

Introduction

Dr. Angelika Reiser
Chair for Database Systems (I3)
www-db.in.tum.de

TU München / Garching

reiser@in.tum.de

Lecture

- Web page of the lecture: see TUMonline

www-db.in.tum.de/teaching/ws1617/DBSandere

- IN4714:
 - Part of the module **Geodatabases** (BV470015)
 - Duration: 2V SWS
 - Credits: 2 ECTS

Schedule

- 2 hours weekly
- Wednesdays, 4.45 – 6.15 p.m.
- Exam (closed book): Date not yet fixed
- IN4714: 40 minutes
- Minimum number of points: 50%

Teaching

- Questions during class are very welcome
- Reading material for preparation
- Beforehand distributed / embedded exercises
- Discussion of problems / solutions on the whiteboard

→ interactive class !!

Overview

- Database Design
 - E/R-Modeling
 - UML-Modeling
- Relational Data Model
- Relational Query Language SQL
- Data Integrity

Overview (cont.)

- Physical Data Organization
 - B-Trees
 - Hashing
- Query Execution
- Transaction Management
- (Main Memory Databases, NoSQL Databases, Data Warehouses, ...)

→ Preparation for Geodatabases,
Andreas Donaubaueer, starting December 2016

Used Material

Slides of Prof. Kemper:

www-db.in.tum.de/teaching/bookDBMSeinf

and Prof. Neumann:

www-db.in.tum.de/teaching/ws1415/grundlagen

(both in German)

Thanks 😊 - Errors are on me ☹️

Literature (in German)

Alfons Kemper und André Eickler
Datenbanksysteme: Eine Einführung
10. Auflage (2015)
(older Editions are also ok)
Oldenbourg Verlag, München
(~ 50 Euros)

www-db.in.tum.de/teaching/bookDBMSeinf

Associated Workbook

Alfons Kemper und Martin Wimmer
Übungsbuch Datenbanksysteme
3. Auflage (2011)
(older Editions are also ok)
Oldenbourg Verlag, München
(~ 35 Euros)

Additional Material

www-db.in.tum.de/teaching/bookDBMSeinf

- Slides
- Videos of lectures
- Data to build own databases
- SQL-Interface
- Programming examples for
 - IBM DB2
 - Oracle
 - MS SQL Server

Literature (in English)

A. Silberschatz, H. F. Korth und S. Sudarshan
Database System Concepts, 6th edition,
McGraw-Hill, 2010.

codex.cs.yale.edu/avi/db-book/db6/slide-dir/

R. Elmasri, S.B. Navathe

Fundamentals of Database Systems, 6th edition,
Addison-Wesley, 2010. (also available in
German)

R. Ramakrishnan, J. Gehrke

Database Management Systems, 3th edition,
2003.

<http://pages.cs.wisc.edu/~dbbook/>

Literature (cont.), MOOCS

J.D. Ullmann, J. Widom

A First Course in Database Systems, Prentice Hall, 3rd edition, 2007.

infolab.stanford.edu/~ullman/fcdb.html

MOOCS

- Self paced mini courses, Stanford
class.stanford.edu/courses/DB/2014/SelfPaced/about
- Datenmanagement mit SQL, HPI
open.hpi.de/courses/sql (in German)

MOOCS (cont.), Lectures online

- Informationssysteme/
Einführung in Datenbanksysteme, Uni Saarland
infosys.uni-saarland.de/datenbankenlernen/
(partly in German)
- Lecture online
ETHZ, D. Kossmann, spring 2014:
<http://www.multimedia.ethz.ch/lectures/infk/2014/spring/252-0063-00L/index?doi=10.3930/ETHZ/AV-4e6da8f5-54d9-4bfa-8a9a-05692a5a440c&autostart=false>
English slides

Terms

- What is a database system (DBS)?

System to store and manage data

- Why not use a traditional file system?

Reliability and scalability only achievable with high effort

Examples

Traditional application areas:

- business data
- accounting
- administration

...

Nowadays a lot broader:

- scientific / medical data
- data mining
- geographical information systems
- web search

...

