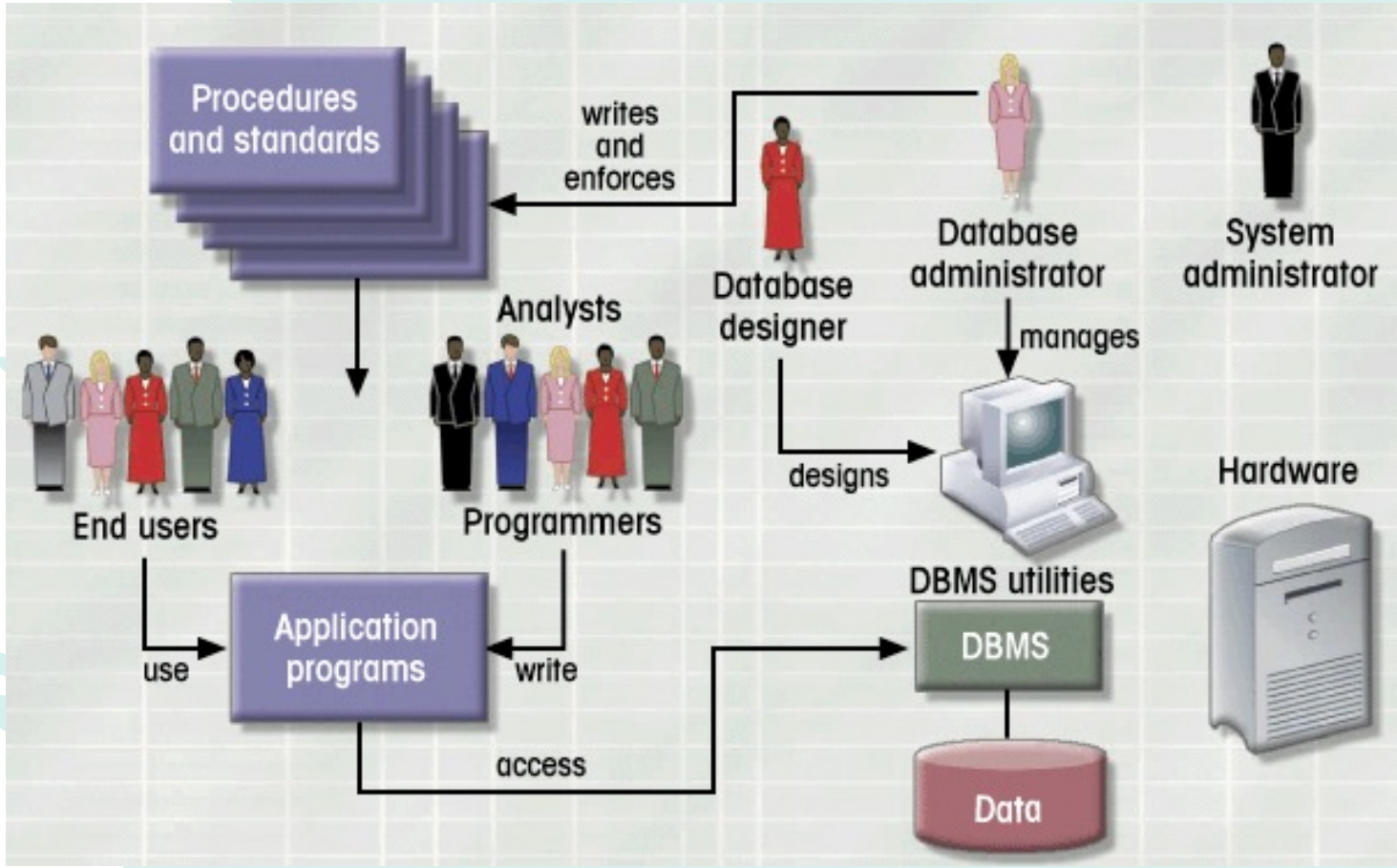
Database Systems

- 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



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