The Latency Problem

- Database applications experience a lot of latency due to network round trips to the database.
- Disk IO at the database.

Prefetching Query Results

Advantages
- Multiple queries could be issued concurrently.
- Allows the database to share work across multiple queries.
- Application performs other processing while query executes.
- Significantly reduces the impact of latency.

Challenges
- Hard to identify earliest and safe points in the code to perform prefetching.
- Complex interprocedural code with queries deep inside.
- Hard to manually maintain as code changes occur.

Our Solution

Prefetching based on Static Analysis
- Inserts prefetches at earliest possible point in the program.
- Works in the presence of loops and interprocedural code.
- No wasted prefetches except due to exceptions.
- Code motion, chaining and rewriting to optimize prefetches.
- Applicable to JDBC, Hibernate, Web Services, and similar data access APIs.
- Being implemented in the DBridge Holistic optimization tool http://www.cse.iitb.ac.in/infolab/dbridge

Prefetching Walkthrough

1. Query Anticipability Analysis: Find valid points of prefetch insertion

2. Identify earliest and insert prefetch statement

3. Prefetch at the beginning of a method can be moved to all its callers

Experiments (upto 75% improvement)

1. Twitter Dashboard
   - Web Service: HTTP/JSON with Twitter4j client.
   - Monitors 4 keywords for new tweets.
   - Interprocedural prefetching: no rewrite possible.
   - 75% improvement at 4 threads.
   - Server time constant; network overlap leads to significant gain.

2. ERP Application: Impact of our techniques
   - Java/JDBC application.
   - Intraprocedural: moderate gains.
   - Interprocedural: substantial gains (25-30%).
   - Enhanced (with rewrite): significant gain (50% over Interprocedural).

Prefetching Enhancements

1. Code Motion with Strong Anticipability
   - Control dependence barrier: Transform into a data dependence barrier by rewriting it as a guarded statement.
   - Data dependence barrier: Apply anticipability analysis on the barrier statements.
   - Move the barrier to its earliest point followed by the prefetch.

Optimizing prefetches in presence of barriers
- Using program and query transformations.
- Preserving program equivalence.

Contact: karthiksr@cse.iitb.ac.in