Examples (cont.)

Databases are the back of many applications:

- web search with Google, Yahoo, ...
- inquiries to Amazon, EBay, ...
- posts in Facebook, Twitter, ...

Many varieties (DBS/Information Retrieval, centralized/decentralized, replicated, etc.)

Databases are used whenever

- data is very precious (\rightarrow reliability)
- amount of data is very big (\rightarrow scalability)

Examples (cont.)

The big commercial database systems:

- Oracle
- IBM DB2
- Microsoft SQL Server
- Sybase

Some open source database systems:

- PostgreSQL
- MySQL
- MonetDB

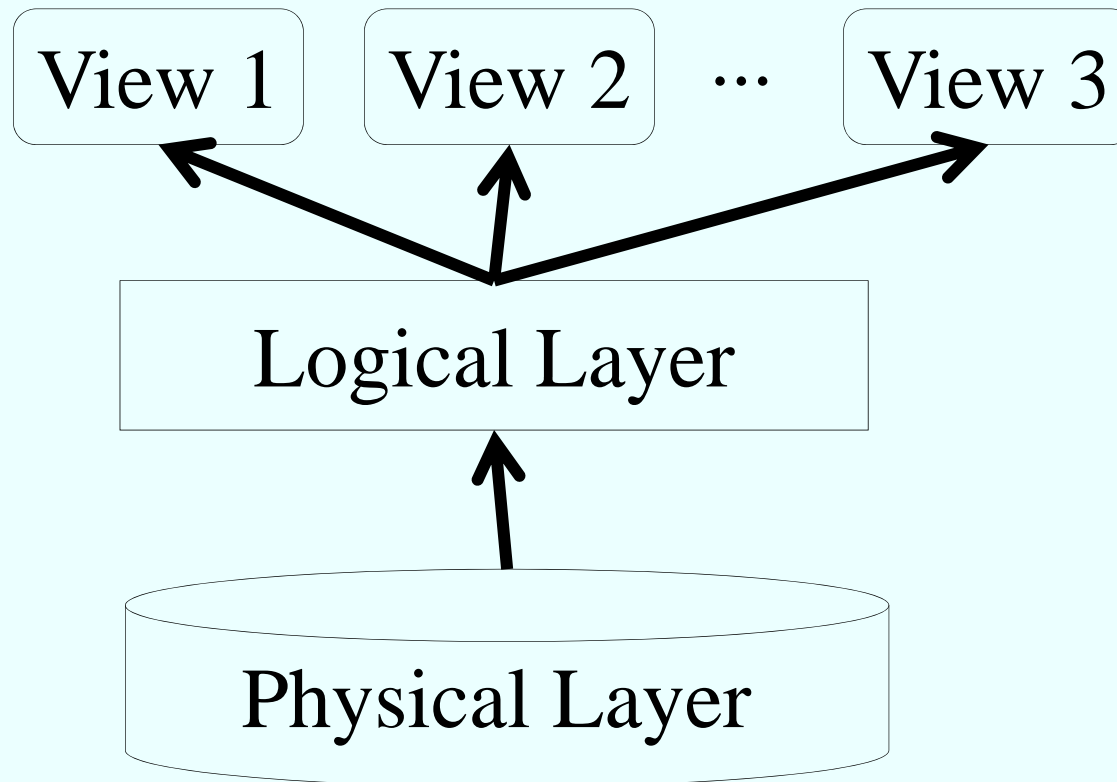
Many more, some very specialized (XLM, object oriented, data streams, ...)

Why use a database system?

- Avoid redundancy and inconsistency
- Rich (declarative) access to the data
- Security and privacy issues
- Synchronize concurrent data access
- Avoid loss of data
- Recovery after system failures
- Efficiency and scalability

→ Concentrate on your business logic

Abstract layers of a database system



Abstract layers of a database system (cont.)

View:

describes how a user / program sees the data

Logical layer:

describes how the data is structured

Physical layer:

describes how the data is stored

Abstract layers of a database system (cont.)

