Wintersemester 2012/2013

Seminare

Bachelor Informatik CS 3702
„Datenbanken und Anfrageverarbeitung“

Master Informatik
„Advanced Topics of Database Systems“

CS 5840 - Fachübergreifende Kompetenzen = englischsprachiges Seminar
CS 5480 - für den Bereich Software Systems Engineering = Seminar
Software Systems Engineering

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Dipl.-Inf. Stefan Werner
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Students’ Duties

- Preparation of Slides
- Preparation of Handout
  – 2 to 3 pages, to be delivered to all participants and to the supervisors directly before the presentation
- Presentation
  – Approx. 1 hour (inclusive discussion)
- Attending presentations of all other students
  – Contributions to a lively discussion after each presentation
Timeline

- Assignment of topics
- Discussion with supervisor about presentation
- Electronic submission of PDFs of presentation and handout via Email (final from student’s view)
- Improving presentation and handout according to supervisor’s comments and remarks
- Participating in all other presentations and contributing to lively discussions
- Presentation, electronic submission of source files and PDFs of slides and handout to the supervisor via Email

2 weeks
Topics Bachelor/Master Seminars

- Green topics -> seminar for bachelor students
- Blue topics -> seminar for master students

Topics may be exchanged to be discussed with the supervisors
  - Bachelor students choosing blue topics
  - Master students choosing green topics
Overview Topics

- FPGA
- Cloud Computing
- Semantic Web
- B\(^+\)-tree
- Compression
- Regular Expressions
- Relational Databases
- Recursive Queries
FPGA (Field Programmable Gate Arrays)

- integrated circuit (IC)
- configuration after manufacturing
- hardware description language (HDL)
- complex functional blocks, arranged in periodic structure
- interconnection network
FPGA (Field Programmable Gate Arrays)

- Advantages towards General CPUs
  - inherent parallelism
  - heavy throughput at low clock rate
  - high energy efficiency
- Reconfigurable computing = offload „expensive“ tasks from software to FPGA
FPGA (Field Programmable Gate Arrays) - Topics -

- A Memory-Balanced Linear Pipeline Architecture for Trie-based IP Lookup (HOTI 2007)
- High Throughput and Large Capacity Pipelined Dynamic Search Tree on FPGA (FPGA 2010)
- Massively Parallel XML Twig Filtering Using Dynamic Programming on FPGAs (ICDE 2010)
- How Soccer Players Would Do Stream Joins (SIGMOD 2011)
- Evaluating FPGA-acceleration for Real-time Unstructured Search (ISPASS 2012)
- Skeleton Automata for FPGAs: Reconfiguring without Reconstruction (SIGMOD 2012)
Cloud Computing

- typically, cloud provider offers online-services
- multiple server-based computational resources via a digital network like internet
- applications are provided and managed by the cloud server
- data is stored remotely in the cloud configuration

Cloud computing - Topics

- **Walnut: A Unified Cloud Object Store (SIGMOD 2012)**
  - Developed at Yahoo! with the goal of serving as a common low-level storage layer for a variety of cloud data management systems (e.g. Hadoop, MObStor, PNUTS)
  - => Enabling sharing hardware resources between different types of clouds.

- **CloudRAMSort: Fast and Efficient Large-Scale Distributed RAM Sort on Shared-Nothing Cluster (SIGMOD 2012)**
  - Sort algorithm, which sorts 1 Terabyte of data in 4.6 seconds

- **PIQL: Success-Tolerant Query Processing in the Cloud (VLDB 2012)**
  - Newly-released web applications often have a „Success Disaster“, where overloaded database systems destroy a previously good user experience, i.e. too much success causes performance problems.
  - The authors propose PIQL for providing *scale independance* for queries, such that applications become *success-tolerant*. 
Semantic Web

• Idea
  – "web of data" that enables machines to understand the semantics, or meaning, of information on the World Wide Web.
  – extends the network of hyperlinked human-readable web pages by inserting machine-readable metadata about pages and how they are related to each other

• Semantic Web databases can be seen as graph databases for labelled and directed graphs

• Additional implicit data is considered based on ontology inference
  – E.g. Peter has the driverLicenseNo 456 (which is a fact) and only a person can have a driverLicenseNo (expressed in an ontology), then Peter is a person (implicitly present)
Semantic Web - Topics

- **DBpedia SPARQL Benchmark – Performance Assessment with Real Queries on Real Data (ISWC 2011)**
  - DBpedia contains data extracted from Wikipedia
  - Benchmark queries are determined from frequently used queries for a SPARQL querying web service *(endpoint)*
- **ANAPSID: An Adaptive Query Processing Engine for SPARQL Endpoints (ISWC 2011)**
  - ANAPSID provides physical operators that detect when a source becomes blocked or data traffic is bursty, and produce results as quickly as data arrives from the sources
- **Castor: A Constraint-Based SPARQL Engine with Active Filter Processing (ESWC 2011)**
  - Constraint Programming was originally designed for solving NP-hard problems, but the authors adapt it to SPARQL processing by exploiting filters early-on instead of a post-processing step
Semantic Web - Topics

- **View Selection in Semantic Web Databases** (VLDB 2012)
  - Use existing views (=materialized results of previous queries) to answer a new query
  - Simple ontology inference is considered

- **The Complexity of Evaluating Path Expressions in SPARQL** (PODS 2012)
  - SPARQL 1.1 allows to query nodes in arbitrary depth. This paper studies its complexity for W3C-conform evaluation and presents an alternative.

