Transactional Information Systems:

Theory, Algorithms, and the Practice of Concurrency Control and Recovery

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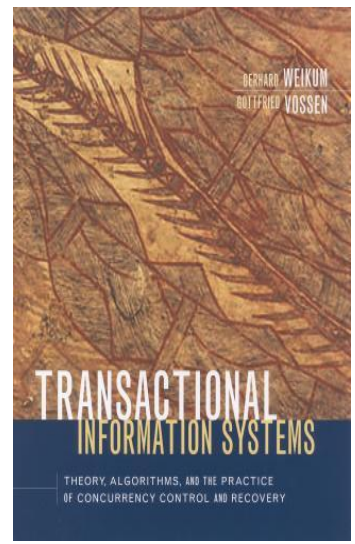


"Teamwork is essential. It allows you to blame someone else."(Anonymous)

Part I: Background and Motivation

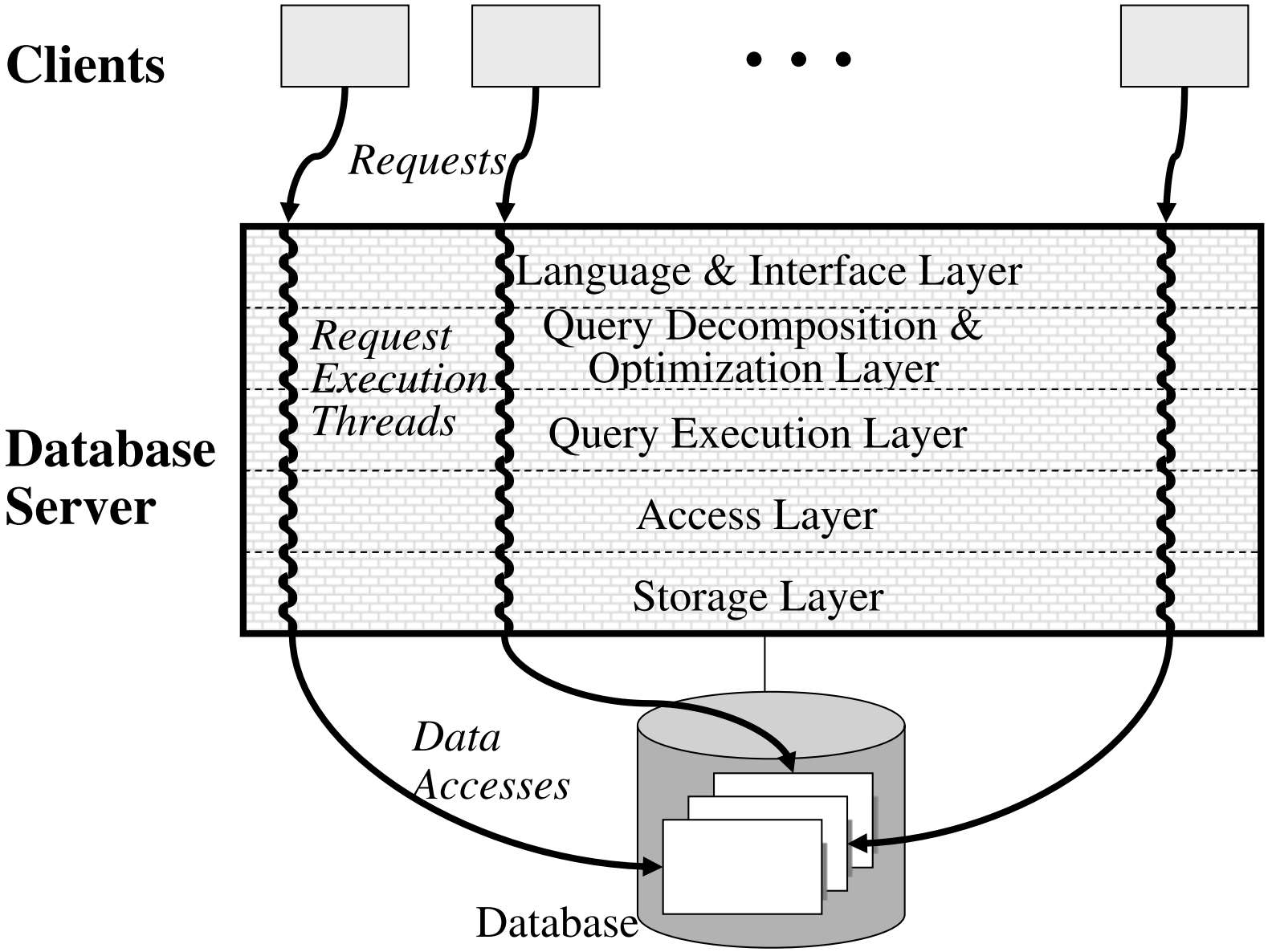
- 1 What Is It All About?
- 2 Computational Models

