Architecture and Implementation of Database Systems (Summer 2020)

Jens Teubner, DBIS Group
jens.teubner@cs.tu-dortmund.de

Summer 2020
A Few Words About Me

Jens Teubner
DBIS Group (LS 6)
Otto-Hahn-Strasse 14, Room 333
jens.teubner@cs.tu-dortmund.de

1996–2001 Diploma in Physics, U Konstanz
2001–2005 Research assistant, DBIS Group, U Konstanz
2005–2007 Research assistant, Database Group, TU München
Oct 2006 PhD in Computer Science (XML query processing)
2007–2008 Postdoc, IBM T. J. Watson Research Center, NY, USA
2008–2013 Senior Researcher, Systems Group, ETH Zurich
since 4/2013 Full Professor, DBIS Group, TU Dortmund University

Topic: Database systems on modern computing hardware
What this Course is About

**TPC-E Industry Benchmark** (modeling a brokerage firm)

- 2.3M customers; 11.5M accounts; 2B holdings; 40B trades
- 18.5 TB initial database size

Current record: **11,059 tpsE (110,590 transactions/sec total)**!

### Numerical Quantities Summary

<table>
<thead>
<tr>
<th>Response Time (in seconds)</th>
<th>Minimum</th>
<th>Average</th>
<th>90(^{\text{th}}) Percentile</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broker-Volume</td>
<td>0.01</td>
<td>0.01</td>
<td>0.03</td>
<td>1.02</td>
</tr>
<tr>
<td>Customer-Position</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>2.96</td>
</tr>
<tr>
<td>Market-Feed</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>2.93</td>
</tr>
<tr>
<td>Market-Watch</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>Security-Detail</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.82</td>
</tr>
<tr>
<td>Trade-Lookup</td>
<td>0.01</td>
<td>0.05</td>
<td>0.08</td>
<td>1.03</td>
</tr>
</tbody>
</table>

### How can databases provide such throughput, yet be transaction-safe?
Architecture of a DBMS / Course Outline

Web Forms ➔ Applications ➔ SQL Interface

SQL Commands

Executor ➔ Operator Evaluator ➔ Files and Access Methods ➔ Buffer Manager ➔ Disk Space Manager ➔ Recovery Manager

DBMS

Transaction Manager

Lock Manager

data files, indices, …

Database

Operator Evaluator ➔ Parser ➔ Optimizer

Copyright © Jens Teubner · Architecture & Implementation of DBMS · Summer 2020

Organizational Matters

**Lecture**
- Mondays, 8–10h, Room OH 12, E.003 → online
- Wednesdays, 10–12h, Room OH 12, E.003 → online

Please visit this website **regularly**. I will frequently post new information during the semester.

**Exercises**
- Mondays, 10–12h, Room OH 14, 304 → online  
  starting **next week**!
- Mondays, 12–14h, Room OH 14, 304 → online
- TA: Oliver Gasser (oliver.gasser@tu-dortmund.de)
- Register via **AsSESS** by **Fri, Apr 24, 2020**.
- Participation is not mandatory, but **highly** recommended.
There will be a **written exam**.

- Friday, July 24, 2020; 14:30h-16:00h; Room SRG 1 / H.001
- Tuesday, September 29, 2020; 11:00-12:30h; Room M / E 28, M / E 29
- duration: 90 minutes
- More information during the semester

**Note:**

- Due to the corona situation, this may change at any time.
I’d like to make this course highly interactive. Please speak up, discuss, ask questions!

The material we discuss is relevant in practice.

- We’ll provide practical examples and exercises.
- You get most out of this course by actively participating in (and solving) the exercises.


Alfons Kemper and André Eickler. *Datenbanksysteme: Eine Einführung*. Oldenbourg Verlag.

Dennis Shasha and Philippe Bonet. *Database Tuning*. Morgan-Kaufmann.

... or pick your own favourite in the library — most text books about advanced database topics will do.

I'll also sometimes point to specific research papers and you’re welcome to search for additional background reading. Search engines like Google Scholar are your friend.
You might also be interested in...

...the course **Data Processing on Modern Hardware**

- Winter Semester
- Many similar concepts, geared to exploit the characteristics of modern computing hardware.

...doing your **Master Thesis** with me

- Chance to participate in the forefront of research.
- Many ways to join, approach me if you’re interested.