DBS decouples applications from the structure and storage of the data:

- Logical data independency
(simple) changes at the logical layer have no influence on the applications
- Physical data independency
changes at the physical layer have no influence on the applications

Implemented in almost all modern database systems

Properties of database systems

Data integrity (consistency)

- Data processing within an application has constraints

→ DBS obeys defined rules and protects automatically from:

- User errors
- Programming errors

Properties of DBSs (cont.)

Declarative query language

- User determines *which* data should be retrieved
. . . and *not how*
- Less error-prone (when querying the data / developing applications)
- No knowledge about the interior layers of the DBS necessary

Properties of DBSs (cont.)

Sophisticated access rights

- Every user can get different rights on the database
- DBS provides a variety of access control mechanisms to enable security and privacy

Properties of DBSs (cont.)

Multi user concurrency

- If you allow several users at a time to update the data without any control you run into big problems
- DBS allows concurrent access and avoids side effects

Properties of DBSs (cont.)

Error handling

- DBS can restore its state consistently in case of a system failure
- Therefore log files are held and managed by the DBS

Properties of DBSs (cont.)

Efficiency and scalability

- DBSs are designed for efficiently handling very large data volumes and a very high number of users

→ In DBSs techniques for scaling with ever higher data volumes are integrated

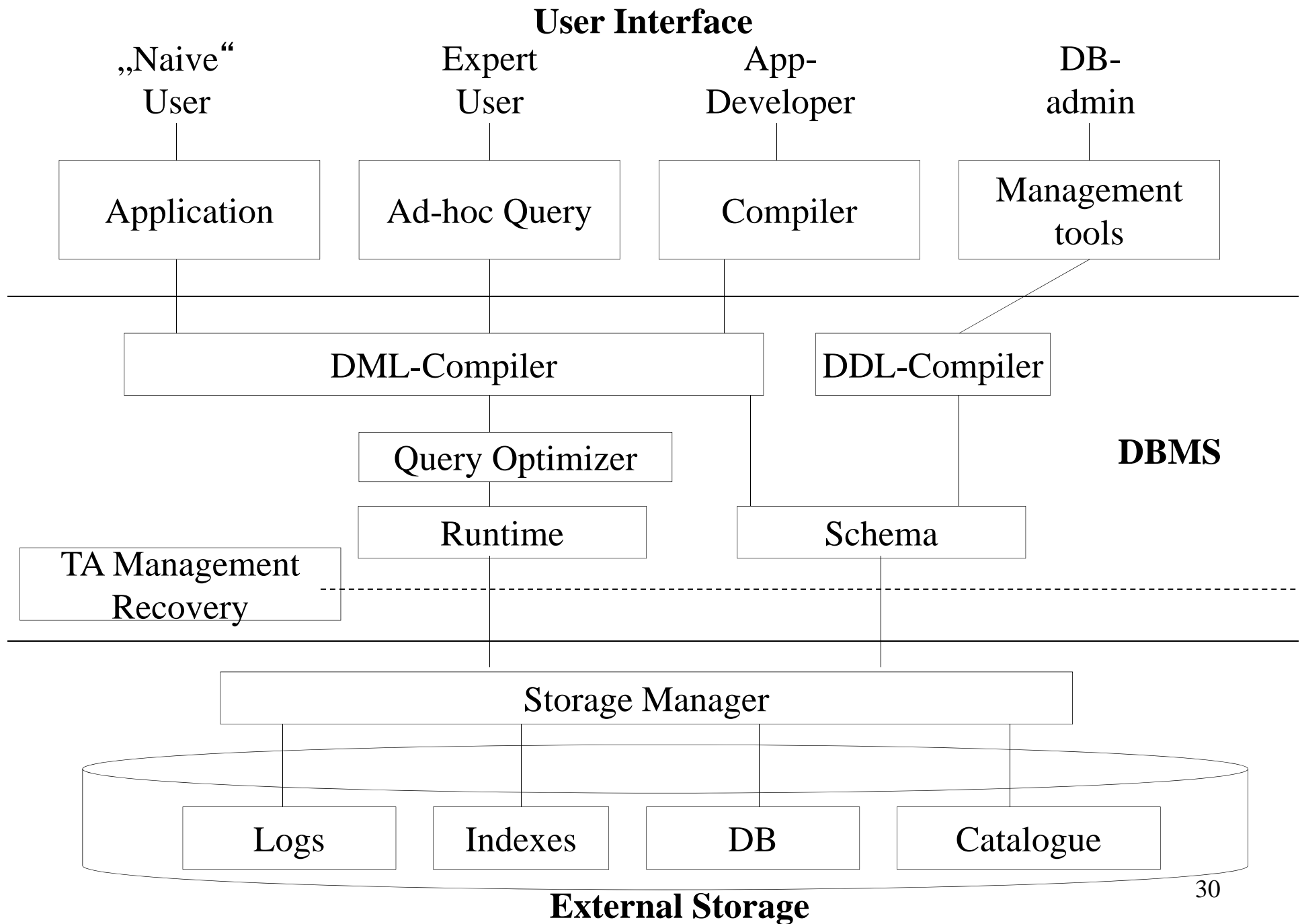
typically: 100 GB (Gigabyte) – transactional Daten (even express versions)
up to EB (Exabyte) maximum data size