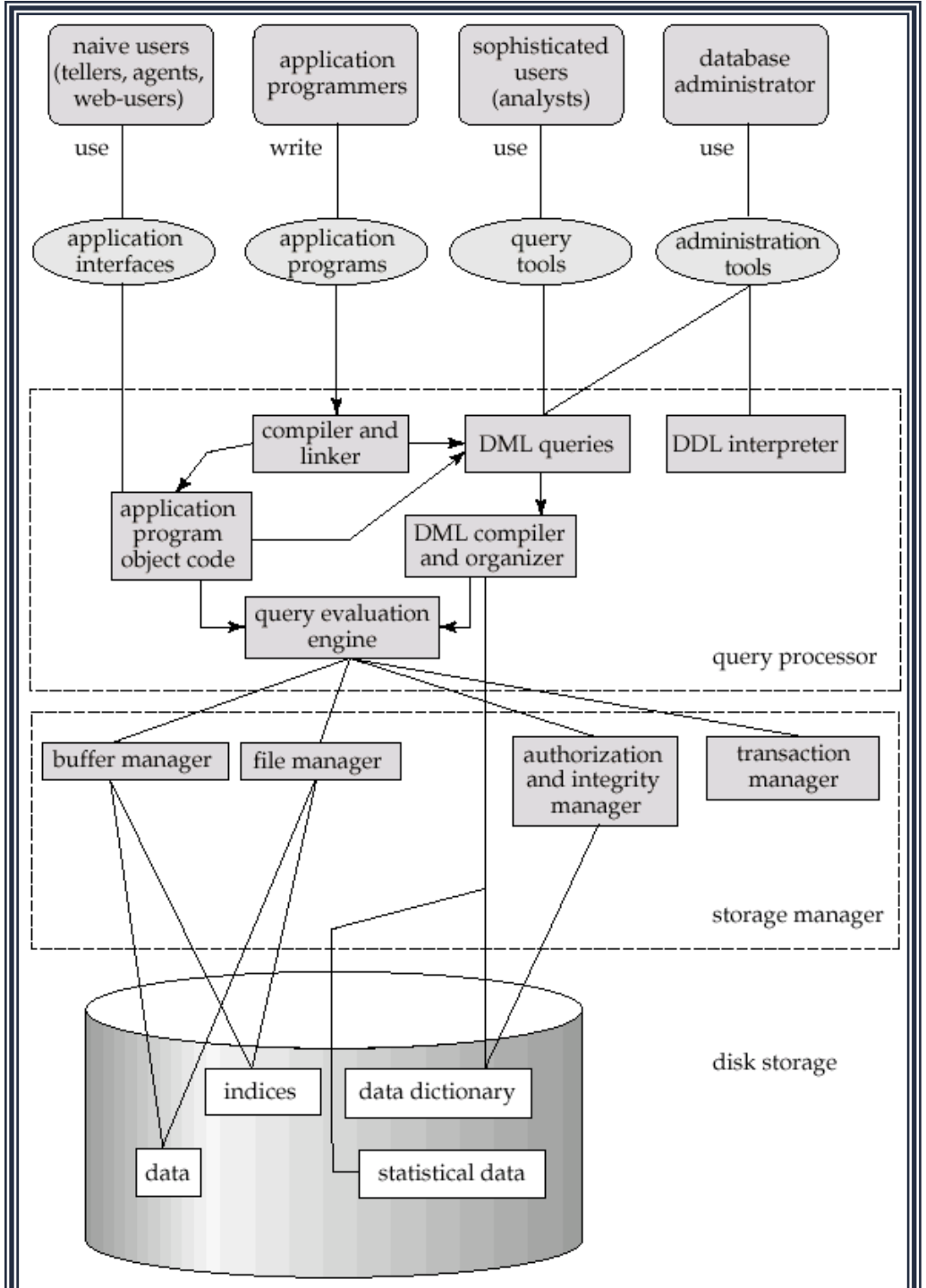
Database Systems: Design, Implementation, & Management, 5th Edition, Rob & Coronel

