The Volcano Optimizer Generator: Extensibility and Efficient Search

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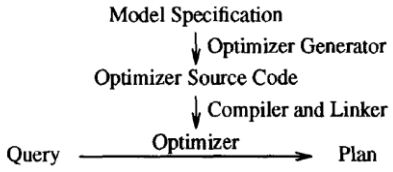
The Volcano Optimizer Generator

- Object-oriented and scientific database systems
- Allowing query optimization to be more tuned towards the application = higher performance
- (Expert) User optimize

The Generator Paradigm



Optimizer Generator

- This is not the first time for this approach (EXODUS).
- Volcano improves on the work of EXODUS: ease of use, expressiveness.

Volcano Requirements

- Usable as standalone tool
- Efficient
- Support physical properties
- Expressive – heuristics, directed search, cost functions

Design Principles

- Relational algebra (logical and physical), especially to support OO
- Rules-based => modularization
- Map queries to same algebraic equiv as Volcano's input
- Rule compilation rather than interpretation
- Dynamic programming

Optimizer: Input/Output

- Input: User Query => Logical algebra expression
- Output: Algorithms to access physical storage => Physical algebra expression

Volcano: Input/Output

- Input:
  - Set of logical operators
  - Algebraic transformation rules (logical -> physical)
  - Algorithms and enforcers
  - Implementation rules (operators to algorithms)
  - Cost functions
  - Applicability function for each algorithm and enforcer
  - Etc.
- Output: Generated optimizer

Volcano Plan Search Engine

- Search engine is same for all generated optimizers
- Directed dynamic programming; goal-oriented (driven by needs rather than by possibilities)
- Find costs of promising moves (transform, algorithm, or enforcer)

Volcano Plan Search Engine

- EXODUS did not consider logical expressions together with physical properties in optimization cost. (Volcano does)
- In OO systems, this can be used to more properly cost access of complex objects.
- Volcano algorithm is top-down (lower levels are explored only when warranted).

Comparison to Starburst

- Starburst has a hierarchy of intermediate levels; harder to see interactions. Volcano uses an algebraic approach which paper claims to be easier to understand.

Comparison to Starburst

- Query rewrites in Starburst does not include cost estimates. (Heuristic)
- Although paper is critical of this, Volcano does allow for heuristic transformations to be specified.

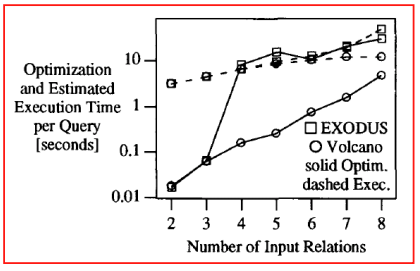
Discussion

- Graefe and McKenna seem adamant about Volcanos superiority over EXODUS and Starburst. Is Volcano better than Starburst or vice versa? Why? How useful does the Volcano system seem?

How good was it?

- Comparison between Volcano and EXODUS.
- Example used a small data model, consisting of relational select and join operators only.
- As similar data model descriptions as possible were specified for Volcano and EXODUS.

How good was it?



How good was it?

- Volcano took less time to optimize.
- EXODUS optimizer generator measurements were quite volatile and took a lot of memory.
- EXODUS's generated optimizer and search engine do not explore and exploit physical properties and interesting orderings.

Summary

- Tools not just relational databases, but also object-oriented and scientific databases.
- Extensibility using optimizer generator.
- Separation of logical and physical algebras.

Summary

- When and how to use heuristic transforms vs. cost-sensitive optimizations
- Physical properties considered throughout the optimization, rather than considered after all logical transforms.