CS 245: Database System Principles

Notes 12: Distributed Databases

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Advantages of a DDBS

- Modularity
- Fault Tolerance
- High Performance
- Data Sharing
- Low Cost Components

Issues

- Data Distribution
- Exploiting Parallelism
- Concurrency and Recovery
- Heterogeneity

Parallelism: Pipelining

- Example:
  - T₁ ← SELECT *
    FROM A WHERE cond
  - T₂ ← JOIN T₁ and B

Parallelism: Concurrent Operations

- Example: SELECT * FROM A WHERE cond

Data location is important...
Join Processing
• Example: JOIN A, B over attribute X

Join Processing
• Example: JOIN A, B over attribute X

Concurrency & Recovery
• Two Phase Commit

2PC: ATM Withdrawal
• Mainframe is coordinator
• Phase 1: ATM checks if money available; mainframe checks if account has funds (money and funds are "reserved")
• Phase 2: ATM releases funds; mainframe debits account

Replicated Data Management
• Key to fault-tolerance, durability
• Illustrates transaction processing issues
• Various concurrency control/recovery algorithms available

Primary Copy Algorithm
• Updates run at primary site
• Backups repeat writes; backups allow "out-of-date" reads
Primary Copy Algorithm

• Updates run at primary site
• Backups repeat writes; backups allow “out-of-date” reads

<table>
<thead>
<tr>
<th>Primary Site</th>
<th>Backup Site 1</th>
<th>Backup Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 5</td>
<td>A: 3</td>
<td>A: 3</td>
</tr>
<tr>
<td>B: 8</td>
<td>B: 8</td>
<td>B: 8</td>
</tr>
<tr>
<td>C: 6</td>
<td>C: 4</td>
<td>C: 4</td>
</tr>
<tr>
<td>D: 25</td>
<td>D: 25</td>
<td>D: 25</td>
</tr>
</tbody>
</table>

T1: A: 5; C: 6
T2: B: 9; C: 7

To be covered in CS347

• More replicated data algorithms
• More commit protocols
• Distributed query processing
• Open Source Systems for Distributed Data
  - Storm, S4, Hadoop, Cassandra, Pregel, etc
• Peer to peer systems
• Distributed information retrieval
• And many, many more fun topics!!