

Announcements

1

- ❖ Homework #4 due in 2 days (April 23)
- ❖ Recitation session this Friday or next Monday?
 - Homework #4 and final review
 - Will announce on newsgroup
- ❖ Project demos start next week (April 28)
 - Sign-up sheet will be circulated
- ❖ Final exam in 10 days (D243; Thursday, May 1, 2-5pm)
 - Comprehensive (everything up to today's lecture, with emphasis on the second half of the course)
 - Open book, open notes
 - No time pressure!
- ❖ Please fill out course evaluations at the end of this lecture

Review: basics

2

- ❖ Relational model/algebra → physical data independence
- ❖ Design theory (FD's, BCNF) → help eliminate redundancy
- ❖ SQL
 - NULL and three-value logic → nifty feature, big mess
 - Bag versus set semantics
 - Subqueries, grouping and aggregation
 - Views → logical data independence
 - Materialized views → reintroduce redundancy to improve performance
 - Constraints → the more you know the better you can do
 - Triggers (ECA) → "active" data
 - Transactions and isolation levels

Review: physical data organization

3

- ❖ Storage hierarchy (DC vs. Pluto) → count I/O's
- ❖ Data layout
 - Record layout (handling variable-length fields, NULL's)
 - Block layout (NSM, DSM, PAX) → inter-/intra-record locality
- ❖ Access paths
 - Primary versus secondary indexes → again, reintroduce redundancy to improve performance
 - Tree-based indexes: ISAM, B⁺-tree, R-tree, GiST
 - Hash-based indexes: extensible, linear
 - Text indexes: inverted lists, signature files
 - Variant indexes: bitmap, projection, bit-sliced indexes
 - Main-memory indexes: T-index, CSS and CSB⁺ trees→ Fundamental trade-off: query versus update cost

Review: query processing

4

- ❖ Buffer management
 - Per-query, per-table policy is ideal→ The more you know the better you can do
- ❖ Sort- and hash-based algorithms (and their duality)
- ❖ Index-based algorithms
- ❖ Pipelined execution with iterators

Review: query optimization or "goodification"?

5

- ❖ Heuristics: push selections down; smaller joins first
 - Reduce the size of intermediate results
- ❖ Cost-based
 - Query rewrite: merge blocks to get a bigger search space
 - Cost estimation: use statistics (e.g., histograms)
 - Search algorithm: dynamic programming (+ interesting orders), randomized search, genetic programming, etc.
- ❖ Online query processing: change in cost metric—throughput ≠ user satisfaction
 - Trade-off: throughput versus responsiveness
- ❖ Adaptive query processing: adapt on a per-tuple basis
 - The sooner you know the better you can do
 - Trade-off: overhead versus adaptivity

Review: transaction processing

6

- ❖ ACID properties
- ❖ Concurrency control
 - Locking-based: strict 2PL; handling deadlocks; multiple-granularity locking; predicate locking and tree locking
 - Validation-based, timestamp-based, multi-version→ Trade-off: blocking versus aborts and restarts
- ❖ Recovery
 - Steal: requires undo logging
 - No force: requires redo logging
 - WAL (log holds the truth)