Chapter 2: Computational Models

- **2.2 Ingredients**
- 2.3 Page Model
- 2.4 Object Model
- 2.5 Roadmap
- 2.6 Lessons Learned

"Between theory and practice, some talk as they were two. Between theory and practice, both can be gained. "
(Bhagavad-gita 5:4)

Reminder: Database System Layers



Ingredients

- Elementary operations
- Transactions (i.e., transaction program executions)
- Histories and schedules
- Characterization of correct schedules
- Protocols (i.e., rules for online algorithms)

Chapter 2: Computational Models

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Page Model

"Syntax":

Definition 2.2 (Page Model Transaction):
A **transaction** t is a partial order of steps (actions) of the form r(x) or w(x), where $x \in D$ and reads and writes as well as multiple writes applied to the same object are ordered.
We write t = (op, <)
for transaction t with step set op and partial order <.

Example: r(s) w(s) r(t) w(t)

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Example: r(s) w(s) r(t) w(t)

"Semantics":

Interpretation of j^{th} step, p_j, of t:
If p_j=r(x), then interpretation is assignment $v_j := x$ to local variable v_j
If p_j=w(x) then interpretation is assignment $x := f_j (v_{j1}, ..., v_{jk})$.
with unknown function f_j and $j_1, ..., j_k$ denoting t's prior read steps.

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Object Model

Definition 2.3 (Object Model Transaction):
A transaction t is a (finite) tree of labeled nodes with
- the transaction identifier as the label of the root node,
- the names and parameters of invoked operations as labels of inner nodes, and
- page-model read/write operations as labels of leaf nodes, along with a partial order $<$ on the leaf nodes such that for all leaf-node operations p and q with p of the form w(x) and q of the form r(x) or w(x) or vice versa, we have $p<q \ \vee \ q<p$

