Final Review

CPS 116
Introduction to Database Systems

Announcements (Dec. 14)

- Final exam tomorrow morning 9am-12pm
  - Open book, open notes; similar format as sample final
  - Focus on materials after the midterm
- Where to find handouts
  - Lecture notes and homework handouts: course Web site
  - Graded assignments and midterm: handout box outside my office
  - Sample solutions and sample exams: handout box (email me if you cannot find a copy); available only in hardcopies
- Check Blackboard to make we entered your scores correctly!
- Project grades will be emailed by Saturday

Review: relational basics

- Relational model/algebra → physical data independence
- Entity-relationship design
- Design theory (FD's, MVD's, 3NF, BCNF, 4NF) → help eliminate redundancy
- SQL
  - NULL and three-value logic → nifty feature, big mess
  - Bag versus set semantics → careful about equivalences
  - SFW (or SPJ) queries, subqueries, grouping and aggregation
  - Modifications
  - Constraints → the more you know the better you can do
  - Triggers (IECA) → "active" data
  - Views → logical data independence
  - Indexes → reintroduce redundancy to improve query performance
  - Transactions and isolation levels
Review: XML

- Data model: well-formed vs. valid (DTD ≈ schema)
- Query languages
  - XPath: (branching) path expressions (with conditions)
  - XQuery: FLWOR, subqueries in return (restructuring), quantified expressions, aggregation, ordering
  - XSLT: structural recursion with templates
- Programming: SAX (one pass) vs. DOM (in memory)
- Relational vs. XML
  - Tables vs. hierarchies (or graphs in general)
  - Storing XML as relations
    - Schema-oblivious: node/edge based, interval based, path based, etc.
    - Schema-aware
      - Joins vs. path traversals

Review: physical data organization

- Storage hierarchy (DC vs. Pluto) → count I/O’s
- Disk geometry: three components of access cost; random vs. sequential I/O
- Data layout
  - Record layout (handling variable-length fields, NULL’s)
  - Block layout (NSM, PAX) → inter-/intra-record locality
- Access paths
  - Primary versus secondary indexes
  - Tree-based indexes: ISAM, B+-tree
    - Again, reintroduce redundancy to improve performance
    - Fundamental trade-off: query versus update cost

Review: query processing, optimization

- Processing
  - Scan-based algorithms
  - Sort- and hash-based algorithms (and their duality)
  - Index-based algorithms
  - Pipelined execution with iterators
- Optimization (or "goodification")?
  - 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: result size estimation; use statistics
    - Search algorithm: dynamic programming (+ interesting orders)
Review: transaction processing, other topics

- Transaction processing
  - ACID properties
  - Concurrency control
    - Serial and conflict-serializable schedules
      - Locking-based: 2PL, strict 2PL
  - Recovery with logging
    - Serial: requires undo logging
    - No force: requires redo logging
    - WAL: log holds the truth
    - Fuzzy checkpointing

- Continuous query processing
  - Database update stream $\Rightarrow$ query result update stream
  - Inversion of queries and data