Online Aggregation
10-Year Feedback

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A Demo is Worth a Thousand Words
**A Demo is Worth a Thousand Words**

![Online Aggregation at Ten!](http://localhost:3000/output/list/)

<table>
<thead>
<tr>
<th>college</th>
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</table>
The OA Back-Story

Jeff Naughton
UW Madison

Joe and Jeff:
“Sloppy Databases”
(email exchange)

Peter, Jeff, & S. Seshadri:
Fixed-precision estimation
For COUNT queries over joins

Helen comes to Berkeley

SIGMOD ’95:
Keynote + hallway chat

SIGMOD ’97 intro paper

Ripple join (SIGMOD ’99)
CONTROL project
A Three-Way Synthesis

Systems
- Index Striding
- Ripple Joins
- Online Reordering

Statistics
- Approximate Answers
- Confidence Intervals
  - CLT approximate intervals
  - Hoeffding conservative intervals
- Over relational ops

HCI
- Continuous interaction
- Multiresolution visualization
- Computation follows focus
Implementations

- **Postgres**
  - Index stride, ripple join in engine
  - Simple Tcl/Tk interface

- **DB2**
  - JDBC client application (differential pacing)
  - Java swing interface

- **Informix Universal Server prototype**
  - Index stride, ripple join, online reordering
  - Integrated with Metacube OLAP tool
  - Visual-basic + Excel interface
Before

Systems

Morgenstein Ph.D. ‘81
Olken/Rotem
Sampling from Access Structure

Statistics

Hou, et al.
Sequential Sampling Histograms
Flajolet-Martin Sketches

“HCI”

APPROXIMATE
Multiresolution Data Model
The Last Decade

Statistics

SQL sampling standard
Synopses/Sketches Galore
AMS, wavelets, DCT, DV, samples …
“Robust” sampling
exploit indexes, workload, precomputation
Stream samples & sketches
General and special purpose
The Florida Renaissance
Large-sample maintenance
Scalable online joins
Monte Carlo methods (bootstrap)
Probabilistic DB
… and so on!

Systems

Oracle/DB2/
Teradata
AQUA
DBO
CONTROL

HCI
The CONTROL Project

- Online Aggregation

- This paper, Ripple Joins, new confidence intervals

- Clouds

- CARMA

- Online “Enumeration”

- Scalable Spreadsheets & Potter's Wheel

- Partial Query Results
If you’re so smart, why ain’t you rich?

• Marketplace Challenge
  • Apps + Engine
  • Customer aversion to statistics (see no evil)
  • OLAP postponed this by a decade
  • If you want to rewrite the DB2 engine, you better have a VERY good business case

• Technical Challenge
  • How many DBMS engineers does it take to screw in a confidence interval?
Why the Renaissance?

• The rise of stat in CS
  • KDD, ML, WebSearch

• Market forces
  • DBMS Market Consolidation
  • Software Appliances/Services
  • New “niche” opportunities

• Web expectations
  • Speed, data-rich, rough-and-ready answers
  • App/Engine integration not a barrier
What Next?

• Clearly, tons of community energy on approximation
  • Especially algorithmics
• The fun (for us) is in the integrative work

“What unlike thing must meet and mate”    -- Melville
With Thanks…

Joe:
Jeff Naughton
Mike Stonebraker

The CONTROL Freaks:
Ron Avnur
Andy Chou
Christian Hidber
Bruce Lo
Chris Olston
Vijayshankar Raman
Tali Roth

Peter:
Jeff Naughton
Pat Selinger
Bill Cody
S. Seshadri
Ashutosh Singh
Guy Lohman
Vijayshankar Raman
Gang Luo