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

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

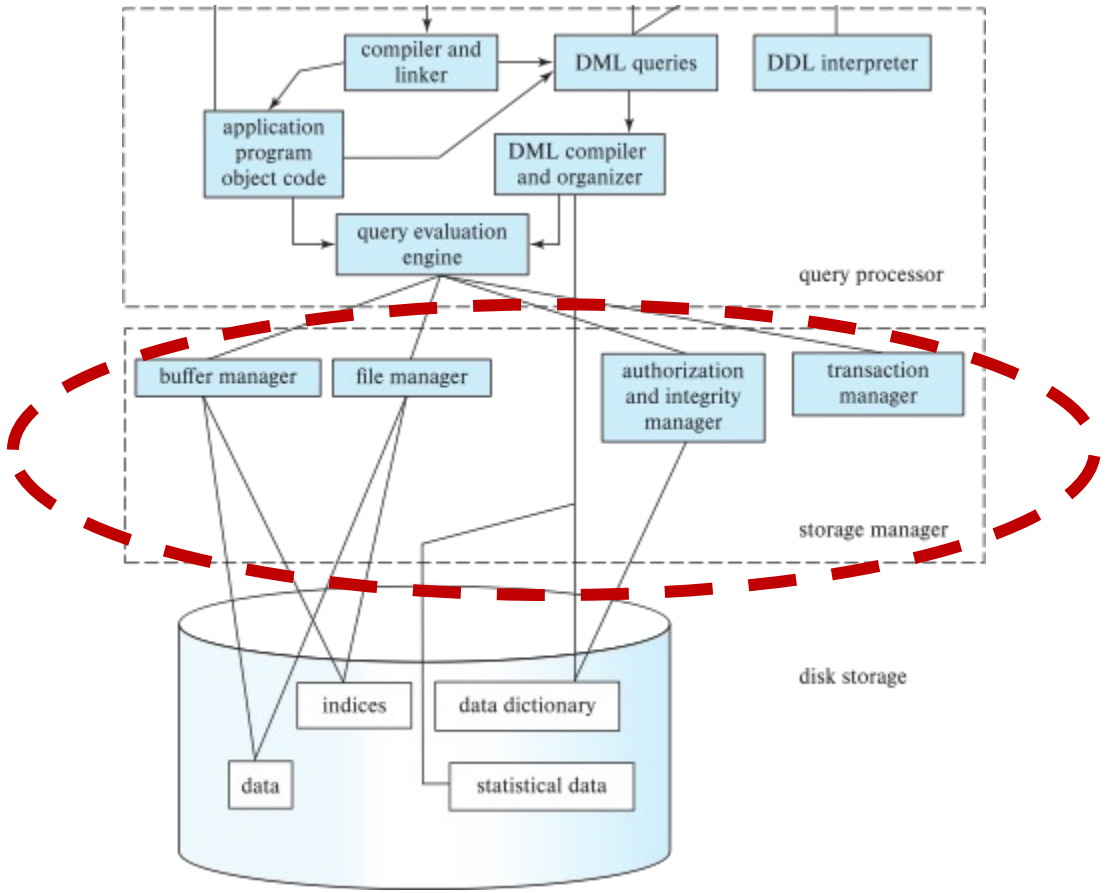
The storage manager

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

