Online Aggregation

[Hellerstein, Haas, Wang]

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to be followed by a presentation on the Ripple Join algorithm by Kashi Vishwanath and Parag Palekar

Outline

- Introduction and motivation
- Related work
- Usability and performance goals
- Building a system
  - random access to data
  - GROUP BY and DISTINCT
  - *index striding*

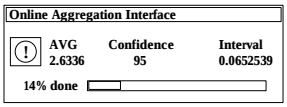
Introduction

- Aggregations - characterizations over data
- Batch processing
  - wait a long time for an exact answer
- Online aggregration
  - get rough approximations quickly
  - give user continuous updates on progress
  - requires a radically different approach

Motivation

```
SELECT AVG(final_grade)
  FROM grades
WHERE course_name = 'CPS216'
```

```
      AVG
------------
| 2.631406 |
------------
```



Advantages

- Natural and intuitive interface
- No understanding of statistics required
- Status bar keeps user interested
- Could also continuously update graphical output (i.e., maps and graphs)

Statistical Estimates

- Running aggregate is a statistical estimator
- Previous research set confidence intervals BEFORE query processing
- Online aggregation allows users to decide DURING query processing
  - also, users can control groups separately without prior knowledge of GROUP BY results

Related Work

- Online Analytical Processing (OLAP)
  - super-aggregation ("roll-up")
  - sub-aggregation ("roll-down")
  - takes a long time
- "Fast-first" query processing
  - get first tuples quickly
  - potentially useful for online aggregation

Usability Goals

- Continuous Observation
  - develop an API
- Control of Time/Precision
- Control of Fairness/Partiality
  - update at same rate
  - confidence intervals decrease at same rate

Performance Goals

- Minimum Time to Accuracy
- Minimum Time to Completion
  - secondary goal
- Pacing

Naive Online Aggregation

- **`POSTGRES`** user functions
  - poor performance
  - cannot use `GROUP BY` clause
  - minimize time to completion
- Better to modify the database engine
  - implemented modifications on `POSTGRES`

Random Access to Data

- Heap Scans
  - probably the best
  - but heaps may reflect some logical order
- Index Scans
  - inappropriate for scans based on indexed attributes
- Sampling from Indices
  - inefficient

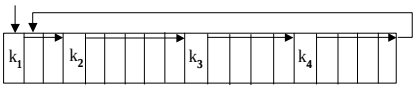
`GROUP BY` and `DISTINCT`

- Traditionally sort by aggregation fields
  - sorting is a *blocking* operation!
- Instead hash into groups
  - but large hash tables may thrash
  - Hybrid Hashing/Hybrid Cache provide solutions

Index Striding

- Hashing not fair to smaller groups
- Want predictable group order but randomness within groups
- Use index on grouping attribute

B-Tree Example



- As efficient as scanning on a clustered secondary index
- No block will be fetched more than once
- Controls delivery of tuples