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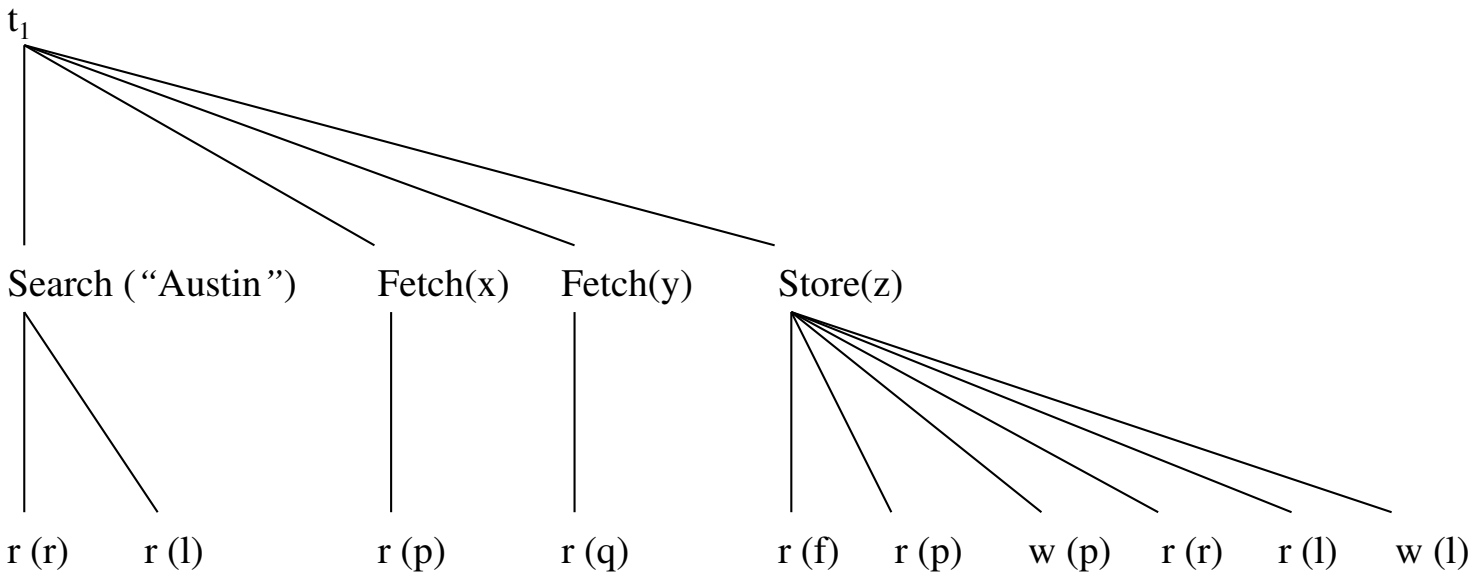
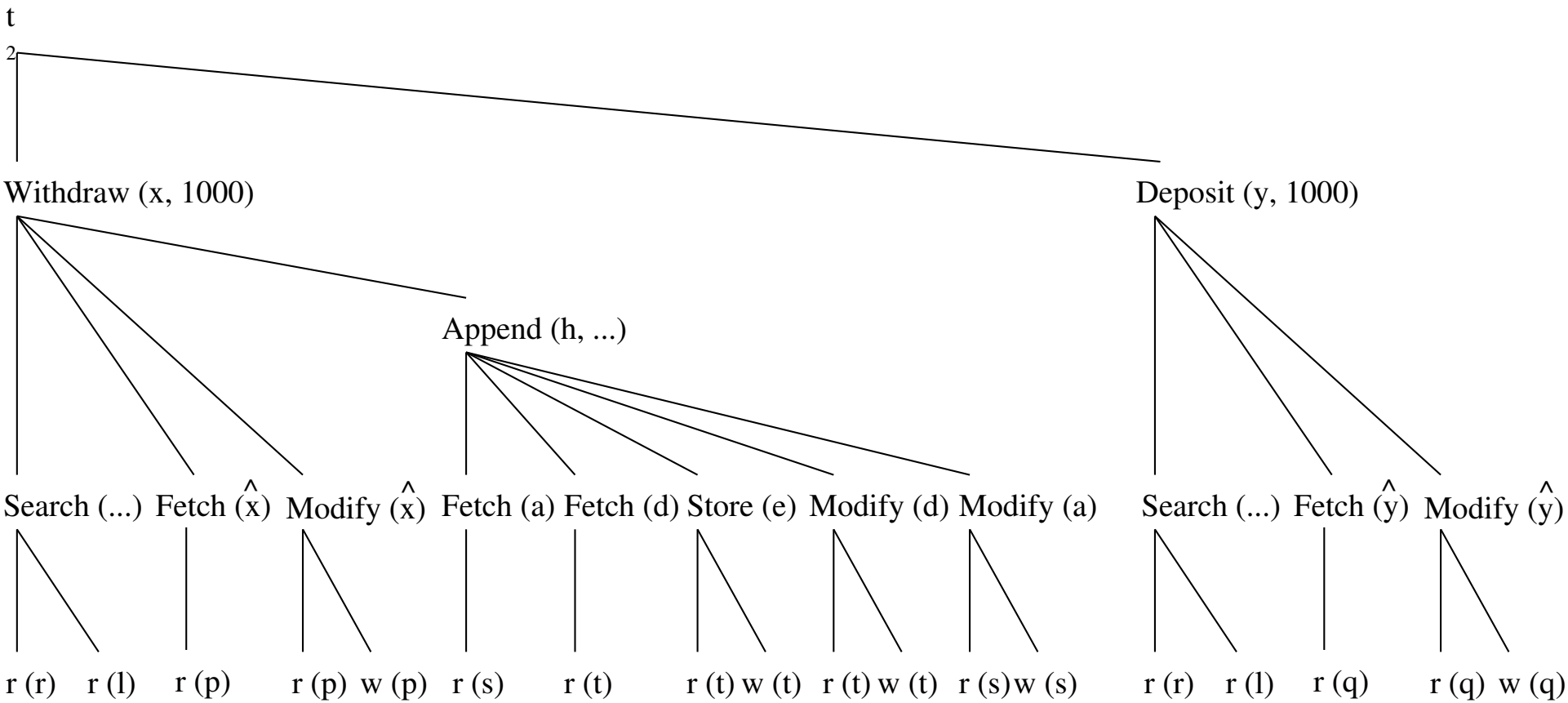
Special case: layered transactions
(all leaves have same distance from root)

Derived inner-node ordering: $a < b$ if
all leaf-node descendants of a precede all leaf-node descendants of b

Example: DBS Internal Layers



Example: Business Objects



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Roadmap

Part II: Concurrency Control
3 Notions of Correctness PM
4 CC Algorithms
5 Multiversion CC
6 Notions of Correctness OM
7 CC Algorithms on Objects
8 CC on Relational DB
9 CC on Search Structures
10 Impl. & Pragmatic Issues

Part III: Recovery
11 Transaction Recovery
12 Crash Recovery Correctness
13 CR Algorithms PM
14 CR Algorithms OM
15 Special Issues of Recovery
16 Media Recovery
17 Application Recovery

Part IV: Coordination of Distributed Transactions
18 Distributed CC
19 Distributed Transaction Recovery

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Lessons Learned

"Nothing is as practical as a good theory." (Albert Einstein)