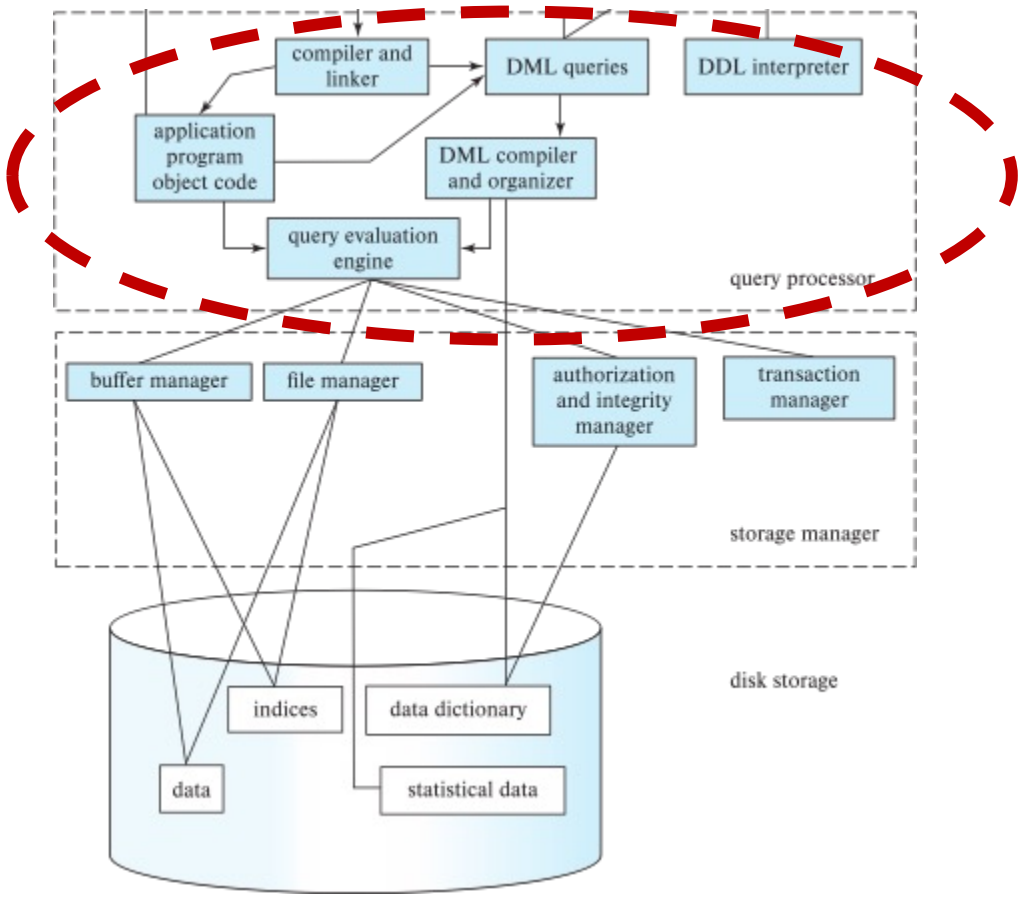
- interprets DDL statements and records the definitions in the data dictionary.

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.