Properties of DBSs (résumé)

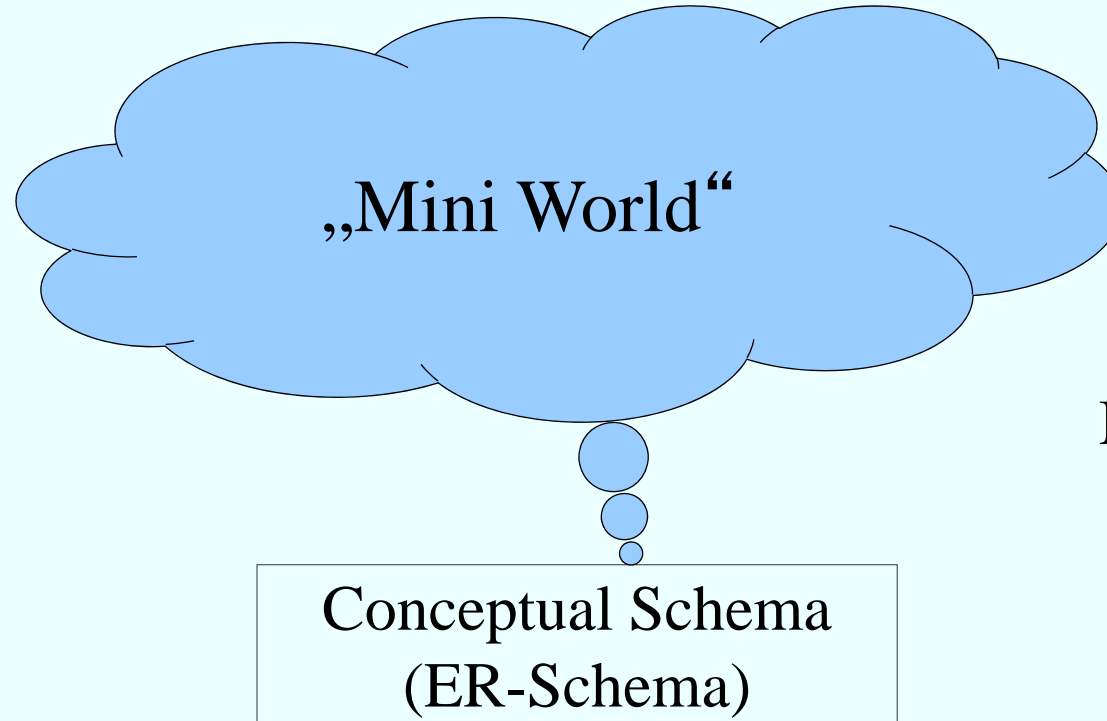
- Data integrity
- Declarative query language
- Access rights
- Concurrency control
- Error handling
- Efficiency and scalability

Architecture & Components of a Database System

- Layered architecture
 - User Interface
 - DBMS
 - External Storage



Next: Data Modeling



Manual Modeling