- **Static Analysis and Optimization of Semantic Web Queries** (PODS 2012)
  - Study of Containment, Equivalence and Evaluation of SPARQL queries
B⁺-tree

- Variant of the B-tree
- Self-balancing, block-oriented search tree for large datasets

![B⁺-tree diagram]

```
Values

2 4 6

3 ≤ ? ≤ 11

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Keys
```
B⁺-tree - Topics

- B⁺-tree Index Optimization by Exploiting Internal Parallelism of Flash-based Solid State Drives (VLDB 2011)
  - B⁺-tree variant for SSDs using parallel I/O
Compression – Window-based Dictionaries

Example: LZ77 for elimination of repeated sequences (simplified)

Compression “ANANAS“:

Sliding Window

Dictionary Lookahead

Compressed Data

Decompression:

Position in Dictionary

Next Character

Length of repetition

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<th>ANAN</th>
<th>(0,0,A)</th>
</tr>
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<td>(0,0,N)</td>
</tr>
<tr>
<td></td>
<td>AN</td>
<td>(6,2,A)</td>
</tr>
<tr>
<td></td>
<td>ANANA</td>
<td>(0,0,S)</td>
</tr>
</tbody>
</table>

01234567

_______A

no compression => "A"

_______AN

no compression => "N"

___ANANA

copy next 2 characters after Pos. 6 and "A"

___ANANAS

no compression => "S"
Compression - Topics

• Relative Lempel-Ziv Factorization for Efficient Storage and Retrieval of Web Collections (VLDB 2011)
  – Instead of window-based dictionaries, a dictionary is generated by sampling the whole document
Regular expressions

• Regular expressions contain operators for
  – concatenation,
  – union,
  – choice and
  – Kleene star

• Used to define searches/matchings in
  – file systems
  – databases
  – programming languages
    (e.g. tokens while compiling and api support)
  – ...
Regular Expressions - Topics

- **Deterministic Regular Expressions in Linear Time (PODS 2012)**
  - Algorithms to test determinism and matching
Relational Database

- Most widely used type of database
- Data model
  - Relation (table)
  
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</table>

- Query language
  - SQL
Relational Database - Topics

- **NoDB: Efficient Query Execution on Raw Data Files (SIGMOD 2012)**
  - NoDB avoids data loading while still maintaining the whole feature set of modern databases, i.e., NoDB works on raw data files.

- **SharedDB: Killing One Thousand Queries With One Stone (VLDB 2012)**
  - deals with multi-query optimization, i.e., query execution plans for many queries to be executed at the same time are generated.
  - High throughput for high workloads
Recursive Queries

- **Datalog as subset of prolog is a rule language for deductive databases**
- **Example:**
  - **Facts:**
    - parent(bill,mary).
    - parent(mary,john).
  - **Rules:**
    - ancestor(X,Y) :- parent(X,Y).
    - ancestor(X,Y) :- parent(X,Z), ancestor(Z,Y).
  - **Query:**
    - ?- ancestor(bill,X).

- **Topic:**
  - More Efficient Datalog Queries: Subsumptive Tabling Beats Magic Sets (SIGMOD 2011)
    - top-down evaluation method with more reuse of answers than the dominant tabling strategy
Recursive Queries

- Recursive query constructs part of ANSI SQL 99

- Topic:
  
  Adaptive Optimization of Recursive Queries in Teradata
  (SIGMOD ‘12)
  - Query execution plan is optimized within iterations of recursive queries
Bachelor

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  - High Throughput and Large Capacity Pipelined Dynamic Search Tree on FPGA (FPGA 2010)
  - Massively Parallel XML Twig Filtering Using Dynamic Programming on FPGAs (ICDE 2010)
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Master

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  - The Complexity of Evaluating Path Expressions in SPARQL (PODS 2012)
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- **B+-tree**
  - B+-tree Index Optimization by Exploiting Internal Parallelism of Flash-based Solid State Drives (VLDB 2011)
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  - More Efficient Datalog Queries: Subsumptive Tabling Beats Magic Sets (SIGMOD 2011)
  - Adaptive Optimization of Recursive Queries in Teradata (SIGMOD’12)

More topics upon request…