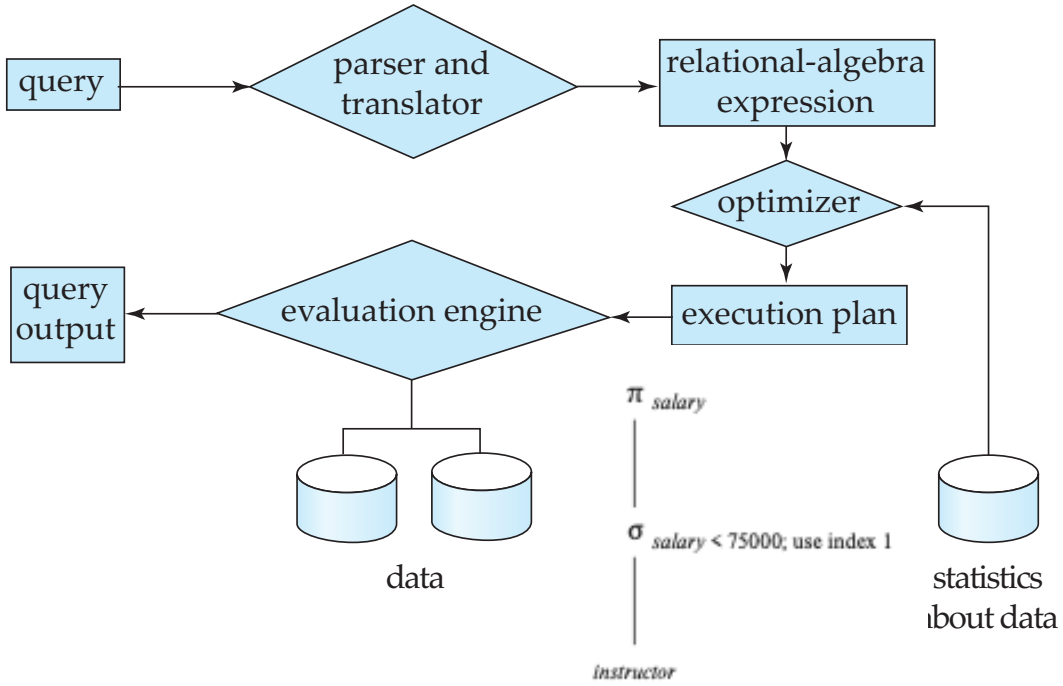


Query Processing (2/2)

1. Parsing and translation
2. Optimization
3. Evaluation

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

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



Database Engine

The storage manager

The query processor component

The transaction management component

Transaction Management

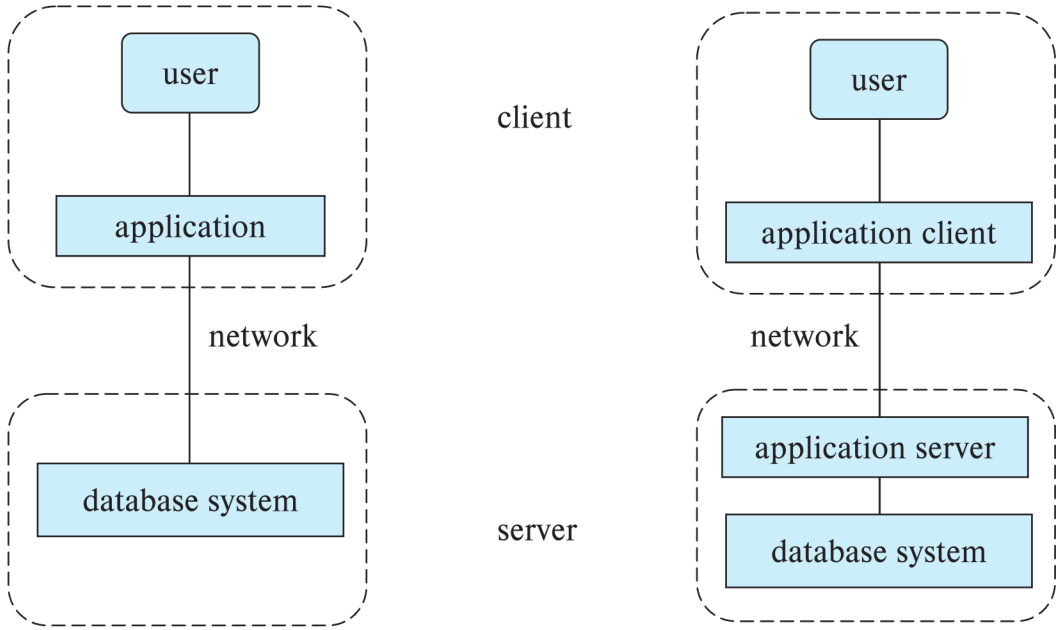
- A **transaction** is a collection of operations that performs a single logical function in a database application
- **Transaction-management component** ensures that the database remains in a consistent (correct) state despite system failures (e.g., power failures and operating system crashes) and 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: read(A);
$A := A - 50$;
write(A);
read(B);
$B := B + 50$;
write(B).

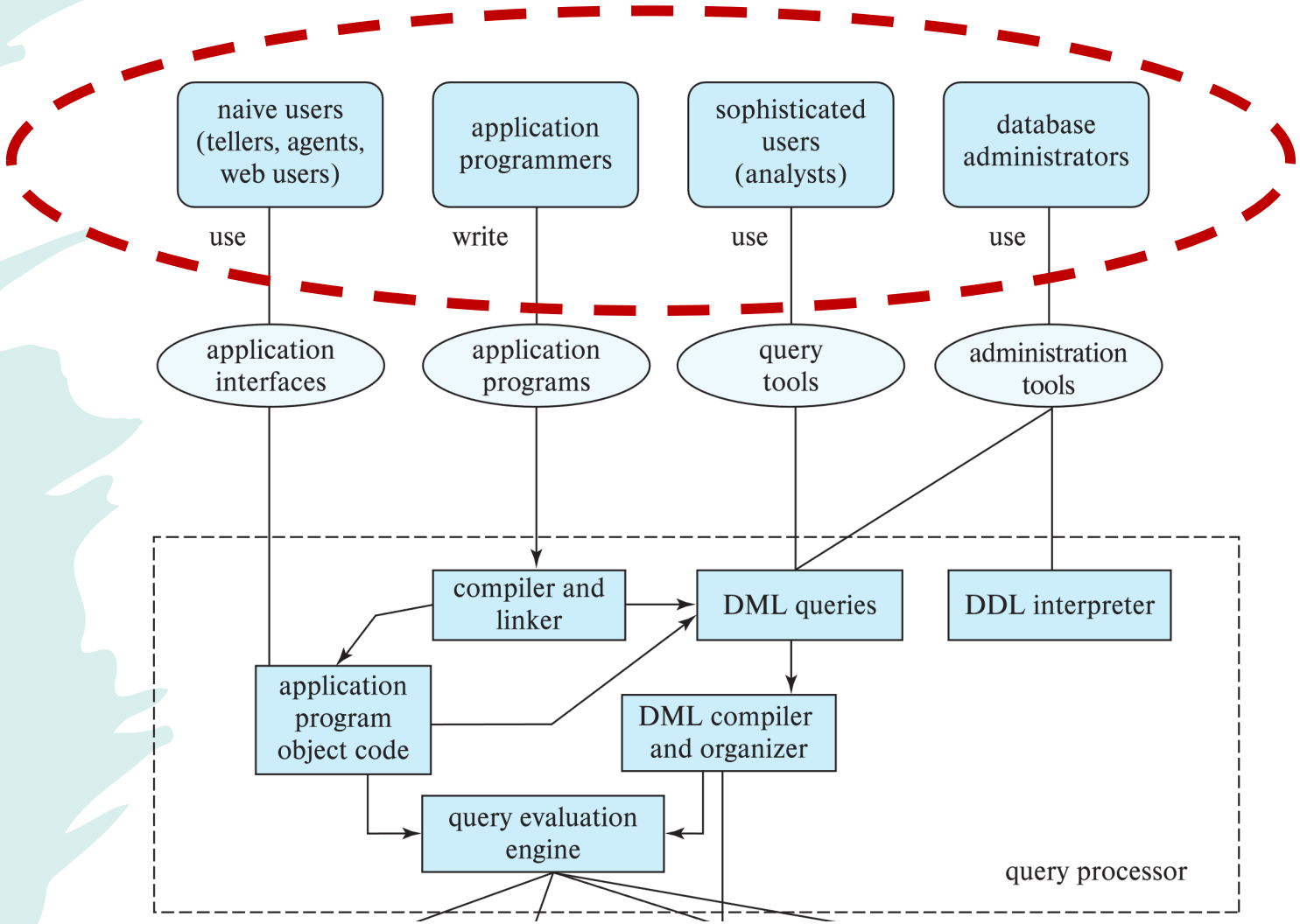
Database Applications

- 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.



(a) Two-tier architecture (b) Three-tier architecture

Database Users



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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